THE IMPACT OF POLICY ON FIRMS' PERFORMANCE: THE CASE OF CNC MACHINE TOOL INDUSTRY IN INDIA

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Proefschrift
ter verkrijging van de graad van doctor
op gezag van de rector magnificus
van Wageningen Universiteit,
Prof. Dr. Ir. L. Speelman,
in het openbaar te verdedigen
op dinsdag 9 december 2003
des namiddags te vier uur in de Aula.

Ashish Kumar

The impact of policy on firms' performance:
The case of CNC Machine Tool industry in India

Ph.D. Thesis, Wageningen University, Wageningen 2003. – With references.
- With summary in English and Dutch.

ISBN 90-5808-948-7

Key words: Government Policy/ Industrial Policy/ Industrialization/ Firms' behaviour and performance/ Innovation/ Resource/ Capability/ Linkage/ CNC Machine Tool industry/ India.

Dedicated to Daddy and Mummy

ACKNOWLEDGEMENTS

The seed for pursuing PhD was implanted the day my mother received her PhD degree from Ranchi University as back as in 1982. However, I got the real motivation while discussing a case study on Problem solving given by Dr. van Geffen during my MBA studies in Maastricht School of Management (MsM) in 1994, which concluded that I should opt for PhD studies. It turned into reality due to encouragement given by the then Dean of MsM Dr. El Namaki and my MBA research paper supervisor Prof. Sander. I stepped into the world of research in the year 1995. Thereafter there has been no turning back, although there were so many ups and downs. There was almost a vacuum of 4 years. For all practical purpose, I restarted in February 2000.

Every research activity is a joint academic endeavor. No thesis will come to fruition without multiple involvements. Many individuals and institutions have contributed in my research intellectually, financially, socially and emotionally. It would have been impossible to complete this research without their advice, guidance, inputs and support. I am indebted to all of them. I know that in spite of all my efforts, I may not be able to mention everyone here. I offer my sincere apologies for such lapse.

First and foremost, I would like to express my sincere gratitude to my promoter Prof. J.C van Dalen and supervisor Dr. L. Alcorta whose constructive criticism, valuable comments and thought-provoking remarks enabled me to get deep into the process of research and complete my thesis successfully. Their encouraging words after every tough discussion have been constant source of inspiration. I wish every PhD candidate should get such supervisors. Then, I would like to thank Prof. N. C. Das for his genuine contribution in conceptualizing the theoretical framework of my thesis by looking into policy-performance causation through partitioned structure of policy-resource matrix and constant guidance. I would also like to express my feelings of gratitude towards the members of the Reading/ Examination committee, Prof. Boorsma, Prof. de Bruijn, Prof. de Bunt, Prof. van Ierland, and Prof. Ganzevoort for going through the manuscript and providing valuable comments and suggestions.

I owe my gratitude to Dr. Rakesh Mohan, who invited me to undertake a research project on competitiveness of Indian Machine Tool industry under the aegis of the National Council of Applied Economic Research (NCAER) and inspired me to go ahead with PhD studies. He also allowed me to use the collected data for the present research. I am thankful to Mr. Venketesan, members of my project team and other staff members of the NCAER for their kind cooperation. The financial support by the World Bank under the WBGS program for the first year of the research; the FION, the Netherlands and MsM, Maastricht for the remaining period is gratefully acknowledged. I am also thankful to my employer, the Department of Industrial Policy and Promotion (DIPP), the Government of India for granting me permission to pursue studies in the Netherlands. I am particularly grateful to Mr. N Mohanty, Mr. Ashok Kumar, Mr. A Ahmad, Mr. S Jagadeesan, Mr. Srinivas, Mr. Ganapati, Mrs Raghvendran and Mr. Mamgain. My appreciations are also due to Ms Alkema, Ms. den Bosch and Ms. Huttinga-Luth of Wageningen University for extending cooperation towards my defense.

Interactions with scholars and researchers at various forums contributed a lot in my research. I am particularly thankful to: Prof. Lynn Mytelka (UNU/INTECH), Prof. Sanjaya Lall (University of Oxford), Prof. Martin Bell (SPRU), Prof. Luc Soete (Maastricht University), Prof. Christos Pitelis (University of Cambridge), Prof. Rajah Rasiah (INTECH), Prof. Sumit Majumdar (University of Texas), Dr. Ashok V. Desai (NCAER), Dr. Sunil Mani (INTECH), Dr. Nagesh Kumar (RIS), Dr. Rajneesh Narula (CBS), Dr. Ken Simons (Royal Holloway College), and Dr. H. Romeijn (Eindhoven University). Besides, I am also thankful to the participants of the three consecutive EUNIP conferences in Vienna, Turku and Porto and the NIE conference in London for the inspiring comments.

In the whole process, MsM commands special appreciation. I owe to the academic fraternity of MsM for their constant intellectual support and encouragement, particularly Prof. Veltman, Prof. Tuninga, Prof. van Beugen, Prof. Foster, Dr. Samson, Dr. Huxell, Dr. Rwegasira, Dr. Fawzi, Dr. Nikolik, Dr. Ankolekar, Dr. Heling, Mr. Gans, Mr. Pouw, Mr. Stadhouders, Mr. Ropers and Ms Frijns. It would be a great injustice if I forget the contribution of the Information center manager Iris and her companions- Silvia, Lourense and Ayen. They have been always helpful to me. The IT team of MsM: Patrick, Rocco and Martijn also deserve my regards. Similarly one cannot forget the cooperation of Arsenio and Erik. I am thankful to Jos and Edith for keeping me away from financial hardships. Ans, Anna, Badia, Diederik, Dolores, Dysty, Esther, Ghadiza, Ien, Jeanette, Judith, Marlene, Nicole, Rebecca, Regina, Ron, Rob, Sandra and Yoke always kept me smiling. My fellow PhD students: Premaratne, De Silva, Dutta, Fathy, Feng, Isdudi, Yingji, Meekanon, Mewan, Nef, WenYu, and YuJing deserve thanks for their excellent comradeship and friendly advice. The PhD participants of UNU/INTCH namely Parameswaran, Pgnoc and Minh also need special mention for their stimulating discussions.

Data collection constitutes a vital part in any research. I am thankful to all persons, firms and institutions for their support and help. Mr. Mukherjee, Mr. Seth and Mr. Pundle (IMTMA); Dr. Gajendran (CMTI); Mr. Yadav, Dr. VasantaKumar and Mr. Chavre (ICAMT); Dr. Rajan (TIFAC), Dr. Lahiri and Dr. S Kumar (Planning Commission), Dr. Gupta (TDB), Dr. V Kumar (DSIR), Mr. Bhuyan (ASSOCHAM) deserve special mention for their guidance. I am indebted to all the CEOs and their colleagues of machine tool manufacturers for providing me vital data and discussing various issues thread bear. Such information has been the core of my analysis of policy-performance causation. As promised, I am not disclosing their names. My superiors in the DIPP namely Mr. Nag, Mr. Das, Mr. Ramasubramanian, and Mr. Sinha as well as my colleagues Vijay Raghavan, Chavre, Sudhir, AP, Mahendru, Nayak, Mathur, and Sandeep helped me in various ways.

I express my hearty thanks to my dear friends Dr. Ajit, Mrs. Alcorta, Alok, Deepan, Elsa, Gyan, Jane, Kishore, Dr. Lal, Manoranjan, Mamta, Matajee, Meena, Dr. Nabar, Preeti, Radha jee, Dr. Sanghamitra, Sirish, Surinder, Rob, Dr. Vaishali and Vipin. Dr. Sanghamitra commands special appreciation for editing the manuscript with unabated enthusiasm and untiring zeal. Her timely cooperation in the final stage of this thesis making process is praiseworthy. I am also thankful to Jan, Peggy and Alex of Unigraphic, Maastricht for their sincere efforts in cover design and printing of this thesis.

I would like to thank Ms. Rameshwari, Mr. Tolia, Dr. Surinder and Dr. Chatterjee for taking care of my family back home in Delhi during all these years. Dear Arun, Arvinda, Anant, Kushal, SK and Sinha jee also deserve my appreciations for the same reason. In this regard the contribution of Papa, Maa, Chasmawale Baba/ Maa, Ashok da, Purnam, Kamal mama, Kakamuni, Bhaiya & Bhabi No 1 through 4, RD, Gajendra mausa and all family members are also worth appreciable. I am grateful to all of them.

I owe unconditional apologies to my sweet heart Sangini and our two little flowers Srishtu and Bibu for putting them in such a difficult situation particularly during the last four years. They patiently bore with equanimity my prolonged absence and extended their emotional support to me throughout. Their sacrifice and love have no parallels. I wish to express my deepest love and thanks to them. Finally, it is my great honour to dedicate this thesis to my father, who always encouraged for higher studies and my mother, who is an icon of love, care and sacrifices. Lastly I humbly thank *The Almighty* who enabled me to complete this strenuous study program smoothly despite odds and adversity.

Maastricht, November 10, 2003. *Ashish Kumar.*

SUMMARY

This study is about understanding how the government policy actually works at firm level in the context of developing countries' industrialization. In the literature, the discussions on impact of government policy on corporate performance primarily stress on macroeconomic aspects of industrial behavior and broad measures of industrial performance. They offer inadequate understanding of the mechanisms through which firms' performance is affected. This study attempts to fill in this void. It specifically endeavours to answer the research question: *how Industrial policy affects performance of the firms*? For empirical evidence, we considered the case of CNC Machine Tool industry in India. The study is primarily *exploratory* and *qualitative* based on *case studies.*

The study endeavors to explain the policy-performance causation placing *resources* of the firms at the *center of analysis*. The three elements of the causality chain: *policy*, *resource* and *performance* are the *building blocks* of our analysis. The policy is seen in terms of *technology, investment, education and training, market development* and *industrial governance*. The resource is segmented as *research, development and engineering; manufacturing; human; marketing and linkage*. All these are further elaborated in terms of three more constructs: *capability, mechanism* and *indicator*. We analysed how the firms adopted various *mechanisms* to leverage the policies in force to build different capabilities that finally culminate in firms' performance. In certain cases the mechanisms were adopted to compensate the absence of policy or lessen its adverse impact. The promotional nature of Technology- and Investment policy as well as increased transparency in industrial governance since 1991, led the firms to emphasize more on mechanisms of assimilation of technology, new product development and subcontracting to build product development- and manufacturing capability that culminated in increased sales and exports. In the absence of suitable Education and Training policy the firms recruited educated persons, imparted in-plant training and periodic training to build human resource capability that increased firms' labour productivity. The observed divergence in firms' performance is attributed to variations in scope and implementation of mechanisms by the firms. A few pro-active firms identified what policy provides and how best that could be used or what policy does not provide and acted accordingly. The small firms appear to give less emphasis on adoption of mechanisms primarily due to resource constraints.

The analyses further led to the identification of certain activities or '*processes*' that are found to be crucial for building various capabilities in the firms. A *process* encompasses one or more *mechanisms* either in its essence or in totality. It may also be an underlying factor that triggers mechanisms to work individually or together. The processes are visualised as *acquisition*, *integration*, *development* and *generation*. Their identification has added another bead in the strand of policy-performance causation. Like the mechanisms, the adoption of processes by the firms is also influenced by various policies in vogue that finally culminates in firms' performance. Thus the government needs to give proper emphasis on strengthening of these processes for sustained development of an industry. From the policy perspective, this research is an attempt to provide a systematic analysis that improves policy-making.

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ACRONYMS and **ABBREVIATIONS**

ASI	Annual survey of industries
B2B	Business to business e-commerce
B2C	Business to consumer e-commerce
BOP	Balance of payment
CAD	Computer aided design
CAM	Computer aided manufacturing
CECIMO	Comite' Euro'pe'en de Cooperation des Industries de la Machine-Outile
CEO	Chief executive officer
CG	Capital goods
CMTI	Central Manufacturing Technology Institute
CNC	Computerised numerically controlled
DIPP, MoI	Department of Industrial Policy and Promotion, Ministry of Industry
DST	Department of Science and Technology
E&T	Education and training
EO	Export oriented
F2F	Firm to firm linkages
FC	Foreign collaboration
FDI	Foreign direct investment
FIEO	Federation of Indian Exports Organisations
FMS	Flexible manufacturing system
FYP	Five year plan
G2F	Government to firm linkages
G2G	Government to government linkages
GDCF	Gross domestic capital formation
GDP	Gross domestic product
GoI	The Government of India
HMT	Hindustan Machine Tools
ICAMT	International Center for Advancement of Manufacturing Technology
ICT	Information and communication technology
IMTEX	International Machine Tool Exhibition
IMTMA	Indian Machine Tools Manufacturers Association
IS	Import substitution
MNC	Multi national companies
NCMT	Numerically controlled machine tool (stand-alone CNC machine tools)
NDCF	Net domestic capital formation
NIC	Newly industrializing country
NRI	Non-resident Indians
OECD	Organisation for Economic Co-operation and Development
PSE	Public sector enterprises (the Government of India enterprise)
QSE	Qualified scientists and engineers
R&D	Research and development
R&D&E	Research, development and engineering
RBI	Reserve Bank of India
RSCA	Revealed symmetric comparative advantage
SME	Small and medium enterprises
SSE	Small scale enterprises
TDB	Technology Development Board
TFPG	Total factor productivity growth
UNIDO	United Nations Industrial Development Organisation
VCF	Venture Capital Funds
WTO	World Trade Organization

Chapter One

RESEARCH OVERVIEW

This chapter portrays an overview of the research. It sketches the background of the study, the problem statement, the research objectives, the research questions and the outline of the thesis.

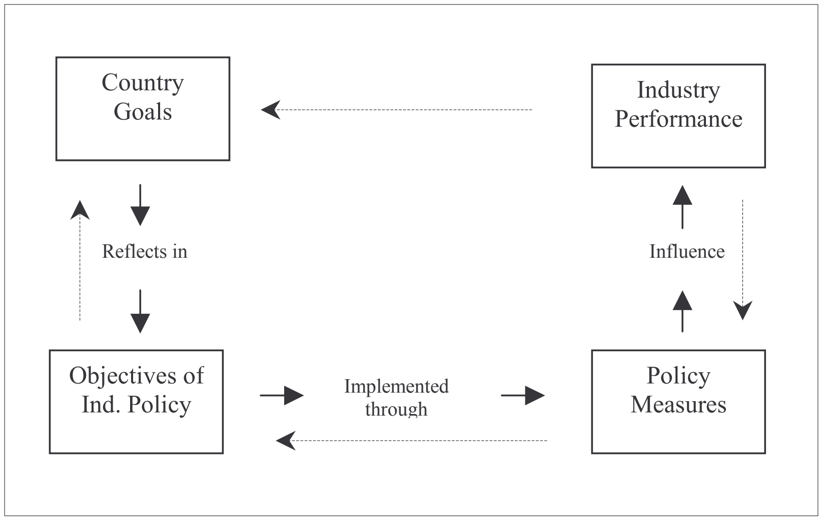
1.1 Background

This study is all about understanding how the micro level government policy works at the firm level in the process of industrialization in the context of the developing countries. Historical evidences suggest that the process of industrialization has been influenced deliberately by external interventions such as the *government policies*. During the first industrial revolution, the British Government intervened by restricting the movement of the skilled craftsman to foreign lands to minimize the flight of technological capability. Similarly, during the 18^{th} and 19^{th} century, the USA and Germany intervened more vigorously. The USA had passed a law in 1789 to protect manufacturing in USA in order to promote rapid industrialization. The most famous proponent of infant industry argument in Germany was Friedrich List. France, Italy and other countries of Europe were no exception (Amsden, 1989; Williamson & Milner, 1991). At the end of World War II, the level of industrialization in the developing countries through out the world was very low. In most of the developing countries, there was acute lack of financial resources, technology, management skill, social and physical infrastructure, and institutional supports. These inculcated the feeling that it would be quite difficult for those countries to industrialize. Yet in a span of twenty years or so, quite a few developing countries, particularly the East Asian countries, have gradually built up a diverse industrialized structure with the help of suitable government policies and are claiming to be industrialized countries. Korea and Taiwan that followed the Japanese model have succeeded in their industrialization program through carefully devised government intervention. Even in the open economies like Hong Kong and Singapore, rapid industrialization could be fostered through suitable government interventions. The success of these countries is based on activist government policies that supported promotion of high levels of investments, savings, entrepreneurship, exports, education and other institutional supports etc. (Hughes, 1980; Weiss, 1990).

In the literature, the discussions on impact of government policy on performance of industry have figured prominently, particularly in the context of East Asian remarkable success. Some of the empirical studies worth mentioning are: Amsden (1989), Auty (1994), Chang (1994), Kim (1998), Lall (1996), Lim (1995), Nelson & Pack (1999); Pack & Westphall (1986); Page (1994), Wade (1990), and World Bank (1993) etc. There are quite a few studies in respect of India as well, e.g. Ahluwalia (1985, 1991), Bhagwati (1993), Jacobson (1991), Joshi & Little (1994, 1996), Kaplinsky (1997), Lucas and Papanek (1988), Mukherjee (1995), and Rosen (1988, 1992) etc. In general, these studies followed a framework that could be schematically outlined as in Figure 1.1. Although the studies are quite meaningful, there has been overwhelming stress on macroeconomic aspects of industrial behavior and broad measures of industrial performance vis-à-vis the role of the government policy in the market setting. They offer inadequate understanding of the mechanisms of the influence of policies on firms' performance in the setting of firms. One of the plausible reasons is that the economists are usually interested in general economic performance of an industry or economy, not the firms.

The theoretical orientation in economics does not agree with the proposition that firm differences matter (Nelson, 1991).

Figure 1.1: Policy- Performance Causation: Macro level



Note: The feedback loop indicates that the ongoing performance of industry gives signals to the policy makers to incorporate appropriate changes in country goal, objectives and policy measures.

In this context two more points merit attention. *First*, we are referring to the micro level government policies that affect the process of industrialization that means Industrial policy. In a broader sense, all government actions that affect industrial development may be considered as Industrial policy (Adams and Klien, 1983; Donges, 1980; Greenaway & Milner, 1993). However, we consider Lindbeck's (1981) definition of Industrial policy as our starting point. He notes that it should be normally understood as a policy that seeks to influence the process of industrial change through *microeconomic* intervention. Although the definition is not so discreet, it gives a direction to arrive at a concrete definition of industrial policy.

The *second* point concerns with the selectivity of policy. During the process of industrialization it may not be feasible for developing countries to give priority to each and every industry due to lack of resources. Evidences suggest that blanket promotion/ protection of too many industries at a time create more distortions. Such efforts do not help in achieving sustained industrialization and international competitiveness. It is therefore necessary to identify certain priority industries at each stage of development. Nelson (1999:16) rightly observes that *"to recognize, explicitly, that effective policies and institutions need to be tailored and that one size shoe does not fit all means that it is not fruitful to think about industrial policies 'in general'."* Further, as Lall (2001:75) notes "*Since technologies differ greatly in their learning needs and externalities, and since different groups of technologies have differing degrees of interaction and dynamic learning possibilities, interventions often have to be selective, at the level of individual industries as well as groups ('clusters') of industries*." In view of the above, we have selected CNC Machine Tools industry in India for the purpose of our discussion.

The strategic importance of the industry in the process of industrialization in this era of technological progress and the researcher's familiarity with the industry are the two main reasons for its choice. The strategic importance of an industry is reflected through amount of externalities it generates for the process of industrialization in terms of its impact on manufacturing, possibility of dynamic increasing returns to scale, influence on product characteristics and production process of other industries, backward and forward linkages, value added and the negative consequences for the economy if the industry is not developed properly (Cohen & Zysman, 1987; Pack & Westphal, 1986). It may be recognised that the activity and technical standards of the Capital Goods (CG) Industry in general and the Machine Tool Industry in particular act as an index of the economic efficiency and productivity of manufacturing industry of a country. While the trend and pattern of its growth determine the productivity and performance of other industries, the production in these industries in itself is derived from the demand emanating from the user industry segments. This interdependence makes this sector all the more important (Rosenberg, 1976; Nelson, 1999). Moreover, the convergence of technology of the three previously separate areas - Machine Tools, Computers and Communications have forced a significant shift in the boundaries of the markets and technologies involved. It has led to the accelerated diffusion of a number of new devices and concepts in this industry that are popularly known as *Flexible automation.* Its adoption develops capacity to produce a variety of products at relatively lower cost with more speed and precision that leads to the possibility of achieving '*economy of scope'* simultaneously with *'economy of scale'*- the foray of mass production system so far. Further, its proper adoption perpetuates changes in organization of production system and associated organizational techniques such as Just-in-time (JIT), and Total Quality Management (TQM) etc. (Alcorta, 1994, 1998, 2001; Jacobson, 1986; Edquist & Jacobson, 1988; Kaplinsky, 1994). Therefore all the industrialised and industrializing countries have significant machine tool industry.

In India, the machine tool sector has largely grown under a protected environment with a view to make it strong and self-reliant. As a result, this sector has recorded significant growth and diversification. But unfortunately the prolonged protection hampered its integration with the rest of the world, technological upgradation and export orientation as evident from the low level of production, declining domestic market share and meager exports. The continuous liberalisation of the Indian economy since 1991 has highlighted the problems of this industry. In order to achieve the vision - India as the fourth largest economy in the world by 2020, the Machine Tool Industry in India needs to have a sustained growth. It is therefore necessary to figure out how policy supports should be extended to the firms in the new environment of openness, rapid technological changes and international commitments. The specific objectives of this study can be enunciated as follows:

1.2 Research Objectives

- To understand causal relationships between industrial policy and performance at the firm level,
- To understand functioning of Industrial policy in India,
- To develop a framework for policy making for development of a strategically important industry,
- To identify policy directions for sustained development of CNC Machine Tool Industry in India.

1.3 Research Questions

It may be mentioned that the impact of the government policy on performance of the firms in an industry depends on several factors. Apart from the nature of the policy itself, one of the important factors is firms' strategies and actions i.e. how the firms operate under a policy regime. A firm may take actions to exploit the existing policy framework to enhance its performance or may choose to stagnate. Sometimes it may also happen that the firm may not be in position to leverage the policies in its favour due to variety of other reasons namely market structure, size, institutional supports etc. Therefore in order to arrive at what issues ought to concern for policymaking for sustained development of an industry, it is necessary to understand how the firms operate under a policy regime in place or in other words how the policy measures shape firms and influence their performance. There are few studies, mostly in technological capability literature, where credence has been given to the firm level analysis such as Bell and Albu (1999), Dosi et al. (1988), Figueiredo (2001), Fransman (1986), Freeman (1987), Lall (1987, 1992, 1996), Lall & Teubal (1998), and Halperin & Teubal (1991) etc. But in all these studies the focus is primarily on the phenomena of technological change rather than firms' performance vis-à-vis government policy. This study proposes to fill in this void and develop micro-level understanding how the government policy works at firm level in the context of developing countries' industrialization. This study attempts to address the following research questions.

1.3.1 Key research Question

- How Industrial policy affects performance of the firms? or in other words, how the firms behave in response to the policies in vogue that culminates in the firms' performance?

1.3.2 Sub-research Question

- Why should it be essential for the government to intervene for sustained industrialization of the country?
- What should be the constituents of the Industrial policy?
- What should be the new policy directions for sustained development of CNC Machine Tools industry in India?

1.4 Relevance of the study

The study is relevant for a variety of reasons. First of all, it is the first micro-level study based on economic analyses that potentially enhances the understanding how industrial policy works at the firm level in the context of developing countries. The analysis of policy-performance causation is an attempt to provide a systematic analysis for arriving at the policy directions for sustained development of an industry. The case of CNC Machine Tool industry has been considered to support the theory as empirical evidence and not as a priori. Therefore the study may be replicated for other industries in India as well as other developing countries. In addition to theoretical relevance it has practical relevance too. The study is relevant for the firms to plan/ implement strategies and actions accordingly.

1.5 Research Methodology

This study could be categorized as an *applied policy-oriented research* since it is aimed to provide policymakers with pragmatic, action-oriented recommendations (Easterby-smith et al., 1991; Majchrzak, 1984; Saunders et al., 2000). It is primarily an exploratory qualitative research. The social research process is such a complex and iterative process that it may not be practical to take extreme positions in respect of the two philosophical positions of research: positivistic and phenomenology. The concepts/ techniques from one camp to another need to be blended together for imparting better credibility to the findings. Therefore, we *view the two philosophical positions* as *the two extremes on the same continuum rather than 'either-or' dichotomous constructs. We consider this as the bottom line* of our research process and research design. This research lie on the above continuum with *leanings towards* phenomenology (*philosophical position),* exploratory *(purpose of research),* empirico-inductive *(research approach),* qualitative *(research method*), focused synthesis & case study *(methods of data collection) and* qualitative *(analyses of data)*.

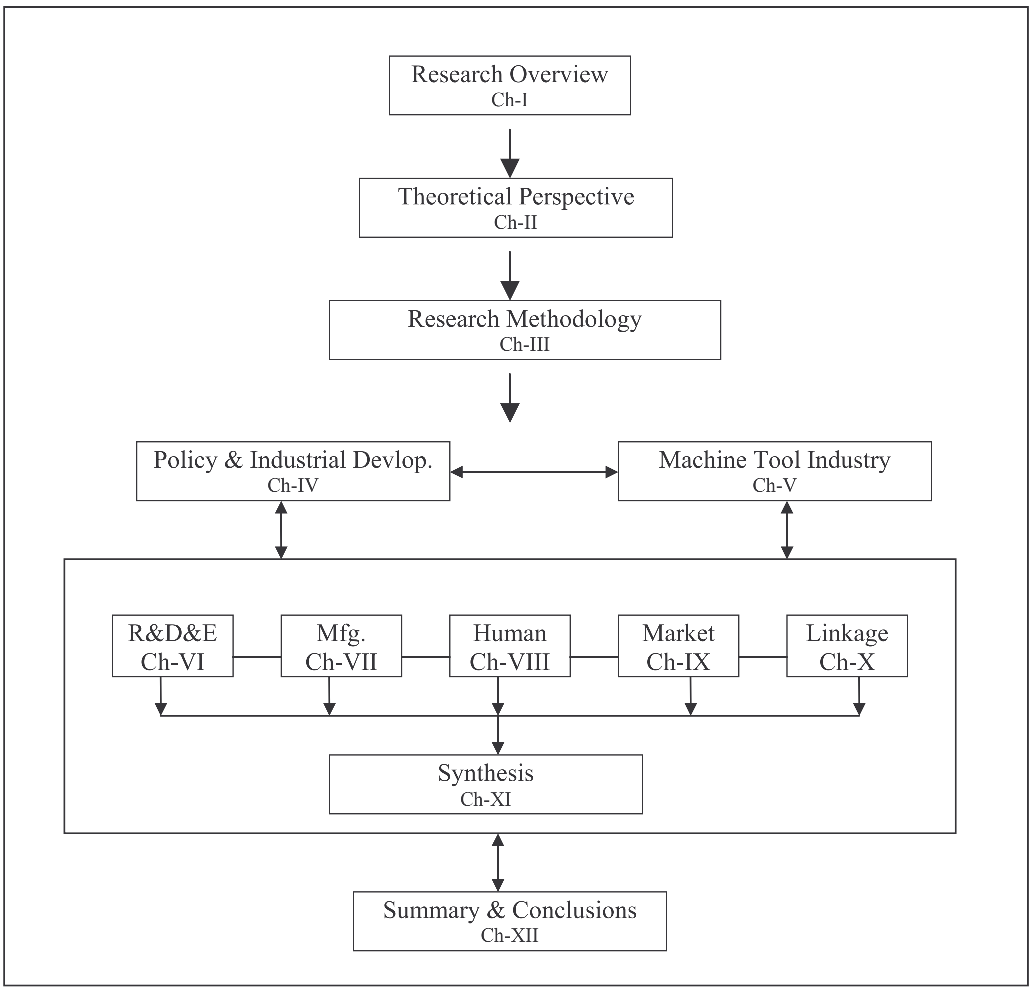
It is proposed to undertake the *case study* of a few firms to gain insights of the phenomenon as most of the questions are of the nature of *'How' or 'Why'*. Yin (1984) observes " *In general, case studies are the preferred research design when 'How' or 'Why' questions are being posed and when the focus is on a contemporary phenomenon within some real-life context*.' It will enable us to examine the process by which various policy measures affects the performance of firms. Such insights will be useful for developing new policy directions for future development. Our approach also draws strength from Tirole's (1988:4) observation, " . . . *IO [Industrial Organization] theorists have often felt more comfortable with case studies than with statistical analysis – perhaps because it may be easier to recover the industry's basic conditions and behaviour from rich case studies than from selective statistics about profit, concentration, advertising, and so on drawn from a very large sample of disparate industries*."

As regards to the evaluation of trustworthiness of the research design, we have used the criterion of *internal validity*, *external validity*, *construct validity,* and *reliability.* It may be relevant to mention that the validity of a research design having leaning towards phenomenology-qualitative paradigm may not be judged in the conventional perspective of positivist-quantitative paradigm. The research design has achieved a reasonable degree of internal-validity, construct-validity and reliability. However, in respect of external validity our claim is limited, which is logical for this type of policy research.

1.6 Organization of the Thesis

This dissertation is organized into twelve chapters (Figure 1.2) comprising of an introductory chapter, a theoretical chapter, a methodological chapter, one chapter on overall policy environment and growth performance of industrial sector in the country, one chapter on machine tool industry, six analytical chapters analysing the policy-performance causation, and a concluding chapter presenting overall synopsis and findings of the study.

Figure 1.2: Organisation of the Thesis



The introductory chapter, **chapter one,** presents the overview of the research in terms of background, research objectives and research questions, research methodology and outline of the study. **Chapter two** builds the theoretical foundation of the study. It begins with discussion on the process of industrialization and the underlying motivation for a developing country to industrialize. It leads to three overriding questions that dominate our discussions: first, *why should the government intervene*?; second, *how should the government intervene*?; and third, *in what way the government should formulate the policies?*. We identify the answer of the '*why*' based on the rationale of '*market failure'*. The '*how*' is established by synthesizing the two school of thoughts '*Neoclassical*' and '*Structuralist*'. In the process , the definition of industrial policy and its constituents are developed. It is followed by conceptualization of industrial policy for development of CNC Machine Tool industry.

Chapter three describes the research methodology. It comprises of research plan and operationalisation. The research plan describes the taxonomy of the research process and research design. The process of operationalisation translates the theoretical constructs into an operating reality. It is undertaken in two distinct but interrelated steps: first, operationalisation of the constructs by way of establishing linkage between the different elements of the construct and second, proposing a general framework of operationalisation. The operationalisation of the theoretical constructs leads us to answer *how policy affects performance of the firms?* It is achieved through establishing a framework to explain the policy-performance causation placing *resources of the firms at the center of analysis* in a simple but comprehensive way. We classify resources on the basis of functional areas in firms namely *R&D&E*, *Manufacturing, Human*, *Marketing*, *Finance and Linkage.* Due to lack of data we drop the analysis in respect of finance resources. The following section presents a brief overview of data & procedure and validity of the research design.

Chapter four sketches the evolution of policy framework for the process of industrialization in India and analyzes the impact of various policy measures on growth performance of the industrial sector. The discussion has been divided into three sections. It begins with the historical background regarding the importance of industrialization for economic development, and the dominant issues identified thereof. The second section deals with various aspects of policy framework and analyses policy vis-à-vis performance in the two distinct phases of policy framework: pre-liberalisation (1947-1991) and post-liberalization (1991 onwards). The concluding section summarizes the findings.

In **chapter five** we analyse performance of Machine Tool industry vis-à-vis policies in vogue. To start with we present a brief introduction to machine tool. Then the evolution & structure of the world machine tool industry is analysed. The following section analyses structure and growth of Indian Machine Tool industry in general and CNC segment of the industry in particular. It is supplemented with assessing Indian Machine Tool industry in the international perspective. The last section presents the conclusions.

The **chapters six to eleven** form the *core of our analyses efforts i.e.* analysis of policy-performance causation. In the *first step* in *chapters six to ten*, we analysed how each resource of the firms had been influenced by the relevant policy measure. **Chapter six** endeavors to analyse the policy-performance causation in respect of Technology policy vis-à-vis *R&D&E resource* of the firms based on the general framework for analysis developed in the methodology chapter. We consider the two main Technology policy measures: policy for imports of technology, which is commonly known as 'Foreign collaboration' (FC) policy and policy for promotion of in-house R&D in the firms for our analyses. **Chapter seven** analyses the causation in respect of Investment policy vis-à-vis *Manufacturing resource* of the firms. Here we analyse the impact of the two main policy measures affecting investments: regulations on entry & expansion (i.e. Industrial licensing policy & FDI policy), and regulations on imports (i.e. Import licensing policy) on performance of the firms. **Chapter eight** is focused on analyse the policy-performance causation in respect of Education and Training policy vis-à-vis *Human resources* of the firms. **Chapter nine** analyses the causation in respect of policy on Market development vis-à-vis *Market resource* of the firms. The analysis is presented in two distinct but interrelated dimensions of market i.e. domestic market and export market. **Chapter ten** attempts to analyse the causation in respect of policy on industrial governance vis-à-vis *linkages resources* of the firms. Due to the abstract nature of these two, we examine the causal interactions through analysis of institutional framework in respect of industrial governance vis-à-vis linkages among various stakeholders. The institutional framework is visualised in terms of government-to-government (*G2G) linkage,* government-to-firm (*G2F) linkage* and firm-to-firm (*F2F) linkage.*

Chapter eleven constitutes the *second step* of analysis of causation. Initially it was proposed to reconfigure the analysis policy measure wise to consider the impacts of a specific policy measure on other resources of the firms. However, our analyses in the five analytical chapters led to identification of certain activities that are found to be crucial for building various capabilities in the firms. These activities we term as '*processes*' since they are particular course of action intended to achieve a defined business outcome. We visualise these processes as the missing links that connect mechanisms to performance. Thus, we introduced some extension in our existing framework of analysis. We considered '*processes*' supplementary to '*mechanisms*' in the analysis of causation. Here our framework of analysis for causation transforms from policy-mechanism-performance (PMP) at the firm level to policy-mechanism-process-performance (PMPP) at the industry level. Such analysis helps in identification of policy gaps and suggests policy initiatives to strengthen the identified processes. At the end the findings are summarized and conclusions are drawn.

Finally, **chapter twelve** concludes the thesis. It presents the overall summary and conclusions. To begin with the chapter describes the objective of the thesis i.e. what I wanted to do? Then it presents the road map of the thesis i.e. how did I proceed? It is followed with the presentation of what did I discover? i.e. the findings and policy recommendations. Then come the limitations and agenda for further research i.e. where to go next? The last section expatiates the concluding remarks.

Chapter Two

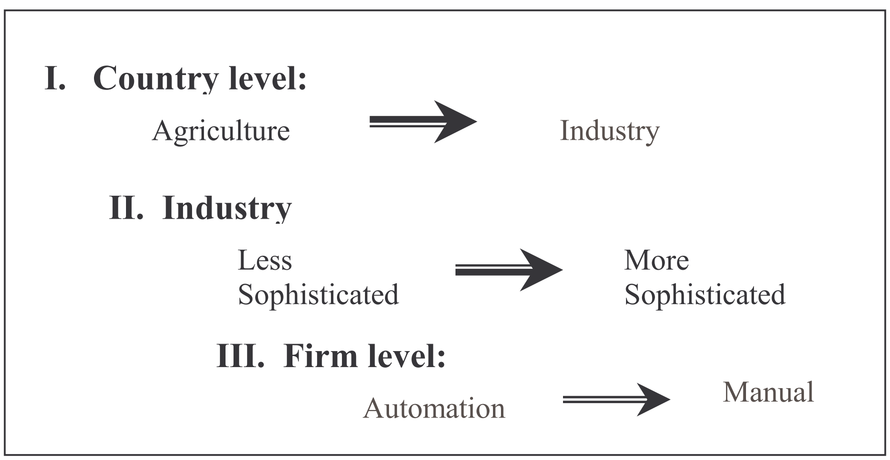
THEORETICAL PERSPECTIVES[1]

This chapter builds the theoretical foundation of the study. It begins with discussion on the process of industrialization and the underlying motivation for a developing country to industrialize. It leads to three overriding questions that dominate our discussions: first, why should the government intervene?; second, how should the government intervene?; and third, How the government policy affects performance of the firms? We identify the answer of the 'why' based on the rationale of 'market failure'. The 'how' is established by synthesizing the 'Neoclassical' and 'Structuralist' perspectives. In the process, definition of industrial policy and its elements have been developed. It is followed by conceptualization of industrial policy for CNC Machine Tools industry.

2.1 Industrialization

Ever since the industrial revolution opened the vistas of a new age, the process of industrialization has been at the core of the economic development of all countries. In a simple sense, industrialization means replacement of human labor by machinery to manufacture goods. In this way it induces a shift from home (craft) to factory based production and initiates transition of an economy from an agrarian to one based on industry. In a more rational sense, it is a process whereby the share of industry in general and manufacturing in particular, in total economic activities increases (Kirkpatrick et al., 1984; Weiss, 1990). In fact, Industrialization may be viewed at three different levels: *country*-, *industry*- and *firm level* (Figure 2.1).

Figure 2.1: Industrialization at the three different levels



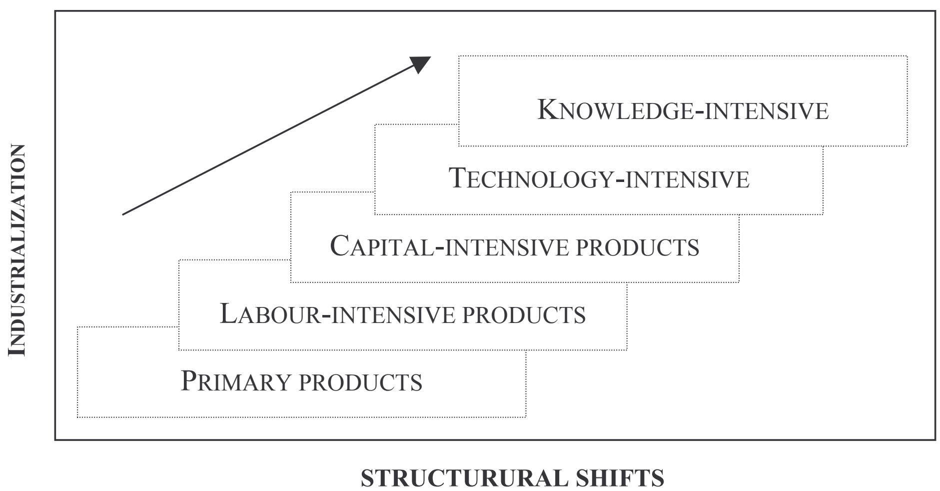
Industrialization at the *country level* is seen as the shift from agriculture to industry with respect to output and labour. At the *industry level* it may be viewed as the shift from less sophisticated technology to more sophisticated technology of product and process. While at the

[1] This chapter is based on Kumar, A., 2001, Government intervention in developing countries: why and how?, 5th Annual European Networks on Industrial Policy (EUNIP) Conference, Vienna, November 29 – December 1, 2001, Vienna, http://www.eunip.com/vienna/v_acceptedpapers.htm

firm level it may be seen as the substitution of manual work and low-level technology to mechanized work and high-level technology. In fact, the process of industrialization leads to improvement of value added at all the three levels. It also leads to higher per capita income, employment and productivity. Moreover, it perpetuates growth in other sectors of economy i.e. in agriculture and services due to its high backward and forward linkages with them. As a consequence, industrialisation becomes instrumental in economic development, especially in the creation of wealth.

In this study we will focus primarily on shifts at the industry level. In the initial stage of industrialization there is an increase in the share of manufacturing in total output and share of employment in manufacturing in total employment. As the development proceeds structural shifts occur within manufacturing itself towards higher value added activities that require gradually higher level of technology, investments, and management skills. The structural shifts in manufacturing may be depicted schematically as follows:

Figure 2.2: Structural Shift at the Industry level



The initial phase starts with crude processing of raw materials and labor-intensive, low-tech activities i.e. manufacture of primary products. In this phase, comparative advantage is usually based on static sources such as rich natural resources and cheap labour. With the progress of industrialization more capital & skill intensive activities are undertaken in technologically matured industrial sector. There is a gradual reallocation of labour and capital from primary products to higher level of manufacturing. More division of labour starts occurring, which results in increased specialization and higher use of intermediate products. These dynamic shifts reflect changes in both technology of products and processes. During this stage, comparative advantage depends on dynamic sources such as sustained investment and acquisition, adaptation, & assimilation of technology i.e. ability to learn. In the advanced stage of industrialization technology intensive and knowledge intensive activities are undertaken that require substantially higher level of investments, technology, management skills and coordination. The sources of comparative advantage at this stage rest on ability to improve & innovate. These structural shifts are reflected in changes in size and composition of demand, imports, exports, product/ process technology, employment, establishment of new industrial sector as well as accumulation of physical and human capital (Chenery, 1986; Syrquin, 1988; Halperin & Teubal, 1991). In this way Industrialization improves the competitive position of that country as well. In view of the above, for this study we define *Industrialization as*:

> "a *process* of *ongoing replacement of labour intensive productive activities by technology intensive productive activities, leading to more value added sophisticated products*."

Industrialization is a '*process*' because there is an element of continuity and it involves causal relationship. Moreover other countries may undergo similar way in the course of their industrial development. However, it may discontinue during political instability, war or massive disaster like earthquake, flood, or cyclone etc. or even in the case of badly formulated and/or implemented policy. On the other hand, under certain circumstances Industrialization may also be used as an '*instrument*' by the government for attaining economic development e.g. some smaller countries whose economy are based on tourism or export of a few commodities etc. may resort to industrialization to expedite economic development.

Historical evidences suggest that the process of industrialization has been influenced deliberately by external interventions such as the *government policies*. During the first industrial revolution the British Government intervened by restricting the movement of skilled craftsman to abroad to minimize the flight of technological capability. Similarly during the 18th and 19th century the USA and Germany intervened more vigorously. The USA had passed a law in 1789 to protect manufacturing in USA in order to promote rapid industrialization. The most famous proponent of infant industry argument in Germany was Friedrich List. France, Italy and other countries of Europe were no exception (Amsden, 1989; Williamson & Milner, 1991). At the end of World War II the level of industrialization in developing countries through out the world was very low. In most of the developing countries there was acute lack of financial resources, technology, management skill, social and physical infrastructure, and institutional supports. These inculcated the feeling that it would be quite difficult for those countries to industrialize. Yet in a span of twenty years or so quite a few developing countries, particularly the East Asian countries, have gradually built up a diverse industrialized structure with the help of suitable government policies and are claiming to be industrialized countries. Korea and Taiwan that followed the Japanese model have succeeded in industrialization through carefully devised government interventions. Even the open economies like Hong Kong and Singapore followed the same path. The success of all these countries could be attributed to active government policies that included promotion of high levels of investment, saving, entrepreneurship, positive investment climate, exports, education and other institutional supports (Hughes, 1980; Weiss, 1990).

Having said so, it is interesting to explore what drove these countries to industrialize! It is seen that apart from economic reasons there has been some socio-psychological pressure that creates inherent desire to develop. It is the psychological desire to "*Catch up*" i.e. to bridge the gap with the developed countries as speedily as possible. It also underscores the proposition that being backward in level of productivity carries a potential for rapid advance (Abramovitz, 1986). Evidences suggest that in the eighteenth century, it took the UK 58 years to double real per capita income while USA achieved it in 47 years between 1839 and 1886; Japan did it in 34 years from 1885, while Korea could do in 11 years from 1966 to 1977 and China achieved the same in less than ten years during the eighties (UNIDO, 1996). The rapidness in Catching up has become possible due to technological development and opportunity to the late industrializing countries to select and adapt technologies already in existence in the leading industrial countries rather developing them afresh. It required less time, cost, risk, and technological capability compared to starting from the scratch. In this context the observation of Amsden (1989) is worth mentioning. She notes that industrialization in England occurred in 18^{th} century on the basis of *invention*;[2] while the USA and Germany undertook industrialization predominantly on the basis of *innovation*[3] in order to catch-up with UK in 19^{th} century. Other European countries followed in the same way. In 20^{th} century Japan and other developing countries tried to catch-up mainly on the basis of *learning* i.e. importing technology from abroad and assimilating, adapting and improving it.

Like the process of industrialization the "*Catching up*" syndrome could be observed not only at the country level, but at the industry level and the firm level as well (Figure 2.3). At the *Country level* it means catching up the per capita income levels of advanced industrial countries, as seen from the evidences above. At the *Industry level* it is desire of the domestic industry to enhance their technological capability and increase international competitiveness by way of attaining technological level of industries of advanced countries. At the *firm level* it is the desire of firms to compete with other firms in the industry (both domestic & foreign).

Figure 2.3: 'Catching up' at the three different levels

I. Country level:

⟹ Per capita level of advanced countries

II. Industry level:

⟹ Technological level of industries in advanced countries

III. Firm level:

⟹ Other firms in industry
(Both domestic and foreign)

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[2] Invention is the process by which a new idea is discovered or created (Rogers, 1995).

[3] An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption (Rogers, 1995). It is a process by which firms master and implement the design and production of goods and services that are new to them, irrespective of whether or not they are new to their competitors – domestic or foreign (Mytelka, 1999).

Evidences suggest that innovators capture markets by bringing new products and new processes. They reap the benefits of being at the frontier of technology and face less competition. In this scenario the government usually extend supports for R&D and creates market for technologically advanced products. On the other hand, the late industrialisers have to compete on the combined basis of low wages, incremental development, and improved productivity. The late industrialisers have to face more competition from fellow late industrialisers as well as from industrially advanced countries both in the domestic and export market. Moreover the rapid pace of changes in technology is presenting growing challenges that is compelling the need to accelerate the learning process to "catch up" technologically otherwise there is chance of being trapped in the vicious circle of a "*low-wage, low growth*" development pattern (Ernst & O'Connor, 1989). This makes catching up syndrome as a necessity in the present times. Therefore, the need of the government supports (intervention) becomes more crucial right from acquisition of technology to marketing of the products.

From the preceding discussion on the process of industrialization, three overriding but interrelated questions emerge:

- *Why* should *the government intervene*?
- *How* should *the government intervene*?
- *How* the government *policy affects performance of the firms*?

These questions will dominate much of our analyses in subsequent sections and chapters.

2.2 Government Intervention- Why?

In order to answer the question *why should the government intervene*?, it may be pertinent to recall briefly the main stylized facts about the developing countries first. In general the developing countries have low level of saving, inadequate capital, lack of technology, small domestic market, high market concentration, low human capital, massive unemployment/ underemployment, lack of entrepreneurship, dependence on conventional agriculture sector, lack of macroeconomic stability, higher inflation, unrealistic exchange rate, lack of governance, and lack of knowledge and information, apart from massive institutional/ infrastructure deficiencies. These deficiencies push the developing countries into the vicious cycle of poverty i.e. low real income to low savings to low investment to low productivity and then back to low real income. These also lead to a severe policy dilemma. In order to stimulate investment, interest rate should be lower, while on the other hand interest rate need to be higher to induce people to save. The exchange rate should be lower for boosting export while overvalued exchange rate becomes mandatory to import machinery/ material inputs as well as to minimize the burden of foreign debts. On the one hand there is need for protecting the domestic industry from foreign competition while on the other hand trade liberalization is required for importing requisite materials and to induce competition in the domestic market.

Under these unhealthy and contradictory circumstances the basic conditions for the success of market: *perfect competition,* perfect *information*, and *full employment* are not fulfilled. In this situation the market mechanism is unable to equate private and social costs & benefits and create pervasive *market failure* and thus arise the need for the government intervention. *Market failure* is defined as a situation in which the market system produces an allocation of resources, which is not pareto-efficient.[4] It is significant due to several reasons such as *externality, increasing returns to scale, imperfect/ nonexistent market, non-competitive market, industry coordination* and *information deficiency* (Amsden, 1989; Chang, 1994; Dutt et al., 1994; Meier, 1995; Stiglitz 1989, 1996; Weiss, 1990).

Externalities (also referred as *external economies or spillovers)* are one of the most important sources of market failure. *Externalities* are the costs or benefits resulting from an economic activity or transaction that accrue to persons or entities other than those engaged in it (Chang, 1994; Stiglitz 1989, 1997a; Todaro, 1994; Weiss, 1990). The logic of *externalities* could be better understood through following example. A new firm set up by an entrepreneur generates lots of social benefits. However, the firm has to bear the 'start-up' costs of adapting technology to local circumstances, for creating new markets and so on for which the firm is not compensated. The social benefits accrue in terms of training of labor, creation of knowledge, increased labor productivity, lower input costs to other industries, introduction of new production equipment/ methods in manufacturing, new markets, and development of work culture in society. This non-compensation of cost to persons or entities engaged in the economic activity is usually termed in economics as *non-appropriability*. We may say that externality occurs, as certain costs are not appropriated. Due to the externalities the infant industry argument finds acceptance worldwide in general. The necessity of government intervention appears in terms of subsidization/ promotion of activities or provision of such goods/ services at subsidized prices that create positive externalities and taxation of those, which create negative externalities.

The government intervention for *increasing returns to scale* (also known as *internal economies or learning-by-doing*) has got its own set of arguments. The *increasing returns* works in two ways. First, it achieves economy of scale that reduces per unit production cost. Second, it increases productivity of the firms as they gain experience (Balassa, 1981; Chenery, 1986; Kaldor, 1967; Lall, 1996; Stiglitz, 1997a, Weiss, 1990). It results from the accumulation of experience and absorption of technology that perpetuates continued enhancement of technological capability. Simultaneously it also generates in the firms increased expertise in respect of project consultancy, installation and post-implementation supports, after sales service, as well as better work culture and managerial competencies etc. Further, these *internal economies* generate externalities in terms of continued diffusion of technology, generation of forward & backward linkages, higher division of labour and specialization as well as other firms get encouragement by the perpetuation of successes achieved i.e. 'demonstration effect'.
In the initial phase of development either market does not exist (*market absence*) or does not function well *(imperfect market)*, so prices are not right and therefore market mechanism is just not able to give appropriate signals for resource allocation. For example, in most of the developing countries the capital market is not adequately developed. There is also lack of infrastructure and institutional support for mobilization of capital, promotion of savings, credit

[4] Pareto-efficient means: it is impossible to make some individual better off without making some other individual worse off. Pareto efficiency is attained when marginal social costs equal marginal social benefits for all activities (Jones & Mason, 1982; Meier, 1995; Stiglitz, 1996)

delivery system and capital market. Moreover, an *imperfect capital market* is not able to generate sufficient fund from other sectors such as agriculture and services to finance further investment in manufacturing for overall economic development. It is one of the logic for infant industry protection. If infant industry is not supported, it will also not generate sufficient fund for further investment even though the long-term returns on investment are high. So one option is either to develop a perfect capital market, which is again an evolutionary process or choose the other option of protection of infant industry. Moreover, most of the firms cannot take advantage of increasing returns to scale without support for cheaper access to credit since they are usually small (SMEs). Government intervention can lower the cost of capital and increase economic efficiency. Apart from underdevelopment of the three basic markets: product-, labour- and capital market there are several areas where markets do not exist in most of the developing countries namely social security system or insurance. These deficiencies create a potential role for government to develop and run these markets in an efficient manner.

In developing countries, there is always prevalence of monopoly or oligopoly that make the *market non-competitive* with distorted prices. In such a situation the supply of goods is less than the demand that inflict overall loss to the society. So intervention is necessary to achieve the optimal output and building technological capability. The *non-competitive market* issue attracts two types of intervention from the government: *promoting competition* through reduced entry barriers, anti-monopoly legislations or public ownership etc. and *regulating competition* to restrain collusive behavior and restrictive trade/business practices.

The industry coordination (or *coordination failure)* implies simultaneous development of upstream and downstream industries as well as related & supporting industries. Coordination failure also occurs within an industry as well. There is always a possibility of under investment or over investment due to problems of strategic uncertainty.[5] Such failures produce waste as assets are mostly industry-specific, which cannot be redeployed without incurring losses i.e. the case of 'asset specificity' (Williamson, 1985, 1996). In the absence of adequately developed market, price cannot perform its coordinating role so industries, which are mutually interlinked, may not develop spontaneously. It creates the need of external coordination. It is interesting to note that in the Neoclassical model (perfect competition), the coordination problems do not exist due to assumption that under equilibrium condition, actions of individual agents are negligible and therefore there is no interdependency among investments (Itoh et al., 1991; Chang, 1994). The mutual interdependence in industries generates a special kind of *externalities* in terms of the generation/ diffusion of technology, higher learning potential, and increased specialization etc. as well as helps in achieving technological deepening.

Another major source of market failure is *information deficiency*. '*Information*' refers to the source of information, the treatment of information, distribution of information and maintenance of information (Van Dalen, 1989). There is deficiency in all the above aspects and thus the distortions. Actually markets with imperfect information are radically different from markets with perfect information. Information deficiency is pervasive in almost all aspects, right from sourcing the technology/product to marketing products. Just to cite an example, on

[5] Each potential entrant not knowing the intention of others (Chang, 1994).

the one hand, due to lack of proper information firms in developing countries are usually not competent in negotiations for technology transfer, FDI or import of capital goods (e.g. in terms of price, source of technology/Capital goods, lump sum/ royalty payment, scope for further dissemination, equity participation and other legal matters) and on the other hand foreign investors are not aware of investment potential of the country. So support from government is desirable to redress the market failure arising from information deficiency through proper collection, dissemination and maintenance of information.

In reality there is no economy in this world where 'market-failure' does not exist, although the requirement of nature of intervention may vary with the stage of development, national objectives, and ability of the government to intervene. However it may be relevant to mention that market-failure is not the only rationale for the government intervention. The other reasons are distribution of income, assertion of rights to certain facilities or goods such as education, health and housing, and the rights of future generations etc. (Stern, 1991; Stiglitz, 1996). For our discussion *we will primarily emphasize on market-failure rationale*.

In literature government intervention has been hotly debated under the umbrella of two different schools of thought: *Neoclassical and Structuralist. Neoclassical* emphasize the importance of market mechanism for allocating resources and see the government intervention as a necessary evil. While *Structuralists* emphasize on importance of government role for allocating resources and consider industry in general and manufacturing in particular, as key to engine of growth. In recent years the neoclassical view has received wider attention in policy discussions and has dominated the thinking of multilateral organizations like the World Bank and International Monetary Fund (IMF) etc.

The key characteristics of *neoclassical* perspective are the *belief in the importance of the price mechanism*, the role of *market forces* and *free trade.*[6] Their proposition is based on Adam Smith's doctrine of *laissez-fair i.e.* for promoting growth government should not interfere in functioning of the market. In the situation of perfect competition where none of the economic agents has any power to control prices, no external economies, no information imperfection, non-existence of *public goods*[7] and *full employment* the interaction among consumers and producers of goods, services and factors of production determine the prices spontaneously and product price equals marginal cost. Higher prices perpetuate higher returns to factors of production and in this way those factors of production move into activities that create the greatest value. Competition among producers (domestic or foreign) forces them to use factors as productively as they can otherwise they are susceptible to failure. In this way at any point of time returns to factors of production (i.e. rent, wage, interest and profit) are maximized as well as customer's satisfaction. In a span of time the perfect system maximizes income growth. In this way investment in both physical and human capital is automatically allocated to the highest productivity uses. In this situation the government's role is simply to establish an

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[6] Free trade refers to the trade in which goods can be imported and exported without any barriers in the forms of tariffs, quotas, or other restrictions. It encourages countries to specialize in activities in which they have comparative advantages, thereby increasing their production efficiencies and hence their total output of goods and services (Balassa, 1981; Todaro, 1994).

[7] Public Goods are commodities or services that, once provided, can be obtained without payment by others (Stiglitz1989, 1996; Chang, 1994).

economic environment in which market forces will realize efficient allocation of resources (Roemer & Radelet, 1991; Pack & Wetsphal, 1986; Itoh et al., 1991; Stein, 1995). But this is an ideal case. The real world situation, particularly the developing country situation, is something very far from this, as discussed earlier.

Neoclassical believe that the slow or negative growth of developing countries is the result of poor resource allocation due to excessive government intervention and neglect of trade opportunities through implementation of policies that discriminated against exports. They therefore advocate promoting competitive free market, price decontrol, privatization, trade liberalization, deregulation, removing barriers in foreign direct investment, emphasize domestic saving and capital formation, support for exports and free international trade, property rights and removing price distortions in factor markets (product, labour and capital) for increased efficiency and economic growth (Balassa, 1981; Chenery, 1986; Krueger, 1988; Little, 1982). However, later generations of Neoclassicals acknowledge the existence of market imperfections and market failure. They admit the need for interventions but of '*functional*' nature i.e. the interventions that support the functioning of markets particularly factor markets without favouring particular industry or firms, such as research & development and education etc. Such approach has been termed as '*market-friendly'* approach in the literature. (Kosacoff & Ramos, 1999; Lall, 1992, 1994, 2001; Stiglitz, 1996; Wade, 1990; World Bank, 1993).

On contrary to the Neoclassicals, the *Structuralist* advocates for the role of the Government in allocating resources in place of the market. They stress on significance of *externalities, linkages,* and support for the *need of protecting infant industries* ((Kosacoff & Ramos, 1999; Lall, 1992, 1994, 2001; Weiss, 1990; Greenaway & Milner, 1993) for the process of industrialization. The infant-industry argument for industrialization provides the rationale for protecting domestic industry from foreign competition in its infancy. According to this argument, new industries cannot compete in the initial stage with established producers of foreign countries, so to establish a new industry the government should support them until they grow strong enough to meet international competition. It is argued that the domestic production may be relatively inefficient in short run but in the long run the nurturing of the infant industry would be advantageous to establish and extend the industrial base for overall economic development. The protection allows the higher-priced domestic producer enough time to learn the business ('*learning by doing'*) and to achieve economy of scale so that the industry becomes competitive in domestic as well as export market (Weiss, 1990; Itoh et al., 1991; Todaro, 1994).

However, it is seen that in the Structuralist view also there are certain inherent assumptions, which drive it out from the realm of reality. As per them *the government can do no wrong* as they assume perfect information and technical efficiency in the government. These are far from the reality and hence there exist the problem of '*government failure'*. The major sources of government failures are *imperfect information, lack of flexibility, problems of incentive & efficiency* and *rent-seeking behaviors* in the government (Chang, 1994; Lall, 1992, 1996, 2001; Itoh et al, 1991; Stiglitz, 1996; Streeten, 1993). Evidences suggest that in the developing countries the Government does not have sufficient mechanism to collect and process all necessary information for formulating interventions, implementing them and monitoring them effectively and efficiently (i.e. problem of *insufficient information*) as the magnitude of information required to be effective is very diverse and big (Chang, 1994; Stiglitz, 1997). *Imperfect information* affects the necessary skills to design and implement various interventions, as well as the capability to look at the long-term effects or side effects of those interventions. Moreover, government *lacks flexibility* to change as per the need of the hour and they are stubborn to correct their mistakes. And last but not the least they are prone to corruption and influence by certain groups of people *(rent seeking*). Due to influence of certain interest groups sometimes interventions are designed and implemented in such a way that benefits certain specific firms or group of firms.[8] It not only results in deadweight losses but also diverts resources in unproductive activities and creates waste. It ultimately results in an inefficient allocation of resources and as a result the Government is not able to achieve its objective what it plans to achieve. In this context it is worth mentioning the observation of Paul Streeten (1993: 1289):

"Citizens, politicians, bureaucrats and states use the authority of government to distort economic transactions for their benefit. Citizens use political influence and pressures to get access to benefits allocated by government; politicians use government resources to increase their hold on power; public officials trade access to government benefits for personal reward; and states use their power to get access to the property of citizens. The result is an inefficient and inequitable allocation of resources, general impoverishment and reduced freedom."

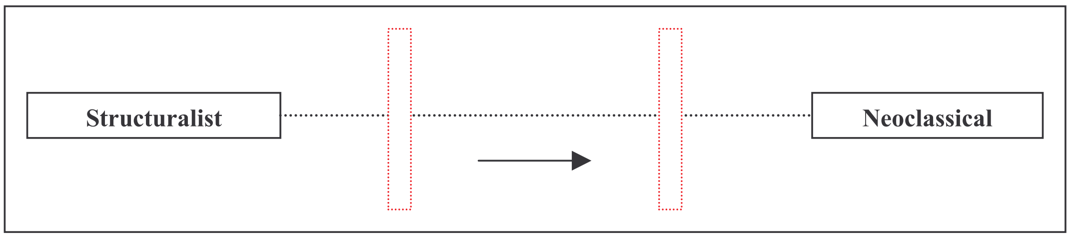
The inefficient government interventions have caused enormous waste and perpetuated inefficiencies in the developing countries. It has become so pervasive that critics of the government intervention declare it unnecessary, ineffective and counterproductive. Historical experience from the centrally planned economies demonstrate that the government action of market replacement i.e. direct physical allocation of resources (Command planning) conforming to the extreme Structuralist perspective eventually developed a lack of dynamism and inefficiencies that produced slower growth rates and culminated to economic crises. Like *market failures* prevent the market mechanism from attaining the most desirable allocation of resources, *government failures* also prevent the government from achieving the same.

From the Neoclassical perspective, Structuralist ignores the fundamental ideas of conventional economic theory, i.e. the importance of prices for resource allocation and the role of comparative advantage in planning trade possibilities. Whereas the Neoclassical perspective cannot be considered appropriate in the context of developing countries as it *concerns with the operation of markets only, not with how markets develop* which is the main concern in developing countries (North, 1994). Kosacoff and Ramos (1999) express the same in terms of '*return to market*' and '*reconstruct the market*'. The above discussions suggest that due to their inherent assumptions neither of the extremes Structuralist (*ideal Government)* or Neoclassicals (*ideal market)* can function in reality. As a matter of fact most of the sources of government failures are equally responsible for market failures. Rent seeking is as common as in the market as in the government. In fact various government interventions are required to minimize it (e.g. anti-monopoly, anti-cartel, creation of competing government enterprises etc.). We have already seen how information deficiency creates market failure. So, the *government failure* is not necessarily an argument for discarding government intervention. Therefore, the Structuralist and Neoclassical perspectives may be considered as two extremes on the same continuum rather than as 'either-or' dichotomous construct. There is nothing like a choice

[8] Such as erecting various entry barriers, subsidy, price-fixing and tariffs etc.

between ideal Government (Structuralism) and ideal market (Neoclassical). Although the design, focus and scope of the government interventions may differ, ***the national policies worldwide can be traced lying at some point of this continuum*** (Figure 2.4)**.**

Figure 2.4: Movement on the Structuralist-Neoclassical continuum



Evidences suggest that in the initial stage of development there has been greater role of government in the development process so they are nearer to structuralism extreme and as the development progress and governments are able to redress market failure problems, they move towards the neo-classical extreme on the continuum but not reaching there. The reliance on market forces as a mechanism for promoting industrial development increases gradually as country advances on the industrialization path conforming to above proposition of movement on the continuum. Therefore we can conclude that the '*government*' and '*market*' are *the two sides of the same coin*. The case of free, unregulated market depends on many assumptions that do not exist in reality. Similarly the case of the government replacing the market is far from reality due to existence of government failure. Nevertheless, *government failure* is not necessarily an argument for eschewing the government intervention. On the other hand for redressing market failure there is always a need for the government intervention. Thus, *what matters is the "how", "where", "when" and "to what extent" of government intervention.*

2.3 Government intervention: How?

2.3.1 Theoretical underpinnings

In spite of several differences between the two schools of thought: Neoclassical and Structuralist, there is a consensus on the role of government as regards to maintaining macroeconomic stability, providing physical and institutional infrastructure, providing 'public goods' like national defense, education, and providing the right environment for improving functioning of market. The major difference appears in the treatment of market failure only. The analytic theoretical arguments and empirical evidences put their weights towards rationality of the Government intervention particularly in the context of developing countries. The government should create conditions, which redress market failures by complementing the market and not by replacing it. One has to understand that while market failures are quite pervasive in the developing countries, the ability of the government to redress those failures is also limited. The problem boils down to *how best an imperfect government redresses the problems of imperfect market*? In arriving at a balanced view one needs to consider the strength and weakness of the government as well as the strength and weakness of the market under the changing global perspectives. So interventions need to be formulated in such a way that minimizes government failures as well as redress the prevalent market failures. In this context it is important to understand that most of the sources of government failures (such as information, rent seeking and efficiency of system) also act as source of market failures. Similarly the government also experiences learning and other externalities. So any effort to reduce these sources improves functioning of both, the government and market. They are interlinked as well. An improvement in one improves the performance of other and vice-versa. So *the entire debate* about the Government intervention in the process of industrialization *directs towards a synthesis: a harmonious synthesis of the Government and the market*. *The basic premise being: the Government intervention should complement the market rather than a substitute for it* (Dutt et al., 1994; Stiglitz, 1996; Streeten, 1993; Sunkel & Zuleta, 1990).

In order to reduce government failure, particularly the rent seeking behavior, the discretionary authority from the hands of bureaucracy and political masters, which is the most common tool of rent seeking has to be reduced by way of making the system more transparent and speedy flow of information. Although it is not so easy as said, the government has no choice but to adopt this path if it plans to improve its performance and attain sustained industrialization. For establishing a conducive environment for market, more emphasis needs to be given on the establishment of institutions that should function as market agents and implement price-determined policies (e.g. taxes & subsidies etc.). Moreover the Government needs to act as a central coordinating agency for mediating among different stakeholders of the market, facilitating information exchange and insuring the implementation of the decision reached. Such efforts would require extensive consultation with the different stakeholders and possibly decisions through consensus building. In few cases it may require at least protracted consultations. The Government needs to complement the market through dynamic actions such as the promotion of markets that are lacking (e.g. capital-, labour-, insurance market etc.), strengthening of incomplete market (e.g. technology market), reduction of structural distortions in industrial structure, as well as adequate attention on different externalities and public goods (Chang, 1994; Sunkel & Zuleta, 1990; Itoh et al., 1991). In this approach if need be, government may adopt an entrepreneur role either through promotion of private entrepreneurs or through promoting own enterprises in the areas where private participation is likely to be less or mandating[9] actions for the private sector or combining two or more of these actions as per the need (Stiglitz, 1997a). It requires reinventing the Government as a catalyst, mission-driven, result-oriented, customer-driven, enterprising and market-oriented (Osborne & Gaebler, 1992). In sum we can say that the Government should participate actively (*activism*) for redressing market failure with more emphasis on complementing the market (*market complement*).

As regards to perspectives with respect to trade, again it is the dilemma of choosing between the two: free trade and import-substitution (IS) policy[10], as none of them on its own is a feasible panacea for sustained industrialization for developing countries. *Neoclassicals* advocate *free trade* while *Structuralists* argue for *inward looking IS* policy. In literature, the

[9] A mandate is requirement imposed by Government backed up by the threat of legal action (Stiglitz, 1997).

[10] The policy of encouraging domestic industry by limiting imports of manufactured goods is known as *import-substituting policy* (Corden, 1965; Krugman & Obstfeld, 1994; Weiss, 1990).

rationale for free trade, particularly for free imports has been widely questioned due to the flawed basis of static nature of comparative advantage, treatment of technology as exogenous and other assumptions of Neoclassical perspective. Nevertheless, the relevance of trade for development is well recognized and has been supported by theoretical as well as empirical evidences. There is consensus on the fact that the real income of each country will be higher with trade than without trade. In order to find a synthesis of free trade and IS policy let us unravel the discussion on the policies concerning imports. In literature it is usually debated in terms of IS and export-oriented (EO) policy.

The IS policy gets theoretical rationale in the *infant-industry argument* (Corden, 1965; Williamson, 1983; Weiss, 1990; Krugman & Obstfeld, 1994; Todaro, 1994). It is seen that due to perceived benefits of the IS strategy and political reasons most of the countries whether it is developed or developing, have implemented it in different forms and belief at different point of time with varying degree of success. As a strategy for encouraging growth of manufacturing, this policy has been successful to the extent of developing diverse manufacturing. However, continued and across-the-board use of this policy has not given satisfactory results. It has rather given an upper hand to the critics of this policy. By limiting the degree of foreign competition, it restricts the introduction of new products & processes, lowers the incentive to improve productivity, creates inefficiencies, and increases local monopolies, creating a high-cost industrial structure, lack of international competitiveness and rent seeking environment. It also discriminates against exports through explicit (say export taxes) or implicit taxation (e.g. effects of protection on exchange rate) of export activities and diverts resources to the sheltered and capital-intensive industries (Balassa, 1981, Meier, 1995). The continued dependence by the government on this policy brings its deficiency in the forefront as well as activates the sources of *government failure*. The selective use of this policy has shown much better results as evident from the progress of Japan and Korea. Hence there should be an element of *selectivity* in terms of specifying the industry, time and degree of protection for attaining better results. We will elaborate on selectivity in the next section also.

Contrary to the IS policy, the EO policy attempts to promote industrialization by way of exports of manufactured goods through price incentives such as market exchange rate, export subsidies & preferential credits etc. and non-price incentives viz. export market research, quality up gradation program and so on rather than emphasizing expansion of domestic market through protection. The EO policy offers several stimuli for development in terms of international competition, which encourages quality control, new products, techniques and modern management practices; economy of scale & scope from increased market size; sophisticated buyers; and low dependence on domestic market expansion etc. (Lall, 1996; Nafziger, 1997). Further, an export-oriented economy has more flexibility to respond to shocks like oil price rise or world recession etc. than a relatively closed economy (Williamson, 1983; Nafziger, 1997). Evidences suggest that countries adopting EO policy have generally experienced better growth than countries opting for IS policy. In this context Balassa's remarks is worth mentioning *"the evidence is quite conclusive: countries applying outward-oriented development strategies had a superior performance in terms of exports, economic growth, and employment whereas countries with continued inward orientation encountered increasing difficulties*" (Ibid, 1981:16).

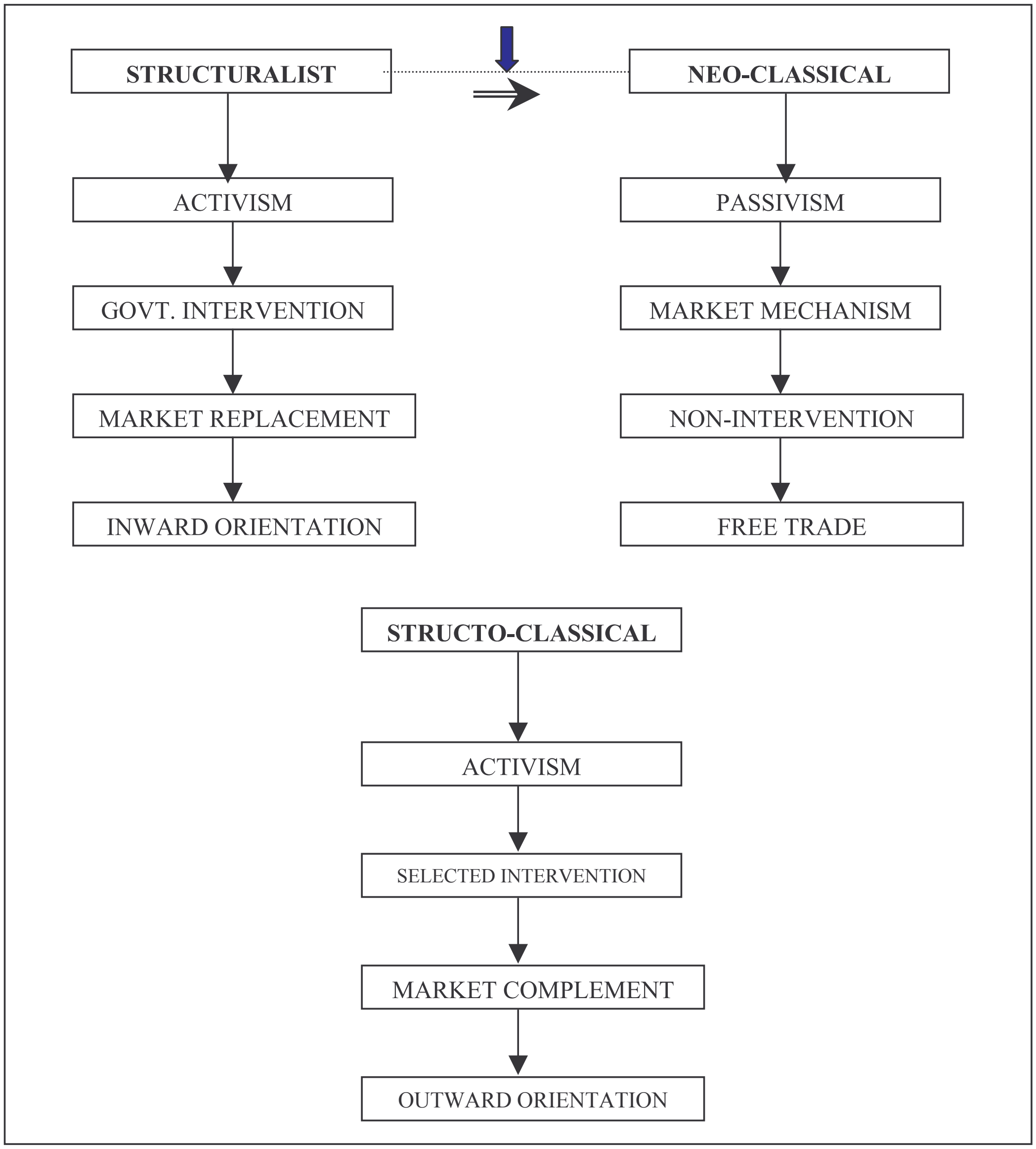
It is well recognized that exports provide stimulus for productivity growth and in turn helps in achieving international competitiveness i.e. increased export performance and ability to compete both in the domestic as well as international market. In fact the EO policy is not against any import protection. It only suggests refraining from the pro-domestic market incentive structure and advocates for providing similar incentives to production for both domestic as well as exports markets (Balassa, 1981; Weiss, 1990). Hence the government should thrust for export led industrialization but not "at any cost'. Policies should be such that the infant industries should begin exports at the earliest and the established industries should also contribute in the exports endeavor. Their performance should be monitored properly with proper export targets and export subsidies. Therefore, it may be concluded that for the sustained industrialization an economy needs to adopt *outward orientation*.

The above discussion answers the question: '*how should the government intervene?'* First of all, the government should participate actively (*activism*) for redressing market failure with more emphasis on *complementing the market* rather than replacing it. There should be an element of *selectivity* in the interventions. The last but not the least the policy should have an *outward orientation*. This perspective may be termed as *Structuro-classical perspective* for the process of industrialization. It *embodies* the *Structuralist view at its heart* and *Neoclassical view as a motivational factor*. It advocates *activism* albeit *with selected intervention to complement the market with outward-orientation.* It sets forth the premise that *rational government intervention is fundamentally important for the process of industrialization although the belief in market mechanism is indispensable*. The three perspectives are schematically presented in figure 2.5.

However, it may be noted that the policy prescriptions for every country are not the same and it should not be the same. The interventions should be designed with utmost caution based on actual economic, social, technological and political situation prevailing in that country and the national goal. It is more meaningful to *consider* such type of *policy* as *Strategy*[11] as it has to function as a carefully devised plan of action to achieve a goal, which is different from policy i.e. a program of actions adopted by the government (Reich, 1982; Rumelt, et al., 1991).

[11] Strategy is seen as more than just coordination or integration of functions. It is collection of related, reinforcing, resource-allocating decisions and implementing actions (Rumelt, et al., 1991).

Figure 2.5: The three perspectives for Industrialization



In the forgoing section we argued that the government intervention is essential for sustained industrialization in the context of developing countries. There are sufficient theoretical justifications and empirical evidences for the same. In the following section we will focus on the taxonomy of the government intervention and argue for need for *selective* (*industry-specific) government intervention*.

2.3.2 Taxonomy of the government intervention

In the literature, government interventions are classified usually on the basis of *applicability* such as functional, horizontal, vertical, sectoral, market-friendly, market-stimulating etc. *or focus on the economy* i.e. macro, micro or social etc. In terms of applicability there are essentially of two types of intervention: *functional* and *selective*. The interventions that support the functioning of market particularly factor markets *without favouring any particular industry or activity* are termed as '*functional'* or 'neutral' *intervention.* They are considered as non-discriminatory and non-discretionary policies (Lall, 1992, 1996; Pack & Westphal, 1986; Roemer & Radelet, 1991; Stiglitz, 1996; Wade, 1990). Facilitating information flow, improving general education system, ensuring adequate investment in human capital formation, liberalization of trade, strengthening of financial market and infrastructure are some of the examples of functional intervention.

The s*elective intervention* has been commonly referred in literature as '*industrial targeting*', 'sectoral prioritization', '*targeted* intervention', 'picking winners' or 'sponsoring national champions'. It intends to allocate resources for the selected industry in order to generate necessary competitive advantage. In this way it aims to develop the industry in a more planned way, which otherwise would not have been possible on its own based on decision of the market. Johnson (1984) views it as a dynamic anticipation of the economically efficient allocation of resources for the future. Theoretically it may be argued that market itself would identify the promising industry and there is no need for the government to undertake this job. But in reality it seldom happens (Chang, 1994; Itoh et al, 1991; Johnson, 1984; Lall 1992, 1996; Lall & Teubal 1998; Wade, 1990).

There could be one additional variant of government intervention. The interventions intended to promote selected activities across sectors are termed as *horizontal intervention* (Lall & Teubal 1998; Teubal, 1997). These policies are not specific to any industry or sector as such. For example, the provision for venture capital for financing innovative venture or subsidizing market development efforts or R & D efforts in general come under the category of horizontal policy. However, when applied for a particular industry, it would be considered as selective policy. In order to achieve simplicity and better understanding, the government intervention may be classified on the basis of its applicability i.e. applicability to overall industry, activity or selected industry as shown in Table 2.1.

Table 2.1: Typology of government intervention based on applicability

Applicability ► **Policy ▼**	**All Industry**	**Selected Activity**	**Selected Industry**
Functional	X		
Horizontal		X	
Selective			X

Evidences suggest that no individual policy may give good results in isolation. A healthy government intervention should be a combination of all the three types enumerated above: *functional, horizontal and selective*. From our previous discussion it has been clear that the Neoclassical prefer only functional intervention, if at all. However, selective policies are as essential as functional policies particularly for developing countries due to their specific characteristics, which cannot be addressed by functional policies properly. In order to clarify we may consider a simple example of human resource development. Improving education system in general and focusing on raising literacy level are functional policies. These are essential for development of any country. Whereas establishing R&D institute for undertaking R&D on Machine Tools or training specialized personnel in this field would be considered as selective *policy*.

In addition to these there is a very simple logic for selective policies. During the process of industrialization it may not be feasible to give priority to each and every industry. Evidences suggest that blanket promotion/ protection of too many industries at a time create a distorted and high cost industrial structure. It does not help in achieving sustained industrialization and international competitiveness. It is therefore necessary to identify certain priority industries at each stage of development. Nelson (1999:16) rightly observes that *"to recognize, explicitly, that effective policies and institutions need to be tailored and that one size shoe does not fit all means that it is not fruitful to think about industrial policies 'in general'."* Apart from general justifications, the need for selective intervention become more apparent due to product life cycle phenomenon (Chang, 1994; Itoh et al, 1991; Johnson, 1984; Lall 1996; Lall & Teubal 1998; Wade, 1990), particularly for entry into higher value added segment of industry as well as planned exit from declining industries.

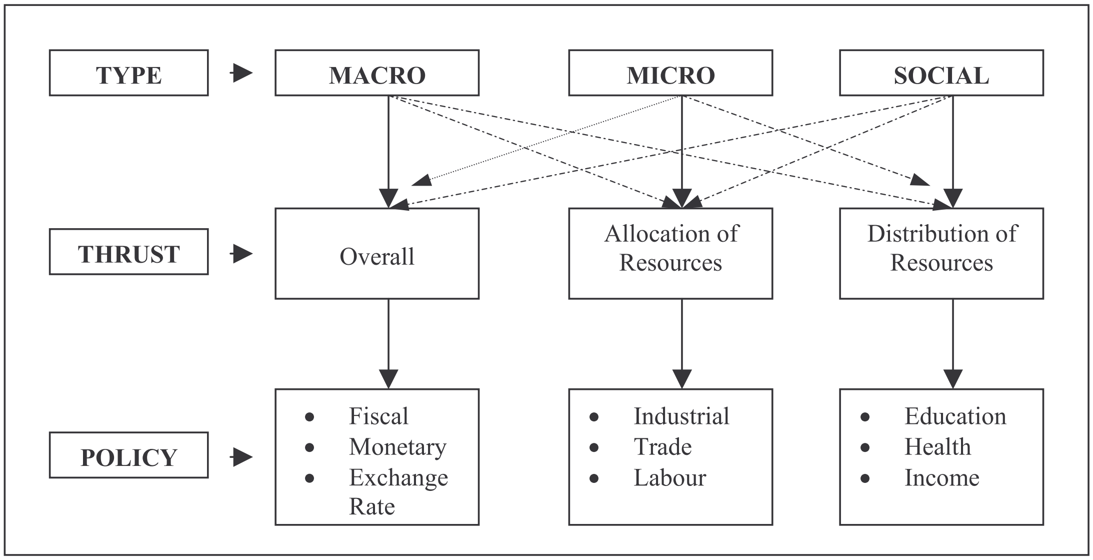
The *product life cycle* (PLC) *theory* emanates from the dynamic perspective of the international comparative advantage. On the basis of this theory it may be said that the process of international division of labour produces a natural evolution of production and therefore for the industrialization. According to it, a product passes through four different stages: *incubation & development* (i.e. *infancy), growth, maturity* and *decline* (Vernon 1966, 1979). At each stage of development there is specific role of the Government for proper development of the industry and these intervention are mostly industry-specific i.e. targeted policy. Usually a new product or technology initially appears in an industrially developed country due to their higher level of technological capabilities. So in the initial phase they dominate the production and trade of the product. Eventually the product and process technologies are widely understood/ simplified and the product passes through growth (*sunrise industry*) and then attains its maturity (*matured industry*). In the process, production shifts from the innovating country to other countries. Evidences suggest that as the technology is perfected and demand increases, production is shifted first to other industrially advanced countries, then to NICs followed by other developing countries and so on to take advantage of low wage, other factor endowments and market. This natural shift of production base from industrially advanced countries to developing countries help industrialization process in the latter. In fact the PLC is replicated with a time lag in developing countries.

In the above course of action the nature of government intervention differs substantially. The difference is more prominent in the initial stage. In the industrially advanced countries where the product is conceptualized first, the Government intervention is mostly in the form of support for basic R&D necessary to generate new knowledge, encourage experimentation, and creation of demand pull through various ways. There is no competition from foreign manufacturers as such. So policies are more functional or horizontal. On the other hand, in the developing countries the process of acquisition, adaptation and assimilation of technology become the dominating function in the initial stage of production of that product. It requires more targeted intervention particularly for smooth technology acquisition and adaptation (technology flow), creation of demand (market development through proper incentives for diffusion of technology and the government buying technologically advanced products) and support to domestic industry against the competition from foreign manufacturers (protection). The infant industry argument is more valid for technology follower countries. In the growth stage the product and process technology are widely understood and simplified. At this stage, targeted intervention in terms of institutional support, investment coordination within the industry (to prevent under investment or over investment) as well across the industry (downstream and upstream as well as supporting/ related industries), efforts for diffusion of technology in domestic market and assistance for export marketing become the important elements of policy. Similar policies are needed in maturity stage as well. However, emphasis has to be more on improvement of technology, to achieve international competitiveness. As the industry enters *decline* stage, demand shrinks which necessitates not only scrapping of capacity but also redeployment of human resources of the existing industry. Industry at this stage is also referred as 'sunset' industries. The government needs to play a vital role in anticipating beforehand which industry is loosing its technological dynamism and international competitiveness.

The next obvious question appears that *which industry to be chosen for targeting* and how? As regards to the choice the industry, it should be either strategically important industry, or a promising (also referred as '*sunrise'*) industry or combinations of both for giving proper thrust for its development or a declining (also referred as 'sunset') industry in order to progressively withdraw from the industry. The *strategic importance* of an industry is reflected through amount of externalities it generates for the process of industrialization in terms of its impact on manufacturing, possibility of dynamic increasing returns to scale, influence on product characteristics and production process of other industries, backward and forward linkages, value added and the negative consequences for the economy if the industry is not developed properly. The 'sunrise' industry may be judged through its prospect of growth, potential for exports, possibility of dynamic increasing returns to scale, its price and income elasticity particularly in export market, its linkages with other industry and its position on technology frontier (Cohen & Zysman, 1987; Nelson, 1999; Pack & Westphal, 1986). However, the judgment of 'sunrise' industry will depend upon the level of industrialization of a country, position of the industry in terms of its product life cycle and objective/strategy of the country with respect to industrialization. For a developing country, industries (or product) which are at the growth stage of its life cycle or which are reaching to maturity stage in the industrially advanced countries market are the potential industries for targeting as a 'sunrise' industry. As most of the efforts in terms of R&D, equipment and human resources are industry specific, the decision regarding identification of the industry and the modalities of intervention should be arrived at after due consultation (at least protracted consultation) with the stakeholders of the industry to induce effective deployment of resources.

The government policy could be segmented into three discreet but interrelated category on the basis of focus on the economy namely: *macroeconomic policy, microeconomic policy and social policy*. They are presented in Figure 2.6.

Figure 2.6: Typology of government policy



Source: Adapted from Greenaway & Milner (1993)

The primary focus of *Macroeconomic policy* (fiscal-, monetary- and exchange rate policy) lies on the overall level of economic activity in the economy such as the level of national income (output), unemployment, inflation and prices. The *Microeconomic policies* (such as industrial policy, trade policy, agriculture policy and labour policy etc.) are concerned mainly with allocation of resources across activities viz. The *Social policies* (such as education-, health- and income policy etc.) are essentially concerned with the distribution of resources between individual and groups. Besides the primary thrust these policies do have their impact on each other within each segment as well as across the segment. Impacts within the segment refer to the influence of fiscal policy on monetary policy or impact of trade policy on industrial policy and so on. While, impact across the segment (inter segment impact) refers to impact of macro policy (say fiscal policy) on allocation of resources (say industrial policy) or impact of health policy on industrial policy and so on.

In order to establish the further 'how' of the government intervention, it is now essential to understand the taxonomy of industrial policy. *The government intervention for industrial development* is usually termed as *Industrial policy*. Hence we will first build up a definition of industrial policy, and then discuss its different dimensions.

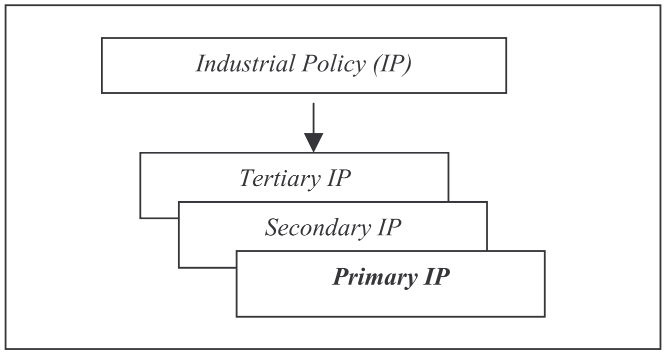
2.3.3 Taxonomy of Industrial Policy

Industrial policy has been approached from a variety of perspectives, since governments frequently attempt to influence different areas of economic activities relating to the industrial sector (Adams & Klien, 1983; Chang, 1994; Itoh et al., 1991; Johnson, 1984; Weiss, 1990). The US view of Industrial policy is characterized as emphasizing the virtues of private capitalism that leads to overall objective as maintaining a favorable climate for business by way of less intervention through industrial policy and often considered as industry specific policy (Johnson, 1984; Reich 1982; Wescott, 1983). Japan treated Industrial policy as a strategy to gain international competitiveness. Japanese IP is designed primarily to influence the structure and performance of private enterprise through measures like administrative guidance & industry specific Industrial policy (Itoh et al., 1991; Johnson, 1984; Matsumoto, 1992). In Europe the main objective of Industrial policy has been to supplement the market in order to increase society's level of welfare and often conceived as an attempt to determine in advance the market competition process as well as the likely success of new technologies (Adams & Klien, 1983; Bollino, 1983; Johnson, 1984). In the centrally planned economies it corresponds to planning and plan implementation. As regards to developing countries it is mostly debated in terms of import-substitution or export-oriented policy and considered as means of industrialization, development strategy and trade policy (Adams & Klien, 1983; Amsden, 1989; Chang, 1994; Weiss, 1990). Since this study is in the context of developing country, we will consider *Industrial Policy as a development strategy to achieve sustained industrialization.*

Although Industrial policy has been discussed extensively in literature, it has not been clearly defined. Different authors have floated definition of industrial policy in different context following different approaches. It is very well reflected from the observation of Hiroya Ueno, one of the Japan's leading theorists: "*Its conception, content, and forms differ, reflecting the stage of development of an economy, its natural and historical circumstances, international conditions and its political & economic situation that develop considerable differences from nation to nation and from era to era"* (Ibid, 1983 as cited in Johnson, 1984: 73). In a broader sense *all government actions that affect industrial development may be considered as Industrial policy* (Adams and Klien, 1983; Donges, 1980; Greenaway & Milner, 1993). The above statement is true but for a meaningful discussion it should address a limited set of issues only. As a matter of fact there are fleet of policies at macro and micro level such as fiscal policy, monetary policy, defense policy, and education policy etc. that affect the overall economy besides having significant impact on industrial development. If we consider such a broad definition it would be very difficult to separate policies from each other and almost all policies of government will look like as Industrial policy since there is some element in every policy that affect the process of industrialization process directly or indirectly. Hence the definition of Industrial policy has to be narrowed down. Nevertheless, we accept the statement as our starting point for arriving at a concrete definition of Industrial policy.

At this point, it may be worthwhile to view Industrial policy at three levels based on nature of impact of the above-mentioned policies on the industrial development. They may be termed as '*tertiary'-, 'secondary'*- and '*primary'* industrial policy (Figure 2.7). At the highest level of aggregation those macro- and social policies having significant impact on industrial development (*inter segment impact*), could be covered under *TIP*. The policies under microeconomic policy (say trade-, labour- and agriculture policy etc.) affecting industrial development (*intra segment*) may be termed as *SIP*. At the lowest level of aggregation are the policies that directly influences the process of industrialization are covered under *PIP or "industrial policy per se"*. In all our further discussions we will concentrate on primary industrial policy and refer this as *industrial policy* unless otherwise stated.

Figure 2.7: Typology of Industrial Policy



The relationship among the three levels of industrial policy i.e. TIP, SIP and PIP and the three levels of government policies i.e. macro, micro and social may be presented in matrix forms as under (Table 2.2).

Table 2.2: Government Policy- Industrial Policy Matrix

Industrial Policy ► / Govt. Policy ▼	*Tertiary* IP	*Secondary* IP	*Primary* IP
Macro & Social policy	X		
Microeconomic policy		X	
Industrial Policy			X

In the beginning of our discussion (see section 2.1) we viewed the process of industrialization at the three different levels: country, industry and firm. Now it may be possible to correlate the primary influence of different Industrial policies (TIP, SIP, & PIP) on different level of industrialization as well. It is illustrated in a matrix form in Table 2.3:

Table 2.3: Industrial Policy- Level of Industrialization Matrix

Industrial Policy	Level of Industrialization		
	Country	Industry	Firm
***Tertiary* IP**	X	X	
***Secondary* IP**		X	X
***Primary* IP**		X	X

It may be recognized that the TIP predominantly influences the process of industrialization at the country and industry level; while SIP and PIP mainly influence on industry and firm level of industrialization as marked 'X' in the concerned cells of the matrix. With these analyses in the mind, we can now proceed ahead for arriving at a definition of the *PIP* and describing its different elements.

2.3.4 Defining Primary Industrial Policy

It may be worthwhile to refer to the definition of industrial policy proposed by Lindbeck (1981). He notes that it should be normally understood as a policy that seeks to influence the process of industrial change through *microeconomic* intervention i.e. allocation of resources among sectors of production. Although the definition is not so discreet, it gives a direction to arrive at a concrete definition of primary industrial policy by narrowing down the scope of IP as microeconomic intervention.

Weiss (1990) defines an active industrial policy, as a conscious attempt by government to influence size, composition and activities of the industrial sector through various interventions, using both price and non-price policy instruments. This definition is relevant but somewhat broad, as it does not bind itself in a specific boundary. It includes all the three levels of Industrial policy, which we described earlier as TIP, SIP and PIP.

A more rational definition of Industrial policy has been proposed by Itoh et al. (1991) while discussing Japanese industrial policy that is applicable in the context of other developing countries as well. He considers industrial policy as policies that are necessary only when market failures prevent the market mechanism from attaining the most desirable resource allocation and income distribution. He has concentrated on the market failure rationale of the industrial policy. But this definition is also somewhat broad as it does not exclude TIP and SIP from the domain of consideration of the definition.

Chang (1994) while discussing the industrial development in Korea, defined industrial policy as a policy aimed at particular industries to achieve the outcomes that are perceived by the Government to be efficient for the economy as a whole. He himself considers the definition to be close to the definition of selective industrial policy targeted towards few specifically selected industrial sectors, which is rather too narrow to be accepted. Prioritization of industrial sectors may be an important element of industrial policy not the policy in totality.

In Dietrich's (1992) view industrial policy can be characterized as long-run supply-side initiatives aimed at restructuring or promoting activities of particular firms or sectors. It includes tools like selective promotion of particular sectors or branches of an economy; financial aid to investment and R&D; and regulation of foreign trade in the interests of national economy etc. He suggests that industrial strategy should acknowledge interdependencies with other economic policies for development of mutually self-supporting policies. But he did not include the demand-side perspective in the definition. The relevance of pursuing a policy that considers only supply side aspects gets diluted if there is little or no demand for what is produced, so stimulation of demand should also be an important aspect of industrial policy.

Suzumora (1997) considers industrial policy as an economic policy that is designed to improve the long-run welfare performance of a national economy by intervening in the allocation of resources between industrial sectors, or in the industrial organization of a specific sector, if the competitive market mechanism fails to function efficiently. He views Industrial policy as policies affecting nation's industrial structure and designed to correct market failures. As we have seen that the process of industrialization induces structural shift in manufacturing sector and the Government intervention is mandatory for accelerating this process. Therefore an industrial policy has to be intricately linked with the formation of an ideal industrial structure suitable for attaining rapid growth in a dynamic situation. It should explicitly take into account the changes in the overall industrial structure attained through execution of these policies. Swayer (1992) also proposes a similar definition on the above line of thinking. He defines *industrial policy as microeconomic measures designed to influence the structure, behavior or performance at the level of the industry.* Although these definitions are logical as they advocate activism and selectivity but does not include demand side perspective.

In view of our *Structuro-classical perspective* of government intervention that *advocates activism with emphasis* on *market complement*, *selective intervention* and *outward orientation*, the definition should reflect the following. First, it is a microeconomic measure that redresses market failures. Second, it is intricately linked with the formation of an ideal industrial structure suitable for attaining rapid growth in a dynamic situation. Third, selectivity should be considered at the level of industry not any particular firm. However it should recognise that it is the firms that compete in industries. Thus IP should create an environment in which the firms can upgrade their competitive advantage by way of increasing their productivity and attaining international competitiveness. Fourth, it takes into account both the aspects of supply and demand. Fifth, it clearly indicates the objective of the policy. In view of the above, we define:

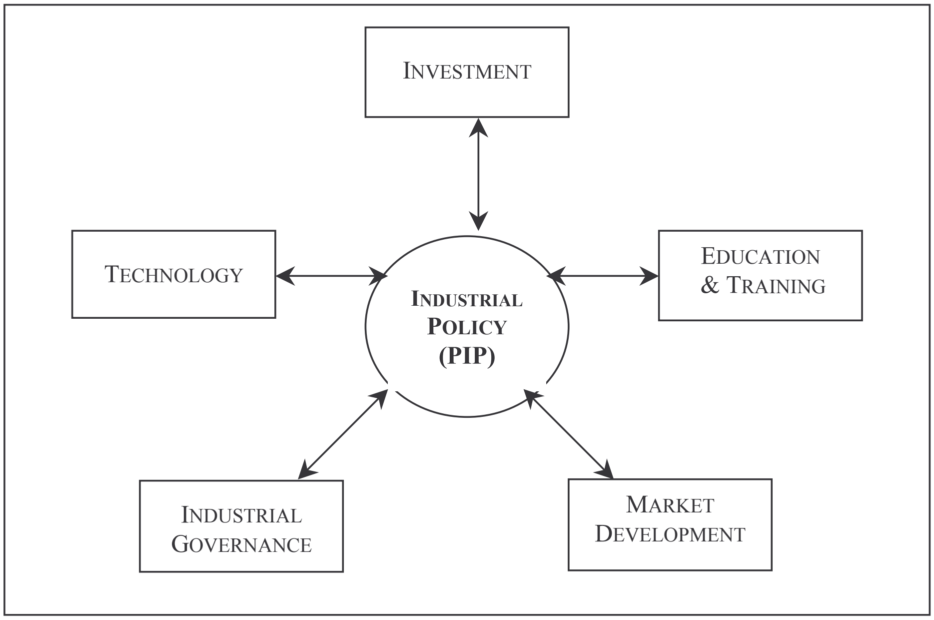
> '*Primary industrial policy* as *microeconomic measures designed to influence the structure, resources, conduct and performance of the industry both from the supply-side and demand-side perspective in order to achieve sustained industrialization and international competitiveness*.'

This definition may be considered as the '*definition per se' of Industrial policy.* Therefore in the subsequent discussions, we will use *primary industrial policy* and *industrial policy interchangeably* unless until stated. In this definition Industrial policy has been considered as a separate policy to exclude macroeconomic measures that we defined as 'tertiary industrial policy' and other microeconomic policies affecting industrial development i.e. 'Secondary Industrial policy' earlier. The supply-side includes intervention in general mechanism of production and allocation of resources while the demand-side covers the measures for stimulating demand in domestic and export market. International competitiveness has been considered as ability to compete in the domestic market as well as in the international market.

2.3.5 Elements of Industrial Policy

In general, industrial policy should concern with policies regarding entry and exit barriers, composition of output, size of firms, scale and scope of production, ownership, location, import of technology, R&D efforts, diffusion of technology, promotion and regulation of domestic investment as well as foreign direct investment (FDI), development of SMEs, creation of demand in domestic as well as export market, institutional support and creation of linkages etc. These measures include an optimal mix of functional, horizontal and targeted policies. For easier understanding these may be segmented in terms of mutually reinforcing elements like *Technology, Investment, Education & Training, Market development and Industrial governance* (see Figure 2.8). We will discuss these individually.

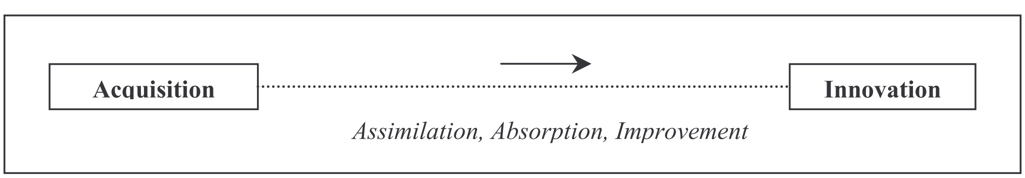
Figure 2.8: Elements of Industrial Policy



2.3.5.1 Technology

Technology includes technical activities in a broad spectrum of areas such as basic research, applied research, development, design, engineering, manufacturing, testing, maintenance and technology transfer for both *product- and process technology* (Pack & Westphal, 1986; Dosi et al., 1988; Lall, 1992, 1994; Lall & Teubal 1998). It has been well recognized that due to requirements of high technological capabilities, cost, time and risk involved in internal development for new product/process, acquisition of technology from foreign sources is more practical and faster route for developing countries. It helps in the process of '*catching up'* more quickly. The thrust should be on access to new technology, mastering them, adapting them to local conditions, improving upon them and achieve international competitiveness (Porter, 1990; Lall, 1992, Kim, 1998). Actually the objective should be the movement on the continuum of the technological ladder from the stage of *acquisition to innovation*.

Figure 2.9: Continuum of the Technological ladder



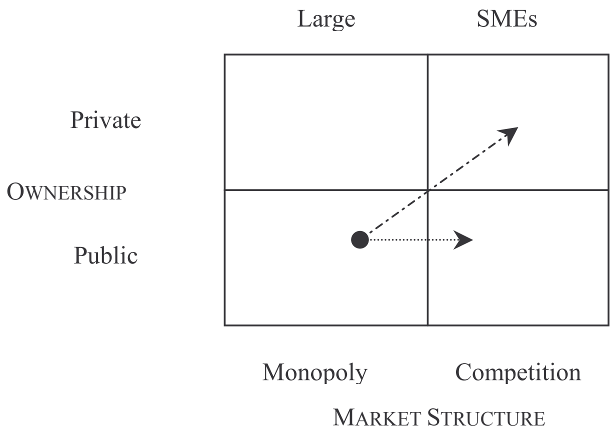
In developing countries market failure is quite pervasive in respect of Technology. For example, due to lower technological level, firms neither get sufficient incentives for investing in R&D&E nor they do have sufficient capacity for doing so. There is an element of risk in even adapting technologies. When successful, they are quickly imitated by way of reverse engineering or some other means. Thus the firms do not get adequate return on investment and when they fail there is always a loss. This deters the firms to undertake proper R&D&E without requisite government supports for *appropriating* the costs and mitigating the risks.

2.3.5.2 Investment

For sustained industrialization, investment in physical capital is a necessary condition. Therefore it should be one of the main tasks of Industrial policy to mobilize investments both domestic as well as foreign investment (FDI). As regards to domestic investment, an *imperfect capital market* is the major source of market failure. The acute lack of infrastructure and institutional support for availability of finance, credit delivery system and capital market deter the firms to tread in. Further, *Coordination failure* (*investment coordination*) sets forth another major role for Industrial policy. Investment coordination is required to mitigate the risk of under investment or over investment *within the industry*, and *between the industries* as well as supporting & related industries. It is needless to mention how proper industry coordination generates positive *externalities*.

Another major role of industrial policy for promoting investment is inducing competition in the market to redress the market failure due to *non-competitive market*. It can be visualized in terms of ownership, market structure, size and scale/scope of production. An important aspect of promoting competition is the question of ownership. It is debated in terms of government and private ownership. The critiques of government ownership argue that the SOEs are less efficient than private enterprises due to their contradictory objectives (social objectives like employment generation as well as profit maximization), lack of autonomy (high political interference), lack of professional management and prevalence of corruption and nepotism. However, a study by Millaward (1988) concludes that there is little statistical evidence to support the view that SOEs have lower operating efficiency than private firms as a result of ownership per se (Weiss, 1995). In developing countries where capital and entrepreneurship are scarce private investment may not be up to the expected level in certain industrial sectors, which are important for long-term growth having longer gestation period or with non-profit development objectives (Jones & Mason, 1982; Heeks, 1996). So there has to be an optimal mix of government and private ownership. A well-articulated industrial policy needs to address the rationale of government ownership in certain industrial sectors, eliminating its inherent problems, its extent of continuing in those sectors and the requisite period for divestment if required. It *should aim at moving the market structure from monopoly/monopolistic government-owned to competitive privately owned market structure* (Figure 2.10). The above scenario sets forth another issue i.e. an optimal mix of large firms and SMEs. The development of SMEs is an important issue in developing countries as it sustains a broad & diversified private sector, entrepreneurship, employment, flexibility as well as overall growth & welfare in the economy (Weiss, 1990; Humphrey & Schmitz, 1996).

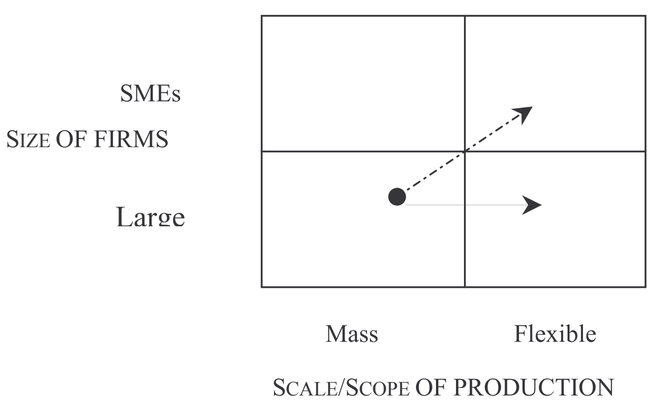
Figure 2.10: Ownership vis-à-vis Market Structure



Source: Adapted from Weiss (1995).

Yet another related issue is the scale of production. In the present scenario industrial policy should encourage efficient plant scale i.e. achieving economy of scale and economy of scope through adoption of flexible manufacturing techniques/ systems. With the modern pattern of consumer demand driven by quality and differentiation emphasis on flexible manufacturing with smaller batch size is more desirable (Alcorta, 1998; Edquist & Jacobson, 1988; Kaplinsky, 1995). It requires reorganization of firms internally as well as externally by way of establishing closer relationship with all stakeholders. It helps in mitigating market failures in respect of *non-competitive market, industry coordination, and other externalities etc*.

Figure 2.11: Size vis-à-vis Scale/Scope of production



As regards to *foreign capital*, its proponents advocate that FDI brings the much needed capital *(partly redressing capital market failure*), technical know-how for both product and process, modern machinery *(redressing technology & information market failure*) and management skill *(redressing labour & information market failure*) as well as extended export market through intra-company linkages, distribution channel, marketing expertise and brand name *(generating externalities and redressing information deficiencies)* etc. for which developing countries usually starve. In fact FDI is one of the ways of breaking the vicious cycle of low productivity, low wage, low saving, low investment and low productivity by complementing local savings by supplying more effective technology, management and marketing skills (Dunning, 1993; Lim, 1995; Moran, 1998; Henley et al., 1999). It induces competition (redressing *non-competitive market* failure) as well and increases international competitiveness. Nevertheless, there are certain pitfalls as well. If left unregulated it might drive domestic producers out of business and drain capital out of the country by way of repatriation of profits/capital or misuse of transfer pricing system etc. The recent conditions of Trade-related investment measures (TRIMs)[12] and Trade-related aspects of intellectual property rights (TRIPs)[13] as proposed by WTO have enhanced the need for formulation of suitable industrial policy which can promote FDI as well as play the role of a watchdog.

2.3.5.3 Education and Training

There is a general consensus in the literature that without human capital, physical capital is simply not productive. In the opinion of Simon Kuznets the major stock of an economically advanced country is not its physical capital but the body of knowledge, capability and training of its population to use the knowledge effectively (Nafziger, 1997). So there should not be two opinions about emphasis on education and training as an important element of Industrial policy. As such, education and training are considered as social policy that basically acts at the *macro level* by way of improving knowledge, reasoning capability, receptivity to new ideas, acquisition of skills, employment opportunities, and attitude towards work/ society/ health/ nutrition etc. However, in our discussion we will concentrate on the *micro level* impact of education and training. At this level there are two important role of this policy: *generating skilled work force* as per the requirement of the industry (*skill creation*) and *training of existing employees* for upgrading their skills *(skill development)* to build up technological capability (Lall, 2001; Tan & Batra, 1995).

It has been well recognised that, *market failure* in both skill creation and skill development is ubiquitous in the developing countries. Firms simply do not have adequate resources or incentive for investment in skill creation process. Even for the skill development, firms do not invest properly due to variety of reasons such as inadequate resources and incentives, lack of professional management, low quality consciousness, lack of foresight to foresee the changing skill requirement, perceived high risk of turnover of employees due to poaching by competitors or otherwise etc. On the other hand as the industry moves forward on the technological ladder, the need for more specific skills increases and becomes wider necessitating more thrust on education and training through well articulated targeted policies. Lall (1996:43) notes, " The selectivity of educational policies increases with the role that the government plays in

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[12] Prohibited list of TRIMs: Local content requirements, Trade-balancing requirements, Foreign exchange balancing requirements, Exchange restrictions, and Export performance requirements.
Other TRIMs: Domestic sales requirements, Manufacturing requirements, Product mandating requirements, Manufacturing limitations, Technology transfer requirements, Licensing requirements, Remittance restrictions and Local equity requirements (Debroy & Kaushik, 2000).

[13] TRIPs relate to Patents, Copyrights, Trademarks, Industrial designs, Layout designs of integrated circuits, Undisclosed information and Geographical indications (Debroy & Kaushik, 2000).

determining the direction of industrial growth. If the government has an active industrial strategy, pushing the economy into more complex areas of activity, it has to select the skills that the education system has to create accordingly."

2.3.5.4 Market Development

From the demand side perspective, creation of domestic demand and promotion of domestic product in the export market should be the integral components of industrial policy for influencing industrial structure of the country. Its main objective should be to improve the quantum and quality of demand to induce technological pull in the domestic industry (Porter, 1990; Nafziger, 1997) as well as to redress various sources of market failures. The floating of early demand for technologically advanced products/ by the government induce domestic producers take up manufacturing of those products mitigating the problems of *market absence*, *information deficiency*, *learning-by-doing* and *non-competitive market* to a large extent. The creation of demand induces more producers to take up the production that mitigates market failure due to *non-competitive* market. The requirement of stringent quality standards more or less near to international standards compels the firms to produce quality goods that generate *marketing spillovers* in terms of country's image, brand name, good will and market information etc. Further, encouraging domestic buyers to purchase technologically advanced products generates *externalities* in terms of generation and diffusion of technology, higher learning potential, increased specialization, entrepreneurship, forward & backward linkages and industrial flexibility etc. It also helps in achieving technological deepening and redressing *coordination failure.*

While domestic market is important, we have seen in our earlier discussion that growth through exports has its own advantage. Therefore initiatives to explore and exploit foreign market should be an integral part of industrial policy. It generates various *externalities* in terms of *marketing spillovers* and low dependence on domestic market expansion; *increasing returns to scale* due to cost economies from increased market size; and exposes to international competition mitigating market failure due to *non-competitive markets* etc.

2.3.5.5 Industrial Governance

The discussion so far has been able to show that how different elements of Industrial policy address problems of mitigating the sources of market failure. But the other side of the coin 'government failure' has been still left untouched. The pervasive government failures in developing countries provide salvos to the critiques of the government intervention. It also extends explanation for the poor performance of Industrial policy in the process of industrialization. It is therefore pertinent that the ways and means of mitigating government failure should also be an integral part of Industrial policy. In our discussion we will consider these aspects within the ambit of the term '*Governance'*.

Although in literature the word governance has been normally referred in the context of behavior of firms as '*corporate governance'* (Aoki, 2000; Boisot, 1994). However, we will apply this construct in slightly modified way in the context of mitigating government failures. We draw strength from the views of Boisot, (1994: 1). He notes "*Governance is, in effect, a cybernetic concept describing the feedback and control mechanisms by which a system, any system, keeps itself oriented towards the purpose for which it was conceived. As such, it can* *apply to nation states, to military organizations, commercial enterprises, or …etc."*. Thus for the purpose of our discussion Governance would concern with mitigating the various sources of government failure i.e. *information deficiency, lack of flexibility, problems of incentive & efficiency* and *rent seeking*. It needs to be undertaken through strategic thinking, formulating & implementing policies; building institutions and last but not the least creating linkages between different stakeholders. Such efforts will introduce efficiency, effectiveness as well as transparency in the functioning of the Government

In general policy formulation is treated just as formulation of actions to be adopted by the government or just coordination or integration of functions. It should be rather, a carefully devised plan of action to achieve a goal. The aim should be to answer the same question like the firms, "given limited resources and uncertain environment, what strategy is likely to yield the best competitive position?" (Reich, 1982). In this case a country is to be seen as a relevant unit of competition. It could be achieved through an insulated and well-informed bureaucracy[14] that is free from the influence of political elites and other interest groups (Chang, 1994; Esser et al., 1996), proper institutional framework and close interaction among all stakeholders. In developing countries institutions to support different activities are normally underdeveloped or missing. It is no coincidence that underdevelopment is usually defined by the deficiency of institutions (Lall, 1992). Evidences suggest that comparative advantage of a country is shaped the way institutions evolve over time (North, 1990; Nelson, 1999). Therefore for sustained industrialization development of institutions with proper emphasis on information flow and transparency are essential. It may be developed in cooperation of both government and private in different functional areas such as policy making, technology, finance, education & training, and marketing etc. There should be regular interactions between the government agencies and non-government agencies like industry associations, chambers of commerce and trade unions etc. to increase flow of information, and improve communication as well as coordination among all the stakeholders.

2.4 Industrial policy for CNC Machine Tool industry

From the preceding discussion on the different elements of industrial policy we have seen *how* Industrial policy could address the problem of mitigating various sources of market failures on the one hand and redress government failure on the other. Here attention is drawn to the fact that these elements of industrial policy do not work in isolation. They are interdependent. For an effective outcome the technology policy has to be integrated with investment policy or education & training policy or so and vice-versa. Similarly there has to be proper mixing and matching of functional, horizontal and targeted policy because they are mutually complementary and synergistic. Further, these policies need to be designed in such a way that they should mitigate the sources of existing market failures and simultaneously develop new factors so that market develops rapidly to function more efficiently and the economy achieves dynamic comparative advantage (Cohen & Zysman, 1990; Lall, 1996; Porter, 1990). Since in this study we have considered CNC Machine Tools industry for empirical evidence, we will examine the role of various elements of industrial policy with respect to this industry in the following discussion.

[14] It has been termed as '*economic technocracy'* by Esser et al. (1996).

2.4.1 Technology*: Capturing Externalities*

In order to pursue sustained industrialization and achieve international competitiveness building technological capability in CNC Machine Tools industry is sine qua non. The *raison d'être* for the need of specific technology policy for this industry is the generation of array of *externalities* that no other industry can boast. This industry possesses certain unique characteristics, which make it distinct from others. It is the '*mother'* or '*master'* machines, the machine that makes all machines including itself (Holland, 1992). It plays a major role in accounting for diffusion of technological innovation and rapid industrialization. It generates and transmits new technologies for the user industries.[15] It imparts initial solutions to technological problems by developing new skills and techniques in response to the demand of specific customers. Once these are developed, the newly learned techniques are transmitted to the other machinery using sectors of the economy (Rosenberg, 1976). Evidences suggest that any increase in its productivity increases the productivity of all the down stream industries. Thus building technological capability in this industry also signifies building technological capability across the industries. This is the most important externality generated by this industry, which the technology policy thrives to capture.

Moreover, the convergence of technology of the three previously separate areas - Machine Tools, Computers and Communications have forced a significant shift in the boundaries of the markets and technologies involved.[16] It has led to the accelerated development, refinement and diffusion of a number of new devices and concepts in this industry that are popularly known as *Flexible automation.*[17] Its adoption develops capacity to produce a variety of products at relatively lower cost with more speed and precision that leads to the possibility of achieving '*economy of scope'* simultaneously with *'economy of scale'*- the foray of mass production system so far. Further, its proper adoption perpetuates changes in organization of production system and associated organizational techniques such as adoption of group/ cellular production layout; multi-tasking, Just-in-time (JIT), and Total Quality Management (TQM), etc. (Alcorta, 1995, 1997, 2001; Jacobson, 1986; Edquist & Jacobson, 1988; Kaplinsky, 1994). These changes also help in achieving non-price attributes like quality, aesthetics, faster delivery schedule, and increased process visibility etc.

In developing countries firms in this sector are mostly SMEs, so they have neither sufficient incentives for investing in R&D&E nor sufficient capacity for doing so. Even larger firms are also reluctant to do so. They perceive an element of risk in even adapting and adopting technologies. When successful, they are quickly imitated by way of reverse engineering or reengineering or through poaching the key technical staff. Thus they do not get adequate return on investment and when they fail there is always a loss. In addition to these, there is acute lack of institutional support for mobilization of capital, and credits for technological development

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[15] Main user industries: Automobile, General engineering, Capital Goods, Defense, and Aerospace etc.

[16] Now this industry could be better classified as a sub sector of the '*Mechatronics*' - *a combination of Mechanical engineering and Electronics* rather than as a sub sector of *Non-electrical machinery*. Electronics constitute up to 40-45% of the total cost of CNC Machine Tools.

[17] For details on advantages of Flexible automation please see (Alcorta, 2001; Edquist & Jacobson 1988; Jacobson, 1986; Kaplinsky, 1994).

activities. The normal financial institutions do not want to take risk of financing such ventures due to high uncertainties involved. These problems of *non-appropriability* deter firms to undertake proper R&D&E activity without proper government intervention. Under such circumstances, for proper development of this industry the policy should concentrate on the aspect of acquisition and absorption of relevant technology since it is more feasible and easier solution than starting from scratch. It should be supplemented with proper policy support for in-house R&D by the firms for assimilation of technology, incorporating incremental development and further improvement of the technology followed by new innovation for achieving sustained international competitiveness.

2.4.2 Investment*: Coordinating Industries*

It has been well recognized that for sustained industrialization, investment in physical capital is an essential condition in general and Machine Tools industry in particular. In the initial stage of industrialization firms produce more of unskilled labour intensive products where efficient scale of output is relatively low, technology is simple, need for user-producer interaction is low and use of intermediate goods are less and therefore requirement of subcontracting is also less for achieving competitiveness. At this stage firms undertake production of relatively simpler Machine Tools. During this period market failure due to *imperfect capital market* is more pronounced and acts as the major bottleneck for investment. Thus policies should be oriented for easier availability of finance through institutionalized credit delivery system as well as various fiscal or non-fiscal incentives in order to raise the profitability of investment.

As the development proceeds, firms start using more sophisticated technology, production of more investment goods and consumer durables are undertaken, more capital and technology intensive products are produced, reliance on export increases and therefore the need for international competitiveness rises. It implies that, for sustaining this type of development production of more sophisticated Machine Tools becomes a necessity. At this stage market failure due to lack of *investment coordination* become more crucial. It becomes mandatory *across the industry* as well as *within the industry*.

Investment coordination *across the industry* connotes balanced development of upstream industries (steel, castings & forgings etc.), supporting industries (components, subassemblies, CNC controls, computer hardware, software etc.), related industries (heat treatment, painting, telecommunication etc.) and downstream industries (users industries: automobile, general engineering, capital goods etc.). In developing countries Machine Tools firms have to depend heavily on imports of components & subassemblies[18] due to lack of supporting industries. Firms are left with no choice other than importing these or set up production facilities, at least for some of them at uneconomic level. Most of the specialized components industry are highly capital & technology intensive, demands economy of scale/ scope and higher interaction between user and producers. Further, there is also a need for proper development of computer (both software & hardware), telecommunication and other related industries. Similar is the case with user industries. Proper attention on their development is essential as they create technological pull and diffusion of technology for further development of Machine Tools industry. Due to the requirement of close technical relationship between the component

[18] Such as CNC controls, servomotors, ball screws, high speed spindles, specialized foundry etc.

supplier, manufacturer, and the users geographical proximity become an important aspect for the development. The process of coordination is self-reinforcing. It builds a chain of component supplier, related industry, manufacturer, and users of Machine Tools. Further, the complementarity of demand increases overall demand reducing the risks and gives incentive for additional investment. Mitigating coordination failure also creates external economies in the sense that it reduces the cost of Machine Tools, and the increased use of Machine Tools by the user industries reduces the cost of the products manufactured due to increase in their productivity and other internal economies.

Investment coordination *within the industry* means balanced development of different segment of CNC Machine Tools industry. The industry data suggests that Machine Tools industry is highly segmented.[19] As production technologies and design features differ for each type of product, specialization in narrow product lines for particular markets is essential for achieving international competitiveness. In developed countries the firms are more specialized and usually confine themselves to one family of Machine Tools.[20] While in developing country the firms try to diversify in different family of Machine Tools sensing the market and for mitigating the risk of lower demand of their own specialization but in the process loose overall competitiveness. Thus policy directions are required for encouraging more specialization.

It may be recognized that mitigating sources of market failure is easier said than done. It requires well-articulated policy design and implementation. Industry coordination has to be undertaken in such a way that it induces requisite investment as well as sufficient competition throughout the supply chain. Hence, one of the main aspects of the Investment policy should be to mobilize domestic investment and simultaneously attract foreign investment (FDI). It requires dismantling the entry barriers for the firms on the one hand and availability of funds on the other with equal treatment to both domestic and foreign investors. FDI in this industry, needs to be encouraged as it brings both the scarce fund as well as the technical know-how. It mitigates other sources of market failure as well. Although dismantling entry barriers induces competition, it needs to be reinforced through proper policy on imports and tariffs on material inputs throughout the supply chain. These facts lead us to a conclusion that the investment policy for this industry should concentrate on regulatory and promotional policy measures for domestic as well as foreign investment. It also requires a matching emphasis on policies regarding international trade and credit delivery policy.

2.4.3 Education and Training*: Raising Internal economies*

At *macro level education & training policy* will produce a mechanical engineer or an electrical engineer or a computer engineer and so on. However, such education can provide only overall knowledge, not the industry specific knowledge, which is essential to produce a product or to manage a process. For example, it won't produce a Machine Tools design engineer who is equally efficient in part programming of CNC Machine Tools. In order to develop such proficiency, *micro policy (selective)* that can cater specific needs of the industry is essential.

[19] CECIMO (1997) has identified about 34 broad categories of Machine Tools and a series of subcategories related to specific processes approx. 380.

[20] Such as Turning & milling; Machining Centers, Grinding; Press, Electro-discharge machining etc.

Moreover, even supply of such human skills may not be adequate for proper assimilation and improvement of technology in the firms. It requires specific in-plant on-the-job training to know the 'why & how' of a function/ operation as well as periodical training to keep abreast with latest changes in technical and management fields.

Machine Tools industry is a technology-intensive and specialized industry where research and development play an important role. It requires a highly skilled workforce and close proximity/ interaction of the design office with the operative staff as well as with the users. No other industry demands such a close linkage within the firm as well as across the firms (users and suppliers). It is such an industry where often goods are sold before it is designed or developed (Holland, 1992). It means most of the machines are tailor made as per the specific requirement of the users. In such a situation both selective *skill creation* and *skill development* become a necessity. It helps in achieving increasing returns to scale by way of proper assimilation and improvement of imported technology. In the process it also exposes employees to modern management techniques (e.g. JIT, MRP, BPR, kaizen, TQM etc.), better work culture and creates quality consciousness. Such efforts also develops expertise in related disciplines such as support services to customers to teach their workers to understand its operation & maintenance, system integration consulting, design and manufacturing of industrial automation & controls equipment, field Installation and post implementation support, better after-sales-service expertise, repair and trouble shooting of other industrial equipment, technical product support for other imported machines, retrofitting of existing machines, engineering & management consultancy and other technical services. In sum it may be said that targeted education and training raises the *internal economies* for the firm.

2.4.4 Market development: *Spreading Information*

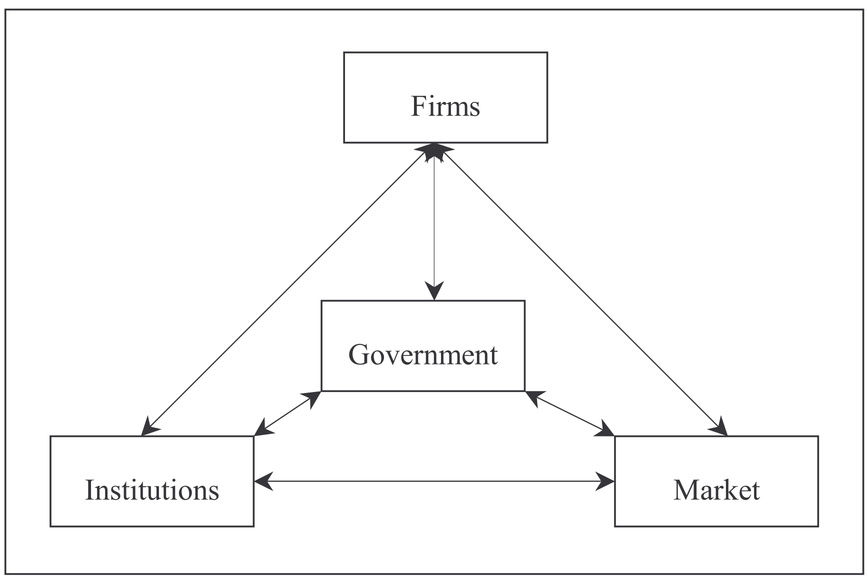
It is well established that Machine Tool industry plays a major role in diffusion of technological innovation and rapid industrialization. We have also seen as how does it generate fleet of externalities and internal economies. But in spite of these facts the market for CNC Machine Tools in developing countries is still limited and small. The firms are unable to achieve economy of scale due to small domestic market and lack of exports. The basic reason for the poor diffusion is the prevalence of information deficiency among the SMEs. The user firms do not have essential information and awareness on nature, type, source and inherent advantages of use of these machines. The capital market imperfection is an added bottleneck. Due to the small size neither the user firms have sufficient fund for investing in flexible automation, nor sufficient motivation to do so. Even larger firms are reluctant to buy the domestic products. Moreover, the fascination for imported machines acts as another deterrent. These imperfections require policy supports in respect of disseminating information regarding source, quality, source of finance, institutional frameworks and other incentives available for adoption of new technologies etc. for proper diffusion of CNC Machine Tools in the domestic market. Alcorta (1998: 173) while discussing policy implications for diffusion of flexible automation in developing countries rightly notes, "*While it may be the case that as markets grow and as diffusion ensues information will increasingly be made available, there is, nevertheless, a clear need for providing potential users with information on the economic and technical potential of the new technologies*."

There is consensus in literature as well as empirical evidences that simultaneous thrust is necessary for promotion of domestic product in export market as well. Spreading information regarding technological capability of domestic firms in export market works in two ways, first, it creates awareness in the export market regarding their products and second, it motivates domestic firms to enhance their technological capability further. Such efforts expose to international competition, reduce dependence on domestic market, help in achieving economy of scale and increase international competitiveness.

2.4.5 Industrial Governance*: Stimulating linkages and information flow*

Our previous discussion on Governance draws attention on three major aspects: formulation of policies in strategic way, building institutions and creating linkages among the stakeholders. This leads us to an important understanding that good governance for the sustained process of industrialization demands dynamic interaction among different stakeholders: the Government, firms, institutions and market as depicted in figure 2.12.

Figure 2.12: Interactive Model of Governance



It may be recognized that certain characteristics of CNC Machine Tool industry make it more vulnerable for good governance. As mentioned earlier, most of the firms in this industry are SMEs usually founded by techno-entrepreneurs. They suffer due to the small size and lack of management capability. The cyclical nature of this industry also makes it a risky venture. It is the first to go into recession and last to come out, thus deferment of capital expenditure is the most common practice during the period of downturn. Due to these constraints the industry is plagued with problems of under capitalization, limited internal cash flow and low profitability etc. Therefore it is pertinent that the government stimulates necessary linkages and information flow among various stakeholders.

The creation of linkage and increased information flow among the various stakeholders stimulates necessary cooperation and coordination between SMEs and help them to attain economy of scale & scope that in turn translates into international competitiveness (Humphrey and Schmitz, 1996; Lall, 1992, 1996). The major role of the government in this regard is to create a system of coordination so that different stakeholders join hands together and interact with each other. In the initial phase the government should finance most of these initiatives to give the necessary boost. It could be progressively reduced and subsequently financed by the member firms in the form of subscription or payment for specific services. Such efforts would impart stronger commitment of the participating firms and help in sustaining the programs. It may be mentioned that all these initiatives spontaneously act in mitigating the various sources of government failure on the one hand and different sources of market failure on the other. In view of the above it may be said that the *ground-rules for good governance is creation of linkage* and *transparent flow of information.*

2.5 Conclusion

This chapter built the theoretical foundation of the study. The discussion starts with an introduction to the process of industrialization. It can be viewed from three different levels: country, industry and firm. In this study we concentrate on the industry level. We define industrialization "*as* a *process* of *ongoing replacement of labour intensive productive activities by technology intensive productive activities, leading to more value added sophisticated products*." International experiences suggest that this process can be influenced by the government intervention. One of the reasons for the government to intervene is the psychological desire to "*Catch up*" i.e. to bridge the gap with the developed countries as speedily as possible. The analyses lead to three overriding questions that dominate our discussions: first, *why should the government intervene*?; second, *how should the government intervene*?; and third, *how* the government *policy affects performance of the firms?*.

We identify the answer of the '*why*' based on the rationale of '*market failure'*. It may be noted that due to the prevailing situation of vicious cycle of poverty in the developing country the pre-conditions for the success of market i.e. *perfect competition,* perfect *information*, and *full employment* do not exist. Therefore the conventional rationale for government intervention: *market failure* still holds good. The main sources of market failures identified are *externality, increasing returns to scale, imperfect/ nonexistent market, lack of industry coordination and information deficiency etc.* It is to be recognized that the same situation also leads to *government failure such as imperfect information, lack of flexibility, problems of incentive & efficiency* and *rent seeking.* The puzzle of choice between market and government is solved through analysis of the two school of thoughts: Neoclassical and Structuralism. It is argued that they should be viewed as two extremes on the same continuum rather than 'either-or' dichotomous construct. In this way national policies worldwide can be traced lying at some point on this continuum. It is suggested that '*government*' and '*market*' are the two sides of the same coin. The case of free, unregulated market depends on many assumptions, which does not exist in realty. Similarly the case of government replacing the market does not conform to reality due to existence of government failure. Thus, *what matters is the "how", "where", "when" and "to what extent" of government intervention.*

Now the question arises: *how should the government intervene? Our discussion points out towards a synthesis: a harmonious synthesis of government and the market. The basic premise being: government intervention is complementary to market rather than substitute for it.* It should participate actively (*activism*) for redressing market failure with more emphasis on *market complement*, selective intervention and outward orientation. This view may be termed as *Structuro-classical perspective*. *It embodies* the *Structuralist view at its heart* and *neoclassical view as a motivational factor.* It sets forth the premise that *rational government intervention is fundamentally important for the process of industrialization although the belief in market mechanism is indispensable*. However, the policy prescriptions should be designed *with utmost caution* based on actual economic, social, technological and political situation prevailing in a country and its national goal.

In order to establish the further 'how' of the government intervention, we established the taxonomy of industrial policy. In a broader sense all government interventions that affect industrial development may be considered as Industrial policy (IP). This statement is true but for a meaningful discussion it should be narrowed down. We segment the IP in three levels based on nature of impact of these policies on industrial development. They are termed as '*tertiary IP*', '*secondary IP*' and '*primary IP*'. The policies that directly influence the process of industrialization are covered under *PIP or "industrial policy per se"*. We define PIP as '*microeconomic measures designed to influence the structure, resources, conduct and performance of the industry both from the supply-side and demand-side perspective in order to achieve sustained industrialization and international competitiveness*.' These measures include an optimal mix of functional, horizontal and selective policies. For easier understanding these may be segmented in terms of mutually reinforcing elements like *Technology, Investment, Education & Training, Market development, and Governance.* These policies could mitigate various sources of market failures on the one hand and redress government failure on the other. They need to be designed in such a way that they simultaneously develop new factors so that market develops rapidly and the economy achieves dynamic comparative advantage.

Since in this study we have considered CNC Machine Tools industry for empirical evidence, we therefore examine the role of various elements of industrial policy with respect to this industry. It is seen that although each element mitigates various sources of market/ government failures, they are more effective for certain sources such as *Technology policy for c*apturing externalities; Investment policy for coordinating industries; *Education & Training policy for r*aising internal economies; Market development policy for s*preading information and G*overnance policy for s*timulating linkages & information flow.* In this way the industrial policy for the sustained development of CNC Machine Tools industry has been conceptualized.

RESEARCH METHODOLOGY

This chapter describes the research methodology. It comprises of research plan and operationalization of the theoretical constructs. The research plan describes the taxonomy of the research process and research design. The process of operationalization is undertaken in two distinct but interrelated steps: first, operationalization of the constructs by way of establishing linkage between the different elements of the construct and second, proposing a general framework of operationalization. It is supplemented with a brief overview of data& procedure and validity of the research design.

3.1 Research Plan

This chapter describes the research plan and operationalization of the conceptual framework developed in the previous chapter. First we discuss the research plan to be chosen for answering our key research question: *How industrial policy affects performance of the firms*? The research plan begins with a brief overview of the social science research process. It is followed by an attempt to explore the typology of research, and research design. Then we move to the operationalization part.

3.1.1 Research Process: *A saga of Continuum*
Research has been described as a systematic and organized effort to investigate a specific problem that needs a solution. It consists of series of steps designed and followed, with the goal of finding solutions to the issues that are of concern in the real world (Cooper & Emory, 1995; Emory, 1980; Neuman, 2000; Sekaran, 1992). Research regarding the problem of the social world is classified as Social science research. It is undertaken by combining theories or ideas with facts in a systematic way using imagination & creativity of the researcher (Neuman, 2000; Robson, 1993). The word 'systematic' suggests that research is based on logical relationships and not just beliefs (Ghauri et al., 1995; Saunders et al., 2000).

In literature, various classifications of research and research design have been mentioned such as natural science & social science; basic & applied; and management & policy etc. Within the social science there are various groups and sub-groups having various purposes and techniques of research. For our discussion, we will consider two prominent groupings or camps of research in terms of philosophical position, purpose of research, research methods, methods of data collection and analyses of data. They are *positivism* and *phenomenology* (Cook & Campbell, 1979; Easterby-smith et al., 1991; Hedrick et al., 1993; Newman, 2000; Robson, 1993; Saunders et al., 2000).

Positivism adopts the philosophical stance of natural scientist. The salient feature of this paradigm is objective analysis (researcher is independent from the object of analysis), detached interpretation of collected data, causal explanations, *hypothetico-deductive approach*,[21] reductionism,[22] generalization (large sample size) and *quantitative* research methods. Unlike

[21] Hypothetico-deductive: a research process where social phenomenon is studied via specific predetermined hypotheses (Easterby-smith et al., 1991; Newman, 2000; Saunders et al., 2000).

[22] Reductionism: The Process of understanding a phenomenon by reducing into the simplest possible elements (Easterby-smith et al., 1991; Newman, 2000; Robson, 1993; Saunders et al., 2000).

positivism, *phenomenology* believes that social science deals with complex and unique situation that are hard to explain in series of law-like generalizations. Its basic premise is that the world is socially constructed and subjective. It believes that the researcher is not aloof from the subject of the research. It gives more credence to *exploratory* nature of research, '*empirico-inductive'* approach and *qualitative method*s of research (Majchrzak, 1984; Neuman, 2000; Saunders et al., 2000).

A cursory look on these groupings indicates that they are way apart and are two different approaches in the research process, which cannot meet. It may be misleading. The process of research is quite complex. Rossi et al. (1978:173) view it "as a *mixture of science, craftlore, and art"*. The science is the body of theory, concepts, and methodological principles. The craftlore could be seen in terms of the set of workable techniques, rules of thumb, and standard operating procedure. The element of art is reflected in the creativity, judgment, and style in which the researcher undertakes the research. The social research process is such a complex and iterative process that it may not be practical to take such extreme positions. In real world research there should always some scope for adjustment. The concepts/ techniques from one camp to another need to be blended together for imparting better credibility to the findings. They are to be tailored based on the nature of the social phenomenon to be explored and the research question to be answered. Therefore these groupings *are to be viewed as two extremes on the same continuum rather than 'either-or' dichotomous constructs. We consider this as the bottom line* of our research process and research design.

3.1.2 Typology of the Research

The very wordings of the research question suggest this research falls in the category of *applied policy-oriented research*. The rationale of this proposition is as follows. The research pertains to the category of *applied research* since this research is done with the intention of applying the results of its findings to solve specific problems. It also reflects other characteristics of applied research such as emphases mostly on solving problems rather than just gaining knowledge; predicting effects rather than finding causes; concern for actionable factors rather than assessing statistical significance; developing actionable factors and interventions rather than developing and testing theories (Cooper & Emory, 1995; Easterby-smith et al., 1991; Hakim, 1987; Hedrick et al., 1993; Neuman, 2000; Robson, 1993; Saunders et al., 2000; Sekaran, 1992). Applied research may be segmented in two groups: policy research and business or management research.

As regards to distinction between *policy-* and *management res*earch, the research belongs to the category of *policy research* as it concerns with the actions of the government. This research will provide policymakers in the government required information and options needed to find solutions of complex contemporary issues. A research concerning to firm or industry is considered as management research whereas when actions of the government is involved, it becomes policy research (Easterby-smith et al., 1991; Majchrzak, 1984; Saunders et al., 2000). However, it may be noted that there are so many commonalities in various elements of research process for these two categories. It is possible to segment the policy research as well, since it varies in terms of focus, orientation or context. Majchrzak (1984) presented a *typology* of policy research based on *action orientation* and *focus*. Action orientation concerns with the utility of results. Higher action orientation implies greater concern for the immediate utility of results. Focus concerns with specificity of the research question i.e. more specific/ narrowly defined question or broadly defined question with wider implications. Her typology segments policy research in four groups: *basic policy research*,[23] *policy analysis*,[24] technical research and policy research. For the sake of better understanding we will use the terms 's*pecific policy research*' for the technical research and '*broad policy research*' in place of 'policy research'.

Figure 3.1: Typology of Policy Research

ACTION-ORIENTATION	Narrow (FOCUS)	Broad (FOCUS)
Low	Policy Analysis	Basic Research
High	Specific Research	Broad Policy Research

Source: Based on Majchrzak (1984)

Specific policy researches are the research structured to resolve very specific, narrowly defined problems. Research questions like 'impact of reduction of tariff in the light of WTO agreement on level of protection (e.g. ERP and NRP)[25] on CNC Machine Tools in India' may be considered as a specific research. In this case focus is more on narrowly defined issue and action orientation is high. The research process with high action orientation and focus on broader issue with wider implications are covered under *broad policy research*. Majchrzak (1984:12) defines it *"as the process of conducting research on, or analysis of, a fundamental social problem in order to provide policymakers with pragmatic, action-oriented recommendations for alleviating the problem"*. Research questions like 'impact of development of CNC Machine Tools on the process of industrialization' may fall under this category. It may be noted that these segmentation are just illustrative. Here we go as per our basic proposition i.e. the groupings *are to be viewed as two extremes on the same continuum rather as 'either-or' dichotomous construct.* These two segments may be considered as extremes. Our research question '*the policy directions for development of a sustainable CNC Machine Tools industry in* India' falls somewhere in between the specific policy research and the broad policy research. In this case although the action orientation is high (i.e. concern for immediate utility of results), the question is neither purely specific nor very broad. Hence, it

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[23] *Basic policy* research refers to traditional academic research done on fundamental social problems. It is more of theoretical nature and has little direct impact on policy decisions as well as action orientation is low.

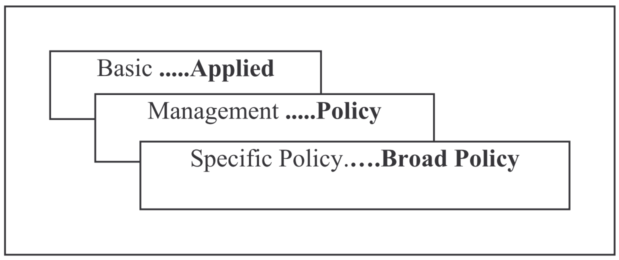
[24] *Policy analysis* is basically a study of the policy making process. It is a research where the researcher is interested in the process by which polices are adopted and the effects of those adopted policies. In such cases action orientation is low and the research questions are more technical in nature.

[25] ERP: Effective rate of protection; NRP: Nominal rate of protection.

may be said that the research question *lies on the continuum of specific and broad policy research*.

The overall typology of our research could be presented in figure 3.2. The extremes on the right hand side of the continuums have been shown in bold letters to depict the leanings. For example, the '*Applied*' in bold letters means: although the research falls on the continuum of basic and applied research, it encompasses more characteristics of applied research and so on.

Figure 3.2: Typology of Research



3.1.3 Research design

It is well recognized in literature that the choice of an appropriate research design is a crucial building block of the research process. It determines the actual construct of the research and leads to a framework within which data are collected and analyzed. In line with our proposition of continuum, we have deliberately taken the approach of mixing and matching. Various techniques have been incorporated in the design to achieve an appropriate research design for answering the research questions. The taxonomy of our research design is described in terms of *philosophical position, purpose of research, research approach, research method, methods of data collection and analyses of data* in the following section.

It begins from the *philosophical position* taken for the research. In this research, *we adopt* the philosophical position on the continuum of *positivist* and *phenomenology* with leaning towards phenomenology. The concepts of reductionism and causal explanations etc. of *positivistic* philosophy are blended whenever required. As regards to the *purpose of the research*, three types of purpose have been elaborated in the literature: *exploratory, explanatory*[26] *and descriptive*.[27] An *exploratory* research is suitable when one has to find out what is happening, to seek new insights, to investigate little-understood phenomenon, to assess phenomena in a new light and when level of theory development is relatively low (Marshall & Rossman, 1999; Robson, 1993; Saunders et al., 2000; Weimer, 1995). It may be noted that basically this research elaborates on the interplay of industrial policy and performance of the industry. The whole discussion revolves around the questions 'what' and 'why' as well as gaining good grasp of the phenomenon. So the purpose of the research is predominantly '*exploratory*'.

[26] Explanatory research seeks an explanation of a situation or problem usually in the form of causal relationships. It may be qualitative or quantitative (Robson, 1993; Saunders et al., 2000; Neuman, 2000).

Nevertheless it will have some elements of '*explanatory*' and '*descriptive*' research as well. While understanding the functioning of industrial policy, there will be explanation of situation in the form of causal relationship of various elements of industrial policy and performance of the industry (means explanatory). Such type of elaboration can be attained through portraying extensive knowledge of situation (i.e. descriptive). This type of mixing and matching is often referred as '*triangulation*' in the literature (Ghauri et al., 1995; Maxwell, 1996; Robson, 1993; Saunders et al., 2000).

The leaning towards *phenomenology* and *exploratory* nature of research lead us to adoption of predominantly '*empirico-inductive'* approach and *qualitative method*s of research. In *empirico-inductive* research approach, concepts and causal theories are induced from the empirical dynamic study of the social phenomena by way of giving more credence to empirical evidence rather than logic and process rather than results (Majchrzak, 1984; Neuman, 2000: Saunders et al., 2000). In the multi-dimensional problem like ours predetermined theory of causes and effects, which is the hallmark of hypothetico-deductive approach may not be suitable. Hence, we have adopted an iterative process where emphasis has been more on understanding of meaning, context and process; observation and proper interpretation in natural settings. There has been focus on understanding the context within which all stakeholders in the process of industrialization act to seek new insights. Such efforts require flexible structure to incorporate changes as the research progresses.

It may be noted that flexibility in structure should not be construed as total absence of pre-structuring of research methods.[28] A structured approach helps in ensuring the comparability of data across sources and their interpretations. It also reduces the amount of data that one has to deal with and simplifies the analytical work required (Maxwell, 1996; Miles & Huberman, 1984). The dangers of unstructured method is reflected in the observation of Miles & Huberman (1984: 27) "…..*highly inductive, loosely designed studies make good sense when experienced researchers have plenty of time and are exploring exotic cultures, understudied phenomena, or very complex social phenomena. But if you're new to qualitative studies and are looking at a better-understood phenomenon within a familiar culture or subculture, a loose, inductive design is a waste of time. Months of fieldwork and voluminous case studies may yield only a few banalities*." It is seen that most of the qualitative research lies on the continuum of these two extremes of loose inductive to highly pre-structured inductive. Therefore it has been proposed to structure our research method accordingly.

Literature is quite rich in demonstrating the importance of *qualitative research methods* in social science research (Bryman, 1989; Ghauri et al., 1995; Marshall & Rossman, 1999; Majchrzak, 1984, Maxwell, 1996; Miles & Huberman, 1984; Neuman, 2000; Robson, 1993; Saunders et al., 2000). So we will not repeat the same. Our intention is to show how the qualitative research methods are to be used for data collection and analysis in this research

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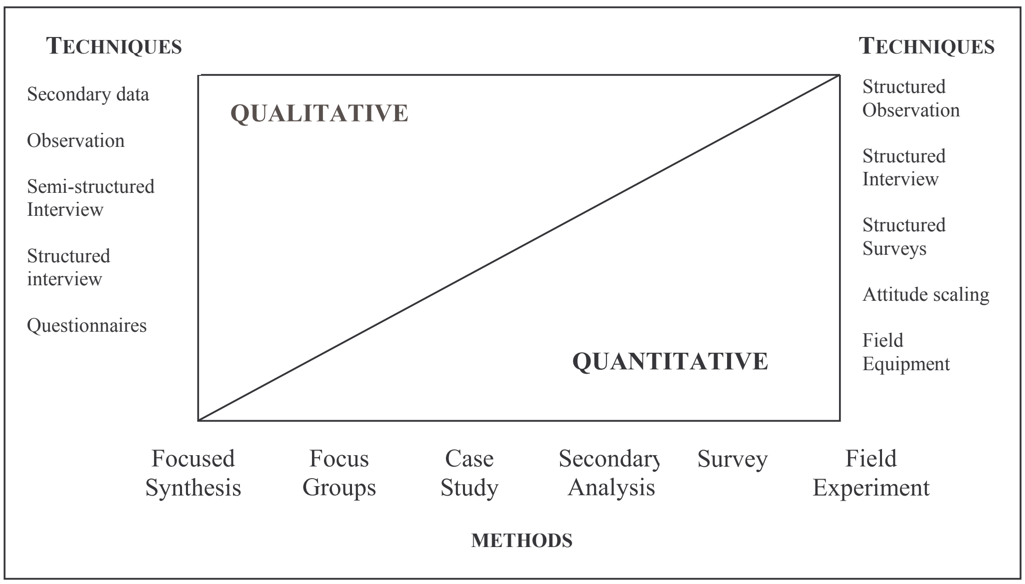
[27] Descriptive research is undertaken to portray an accurate profile of events or situations, requires extensive previous knowledge of situation. It may be qualitative or quantitative (Robson, 1993; Saunders et al., 2000; Neuman, 2000).

[28] For details of choice between structured and unstructured methods pl. see Maxwell, (1996); Miles and Huberman, (1984, 1994); Robson, (1993).

rather than demonstrating its importance per se. One word of caution, the choice of qualitative method does not mean that we ignore quantitative methods altogether. As stated earlier they are to be viewed as two extremes on the same continuum rather as 'either-or' dichotomous construct. There are an array of methods and techniques for undertaking a policy research. The figure 3.3 below depicts the taxonomy of data collection methods for Policy research. Here *methods* denote the general plan of data collection to be adopted in the research. *Techniques* refer to the specific procedures of data collection. The methods from left to right on the x-axis show more leaning towards quantitative method. Techniques show the similar leaning from top to bottom on the y-axis.

Figure 3.3: Taxonomy of Data Collection Methods for Policy research



Source: Based on Ghauri et al. (1995) & Majchrzak (1984)

Focused synthesis involves review of existing written materials, related findings relevant to the particular research questions whether published or unpublished, government and other related agency reports/databases, discussions with experts & stakeholders and personal experience of the researcher (Majchrzak, 1984). It is a synthesis of secondary data, primary data (through discussions with experts and stakeholders) and experience of the researcher. In order to understand the functioning of Industrial policy and to frame an industrial policy for a strategically important industrial sector like CNC Machine Tools, it is essential to understand what happened in the past and what is going on at present so that one can come out with new policy directions for future accordingly. So adoption of *focused synthesis* method suits to our requirement.

The method of *focus group* is nothing but a type of group discussion where several respondents sit together and interaction occur between the respondents and the researcher. The information (data) collected during the discussion is analyzed subsequently (Majchrzak, 1984). Although a relevant one, it is not feasible for an independent researcher with limited funds and networking to get various stakeholders or even members of one group of stakeholder in one forum for such interaction.

We propose to undertake *Case study*[29] of a few firms to gain insights of the phenomenon as most of the questions are of the nature of *'How' or 'Why'*. Yin (1984) observes " *In general, case studies are the preferred research design when 'How' or 'Why' questions are being posed and when the focus is on a contemporary phenomenon within some real-life context*.' It will enable us to examine the process by which various policy measures affects the performance of firms. Such insights will be useful for developing new policy directions for future development.

The method of *Secondary analysis* that refers to the analysis of existing databases available on the research topic through various quantitative techniques (Hakim, 1987; Miller, 1991) may not be feasible due to lack of databases related to our research topic. Although *Survey* is a good method for collecting primary data, it is not envisaged due to feasibility of administration, time, cost and conservative behavior for response by firms in India. Nevertheless, we have already envisaged multiple case studies, which is nothing but one kind of small survey. In this research, we do not see appropriateness of *field experiment*. It is basically a method for collecting primary data through a suitable design of certain interventions to be implemented into the target population (Ghauri et al., 1995; Miller, 1991). In sum, we propose to undertake triangulation of methods i.e. a combination of *focused synthesis* and *multiple case study* method for the research.

As regards to the *data collection techniques*, it is proposed to adopt an admixture of techniques shown in the figure 3.3. The choice of focused synthesis and multiple case study method emphasizes the use of secondary data, semi-structured interview, and questionnaire as the potential data collection techniques. Secondary data and semi-structured interview are appropriate to focused synthesis method. On the other hand questionnaire, and semi-structured interview are the techniques to be used for the multiple case study. Secondary source consists of literature on government intervention, industrialization, policy formulation, evolution of policy framework and industries in India, Machine Tools industry, various government studies and reports, government policies, studies and reports of institutions connected with the process of industrialization etc. It would be appropriate to conduct personal in-depth interview with various stakeholders particularly the policy-making bodies and Machine Tools manufacturers. Semi-structured interview is preferred as the researcher predetermines the topics/ issues to be covered, people to be interviewed and pattern of questions to be asked beforehand. Such endeavor helps in minimizing bias, inadvertent omissions of questions as well as the representative respondents. Moreover, the researcher can modify the interview what seems most appropriate during the interview (Ghauri et al., 1995; Robson, 1993). For the multiple case studies it is proposed to send questionnaire with mostly closed-ended[30] questions before

[29] Robson (1993:5) gave a very illustrative definition of case study as "*a strategy for doing research which involves an empirical investigation of a particular phenomena within its real life context using multiple source of evidence*."

[30] Closed-ended: Structured, fixed response; Open-ended: unstructured, free response (Neuman, 2000; Saunders et al., 2000).

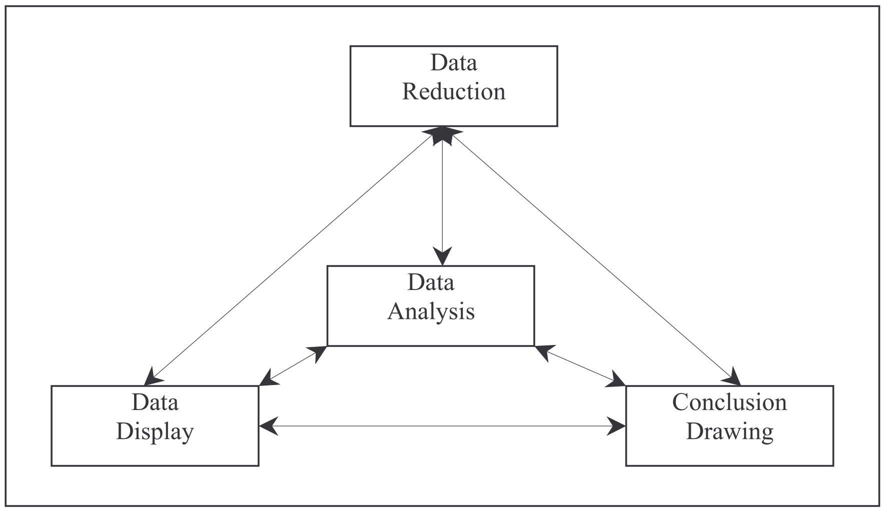
requesting them for an interview. The advantage of sending questionnaire before interview is two fold. First, all respondents get the same set of question in the same order, so that variation in response can be attributed to genuine variations and not due to divergences in the manner of asking questions. Moreover, it generates standardized data that are easier to quantify for further analysis. Second, the researcher gets an idea/commitment about the inclination of the respondents for the in-depth interview as well as most of the necessary information through their responses, which is quite helpful during the discussion for gaining proper insights subsequently (Bryman, 1989; Neuman, 2000; Saunders et al., 2000).

So far we pondered over various elements of research design such as research philosophy, research approach, research methods, data collection methods, and data collection techniques. The last but not the least important element of research design is the *mode of data analysis*. From the previous discussion it is clear that the *emphasis* will be on *qualitative mode of data analysis*. *But it does not mean that we ignore quantitative mode altogether*. Its use has been envisaged for preparation of data (coding data, entering data, cleaning data and organizing data for analysis), data description (i.e. descriptive statistics) as well as for drawing inferences through frequency distribution, measures of central tendency, measures of variation, and scatter diagrams etc. However, we foresee limited use of multivariate analysis and inferential statistics due to small size of population (< 50) and small sample size. It may be worth noting that in social science research, research design, measurement, sampling and specific research techniques are interdependent (Neuman 2000; Saunders et al., 2000). It is precisely due to this reason we propose to emphasize more on qualitative mode rather than quantitative one. Nevertheless, we stick to our proposition of being on the continuum. *We view the quantitative and qualitative modes of data analyses as two extremes on the same continuum rather as 'either-or' dichotomous construct.*

Since emphasis is more on qualitative mode of data analysis, it is imperative that we explain it in little more detail. The methods of data analysis for qualitative research have received wide attention in literature (Bryman, 1989; Easterby-Smith, 1991; Ghauri et al., 1995; Marshall & Rossman, 1999; Maxwell, 1996; Miles & Huberman, 1984, 1994; Neuman, 2000; Robson, 1993; Saunders et al., 2000). However, the approach described by Miles and Huberman (1984) has been widely recognized by scholars subsequently. We will also base our discussion on the same, particularly the interactive model of data analysis (see figure 3.4).

The process of analysis of data in qualitative research in general and policy research in particular includes three iterative activities: *data reduction*, *data display* and *conclusion drawing*. *Data reduction* implies the process of selecting, simplifying, abstracting and transforming the 'raw' data. It includes both quantification as well as transformation of information through selection, summary, and paraphrasing etc. It may be interesting to note that it starts from the very beginning of the research project i.e. the stage of conceptualizing the research proposal and continues till the completion of the project. The *second* major activity in the process of data analysis is *data display*. Miles and Huberman (1984: 21) define it as "*an organized assembly of information that permits conclusion drawing and action taking*". It includes presenting data in the form of well-structured narrative text, matrices, graphs, networks and flow charts etc. A well-structured narrative text presents information in a systematic manner under certain framework in selective and simplified way that provide the basis for drawing conclusions. We propose to use narrative texts, frameworks, matrices and flow charts extensively for data display in our analyses.

Figure 3.4: Interactive Model of Data Analysis

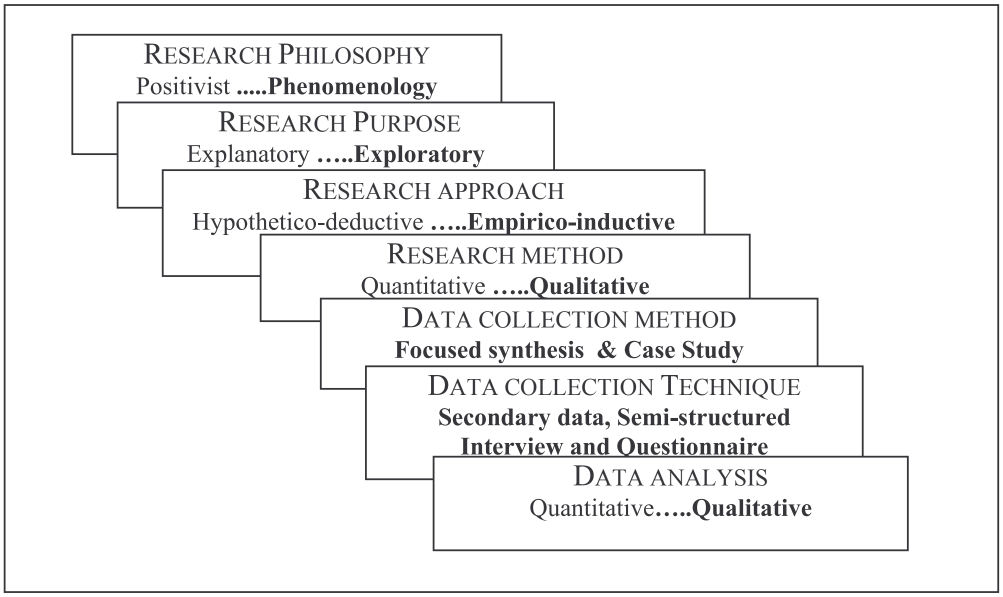


Source: Adapted from Miles & Huberman (1984:23)

The *third* cornerstone of the process of data analysis is *conclusion drawing*. In policy research, the process of drawing conclusions (although tentative and vague) starts from the beginning of the data collection period, and as the research proceeds it becomes more and more explicit. Miles and Huberman (1984: 215) mention twelve tactics for drawing conclusions. Out of these, we will emphasize more on building logical chain of evidence, seeing 'plausibility', clustering, splitting variables (reductionism), making metaphors (implicit comparisons), and making inferences. It may be noted that the three elements of the process of data analysis are interwoven to each other and therefore they are to be built up simultaneously.

In sum, the overall design of this research could be visualized through figure 3.5: *Taxonomy of the research design*. It may be noticed that the taxonomy has been depicted in terms of continuum except for data collection method and data collection techniques. The extremes on the right hand side of the continuums have been shown in bold to show the leanings only. It should not be construed otherwise. For example, the '*phenomenology*' in bold letters implies that the philosophical position of this research encompasses more characteristics of phenomenology paradigm rather than positivist and so on.

Figure 3.5 Taxonomy of the Research Design



3.2 Operationalization

Operationalization refers to translation of constructs into an operating reality. It details the series of procedures (operations) required to establish empirically the existence of what is described by a concept or construct (Ghauri et al., 1995; Neuman, 2000; Sekaran, 1992; Trochim, 1999). The objective of this section is to translate the abstract construct that has been developed in previous chapter (Theoretical perspective) into an operating reality in order to draw valid conclusions. Such endeavor also imparts construct validity to our research design, as illustrated later in this chapter. The process of operationalization is undertaken in two distinct but interrelated steps: *first*, operationalization of the constructs by way of establishing linkage between the different elements of the construct (3.2.1) and *second,* proposing a general framework of operationalization (3.2.2). It is supplemented by description of data & procedures (3.3), the validity of the research design (3.4) and the conclusions (3.5).

3.2.1 Operationalization of the Constructs

The assessment of impacts of policy of firm's performance and identification of policy directions for sustained development of an industry may be undertaken by ascertaining the following:

- What is the present status of industrial policy?
- What are the impacts of those policies on firms' performance?
- Where, when and why did they succeed or fail?
- What needs to be done (policy options)?

The first three questions although seem to be distinct, are interwoven and complex. Therefore they need to be analyzed in a systematic way. It is proposed to undertake the analysis through two distinct but interrelated steps:

- Defining the ***key constructs***/ terminologies used during the discussion such as industry, firm, resources, performance criteria and policy measures etc.
- Analyzing the ***linkage between policy and performance*** i.e. analyzing the mechanisms through which policy affects performance of an industry;

3.2.1.1 Key Constructs

In our earlier discussion and statements certain key words or constructs have appeared that need to be understood and explained in clear terms, before proceeding further. They are *industry*, *firm*, *resource, performance criteria, and policy measures etc.*

3.2.1.1.1 Industry

The terms have been used in a variety of different ways in economic literature. It may be necessary to specify their meaning to avoid any ambiguity subsequently. We have used the term *industry* in two ways. In the beginning of the study while discussing industrialization etc., it has been used in a broader sense covering four divisions of the ISIC classification (see chapter 2, page1). However, in subsequent discussions, it has been used in a narrower sense. It refers to *a collection of producers with similar output* (Kirkpatrick et al., 1984; Weiss, 1990) e.g. Machine Tools industry or Automobile industry etc., which is mostly defined at four digit level under Tabulation category- 'D: manufacturing' of ISIC classification system (revision 3) or three digit level of SITC classification system (revision 3).[31]

3.2.1.1.2 Firm

As regards to firms, we consider a *firm*[32] as a unit of ownership and control of economic activities (Kirkpatrick et al., 1984; Shepherd, 1997). It may consist of single plant or number of plants at one location or several locations. They are the basic unit of analysis. The output, employment or capital investment etc. of all firms within an industry when added together becomes the output, employment or capital investment etc. respectively of the industry.

3.2.1.1.3 Resources

In the traditional economics *resources* are considered akin to factors of production i.e. inputs used in a production process. These are conventionally defined as land, labour, and capital. In the modern approach, entrepreneurship or management is also considered as a fourth factor of production (Schotter, 2001; Stiglitz, 1997b). In order to isolate the role of industrial policy on performance of industry it is imperative that resources should be viewed somewhat different from the framework based on traditional economics. In place of viewing them at the macro level of overall economy they may be viewed at the micro level of firm. For this study, the we

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[31] ISIC classification (revision 3): D-2922- Manufacture of Machine Tools.
SITC classification (revision 3): 731- Machine Tools working by removing metal or other material.

[32] Also referred to as an enterprise.

adopt the definition used by Barney (1991; Grant, 1991) that resources of a firm could be understood as stocks of available factors both tangible and intangible that are owned or controlled by the firm and which enable a firm to conceive of and implement strategies in order to improve its performance. The individual resources of the firms include plant & machinery; technology; employees and their skill/ knowledge; finance; firm's systems and processes; marketing capabilities and brand image etc. The typology of resources is discussed in detail in the following section. Since firm is the basic unit of analysis, these resources when aggregated at the level of industry may be considered as resources of the industry.

Typology of Resources

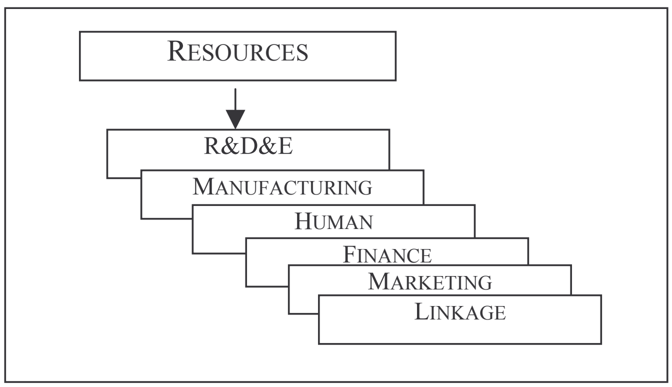
In literature scholars have classified resources of firms in different manner. Hofer and Schendel (1978:145) note that firms possess five types of resources that they use to achieve their objectives: i) *physical resources*, such as plant and machinery, warehouses, distribution facilities etc.; ii) *financial resources*, such as cash flow, debt capacity; iii) *human resources*, such as scientists, engineers, skilled workers, financial analysts etc. iv) *organisational resources*, such as quality control systems, cash management systems etc. and v) *technological capabilities*, such as high quality products, low cost plants etc. Grant (1991) suggests one more type of resource, which is more intangible in nature i.e. reputation, brand name, or goodwill.

Barney (1991) classifies firm resources in terms of physical capital-, human capital- and organisational capital resources. *Physical capital resources* include the physical technology used in a firm, plant and equipment, geographical location its access to raw materials, and distribution network etc. *Human capital resources* include the experience, capabilities, knowledge, skills, training, judgment, intelligence, relationships, and insight of individual managers and workers in a firm. *Organisational capital resources* include a firm's systems and processes, including its strategies, structure, its formal and informal planning, controlling and coordinating systems, as well as informal relations among groups within a firm and between a firm and those in its environment. Lado & Wilson (1994) name firm's resources as '*organisational competencies'*. In their views, organizational competencies describe firm-specific resources and capabilities that enable a firm to develop, choose, and implement value-enhancing strategies and include all firm-specific assets, knowledge, skills and capabilities embedded in the organisation's structure, technology, processes, and interpersonal (and inter group) relationships.

Van Dalen (1989) classifies resources in seven subgroups: i) *production and logistics*, describing the ways of producing the products and services of the organisational setting; ii) *client acquisition* resources which is more than just marketing, include the identification of clients, servicing the clients and satisfaction of clients; iii) *research and development* concern with development and improvement of new products and processes, strategic & applied research, product testing and scanning environment for new technologies etc.; iv) *human resources* include acquisition, training, deployment and maintenance of human resources throughout the organisational setting; v) *material resources* deal with the acquisition, distribution, maintenance and repulsion of production means; vi) *financial resources* encompasses attraction of the money means, distribution throughout the organisational setting and spending; vii) *information resources* refer to sources of information, the treatment of information (leading to proper information supportive to decision making), distribution and maintenance of information. Intangibles like reputation, brand names and goodwill etc. are also included in this subgroup.

The bottom line of these classifications of resources is their *functional significance*. Therefore for the sake of simplicity and easier operationalization, it is proposed to classify resources on the basis of functional areas of the firms in terms of *research, development and engineering (R&D&E)*, *manufacturing*, *human resources*, *marketing*, and *finance*. In addition to these, there are certain other factors that affect the performance of firms. They are industry specific institutions and infrastructures. They act like links between the firms and other stakeholders and lead to increased coordination and cooperation. The linkages so created enable the firms to improve their performance. Hence we consider it as an additional factor of production or a resource at the level of the industry. It may be nomenclature as *linkage resource*. The typology of the resources considered for this study is depicted in figure 3.6.

Figure 3.6: Typology of Resources



R&D&E resource
R&D&E resources include technical activities in a broad spectrum of areas from concept development, product planning, product design, product engineering, process design, process engineering, and prototype development.

Manufacturing resource
Manufacturing (operations) resources include all items and activities related to manufacturing in a firm such as production planning, plant and machinery, inspection, testing, quality control, maintenance and other allied items.

Human Resource
Human resources include human capital (e.g. scientists, engineers, skilled/ non-skilled workers, and their experience, knowledge, skills, training, and insight of the individual employee); and organizational capital such as firm's systems, processes, organization structure, as well as interpersonal relationships (Barney, 1991; Lado & Wilson, 1994).

Marketing Resource

Marketing resources include all those elements that can be referred to as constituent of the total marketing effort. It includes analysis of marketing opportunities, selection of target market, design of marketing strategies and their successful implementation in close co-ordination with other functional areas of firm, and after sales-service. It concerns with decisions regarding the 4 Ps of marketing i.e. *product* (product varieties- standard/ differentiated, quality, features, services, warranties etc.), *pricing* (cost-leadership/ differentiation/ focus, credit availability etc.), *place* (distribution channel, coverage, locations etc.) and *promotion* (sales promotion, advertising, sales force etc.) (Kotler, 1991, 1999).

Financial Resource

Financial resources include the sources of funds, uses of funds and control of funds. The sources and uses of funds concern with such as obtaining capital, managing cash, the control of debtors/ creditors and managing of suppliers of money such as banks, shareholders (both domestic and foreign) and financial institutions etc. Managing financial resources become more crucial in capital scarce developing countries caused by low levels of income and savings and weak financial institutions and markets.

Linkage Resource

Linkage resources refer to the coordinating mechanism at the level of industry. It leads to coordination and cooperation of firms with industry specific institutions, infrastructures and various stakeholders. This study concentrates on three main types of institutions and infrastructures: supply oriented (technology, credit, and training etc.), demand oriented (marketing, diffusion and public procurement etc.) and policymaking & implementing institutions. The importance of linkages becomes crucial particularly for development of sustainable SME sector. It enhances efficiency, effectiveness as well as transparency in overall system.

3.2.1.1.4 Performance measures

In literature an array of performance measures have been suggested. It is seen that no single measure captures all the notions of performance. They vary enormously in scope, context, level of analysis and give varying signals (Buckley et al., 1988; Scherer, 1980; Shepherd, 1997). Therefore we propose to describe the selected performance measures used in the study only and not to review the measures mentioned in the literature. For the selection of performance measures availability of reliable data has prevailed over the logic. We consider it as one of the limitations of this study as it limits the comprehensiveness of assessment. Nevertheless, an overall view of the interrelationship between different performance measures would be able to capture the dynamics of the context and lead to required comprehensiveness. For a better understanding we consider the performance measures at *firm level* as well as at *industry level*.

Firm level performance measures:

We propose to use three performance measures at the level of firm. They are annual sales, export intensity and labour productivity.

- *Annual sales* (P)[33]: It is the basic indicator of performance. Firms cannot survive unless they sell. This indicator is based on the assumption that in order to be competitive firms should able to produce and sale. Increasing sales implies better performance and therefore increased competitiveness. It may be noted that due to lack of availability of annual sales data as well as for ease of comparison over time, the annual production figures in value terms- Rupee million have been considered as proxy of annual sales. It has been indicated in relative terms considering the mean of the sampled firms as 100 in order to retain confidentiality of the data.

- *Export intensity* (X/P): The share of export relative to production is the frequently cited criteria of performance in the literature. Increased export intensity reflects better performance and vice-versa. Although it does not take into consideration the aspects of profitability (e.g. export at any cost or dumping).

- *Labour productivity:* The role of productivity is well recognized in literature as one of the critical factors for achieving cost-competitiveness of firms and consequently accelerating the pace of economic growth of a nation (Ahluwalia, 1985; Solow, 1957; Wagner & Ark, 1996). Productivity is usually measured in respect of the two factors of production namely labour and capital as well as the residual factors i.e. technological changes in product, process or management in terms of Total Factor of Productivity (TFP). Considering the matter of measurability and availability of data rather than theoretical appropriateness in the choice as well as calculation, we propose to use labour productivity in terms of output per unit of labour employed. The output is measures in terms of annual production as Rupee million at current prices. For expositional convenience it has also been presented as an index considering the mean of the sample firms as 100.

Industry level performance measures:
At the industry level we propose to use ten different performance measures. They are annual sales, export intensity, domestic market share, price competitiveness, revealed comparative advantage, level of concentration, gross fixed capital formation, net fixed capital formation, wage index and productivity index. Annual sales and export intensity have the same connotation as in the case of firm level so we do not repeat the same.

- *Domestic market share* (1 – M/C): The share of domestic production in total apparent consumption denotes domestic market share. It indicates the ability of the industry to defend in the domestic market against international competition. It is based on the rationale that industry's can perform well if it is able to serve domestic market. It also indicates the degree of self-sufficiency. A rise in domestic market share is considered to be an indicator of increased competitiveness and vice versa. The measure is complementary to the measure of i*mport penetration* i.e. share of imports in total apparent consumption (M/C).

- *Revealed Symmetric Comparative Advantage* (RSCA): The RSCA is an improved version of revealed comparative advantage (RCA) proposed by Balassa (1965) as a measure of international trade specialization (Laursen, 1998). As such, the RCA is ratio of world share

[33] P = Production; X = Exports; M = Imports; C = Total apparent consumption (P+X-M).

of country's export of a commodity (i.e. machine tool) to world share of total merchandise exports of the country.

$$RCA = \frac{(\text{Country export of machine tool / World export of machine tool})}{(\text{Country total merchandise export / World total merchandise export})}$$

- The country is said to be specialized in that sector if the value of RCA is above 1, and the reverse when RCA is below 1. However, since the RCA produces values, which cannot be compared on both sides of 1, the index has been made symmetric by way of calculating RSCA that equals (RCA – 1)/ (RCA + 1). It ranges from –1 to +1.

- *Gross Fixed Capital Formation (GFCF*): It measures the investments made in fixed capital by the firms of machine tool industry over a period of time. It equals the total value of a firm's acquisitions, less disposals, of fixed assets during the accounting period. Fixed capital covers all types of assets, new or used or own constructed, including the full value of assets taken on hire-purchase basis excluding interest element. To nullify the impact of inflation and to compare the values over time the values has been converted to constant prices of 1993-94 in Rupee million.

- *Net Fixed Capital Formation (NFCF*): It represents the excess of net fixed capital at the end of accounting year over that at the beginning of the year. It takes into account the depreciation of the fixed assets. It has also been converted to constant prices of 1993-94 in Rupee million.

- *Labour productivity index*: This measure is used to gauge the change in labour productivity (output per employee) over time at the industry level. We propose to construct a time series for labour productivity values for machine tool industry for the period 1982-83 to 1997-98 based on latest available Annual Survey of Industries (ASI) data. The impact of price rise is neutralized by deflating the value of output by wholesale price index (WPI) for non-electrical machinery at 1993-94 prices.

- *Wage index:* It measures the increasing level of skill at the level of industry. The wage index is constructed based on the latest available ASI time series data for annual emoluments paid to employees of machine tool industry for the period 1982-83 to 1997-98. The changes in average wage per employee over time could be attributed to two main factors, first, price rise and second increase in employee skills. In order to isolate the effect of wage increase due to employee skills, the changes due to price hike is nullified by deflating the total wage paid by consumer price index for industrial workers (base 1982-83 prices). The changes in wage index constructed thereof could be considered as a proxy for changes in skill level of employees.

- *Average unit price:* It measures the price competitiveness of the industry. Due to lack of comparable data, we propose to compare average price per unit (thousand US dollars in current prices) of CNC lathe and machining center.

3.2.1.1.5 Policy measures and their objective

The discussion in chapter II regarding industrial policy, flags the main issues in respect of each element of Industrial policy. It has led to identification of relevant policy measures. Policy measures are to be understood as a sub set of the elements of Industrial policy to deal with the main issues. They also have specific objective to achieve, which are usually set in concurrence with the objectives of Industrial policy and national goals by the policy makers. In this section we will make them operational.

Technology policy

Technology policy concerns with access to new technology, its adaptation to local conditions, assimilation, improving upon them and innovating new products & processes. Its overall objective is to move forward on the technological ladder from the stage of *learning to innovation*. The facilitation of acquisition of technology from abroad and their absorption is addressed through technology import policy that is popularly known as *foreign collaboration (FC) policy*. The adaptation, further assimilation and improvement of technology as well as new innovations come under the domain of *policy for promotion of in-house R&D*. Obviously the *objectives* of these policy measures are acquisition & adaptation of technology and assimilation & improvement of technology respectively.

Investment policy

Investment policy concerns with mobilization of domestic and foreign investment (FDI) to induce competition in the domestic market. The main policy measures identified are industrial licensing (IL) policy, FDI policy, and import policy. *Industrial licensing policy* regulates the entry and expansion of the firms or in other words it concerns with barriers to entry. In liberalized scenario its objective is to facilitate investments by way of dismantling entry barriers. It is equally applicable to both domestic and foreign investors. *FDI policy* facilitates entry of foreign investors in the domestic market. Its main objective is to attract foreign investments. *Import policy* concerns with regulation of import of goods and services through tariff and non-tariff measures. A liberalized import policy induces competition and hence modernization in the domestic industry.

Education and Training policy

Education & training policy concerns with *micro level* impact of education and training. Education policy concerns with generating skilled work force as per the specific requirement of the industry *(skill creation)* and training policy deals with pre-employment and post-employment training for upgrading skills *(skill development)* to build various capabilities in firms. The objective of these policies is to build human capital. Although the two policies are independent, they are dealt jointly as there lots of commonalities and complementarities exist between them in terms of objective, instruments and implementation.

Market Development policy

Market development policy concerns with the creation of demand in domestic market and promotion of domestic product in the export market. In order to make the analysis more explicit it has been split in two policy measures: domestic market development policy and export market development policy. The main objectives of these measures are creation of domestic demand and promotion of export market respectively.

Industrial Governance

Industrial Governance includes strategic thinking, formulating and implementing policies, building institutions and developing infrastructure to facilitate the process of industrialization. It is achieved through creating linkages by stimulating coordination and cooperation among various stakeholders. The main policy measures and their objectives for each element of industrial policy are summarized in Table 3.1.

Table 3.1: Policy Measures and their Objective

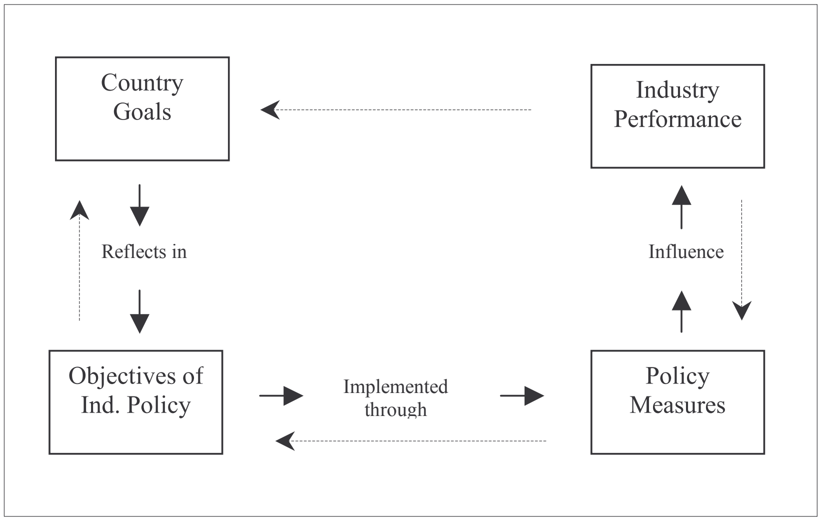
Dimension of Industrial Policy	Policy Measures	Objectives
Technology	Technology Import Policy In-house R&D Policy	Adaptation and absorption Improvement and generation
Investment	Industrial Licensing Policy FDI Policy Import Licensing Policy	Dismantling entry barriers Attracting investments Inducing Competition
Education & Training	Education & Training policy	Building Human capital
Market Development	Domestic Market Development Export Market Development	Creating domestic market Expanding exports
Industrial Governance	Policy on Industrial Governance	Stimulating Cooperation and coordination

3.2.1.2 Linkage between Policy and Performance

While discussing the theoretical perspective in chapter II it has been established that Industrial policy influences the process of industrialization and hence industrial performance. It influences the performance both from the supply side and demand side perspectives. The policy performance causality can be viewed in the following way. Government formulates policies keeping into mind the national goals.[34] There is interdependence between policy goal/ objectives and policy measures/ instruments (Cody, Kitchen & Weiss, 1990; Greenaway & Milner, 1993). The national goals (say *self-sufficiency*) are reflected in the broad objectives of Industrial policy (*import substitution*) and vice versa. The objective is achieved through implementation of a combination of policy measures (*import policy*) and policy instruments (*quantitative restrictions*), which in turn influence the performance of the firms (*high cost and low quality*). The example given in the parenthesis is just for illustration. It may not be viewed otherwise. The causality chain of policy and performance may be schematically outlined through a *simple model* in figure 3.7.

[34] Goal has long-term connotation, while Objective short term.

Figure 3.7: Policy- Performance Chain at Macro level



Note: The dashed arrows represent the feedback loop.

The feedback loop indicates that the ongoing performance of the firms give signals to the policy makers to incorporate appropriate changes in country goal, objectives of industrial policy and policy measures/ instruments. It may be recognized that even in the stage of policy planning of a country (say after independence or commencement of new regime) performance of the existing industries are taken into account. Hence the interplay of policy and performance is usually iterative. A well-articulated policy when implemented in a proper way enhances performance and inappropriate policy or poor implementation of good policy may even work in reverse direction.

In order to evaluate what issues ought to concern for arriving at policy options w.r.to industrial policy it is necessary to understand how firms operate under the policy regime in place or in other words how industrial policy influences the strategies and performance of the firms. Although some insights have been provided by *structure-conduct-performance* (S-C-P) paradigm[35] of Industrial Organisation economics (Porter, 1981; Scherer & Ross, 1990; Shepherd, 1997; Shy, 1995), it does not capture the impacts through the internal organization of the firms. There is a need for more elaborate analysis. The essence of the S-C-P paradigm is that a firm's performance primarily depends on the industry environment in which it competes. The market *structure*[36] determines the state of competition within that industry and sets the context for firms' *conduct*, [37] which in turn determines *performance* (Collis & Montgomery,

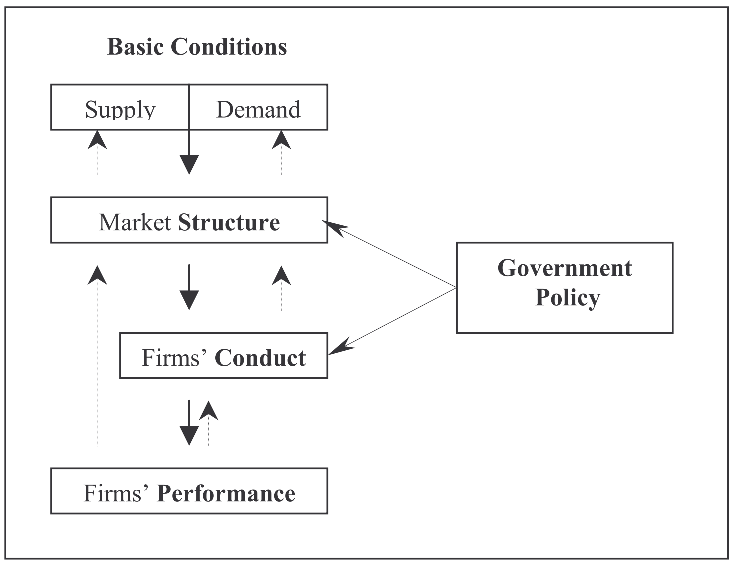
[35] Also known as Bain/Mason paradigm (Porter, 1981; Scherer & Ross, 1990).

[36] *Structure* refers to the size distribution of firms in the market. It is characterized by the number and size distribution of sellers and buyers; market share, concentration, presence or absence of barriers to entry, degree of product differentiation, and degree of vertical integration etc. (Scherer & Ross, 1990; Shepherd, 1997; Shy, 1995).

[37] *Conduct* refers to the behavior of the firms in a given market structure e.g. how firms determines price policy, product strategy, R &D or investment in plant & machinery etc. (Scherer & Ross, 1990; Shy, 1995).

1995; Hoskisson et al., 1999; Scherer & Ross, 1990; Porter, 1981). Performance refers to the welfare aspect of the market interaction i.e. whether the interaction in the market leads to a desired outcome or not. As we have discussed earlier that for various reasons market fails resulting performance falling below the acceptance level, which require government intervention. The Government influences the performance of firms by applying policy measures/ instruments that affect market structure and/ or conduct of firms. The S-C-P paradigm offers explanation of policy-performance linkage in the market settings only. It offers inadequate understanding of the mechanism of influence of policies on performance in the setting of the firm.

Figure 3.8: Structure-Conduct-Performance (S-C-P) Paradigm



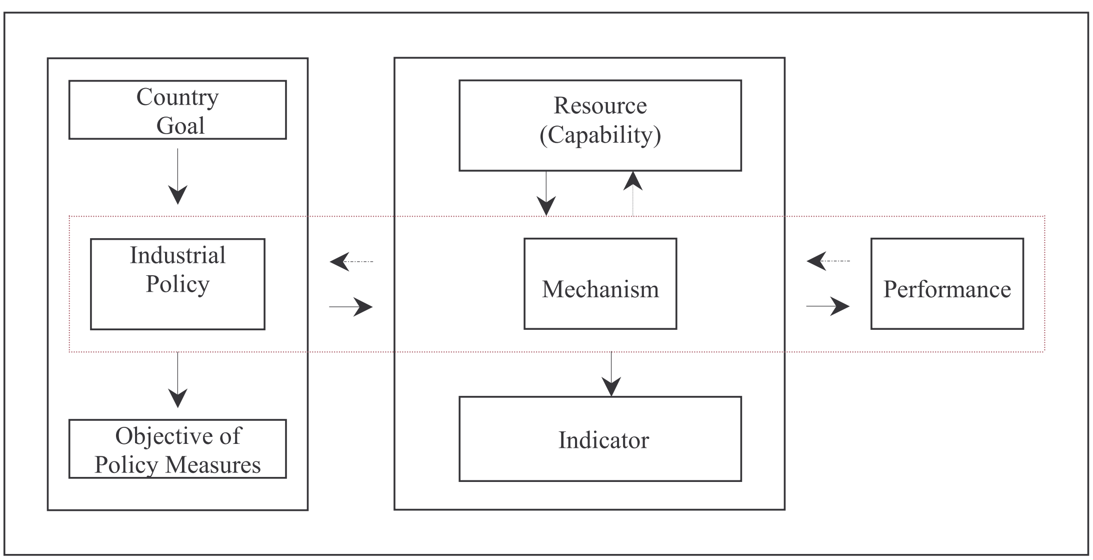
Note: The thinner dashed arrows represent the reverse causality (feedback).
Source: Adapted from Shepherd (1997: 5)

Subsequent research indicates that performance predominantly depends on the *resources* owned and controlled by the firms rather than market structure or conduct only (Barney, 1991; Collis & Montgomery, 1995; Grant, 1991; Penrose, 1959; Peteraf, 1993; Prahalad & Hamel, 1990). Resources are essential for attaining static efficiency that requires a current set of resources as well as for dynamic efficiency (technological progress), which necessitates continuous development of resources. In this way it influences the conduct of the firms. On the other hand, Government policies influence acquisition and development of various resources. In fact it is the interplay of external environment (market structure), internal environment (resources) and government policies that affect the performance of the firms. So *resources acquire central place in both the causality chain: policy-structure-conduct-performance and policy-resource-performance*. Hence, *resources* may be considered as pivot in the analyses of the *policy-performance* causation. It may be recognized that the causation usually flows from left to right in the above causality chains but in actual practice reverse causations also occur that create a situation of mutual dependence.

In literature the discussion on impact of government policy on performance of industry has figured prominently particularly in the context of East Asian remarkable success. Some of the empirical studies worth mentioning are: Lall (1996), Page (1994), Vogel (1991), Wade (1990) and World Bank (1993); Amsden (1989), Chang (1994), Kim (1998), Pack and Westpall (1986) for Korea; Aberbach and Dollar (1994), and Amsden (1985) for Taiwan; Lim (1995) for Singapore; and Auty (1994) for a cross country analysis of Korea, Brazil, Mexico, China and India etc. There are quite a few similar studies in respect of India as well viz: Ahluwalia (1985, 1991), Bardhan (1984), Bhagwati (1993), Jacobson (1991), Joshi and Little (1994, 1996), Kaplinsky (1997), Lucas and Papanek (1988), Mookherjee (1995), and Rosen (1988, 1992) etc. In all these studies there has been overwhelming stress on macroeconomic aspects of industrial behavior and broad measures of industrial performance vis-à-vis the role of government policy. But the analyses of the mechanism of influence of policies on performance of the firms and organization of specific industries have received scant attention.

There are only a few studies where *resources* have been given some credence in analysis of firms' performance vis-à-vis policies. They mainly concern with studies regarding technological change in the context of developing countries such as Bell and Albu (1999), Dosi et al. (1988), Fransman (1986), Freeman (1987), Lall (1987, 1992, 1996), Lall and Teubal (1998), Halperin and Teubal (1991), and Pavitt (1984) etc. But in these studies the focus of study is the phenomena of technological change rather than performance of the firms vis-à-vis industrial policy. Moreover the discussions are limited to technology resources only. This study attempts to fill in this void. It endeavors to explain the *policy-performance causation* in a simple but comprehensive way. The model for evaluating the causation is presented in Figure 3.9 overleaf.

Figure 3.9: Framework for evaluating Policy – Performance Causation



The three elements of the causality chain: *policy*, *resource* and *performance* are the *building blocks of our analysis*, with resource being the central one. The first building block pertaining to policy consists of three elements: national goal, objective of industrial policy and objective of the specific policy measures. It is similar to the first three elements of policy-performance chain described earlier in figure 3.8. The definition and various dimensions of Industrial policy we have already described earlier in section 2.3 and therefore needs no further explanation. The third block i.e. performance has been elaborated in the section 3.2.1.4 in terms of performance criteria. Thus, in this section we will concentrate on the central element of the causality chain: resources, although in conjunction with policy and performance. In order to do that we introduce here three more constructs: *capability, mechanism* and *indicator*.

It may be mentioned that resources are inputs into the production process but on their own few resources are productive. They become productive in cooperation and coordination with other resources using human capital. In this way each resource is manifested in specific capability that leads to performance. For example, a firm is able to create capability of *developing new product and process,* which we term as *technological capability of product* or *product development capability* on the basis of its resources such as R&D&E in cooperation with marketing research (marketing resource), manufacturing department (manufacturing resource), availability of finance for investment in R&D facilities/ activities (financial resource), technical personnel and organizational systems (human resource), interactions with technical institutions (linkage resources). Table 3.2 summarizes the main capabilities as envisaged for the purpose of our discussion.

Table 3.2 Resource– Capability Matrix

Resources	**R&D&E**	**Manufacturing**	**Human**	**Market**	**Finance**	**Linkage**
Capability	Prod. Dev. Capability	Manufacturing Capability	Human Resource Capability	Market Development Capability	Financial Capability	Linkage Capability

Mechanisms could be understood as purposeful activities or actions undertaken by a firm to build capabilities that culminate in performance. It is more or less similar to Conduct of S-C-P paradigm. The difference being, *conduct* is seen in the *market setting*, whereas *mechanism* is to be seen in the *internal setting* of the firms. It has more functional connotation. It may be better understood with the help of examples. For example, to achieve capability of product and process development, the firms need to undertake activities such as design & engineering, hiring new skills or training existing employee, investment in R&D facilities, interactions with buyers to develop machines as per customers' need, intra/inter department interactions, create linkage with various institutions and so on. These activities are termed as mechanisms. Some mechanisms may be common for achieving various capabilities as well. These mechanisms are more productive when used in combination with others rather than in isolation. There are considerable linkages between *mechanism* and *policy measures*. Policy measures influence the choice and thrust on use of various mechanisms. In other words it may be said that the firms adopt different mechanisms in various combinations based on policies in force. Some mechanisms may be specific to certain policy measures and some may be common for various policy measures. We will revert back to this discussion in subsequent sections again.

Indicators may be considered as the measure of judging the outcome of adoption of a mechanism or combination of mechanisms to achieve various capabilities in the context of polices in vogue. They are the reflections of adoption of mechanisms. They may also be understood as *intermediate performance measures*. For example, the outcome of adoption of mechanisms such as transplanting product concept & design, adaptation of product & process and continuous interaction with collaborator for imported technology may be measured in terms of number of new products introduced in the market and so on. Indicators may be specific to certain mechanism or combination of various mechanisms.

After understanding each element of the policy-resource-performance causality chain, it may be now possible to establish linkages between them. It is proposed to undertake the analysis through following distinct but interrelated steps:

i. Identification of the main policy measures and their objective
ii. Identification of main resources of the firms
iii. Identification of the capabilities
iv. Identification of performance criteria
v. Formation of Policy – Resource matrix
vi. Identification of Mechanism and Indicators for each cell of the matrix
vii. Analyses of impact of industrial policy on firms' performance

The steps i - iv have already been described in our earlier discussions. Hence in the following sections we describe the last three steps. We start with formation of the policy-resource matrix.

Policy-Resource matrix

To ascertain the impact of various elements of industrial policy on the performance of the industry through various resources it is imperative that these parameters are placed in such a way that the process of analysis and drawing conclusion become systematic and practical. In order to do so, it is proposed to structure these parameters in the form of a matrix in terms of the five *elements of industrial policy* and five *resources of firms* as presented in Table 3.3. The horizontal dimension i.e. row represents elements of industrial policy and the vertical dimension i.e. column represents various resources.

It may be seen that a few cells in the matrix presented in Table 3.3 have been shaded. The objective of shading is to indicate the *direct and indirect* impact of different element of policies on various resources. It is important to recognise that although, each policy influence all the resources, but certain policies exert more influence on some resource than others. For example, Technology policy has direct impact on building technological capability for product i.e. technology resources for product rather than organization resource or financial resource of the firms; or Investment policy influences directly on operations and financial resource of the firms compared to others and so on. We may term these as *direct impact* and *indirect impact*. It may be noted that the distinction has not been made just for expositional convenience but for certain purpose. For systematically analyzing the influence of policy on resources, it is imperative that appropriateness of influence is identified. For example, the marketing capability of the firms cannot be influenced directly by technology policy and vice versa. In other words, technology policy is not an appropriate measure for building marketing capability of the firms and so on. In our analysis, we will *concentrate* more on *direct impact* of policy on various resources. This proposition will become more apparent as we proceed.

Table 3.3: Policy-Resource matrix

Resource ➤ / Policy ⮟	R&D&E	Manufacturing	Human	Market	Linkage
Technology					
Investment					
Edu. & Trng.					
Market Dev.					
Governance					

Identification of Mechanisms and Indicators

The next step is identification for relevant mechanisms and indicators for each cell. These mechanisms and indicators become the medium for analyzing the impact of various elements of industrial policy on different resources of the firms. It is mentioned that these mechanisms and indicators however had to be modified accordingly to meet the situation and practical considerations met in course of field investigations. The final list of mechanisms and indicators have been indicated for each of the 40 cells of 8x5 matrix in Table 3.6 at the end of this chapter. For illustration, mechanisms and indicator for R&D&E resource in respect of FC policy are presented in Table 3.4. Here attention is drawn that although every attempt has been made to identify the appropriate mechanism and indicators for each cell, we do not claim exhaustiveness that offers scope for further elaboration depending on time, scope and situation of the study.

Table 3.4 Mechanism and Indicators for R&D&E Resources

Policy	**Mechanism**	**Indicator**	**Performance**
Foreign Collaboration Policy (*Technology Adaptation & absorption*)	-Transplanting Product concept & design -Adaptation of product & process -Improvement of product & process -Continuous interaction with the Collaborator	-No of products introduced in market based on last FC -R&D intensity -No of QSE	-Annual sales -Export intensity

Analyses of Policy- Performance linkage

After describing all the elements of the framework for evaluation of policy performance linkages, now it may be possible to tread in the analysis part. We start our discussion with the first row in general and the first cell in particular (see Table 3.6). The first row pertains to policy regarding Import of Technology i.e. FC policy. It concerns with regulation of the import of technology.[38] It imparts direct influence on Technology resource of product of the firms. The first cell is the point of interaction of FC policy and Technology resource for product. So it is the *direct impact cell* and rest of the cells 12 to 16 are indirect impact cells. In the context of the national goal of integration with the global economy, the objective of the FC policy is usually adaptation & absorption of technology i.e. to understand the technology, and adapt them to local conditions. In the long run the technology is improved upon, and even exported, which necessitates enhanced in-house R&D efforts. As mentioned earlier, firm's capability of product & process development is directly influenced by FC policy. It starts from the very choice of technology, assimilation of product concept & design to reproduction of prototype and so on. In order to adapt the technology firms use mechanisms such as understanding the concept and design of machine, designing and engineering the machine, adapting them to local conditions by necessary material substitution and incorporating the necessary changes etc. Firms keep on improving by continuously getting support from the technology supplier through training of their employee at collaborator's plant as well as hiring new skills suitable for adaptation for the technology etc. The result of adoption of these mechanisms is reflected in the indicators namely number of new products introduced in the market, and R&D intensity etc. These finally culminate in performance of the firms, as seen from various performance measures e.g. annual sales or export intensity.

As regards to the analysis of other cells in the first row, one should recognize that they pertain *to indirect impacts*. FC policy influences the manufacturing capability of the firms albeit indirectly. With the assistance of foreign collaborator, firm modernizes its manufacturing facilities; undertakes manufacture of critical components and start using modern manufacturing practices & systems. Similarly organizational capability is enhanced by implementation of new systems, training of existing employee and hiring new skills etc. The buy back arrangement and assistances in export marketing enhance marketing capability of the firms. Finance is strengthened through ability to negotiate with the collaborator in respect of lump sum payment and royalty rates etc. under the influence of the FC policy. The influence on linkage resource could be gauged through use of institutional mechanism for search on technology through Technology Data Bank or dissemination of information in respect of imported technology to other manufacturers or suppliers of component through respective institutional mechanisms etc. These examples are discussed here just to illustrate the linkage between the policy, resource and performance through the mechanisms adopted by the firms.

Similarly row four pertains to Industrial licensing policy. It directly influences the manufacturing capability of the firms. The Industrial Licensing policy steers the process of industrialization along a trajectory that is consistent with the national goal. It regulates the entry into the industry and expansion of capacity. While attaining the goal of *self-reliance* it

[38] Lump sum Technology fee, royalty payment for domestic sales and export sales, training of employee at the technology supplier's plant, export marketing region restrictions, and buy back arrangements etc. are the some of the important dimensions of the agreement which are of concern to the Government.

imparts *protection to the industry* from domestic competition. On the other hand, for the national goal of *integration with the global economy*, its objective becomes *dismantling the entry barriers*. In this situation, the firms feel the pressure of competition and try to build their technological capability by augmenting their manufacturing capability through *mechanisms* such as fresh investments in new ventures or for modernization, and more use of subcontracting etc. The result of these efforts is reflected in the *indicators* namely quantum of investment, production capacity, plant efficiency and productivity etc. The technological capability of product development is build through mechanisms such as thrust on product/process development, continuous up gradation of technology and increased intra/inter department interactions etc. The firms make use of government assistances provided for removing procedural impediments in implementation of their project. All these mechanisms enable the firms to improve their performance.

The *evaluation of performance* may not be trustworthy unless they are compared with some of the *benchmarks*. We propose to employ two types of benchmarks. The firm level data will be benchmarked against the best performing firm in the industry under the same policy regime. As regards to the industry level data, performance of other developing countries that are successfully in building up their Machine Tool industry like Korea and Taiwan will be used. These countries have been successful in developing their CNC Machine Tools industry in the recent past under the same global conditions that was available to India as well.

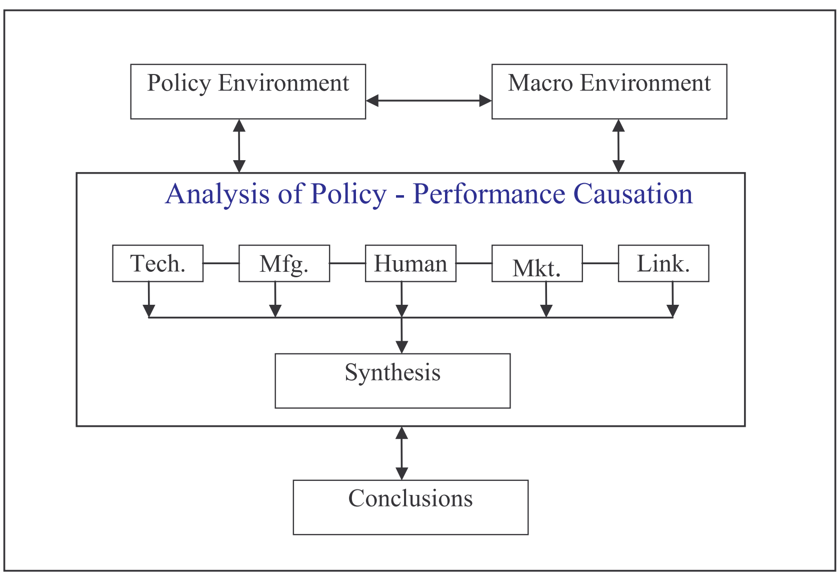
It may be noted that the analysis through the partitioned structure i.e. different cells brings out the intricacies of linkage. However, one should be cautious in drawing inferences from such analysis, as there are lots of interdependencies both within and between the various elements of policy and resources. In order to make the analysis more systematic and comprehensive, it is proposed to undertake the analysis in *two steps*. In the *first step*, we analyze how each resource of the firms has been influenced by the relevant policy measure i.e. column-wise analysis in the policy-resource matrix. It means analysis of policy-performance causation for the five *direct impact* cells. Such analyses will allow us to answer the first three questions of the process of assessment (see section 3.2.1). In the *second step*, we reconfigure our analysis row-wise i.e. policy measure wise. Here we analyse the impact of a specific policy measure on other resources of the firms as well as we also take into consideration the impact of other policy measures on various resources. Such analyses when seen in the perspective of discussion in earlier part of the study (chapter 1 to 4) lead to identification of the new policy directions i.e. what needs to be done?

3.2.2 General framework of Operationalization

The overall plan of operationalization of our research is depicted in figure 3.10. It consists of four major elements: *policy environment*, *macro environment*, *analyses of policy-performance causation* and summary & *conclusions*. We will describe each element in brief to give the readers a feel of the overall scheme.

In order to understand the functioning of industrial policy in India one needs to understand how industry in India performed under the policy regime till date in the first place. It has been suitably named as *'policy environment'*. It helps in understanding the evolution of policy framework and overall industrial performance in India. We attempt to review the evolution of industrial policy and the concomitant impact of these policies on the process of industrialization. The analyses adhere to the framework illustrated earlier (see figure 3.7). Such analyses help in understanding the sequence of events of the past and what is going on at present so that one can come out with policy recommendation for the future accordingly. It bridges the past with the present. So far, the protective regime had made the domestic market virtually free of competition making the firms complacent and inefficient. Since 1991, India undertook sweeping reforms in order to integrate with the global economy. It has stimulated an atmosphere of dynamism and competition. We propose to give more emphasis on post-liberalization phase i.e. 1991 and beyond. While discussing the evolution and performance of industry attention has been given to analyses of the profile of Indian economy, its evolution, structure of markets, industrial performance and impacts of liberalization in general. We have adopted *focused synthesis* as the main method for data collection. It includes review of existing published & unpublished literature; discussions with experts in the field of policymaking, industry associations and chambers of commerce etc.; and personal experience of the researcher himself. Accordingly, secondary data and semi-structured interview are the main techniques for data collection. The analysis of data has been done through the three iterative activities: *data reduction*, *data display* and *conclusion drawing* as mentioned earlier. We used tactics such as seeing plausibility, implicit comparisons, building logical chain of evidence, and making inferences for drawing conclusions.

Figure 3.10: General Framework of Operationalization



In the *second stage* of operationalization we narrow down our analyses from overall policy & performance to Machine Tools industry under the heading '*macro environment'*. It helps in identifying and *understanding* the channels through which external environment impact development of the industry and policy formulation by way of systematically recognizing the connections and interdependencies. To start with, an overall evaluation of the World Machine Tools industry is undertaken by way of examining evolution of the industry, main characteristics, structure, growth, and position of developing countries in general and India in particular. It is followed by analyses of Indian Machine Tools industry in respect of its present status, evolution, structure, technological status and position relative to other countries. In this case also *focused synthesis* has been adopted as the main method for data collection. Accordingly, secondary data and semi-structured interview of various stakeholders are used as techniques for data collection. The process of analysis of data has also been the same i.e. the three iterative activities: data reduction, data display and conclusion drawing. The tactics for drawing conclusion are more or less the same such as seeing plausibility, implicit comparisons, building logical chain of evidence, and making inferences.

The *third bead* in the strand of operationalization effort is analysis of policy-performance causation. It forms *the core of our analyses efforts*. It is important to note that in general the analyses have been undertaken at the level of industry. Nevertheless, firms are the basic unit of analysis. The study attempts to analyse the impact of various elements of industrial policy on the different resources of the firms that culminates in performance. The method of analysis has already been described in section 3.2.2. So there is no need of repetition. At this stage *multiple case study* has been adopted as the main method of data collection. Existing manufacturers of CNC Machine Tools in India have been chosen for case study. In this case questionnaire and semi-structured interview are used as techniques for data collection, besides secondary data. The process of analysis of data has been the same i.e. the three iterative activities: data reduction, data display and conclusion drawing. The splitting variables (reductionism), seeing plausibility, implicit comparisons, clustering, building logical chain of evidence, and making inferences are used as tactics for drawing conclusion. The analyses have been placed in five chapters i.e. chapter 6 through 10. The analyses are further reconfigured row-wise (policy measure wise) to identify the new policy directions. It is basically an act of making inferences for each of the five dimensions of industrial policy based on the analyses done in the preceding chapters. This discussion is presented in chapter 11. The chapters 6 to 11 are considered to be the main analytical chapters of the study. Finally in chapter 12, the conclusions are drawn and agenda for the future research are presented.

This section was devoted on operationalization of the constructs. It comprised of three elements: operationalization of the key constructs, analysis of linkage between policy and performance and a general framework of operationalization. The next section will highlight the details about the field study i.e. data and procedure of data collection.

3.3 Data and Procedure

3.3.1 Data

The research questions, theoretical constructs and their operationalization set the challenge of acquisition of appropriate data. It is seen that the data requirement for this study pertains to three different levels: mega/ macro level, industry level and firm level. As discussed earlier, the mega/ macro level data are required for analysing policy environment and macro environment (see section 3.2.2). These data are mostly in public domain and therefore will be acquired mainly through secondary data source. Similar solution applies to most of the industry level data as well. Nevertheless, it needs to be supplemented with discussions with experts in the field and various stakeholders. The real challenge of data acquisition appears in respect of the firm level data, as secondary data sources do not provide sufficient information and evidences. The 8 x 5 Policy Measures-Resource matrix with 40 cells having various variables i.e. *mechanisms and indicators* (see Table 3.6 annexed at the end of the chapter) has necessitated the collection of *primary data* on these mechanisms and indicators from the firms. These are collected primarily through questionnaires and in-depth interviews. For reasons of confidentiality, the names of neither the firms nor the persons responding to the questionnaire or participating in the interview are disclosed.

3.3.2 Sampling

The first action in the endeavour of primary data collection is the sampling of the firms. The main objective of sampling is to collect primary data on mechanisms and indicators through study of specific cases in order to deepen our understanding of industrial policy making. There are approximately 300 firms in India manufacturing Machine Tools. Out of these, about 50 firms have undertaken the manufacture of CNC Machine Tools. They account for 80 per cent output of the industry. The geographical *location* is *India*. The *sampling frame* or temporal boundaries of population is considered as firms who are *members of* Indian Machine Tools Manufacturers Association (IMTMA). Since this study concentrates on CNC Machine Tools, we consider the *population size* as total number of CNC Machine Tools manufacturers who are the members of the IMTMA i.e. *45* firms. The *population parameter* is the firms manufacturing CNC Machine Tools. Due to *small population size* and concern for choice of cases that would enhance the understanding of policy- performance linkage through impact on resources of the firms for the social phenomena like industrial policy making, it is proposed to adopt *non-probability sampling* in general, *purposive sampling* in particular and *dimensional sampling* to be more precise. It is proposed to identify specific cases for in-depth analysis and select unique cases that are especially informative. The characteristics of surveyed firms are presented in Table 3.5.

Table 3.5: Characteristics of the surveyed Firms

<table>
<tr><td>Ownership</td><td colspan="2">Public Sector
12 %</td><td colspan="2">Private Sector
88 %</td></tr>
<tr><td>Nationality of control</td><td colspan="2">Domestic
94 %</td><td colspan="2">With foreign equity (< 20 %)
6 %</td></tr>
<tr><td>Source of Technology (with or without FC)</td><td colspan="2">Having FC
70 %</td><td colspan="2">No FC
30 %</td></tr>
<tr><td>Size in terms of Sales (Rs million)</td><td>Large (> Rs 500 m)
12 %</td><td colspan="2">Medium (Rs 50-500m)
64 %</td><td>Small (< Rs 50m)
24 %</td></tr>
<tr><td>Size in terms of employment (Nos)</td><td>Large (> 500 No)
35 %</td><td colspan="2">Medium (50-500 No)
53 %</td><td>Small (< 50 No)
12 %</td></tr>
<tr><td>Export Status
(% of sales)</td><td>10-20 %
12 %</td><td colspan="2">< 10 %
41 %</td><td>Nil
47 %</td></tr>
</table>

Efforts have been made to get data from different types of firms based on various criterion *(dimensions)* such as *ownership*: government- or private owned; *nationality of control*: domestic, foreign; *source of technology*: firms with imported technology or domestically developed technology; *size in terms of annual sale:* small, medium and large*; size in terms of employment*: small, medium and large; and *market orientation*: export- or domestic market etc. Such selection of firms would allow us to get understanding of unique cases that are especially informative from the cross section of firms manufacturing CNC Machine Tools. The selection of firms was done based on opinions of representative of the IMTMA, the Government of India officials dealing with Machine Tool industry and careful planning to address the problem of sample biases. The table suggests that the sample covers wide spectrum of firms and therefore may be considered as representative response of the industry.

3.3.3 Data collection

A well-structured questionnaire was mailed to 45 firms manufacturing CNC Machine Tools in India. Initially only four firms responded i.e. an initial response rate of 9 percent only. Eleven firms refused to respond, however after further request three firms responded. Thus the overall *refusal rate* was 18 per cent. Ultimately after lot of persuasions we could get response from 17 firms. This amounts the *active response rate* approx. 38 per cent. It was seen that all purposeful firms respond with the help of reminders and personal networking.

3.3.4 Questionnaire

The questionnaire served to the firms were so designed that it was easy to understand and simple to answer. The sole intention was to get as much relevant data from the firms as possible. It was divided in five sections: general, technology, management, marketing and role of the government. It had 39 open ended and 162 pre-coded closed-ended questions. The questionnaire was designed on the basis of requirement of information based on the objective of the study, theoretical perspective and its operationalization.

3.3.5 Interview

Subsequently the researcher interviewed the firms personally. The interviews were semi structured and face-to-face mostly with CEO or corporate level executives. The interview started with a brief introduction of the researcher, the background of the study and its objective. Initially open-ended questions concerning possible role of the government for the sustained development of CNC Machine Tool industry were discussed followed by their views on mechanisms adopted vis-à-vis specific policy measures for achieving better performance, indicators, firm's innovative efforts and lessons learned from the past etc. as well as views on consortium approach of dealing things. The interviews were approximately one and half-hour duration on an average.

3.3.6 Limitations of Data collection

It is important to direct attention to the limitations of the present study, so that adequate caution is exercised in drawing inferences from the estimates. The main constraint in the study arose from unwillingness of firms to respond properly. The firms were reluctant to provide data about future production and investment plans, marketing strategies and other financial data as they regard all these as trade secrets. In fact, most of them were very touchy about being asked questions on these issues particularly the financial issues. Precisely due to this, we had to drop the analysis regarding financial resources of the firms. We feel that the firms were under a constant fear of their information being passed on to the competitors and other government authorities. Further, the firms did not like to spend time to dig out data from the firms' record. Thus certain figures like *turnover rate of employee* or various *rankings on the Likart type five points' scale are mere approximations*. Such reluctances on the part of the firms have placed serious constraints on the collection and reliability of data. We could overcome such problems to some extent by developing good rapport with the respondents in the course of the field visits that increased the active response rate as well as the quality of response considerably.

3.3.7 Variables and scoring

As stated earlier, the basic objective of acquisition of firm level data was to obtain data pertaining to the mechanisms and indicators. Efforts have been made to quantify these attributes on the basis of answers given by the firms. Most of the answers of the questionnaire pertain to the operationalized indicators. The operationalized indicators are the main measurement instruments used in this study. They were mostly measured at the ordinal or ratio level. For example, the number of products introduced in the market is measured in terms of number i.e. at ordinal level; or R&D intensity is measured as percentage of expenditure incurred on R&D&E activities vis-à-vis annual sales i.e. at ratio level; or importance attached to monitoring new developments is measured at the ordinal level on a scale ranging from 1 (little importance) to 5 (crucial) etc. The answers, which were based on subjective ranking in five-point scale had to be helped by the investigator through providing necessary hints whenever required. It was preferred to adopt Likart type five points' scale (Neuman, 2000; Robson, 1993) for seeking graded response or ratings. At times, summated ratings are obtained for scores pertaining to related questions. For those cases where reasonable crisp answers could not be obtained, the technique of proxy attributes[39] was adopted. For quantifying some of these attributes a five-point scale was adopted and scores were given from own judgment. The judgment was based on overall information given by the firms, personal interviews and other secondary sources about the firm viz. annual reports and information from other stakeholders.

3.4 Validity of Research design

Till now our discussion has been focused on building various strands of our research design. But the question arises '*is our research design trustworthy?*' or in other words 'does it provide a clear explanation of the phenomenon under study?'. In the research methodology literature, it is addressed by way of assessing the validity. In the traditional positivist paradigm the criteria are termed as *internal validity*, *external validity*, *objectivity* and *reliabilit*y (Cook & Campbell, 1979; Easterby-Smith, 1991; Ghauri et al., 1995; Marshall & Rossman, 1999; Maxwell, 1996; Neuman, 2000; Robson, 1993; Saunders et al., 2000). While, in the context of phenomenology/ qualitative paradigm Lincoln and Guba (1985) proposed an alternative construct in terms of *credibility, transferability, confirmability,* and *dependability* (Marshall & Rossman, 1999; Robson, 1993). Nevertheless, the essence of both the constructs is same. For the sake of simplicity and clarity, we consider these criterions in terms of *internal validity*, *external validity*, *construct validity,* and *reliability.* It may be noted that while judging the validity of the research design one needs to apply some caution. It should not be seen in the conventional perspective of positivist-quantitative paradigm for a research design that has leaning towards phenomenology-qualitative paradigm. The three constructs could be seen in figure 3.11.

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[39] A Proxy attributes is one that reflects the magnitude to which an associated answers are not but does not directly provide measure for the variables as indicated in the matrix (Neuman, 2000; Saunders et al. 2000).

3.4.1 Internal validity

Internal validity refers to the logic of design (Hedrick et al., 1993; Neuman, 2000). It should be demonstrated through proper identification of complex social problem, its description, conceptualization of theoretical perspective, analyses and the results of the research. In this research it has been achieved through proper identification of the research question, building of theoretical perspective based on concept of market failure that is more relevant in the context of process of industrialization in developing countries, conceptualization of a framework in terms of various elements of industrial policy and their impact on performance of CNC Machine Tools industry, analyzing secondary data in respect of evolution of policy regime in a systematic manner and last but not the least arriving at policy recommendations after properly analyzing impact of policies on development of various resources at the level of industry. Such endeavors have imparted i*nternal validity* to the research. Further, adoption of appropriate triangulation at different levels of the research design such as philosophical (phenomenology and positivist), purpose (exploratory and explanatory), method (qualitative and quantitative), data collection method (focused synthesis and multiple case study), data collection techniques (secondary data, interview of various stakeholders and questionnaire) etc. have also contributed sufficiently to internal validity of this research.

3.4.2 External validity

The essence of *external validity* is making *generalizations*. It refers to, the extent to which the research findings could be *generalized* to larger populations and applied to different settings (Cook & Campbell, 1979; Cooper & Emory, 1995; Hedrick et al., 1993; Marshall & Rossman, 1999; Neuman, 2000; Robson, 1993; Sekaran, 1992; Trochim, 1999). However, in the case of policy research like ours such generalizations in that manner may not be possible. Rather any claim for generalization would be misleading. Such claim should be considered as a weakness of the research design. The prevailing economic, social, political, technological capability, national objective and socio-political environment of countries are so diverse that recommendations for one country cannot be applied in the context of other countries. Moreover, external *validity* of quantitative research is based on formalized sampling methods, which is not applicable in our research. We assert that in the *positivist sense this research* has very *limited external validity*. In the research design like ours, *external validity* could be referred as the degree to which the recommendations could be transplanted to other contexts or settings. It is more comparable to *transferability*[40] criteria of phenomenology paradigm. In our research, efforts have been undertaken to describe the situations/ context/ methods so vividly that other researchers who would like to transplant the methodology or findings may do it with less hassles by incorporating necessary modifications.

3.4.3 Construct validity

In literature scholars have viewed *Construct validity* in various ways (Cook and Campbell, 1979; Hedrick et al., 1993; Marshall & Rossman, 1999; Neuman, 2000; Robson, 1993; Sekaran, 1992; Trochim, 1999; Yin, 1994). Nevertheless, the central theme of all definitions is the same. It concerns with the validity of relationship between theoretical constructs, operationalization and conclusions to be drawn. It assesses how well the theories have been

[40] Transferability means results or findings of a research will be useful to others in similar situations, with similar research questions (Marshall & Rossman, 1999).

translated into actual measures to draw valid conclusions in the research study. In order to achieve construct validity it has been our earnest exertion to weave all the threads of research in a systematic way right from the very beginning. It begins with the arriving at the definition of industrialization, visualizing the process of industrialization from three different levels (country, industry and firm) in the context of developing countries, building the rationale of the government intervention, and defining industrial policy/ its various elements (technology, investment, education & training, market development, and governance). Identification of the main policy measures and resources of the firms further operationalizes them. They are put in the form of policy measure-resource matrix to analyse the impact of various policy measures on the performance of the industry through different resources. In order to do so various mechanisms and indicators are identified to examine these impacts for each cell of the policy-resource matrix. This operationalization of theoretical constructs lead us to conclusion for policy options for development of sustained development of CNC Machine Tools industry in the context of continued liberalization of Indian economy. In view of the above our research design has achieved construct validity to a reasonable degree.

3.4.4 Reliability

The last criterion is the criteria of *reliability*.[41] In literature reliability has been referred as dependability or consistency. A measure is said to be reliable if it produces the same result over and over (Cook & Campbell, 1979; Marshall & Rossman, 1999; Neuman, 2000; Sekaran, 1992) or in other words, *replication of both results and method.* It may be noted that for judging our research we need to apply some caution. Such positivist notion of reliability may not be applicable in this case due to continuous changes in political, social and economic situation any two settings can never be the same. It assumes an unchanging universe where inquiry could, quite logically, be replicated. Moreover, positivist notion of reliability has been based on the notion of true score theory and for qualitative data there is no appropriate mechanism for estimating the true score (Marshall & Rossman, 1999; Neuman, 2000; Sekaran, 1992; Trochim, 1999; Yin, 1994). Therefore, we *do not claim the positivist notion of reliability* i.e. *replication of both the results and method*. However, we claim *replication of the method* only i.e. other researchers could replicate the method of conducting the research albeit with suitable modifications. In our case *reliability* could be referred as the *degree to which the method of analysis could be replicated to other contexts or settings*. In order to facilitate replication we have included certain elements of *case study protocol*[42] (Yin, 1994) viz. overview of the case study, field procedures, and case study questions etc. as a part of the research design. It is supplemented by keeping extensive notes for various design decisions and all collected data in well-organized retrievable form for further inspection or analysis by another researcher. These actions impart sufficient reliability to our research design.

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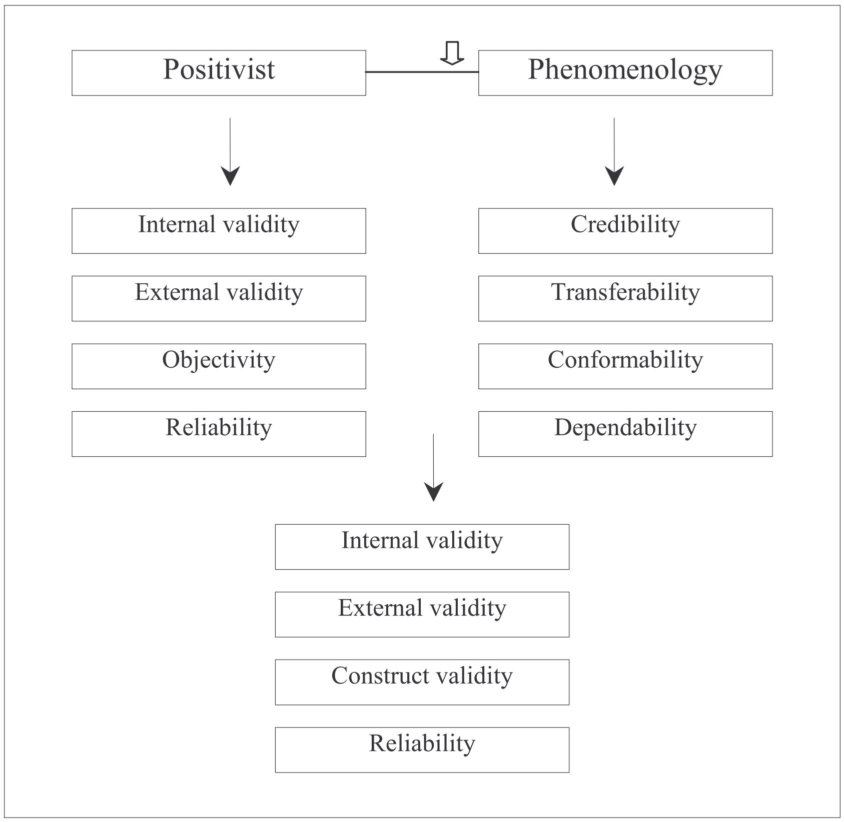
[41] Reliability: The consistency of a measuring instrument. A measure is reliable to the degree that it supplies consistent results (Marshall & Rossman, 1999; Neuman, 2000; Sekaran, 1992).

[42] A *case study protocol* refers to instruments, procedures and general rules that should be followed for data collection during a case study. It includes overview of the case study, field procedures, case study questions and guide for the case study report (Yin, 1994).

In sum, it may be concluded that the research design has achieved a reasonable degree of internal validity, construct validity and reliability. As regards to external validity our claim is limited, which is logical for this type of policy-oriented research.

Figure 3.11: Taxonomy of Validity Constructs for Research Design



3.5 Conclusions

This chapter describes the overall research methodology. It consists of four sections: research plan, operationalization, data & procedures and validity of the research design.

The research plan (section 3.1) presents the research process and research design. A cursory look on various groupings of the method of research indicates that the different approaches in the research process cannot meet. It may be misleading. In real world research there should always a practice of adjustment. The concepts/ techniques from one camp need to be blended together with another camp for imparting better credibility to the findings. Nevertheless, the degree of blending may vary based on the nature of the social phenomenon to be explored and the research question to be answered. Hence we view these groupings *as two extremes on the same continuum rather than as 'either-or' dichotomous constructs. We consider this as the bottom line* of our research process and research design. Following the above dictum, we consider this research to be an applied policy-oriented research *having a leaning towards* phenomenology (*philosophical position),* exploratory *(purpose of research),* empirico-inductive *(research approach),* qualitative *(research method*), focused synthesis and case study *(methods of data collection) and* qualitative *(analyses of data).*

The process of *operationalization* (section 3.2) translates the abstract construct that has been developed through theoretical perspective into an operating reality to draw valid conclusions. It has three elements: operationalization of the key constructs, analysis of linkage between policy and performance and a general framework of operationalization. In literature there has been overwhelming stress on macroeconomic aspects of industrial behavior and broad measures of industrial performance vis-à-vis the role of government policy. But the analyses of the mechanism of influence of policies on performance of the firms have been given scant attention. This study proposes to fill in this void by explaining the *policy- resource - performance causation* in a simple but comprehensive way. In order to achieve this two key constructs are introduced: mechanisms and indicators. *Mechanisms* are actions undertaken by the firms to achieve better performance under the policy regime in vogue. Indicators are the measure for judging the outcome of adoption of those mechanisms. They may also be understood as *intermediate performance measures*.

They are further operationalized through formation of 5x5 policy–resource matrix (Table 3.3), identification of mechanism and indicators for each cell of the 8x5 policy measure-resource matrix (Table 3.6), and analyses of impact of industrial policy on performance of the firms through various resources. In order to make the analysis more systematic, it is undertaken in two steps. First, analyze the influence of different policy measures on each resources of the industry i.e. column-wise analysis. It is further reconfigured row-wise (policy measure wise) to identify the new policy directions. These discussions are presented in chapter 6 to 11. They are the main analytical chapters of the study. Finally, the conclusions are drawn and agenda for the future research are presented in the concluding chapter (chapter 12) of the study.

The section on *data and procedures* (section 3.3) describes the data requirement, sampling plan, questionnaire, interview, variables and limitations of data collection. The data on macro- and industry level are to be collected from secondary sources and discussions with various stakeholders. But the data on *mechanisms and indicators* necessitates collection of primary data. A *non-probability, purposive, dimensional sampling* plan is adopted for selecting the firms from a population of 50 firms. A structured questionnaire was mailed to 45 firms manufacturing CNC Machine Tools in India. Out of these only 17 firms responded after great persuasion (*active response rate* 38 per cent). It was supplemented by interviews with CEO or corporate level executives of the firms. For reasons of confidentiality, the names of the firms and the persons responding to the questionnaire or participating in the interview are not disclosed.

In the last section the trustworthiness of the research design has been assessed (section 3.4). It is concluded that this research design has achieved a reasonable degree of internal-validity, construct-validity and reliability. However, as regards to external validity our claim is limited, which is logical for this type of policy-oriented research.

Table 3.6: Policy – Mechanism – Indicator - Resource Matrix

RESOURCE>	R&D&E		Manufacturing		Human		Market		Linkages	
Policy Measure	Mechanism	Indicator	Mechanism	Indicator	Mechanism	Indicator	Mechanism	Indicator	Mechanism	Indicator
1. Foreign Collaboration (FC) policy *(Adaptation/ Absorption)*	-Transplanting Product concept & design -Adaptation of product & process -Improvement of product & process -Continuous interaction with the Collaborator	-No of products introduced in market based on last FC -R&D intensity -No of QSE - Use of modern technology (e.g. CAD)	-Introduction of flexible mfg. -Use of modern mfg. techniques (JIT, TQM etc.) -Benchmarking against the collaborator	-Investment in flexible mfg. - Degree of Product/ Volume/ flexibility -ISO9000 certification	-Training by the Collaborator in India and abroad -Hiring foreign experts -Hiring new skills -Training employees	-No of QSE - Skill intensity -Industrial relations -Labour productivity	-Buy-back arrangement -Cooperation with Collaborator for Export marketing -Acting as agents for other models in domestic/ regional mkt.	-% of Buy-back -Export intensity -Brand image	-Interaction with the Govt. in respect of FC application -Information on Tech. & its source -Participation in Technology Buyer-seller meet -Forming Consortium for common-use tech. imports or hiring foreign experts	-Time taken for clearance of FC -No of Tech. Buyer-seller meet -No of Technology import as Consortium - No of cases of import of tech. import and hiring foreign experts
2. Promotion of in-house R&D policy *(Assimilation/ Improvement)*	-New Product Development -Thrust on assimilation of technology -Continued up gradation of technology	-No of products developed based on own R&D -R&D intensity -No of QSE	-Introduction of flexible mfg. -Use of modern mfg. techniques (JIT, TQM etc.) -Benchmarking against the collaborator	-Investment in flexible mfg. - Degree of Product/ Volume/ flexibility -ISO9000 certification	-Creating Vision & Mission -Hiring new skills and training existing one -Stimulation of entrepreneurship -Implementation of MCS & MIS	-No of QSE - Skill intensity -Industrial relations -Labour productivity -Degree of cross functional coordination	-Coordination with suppliers -Interaction of R&D staff with buyers -Cross-functional coordination	-Marketing intensity -Degree of Knowledge of customer needs -Degree of cross-functional coordination	Participation in: -Industry-institute linkage programs -Joint R&D programs -Technology consultancy services -Interaction with different stakeholder	Quantum of participation in: *Industry-Institution linkage *Joint R&D programs *Industry-User linkage
3. Industrial Licensing Policy and FDI Policy *(Dismantling entry barriers)*	-Development of prod. strategy -Thrust on assimilation of technology -Customer driven product development -Continued up gradation of technology	-No of products introduced in market - R&D intensity -Av. Gestation period	-New investments/ modernization -Outsourcing/ sub-contracting	-Investment in plant & machinery -CNC MT mfg. capacity -Breadth of product-line -Plant efficiency -ISO-9000 certification	-Identification of business opportunities -Creating cross-functional teams -Hiring new skills/ training existing one	-No of QSE -Skill intensity -Degree of cross-functional coordination	-Acting as agents for other models in domestic/ regional mkt.	-Export performance -Impact on Brand image	-Interaction with the Govt. in respect of IL/ other applications - Collect information on Technology & its source -Participation in Technology Buyer-seller meet	-Time taken for clearance of Il -No of Buyer-seller meet –Availability of Project implementation facilitation service
4. Import Licensing and Tariff structure Policy *(Inducing Modernization)*	-Development of Product strategy -Thrust on assimilation of technology -Improvement of product & process -Continued up gradation of technology	-No of products introduced in market - R&D intensity -Av. Gestation period	-New investments/ modernization -Importing material inputs	-No. of products introduced in the market -Investment in plant & machinery - Capacity to mfg. CNC MT -Breadth of product-line -Plant efficiency -ISO-9000 certification	-Identification of strategic business opportunities -Selecting and training cross-functional development team -Hiring new skills and training existing one	-No of QSE -Skill intensity -Degree of cross-functional coordination	-Acting as agents for other models in domestic/ regional mkt.	-Export performance -Impact on Brand image	-Interaction with the Govt. for processing of import license applications -Interaction with the Govt./ Industry Association for import related matters	-Time taken for clearance of applications - Quantum of programs attended about awareness of Trade and Tariff related matters (WTO etc.)

RESOURCE >	R&D&E		Manufacturing		Human		Market		Linkages	
Policy Measure	**Mechanism**	**Indicator**	**Mechanism**	**Indicator**	**Mechanism**	**Indicator**	**Mechanism**	**Indicator**	**Mechanism**	**Indicator**
5. Education & Training policy *(Building Human capital)*	-Recruiting skilled R&D personnel -In-house training -Periodic training	-No of products introduced in mkt. -No of QSE - Skill intensity	-Recruiting skilled personnel -In-house training -Periodic training -Use of modern mfg. techniques (JIT, TQM etc.)	-Skill intensity -Plant productivity -Labour productivity	-Recruiting skilled personnel -In-plant training -Periodic training	-Skill intensity -Turnover rate of employee -Industrial relations	-Recruiting skilled marketing personnel -In-house training -Periodic training	-Marketing research intensity -Interaction with users -Brand image -Customer service	-Interaction with the Govt. Institutions -Organising Industry specific education & training program -Forming consortium for the above -Agreement on non-poaching of employee	-Quantum of interaction with the Govt. and other bodies -Quantum of participation/ organizing in Industry specific education and training program
6. Domestic Market development policy *(Creating domestic demand)*	-Developing as per the customer needs: simple m/c for SMEs and complex m/c for sophisticated user -Providing total soln. (concept to after-sales) -Interaction with the users -Continuous upgrading of technology	-No of products introduced in mkt. -R&D intensity -Knowledge of customer needs	-Manufacturing reliable m/c -Manufacturing tooled up m/c	-Plant productivity -Labour productivity -Skill intensity	-Recruiting skilled personnel -In-plant training -Periodic training	-No of employee in Marketing dept. -Marketing skill intensity	-Interaction with the users -Creating awareness for use of CNC MT -Participation in Industry/ Trade fairs -Forming consortium -Use of e-commerce	-No of products introduced -Marketing intensity -No of sales & after-sales outfits -Brand image in domestic market	*Participating in:* -*Industry-User linkage:* Awareness program for 'use CNC'; 'buy INDIAN', and 'buy NEW' m/c -*Industry-Institution linkage* -*Forming consortiums* for domestic marketing; Financing & Leasing	Quantum of participation in: -*Industry-User linkage* -*Industry-Institution linkage* - *Consortiums*
7. Export Market Development policy *(Promoting exports)*	-Developing machines as per export demand -Interaction with foreign buyers -Continuous up gradation of technology -Thrust on safety and aesthetics features	-No of products introduced in mkt. -Knowledge of customer needs -R&D intensity	-Mfg. Quality and reliable m/cs -Introducing flexible mfg. -Thrust on safety and aesthetics features	-Plant productivity -Labour productivity -Skill intensity	-Recruiting skilled personnel -In-plant training -Periodic training	-No of employee in Marketing dept. -Marketing skill intensity	-Participation in International Trade fairs -Forming consortium for Export Marketing - Use of e-commerce	-Marketing intensity -No of sales & after-sales outfits abroad -Brand image in export market	Participating in: -*Industry-User linkage:* Awareness program for 'buy INDIAN', -*Industry-Institution linkage* -Forming *consortiums* for export marketing; Financing & Leasing	Quantum of participation in: -*Industry-User linkage* -*Industry-Institution linkage* -*Consortiums*
8. Policy on Industrial Governance *(Stimulating linkages)*	-Thrust on product & process development -Participating in joint R&D programs -Consortium approach for import of common use technology and foreign experts	-No of products introduced in market -Lead time -R&D intensity -Investment in CAD etc.	-New investments -Modernize and improve productivity -Thrust on quality and delivery schedule-	Quantum of New investments -Modernization efforts by existing firms	-Employing Industry-specific QSEs -Imparting need based training to existing staff -Inter-firm coordination	- Skill intensity -Industrial relations -labour productivity	-Interaction with the users -Creating awareness for use of CNC MT -Participation in Industry/ Trade fairs -Forming consortium -Use of e-commerce	-No of products introduced -Marketing intensity -No of sales & after-sales outfits -Brand image in domestic market	-Liaison with the Government depts./ institutions -Creating linkage with support institutions -Forming networks - Forming consortium	Quantum of: - Liaison with GI - Linkages with GSI - Linkages with suppliers - Linkages with other firms

POLICY AND INDUSTRIAL DEVELOPMENT

This chapter sketches the evolution of policy framework for the process of industrialization in India and analyzes the impact of various policy measures on the growth performance of the industry sector. The discussion has been divided into three sections. It begins with a historical background regarding the importance of industrialization for economic development, and the dominant issues identified thereof. The second section analyses performance of the industrial sector vis-à-vis policy measures in the two distinct phases of policy framework: pre-liberalisation (1947-1991) and post-liberalisation (1991 onwards) phases. The concluding section summarizes the findings.

4.1 Background

4.1.1 Evolution

The origin of importance of industrialization for economic development and involvement of the government with economic activity in Indian policy planning could be traced back in the writings of Dadabhoy Nowroji, M. G. Ranade, and G. V. Joshi etc. during the initial period of freedom struggle in the late nineteenth century and the early twentieth century (Marathe, 1986; Rosen, 1988). The '*swadeshi*' movement i.e. movement to encourage the purchase of Indian made goods in 1920s echoed the importance of industrialization and policy of self-reliance. It became pivotal of Indian policy framework after the independence. Subsequently in 1934, Sir M. Visveswaraya, a distinguished engineer-administrator, in his book 'Planned Economy for India'[43] stressed that India could prosper only through industrialization, which ought to be organized, planned and worked for (Marathe, 1986; Srinivasan, 2000). In 1938, the National Planning committee of the Indian National Congress[44] under the chairmanship of Pundit Jawaharlal Nehru, the first Prime Minister of India, took a view that industrialization was the key for solving the problems of poverty, unemployment, national defense and economic regeneration of the country. The committee had representation from all walks of the society: industrialists, academics, financiers, trade unions and even village industries associations that suggest that the decision had concurrence of all the stakeholders.

In the early 1940s some of the plans suggested by private sector and labour unions in 1940s namely the '*Bombay plan'* of industrialists[45] and *'People's plan'* of the Indian Federation of Labour also emphasized the same notion. These plans advocated active government intervention for rapid industrialization of the country. It is evident from writings in the Bombay Plan, *".... No economic development of the kind proposed by us would be possible*

[43] The book was based on the proposition that the country would require a blueprint for action in the way an engineer needs the drawing to implement his project (Marathe, 1986).

[44] It was the major political party during the freedom struggle. It also ruled the country for almost four decades after the independence in 1947.

[45] It included leading industrialists of that era such as J. R. D. Tata, G. D. Birla and Lala Sri Ram etc. (Marathe, 1986). Their empires are still the leading industrial houses of the country.

except on the central directing authority . . . An enlargement of the positive and preventive functions of the State is essential to any large-scale economic planning" (as quoted in Marathe, 1986: 15). In Dhar's (1988) words, '*they were more impressed by Friedrich List and Alexander Hamilton than by Adam Smith'*. Moreover, the policies of the British government in 1930s and particularly during the Second World War also supported the same. The success of the erstwhile Soviet Union in its industrialization efforts with command planning system also influenced the thoughts of the nationalist leadership (Dhar, 1988; Marathe, 1986; Rosen, 1988; Srinivasan, 2000).

The contemporary intellectual thoughts were also in favour of the above notions. The detoriating of terms of trade of primary commodity in the post-war period had given impetus to structuralist and pro-industrial model that stressed on the benefits of industrialization (Heeks, 1996). It was being adopted in various developing countries across the world during that time. In general, the policy makers were under the impression that underdevelopment was the result of deficiency of capital, which needs to be redressed by the government by promoting capital formation and allocating it according to priorities. The Harrod-Domar model, which postulates economic growth as a function of savings/ investment rate and of capital to output ratio (productivity of capital)[46] was considered to be relevant for developing countries. It laid emphasis on capital formation as the key element of economic growth. The concepts of "Big push" and "Balanced growth theory" on the line of thinking of Arthur Lewis, Nurkse, Rosenstein-Rodan and Scitovsky had gained wide acceptability during that time (Ahluwalia 1985, 1991; Dhar, 1988; Ghosh, 1992).

In respect of implementation of policy also, the Indian bureaucracy, particularly the Indian Administrative Service, which was nurtured in the British colonial rule, found itself more comfortable with the policy of regulation and control rather than promotion and development. It felt confident in dealing with the economic future of the country although it had little experience and expertise for the same (Dhar, 1988; Mohan & Aggarwal, 1990; Rosen, 1992). It is also observed that there was a broad consensus among all stakeholders regarding the process of industrialization and active role of the Government in the process as a means of achieving sustained development even before the independence.

4.1.2 Dominant issues

After the independence the political leadership were concerned with both political and economic development of the country. The political goal was national unity & identity whereas the economic goal was rapid structural transformation from a backward agrarian economy to a modern industrial economy. Some of the dominant issues recognized at that time for economic development in general and the process of industrialization in particular were (Ahluwalia 1985; Chandrasekhar, 1994; Dhar, 1988; Joshi & Little, 1994; Kaplinsky, 1997; Mookherjee, 1995; Rosen, 1992):

- The dependence on the market forces may not be desirable so the government should take the major responsibility for the development,

- The objective of self-reliance could be achieved through an import substitution strategy,
- The rapid accumulation of capital could be achieved through increased investments and savings,
- The development of heavy and basic industries is crucial for long-term growth,
- The role of foreign capital and foreign technology should be restricted to build domestic technological capability,
- Private capital always has the tendency to move towards monopoly, thus the government should regulate the growth of monopoly to prevent concentration of economic power,
- In a capital scarce and labour abundant economy, generation of employment and entrepreneurship could be achieved through thrust on development of small-scale sector as well as dispersion of industries in backward & rural areas.

These coupled with the success of the planning approach in achieving rapid industrialization in the erstwhile Soviet Union led the creation of one of the most regulated economy outside the communist world. India adopted socialist pattern of society as the objective of social/ economic policy and pursued planned economy approach in a framework of *'mixed economy'* with an increasing role for the public sector and a government-regulated private sector. In the following section we will see how these issues mirrored in the policy framework.

4.2 Policy framework

4.2.1 Overview

The policy framework as regards to industrial development in the country was first formalized in the policy statement of 1945, reinforced in the Industrial Policy Resolution (IPR) 1948 and finalized in the IPR 1956. The IPR 1948 had set the broad outline for industrial growth and development. It segmented industries according to end use of their outputs (capital goods, intermediate goods and consumer goods); ownership (public, private, cooperative and joint) and size (large & medium scale, small-scale, village & cottage). Moreover industries were prioritized about their development exclusively in public sector, private sector or open to both public and private sector. It was believed that by controlling the course of development of industries in public or private sector will perpetuate allocation of resources in socially desirable directions (Ahluwalia, 1985, 1991; Bowonder, 1998; Marathe, 1986; Srinivasan, 2000). The Industries (Development and Regulation) Act, 1951 commonly known as I (D&R) Act provided the legislative framework for the same. It was mainly concerned with entry and expansion of firms and therefore become instrumental in providing protection from domestic competition. The classification of industry in respect of public- or private sector was made more explicit in the IPR 1956.[47] Subsequent changes were introduced through the IPR 1973, Industrial policy Statement 1980 and Statement on Industrial Policy 1991.

[46] Ironically, for policy purpose it (productivity of capital) was treated as given and emphases were more on rate of investments only (Ahluwalia, 1991; Bhagwati, 1993).

[47] It classified industries into three broad groups. The first group: *Schedule A* listed 17 key industries that were to be reserved for exclusive development in public sector. However, the existing private sector was allowed to operate. *Schedule B* included twelve industries. It included mostly intermediate goods. They were intended to be progressively under public sector, nevertheless the existing private sector were also allowed to exist and expand.

The 1991 policy introduced sweeping reforms and liberalization. The reforms were sweeping in its scope because it disowned the economic philosophy of self-reliance that guided the process of industrialization into an inward oriented, public sector driven industrialization for more than four decades and took steps towards integration of Indian economy with the global economy. Moreover it shifted the driving force of resource allocation in favour of the market particularly in the situation when India was facing serious macroeconomic and balance of payments crisis in 1990-91 (Ahluwalia & Little, 1998; Kaplinsky, 1997; Mookherjee, 1995; Srinivasan, 2000). Accordingly we will refer the period 1991 onwards as post-liberalization era and the period before 1991 i.e. 1947-91 as pre-liberalization era. Initially we propose to present a glimpse of the policy framework in respect of various dimensions of industrial policy as identified in our theoretical perspective i.e. technology, investment, education & training, market development and governance. The detailed account will be presented in the various analytical chapters (i.e. ch. 6-10). It may be mentioned that the policy framework has predominantly concentrated on Investment and Technology dimension. There has been less emphasis on market development, education & training and governance per se. Therefore in our discussion also, the investment and technology dimension will attract more attention compared to others. In order to present a synoptic view we will discuss policy framework for both the eras simultaneously for each of the aforesaid dimensions.

4.2.2 Technology Policy

The two major components of Technology policy are policy regarding *import of technology* (commonly known as *Foreign Collaboration or FC policy*); and policy for *promotion of in-house R&D*. In the policy framework, FC policy is considered usually along with policy of foreign investment. However, the thrust has been more on import of technology rather than import of capital. But unfortunately, this too was quite restrictive. Each case used to be scrutinized individually. Limits were imposed for payment of lump sum fee and royalty payment for transfer of technology irrespective of its age and sophistication. Royalty rates and period of foreign collaboration were usually restricted to 5% and five years. Besides, imports of technology for the same product from different sources were discouraged to avoid duplication and to conserve foreign exchange, which usually resulted in creation monopoly situation. In the post-liberalization era the *FC policy* has also been completely liberalized. Like FDI applications, now the RBI gives majority of approvals through automatic route. All technology collaboration agreements subject to the lump sum payments not exceeding $2 Million; royalty payment up to 5% for domestic sales and 8% for exports; the period for payment of royalty not exceeding 7 years from the date of commencement of commercial production, or 10 years from the date of agreement, whichever is earlier are covered under automatic route. Only those case, which are not falling under the purview of automatic route are dealt with the Government of India expeditiously within a stipulated time frame.

As regards to encouraging innovation in industrial sector, major policy initiatives were Scientific Policy Resolution, 1958; Indian Patent Act, 1970; Technology Policy Statement, 1983 and R&D Cess Act, 1985 (Mani, 2001). Thrust was given on creation of technology infrastructure in the form of scientific & industrial research institutes and industrial in-house

All remaining industries mostly consumer goods were put in the third group. They were open to both private and public sector (Bowonder, 1998; Marathe, 1986). *Machine Tool* was placed in *Schedule B*.

R&D centers for speedy acquisition and assimilation of technology.[48] In 1971, the government established the National Committee on Science and Technology (NCST) to formulate comprehensive S&T plans on sustainable basis. Based on its recommendation, in 1973 a scheme for the recognition of in-house R&D units was introduced to encourage firms to pursue in-house R&D to successfully adapt and assimilate imported technology, introduce new products and processes, and develop import substitutes (DST, 1999). It provided various fiscal and non-fiscal incentives. The government reiterated its commitment to promote domestic technological capability through announcement of another policy document in the form and style of Technology Policy Statement (TPS), 1983. It stated, "*there shall be a commitment to ensure an adequate scale of investment in R&D for the absorption, adaptation and, wherever possible, improvement on and generation of new technology*." Further, to inculcate technological entrepreneurship in the country, the government launched Venture Capital Fund (VCF). The R&D Cess Act 1986 was introduced to generate funds for the same. It empowered the government to levy cess at the rate of 5% on all payments made for imports of technology from abroad.

In the post-liberalization period, some of the important policy documents announced are CSIR 2001 Vision & Strategy, 1996; Venture Capital Funds Regulation, 1996; amendment of Indian Patents Act 1999; TIFAC 'Vision 2020' and New Millennium Indian Technology Leadership 2000. The ninth FYP, 1997 elaborates in detail the plan for thrust on building technological capability. The overall approach seems to be creating enabling environment for R&D in terms of improving technology infrastructure, enhancing industry-institution linkages, development of science & technology manpower and providing fiscal incentives for encouraging in-house R&D. However, a common problem with all these documents is the lack of specificity for plan and strategy for building in-house industrial R&D and therefore implementation is not to the desired level. The total expenditure on R&D as percentage of GNP has been quite low less than 1% of GNP. Still most of the research expenditure is borne by the government. The share of private sector is increasing albeit slowly. It was almost nil in 1950-51. It gradually increased to 10.4% in 1970-71, 13.8% in 1990-91 at current prices (DS&T, 2000). In the present liberalized scenario there is no compulsion of undertaking R&D for import substitution as the non-financial conditionality on FC as well as import policy have been relaxed considerably. Now the driving force for in-house R&D is need for survival in the competitive market to face competition from imported products as well as domestic firms. The main instruments for inducing in-house R&D are provision of adequate institutional support and fiscal and non-fiscal incentives.

4.2.3 Investment Policy

The *investment policy* during the pre-liberalisation era primarily hovered around regulation on entry and expansion and regulations on imports. *Industrial licensing* and *FDI policy* has been the main instruments for regulating entry and expansion of firms. It was believed that in a resource-scarce economy like India, there is a need to direct investments in particular sector or

[48] As on date more than 40 government research institutes (CSIR labs) and about 1200 recognized in-house industrial R&D centers are functional in India (DS&T, 2000).

industry for translating the priorities and targets set in the plans into concrete capacities in the economy (Ahluwalia, 1985; Bowonder, 1998; Joshi & Little, 1994; Marathe, 1986). The I (D&R) Act of 1951 stated that any enterprise that intends to manufacture an item or introduce a new article or to alter output mixes or plans substantial expansion of its existing capacity must obtain a permission in the form of a license or registration from the relevant government authorities. Licensing was also used to reserve the production of certain items either for small scale or public sector; to prevent entry of large firms for taking up manufacture of certain items; conservation of scarce inputs; conservation of foreign exchange and geographical dispersal of firms.[49]

The second major Act, which necessitated further licensing and permission requirements for larger firms, was the Monopoly and Restrictive Trade Practices (MRTP) Act of 1969 to limit monopolistic tendencies in the private sector. A firm or a group of related firms with gross assets worth more than Rs 200 million (Rs 1,000 million since April 1985)[50] or a 'dominant undertaking' (controlling more than one third of the market till 1982 and one fourth of the market since then) with assets of the value not less than Rs 10 million came under the ambit of this Act. Firms attracting the provision of this Act need to take additional permission from the government (i.e. Department of Company Affairs, GoI) for setting up of new unit, or new article of substantial expansion in addition to adhering to regular licensing procedures under the I (D&R) Act of 1951.

The third major policy was reservation of items for exclusive production in the small-scale sector.[51] The Industrial Policy Resolution of 1956 envisaged explicit support for small firms for industrial decentralization and increased employment. The rationales extended were the inherent characteristics of small firms such as high labour-intensity, low capital requirement, seedbed for entrepreneurial talent, ease of industrial dispersion in rural/backward areas, operational flexibility, utilization of local human & material resources and potential for rural industrialization etc. (Ahluwalia, 1985,1991; Desai, 1988; Gang, 1995; Rosen, 1988). This has been reiterated in the Industrial Policy resolution of 1977 and subsequent statements. The thrust on development of small-scale sector vis-à-vis heavy industries could be gauged by Mahalanobis views as quoted in Ahluwalia (1991):

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[49] Two types of firms were exempted from industrial licensing procedure: SSEs and medium scale firms having investment in fixed assets below Rs 50 million provided their annual requirement of import of raw material and components does not exceed 15% of ex-factory value of the output or Rs 4 million, whichever is less and do not attract other conditions of industrial licensing.

Initially the limit was just Rs 0.1 million. It progressively increased to Rs 1 million in 1960, Rs 30 million in 1978, Rs 50 million in 1982 and Rs 150 million in 1988. These firms need to register with the Directorate General of Technical development (DGTD), Govt. of India. Thus they were commonly known as DGTD units.

[50] Rs 200 million = approx. $27 million @ $1 = Rs 7.50 in 1969 and
Rs 1,000 million = approx. $81 million @ $1 = Rs 12.37 in 1985.

[51] The definition of small scale was based on the original value of investment in plant & machinery rather than employment or any other criteria. The investment limit has undergone changes over the years from Rs 0.5 million in 1950 to Rs 10 million in 1999. It was first increased to Rs 0.75 million (1966), Rs 1 million (1975), Rs 2 million (1980), Rs 3.5 million (1985), Rs 6 million (1991) and to Rs 30 million in December 1997. However, it has been reduced as per the wishes of the industry in 1999 to Rs 10 million (DCSSI, 1999).

"*The long-term aim would be to use as quickly as possible the most technologically advanced machinery for the production of both investment and consumer goods. This is not immediately possible because of the lack of a sufficiently broad base of heavy industries. It is therefore necessary, to plan for a transition phase, in which preference would be given to capital-light and labour-intensive, small-scale and household industries to create as much employment as possible in the immediate future and, at the same time, to release capital resources for the heavy industries*."

A medium or large-scale unit has to get an industrial license to manufacture items reserved for small-scale sector. Usually it was not approved. In certain cases it used to be approved if the firm guaranteed to undertake 50% export obligation. However, those medium and large-scale firms who had been manufacturing reserved items prior to date of reservation or those small-scale firms who grew due to natural growth could continue to do so with the capacity pegged at the existing level after obtaining carry-on-business (COB) license, which was nothing but a kind of industrial license. As such Small-scale sector has been exempt from licensing procedure. But they have to get themselves registered with the provincial government, which is no less, cumbersome.

The interplay of these policies resulted in development of a three-tired industrial structure: the public sector, the medium & large scale private sector and small-scale sector on the one hand; and pervasive protection from competition within the segment and between the segments on the other. The emphasis on the role of public sector resulted in development of public sector. In Ahluwalia's (1991) words, *"it was believed that given the degree of underdevelopment, industrial take-off must be actively steered by the state*". All the basic and key industries were reserved for public sector. Such reservation made the public sector aloof from competition against private sector. Moreover, the Government entered into production of intermediate goods and consumer goods. In the process the Government became the major producer of industrial goods and services. As on date it dominates the basic goods and capital goods manufacturing. It has a virtual monopoly in rail, air transport, electricity and telecommunication services etc. It also manufactures wide range of intermediate goods and consumer goods such as automobiles, textiles, electrical & electronic consumer items, soaps, and white goods etc. Similarly, the thrust on development of small-scale sector saw development of wide-based small-scale sector. Moreover, the reservation policy restricted medium & large firms to enter into that segment and thus protected it from competition.

The policy of industrial licensing restricted entry, expansion and diversification as well as choice of location for individual firms. Moreover, requirement of additional clearances for large houses under MRTP Act and foreign-owned firms under FERA Act restricted the growth of large firms and foreign-owned firms and thus imparted additional protection to non-MRTP or non-FERA firms. They are also protected from competition from small-scale firms, as they do not want to grow otherwise they would loose various fiscal & non-fiscal incentives provided to them. Ahluwalia (1985:158) rightly remarks, *"... the most serious economic consequences of the industrial licensing system has been its contribution towards creating barriers to entry into individual industries. The fundamental economic insight that it is the possibility of entry into the industry, which makes for competition has eluded the policy makers."* It also prevented from achieving economies of scale due to restriction on capacity as well as economies of scope due to restriction on diversification. It in turn affected productive efficiency and induced technological backwardness. On the other side of the coin, firms also lobbied with bureaucracy and politicians to circumvent this policy to prevent the entry of potential entrants. It perpetuated pervasive corruption and rent seeking attitude (Ahluwalia, 1991; Bhagawati, 1993; Rosen, 1992, Srinivasan, 2000).

As regards to *foreign investment (FDI)*, the Industrial Policy Resolution of 1948 first elaborated the policy for the same. Although it took note of the importance of foreign investment, it was conspicuous about competition from more powerful and resourceful foreign firms. Thus it laid stress on Indian majority ownership and effective control. But in the absence of enactment of any legislation thereafter, the policy of foreign investment was governed for quite some time by the policy statement tabled in the Parliament by Mr. Nehru in April 1949. It was more liberal than IPR of 1948. It promised to give 'national treatment' to existing and future foreign investments, liberty of remittance of profits, fair compensation to firms 'compulsorily acquired' in the national interest, majority foreign holding for a limited period and permission for hiring of foreign experts. Nevertheless, it also gave emphasis on majority ownership by Indians, training to Indian personnel & technicians and approval on case-to-case basis (Bhagwati & Desai, 1970; Marathe, 1986).

The first act concerning FDI, although indirect, was enacted as Foreign Exchange Regulation Act (FERA) in 1973. It is interesting to note that till date there is no specific Act governing FDI in India. The FERA, 1973 indirectly dealt with FDI and payment for purchase of technology and know-how. It laid down quite restrictive guidelines for foreign equity participation, which was pegged at 40% for most of the cases.[52] The objective was to ensure majority ownership and effective control of firms in the hands of Indian. The implementation of policy was even more restrictive. Each application used to be scrutinized thoroughly in terms of foreign exchange outgo, equity participation, dividend balancing and repatriation of profits etc. The process was so cumbersome and time consuming that foreign investors quite often moved to another country for investment. Such actions reduced the inflow of investment considerably, particularly with higher level of equity participation in the seventies and eighties. Weiss (1988) mentions that the stock of foreign investment in manufacturing in fact reduced from $1261 million in the early seventies to $1238 million in the late seventies. The restriction on foreign ownership, which limits the ability to exercise strategic & managerial control, was considered to be the main deterrent for the inflow of FDI. It proliferated in inadequate access to contemporary world technology for product, process and management and export market. However, during the 1980s there was considerable relaxation in terms of cap on equity, scope and operations of FERA companies, and facilities for Non-resident Indians (NRI) etc. Nevertheless the basic tenets had remained the same. Thus FDI inflow was quite stagnant till 1991.The data on FDI/ FC approvals reveals that during the seventies only 386 applications worth Rs 0.50 billion were approved and in the eighties the corresponding figures were 1929 and Rs 12.8 billion respectively (Table 4.9).

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[52] There were certain exceptions such as export oriented units (EOU) and firms using sophisticated technology were permitted to have foreign equity up to 74%. Firms established in export processing zones (EPZ) exporting 100% of their output were allowed up to 100% equity.

The sweeping reforms undertaken in 1991 substantially dismantled the regulations on entry and expansion, announced measures facilitating foreign investment and technology transfers, and threw open most of the areas hitherto reserved for the public sector. Now the requirement of obtaining an industrial license for manufacturing activity is limited to only six industries of strategic, social or environmental concern.[53] A number of areas that had earlier been reserved for public sector, such as defense, steel, telecom, and oil refining, have now been open to the private sector. Now only two industries: railway transport and atomic energy are reserved for the pubic sector. The list of items reserved for development in small-scale sector has also been pruned considerably. The industrial undertakings exempt from obtaining an industrial license are required to file an Industrial Entrepreneur Memoranda (IEM), which is a post-scrutiny measure rather than pre-scrutiny one. This is complete departure from the earlier norm. Now firms are free to choose capacity, technology and location as per their business decisions. Moreover, the MRTP Act, 1973 and FERA Act have been scrapped. Thus no prior permission is required any more for manufacturing new item or expanding existing capacity by the erstwhile MRTP or FERA firms. The *foreign investment policy* has also turned a full circle from regulation to promotion, with most of the regulatory measures withdrawn. Now FDI is considered as vehicle for injecting the desired level of technological dynamism in Indian industry. Unlike earlier years, majority of approvals are given through automatic route under delegated powers exercised by the Reserve Bank of India (RBI). Only those cases, which are not falling under the purview of automatic route, are to be dealt with the Government of India. These are dealt expeditiously within a stipulated time frame of sixty days only. In this way the regulations on entry and expansion have been virtually abolished.

The other major policy that provided protection to domestic industry was *regulations on trade*. Its basic objectives were to provide protection from foreign competition and to conserve scarce foreign exchange.[54] Marathe (1986) notes that the tone was set in the National Planning Committee of 1938 under the chairmanship of Jawaharlal Nehru, which viewed that: *"The objective for the country as a whole was the attainment, as far as possible of national self-sufficiency. International trade was certainly not excluded, but we were anxious to avoid being drawn into the whirl-pool of economic imperialism."* The regulations on trade were mainly implemented through the Imports and Exports (Control) Act of 1947 and Import Trade Control Order of 1955 that brought all imports under the ambit of QR i.e. the need of import license.[55] Moreover, it was allowed on 'actual user (AU)' basis only, which prohibited imports by third party for stock & sale. The underlying idea of AU condition was to restrict imports to the actual users of the items and to prevent profit making by intermediaries (Bhagawati & Desai 1970; Bhagwati & Srinivasan, 1975; Joshi & Little, 1994). The import-licensing regime was

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[53] Electronic Aerospace & defense equipment; Industrial explosives; Hazardous chemicals; Drugs & Pharmaceuticals; Distillation and brewing of alcoholic drinks; Cigarettes & other tobacco products.

[54] As regards to conservation of foreign exchange, the Foreign Exchange Regulation Act (FERA) of 1947 was enacted, which was later replaced by a more cumbersome FERA in 1973. However, after liberalization a more pragmatic Foreign Exchange Management Act (FEMA) has replaced it.

[55] Imports were segmented into four categories: prohibited or banned; restricted (requires import license and includes majority of items), canalized (imports through designated public sector agencies) and OGL (open general license i.e. import license not required but subject to AU condition and tariff).

quite cumbersome and non-transparent. For each application the AU had to obtain '*indigenous clearance*'[56] i.e. non-availability of similar items from domestic manufacturers from DGTD, which invariably used to ignore the aspects like quality, cost and delivery schedule as well as '*essentiality certificate'* from respective sponsoring authority that the items sought are essentially required for production by the applicant firm.

In addition to the above regulations the domestic industry was also heavily protected through imposition of tariff and non-tariff barriers on imports under the Customs Act, 1962 and Customs Tariff Act, 1975. The tariff rates were quite high before 1991, the peak tariff rates being over 300 per cent (Debroy, 1998; Panagariya, 1999). Moreover its structure and calculation were quite discretionary and non-transparent. Usually tariff on an item comprised off basic duty, countervailing duty, and additional duty. [57] All of them had different basis of calculation. It was very difficult to assess the actual amount of protection (i.e. effective rates of protection) for different industries. As a matter of fact the entire process of imports right from the application to actual arrival of the product used to be a nightmare. In sum it may be said that, the objective of self-reliance was pursued through elaborate restriction on imports by way of quantitative restrictions supplemented by a high tariff regime and complex foreign exchange regulation act.

In the post-liberalization era there has been drastic deregulation. The new policy framework has removed most quantitative restrictions on imports, relaxed exchange controls on foreign trade, and made significant reductions in the tariffs levels on all items (from 125% to 40%). Now there has been no licensing requirement for import of Capital Goods and other industrial inputs. The Actual user (AU) condition for imports has been abolished. The procedures of '*indigenous clearance'* and '*essentiality certificate'* have been withdrawn. Firms can freely import as per their requirement. There has been a long-term plan for bringing down the high import tariffs to make them comparable with global levels, in compliance with the WTO obligations. The peak customs duty has been progressively reduced from 150% in 1991 to 30% in 2002. The Rupee has been made fully convertible on current account transactions and steps are being initiated to make it convertible on capital account as well. In order to impart stability to the policy regime five-year import-export policy are being announced.

4.2.4 Education and Training (E&T) Policy

In the policy framework, Education and Training in India is considered as a social policy that basically acts at the macro level. After independence in 1947, the first prime Minister of India Pandit Nehru, who had strong belief in importance of scientific and technical education for

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[56] The firms were required to advertise in the relevant trade journal indicating all necessary details of the item regarding intention to apply for license. In case of any response from He had to approach the domestic manufacturers to get a no-objection certificate stating that they are not able to supply the item, then only his application used to be considered otherwise rejected.

[57] *Basic duty*: This is the basic duty levied under the Customs Act. The rate varies for different items.

Countervailing Duty (CVD)**:** This additional duty is equal to excise duty levied on a like product manufactured in India. Such duty is leviable on the value of goods plus basic custom duty payable.

Additional Duty: to compensate duty on inputs used by Indian manufacturers to counter balance excise duty leviable to raw materials, components and other inputs similar to those used in the production of such good.

sustained development, gave special emphasis for creating scientific training and research infrastructure (Eisemon, 1984). As a result there are about 550 engineering & technical colleges, 600 management institutions, 1100 polytechnics and 4500 industrial training institutes in the country now (DoE, 2002). It offers education and training in a wide variety of trades and disciplines at certificate, diploma, degree, postgraduate degree and doctoral levels in institutions located throughout the country catering to the various levels of knowledge, skills and competences required by the economy.

Although the government spends 3.2% of its GNP on education annually (World Bank, 2000) and so many institutes have been established, there is lack of thrust in creation of manpower related to industries. It is contrary to the general perception that India has abundant skilled manpower.[58] The involvement of the government is more at a *functional level* that provides more generalist skills. The extensive E&T system generates scientists, engineers, and technicians but without adequate industrial exposure and practical knowledge. There is perceptible lack of linkage between education, training and employability of a person. The system produces primarily educated persons that need to be trained afterwards. Although the government recognizes the gap and took initiative by enacting Indian Apprentices Act, 1961 and establishing the National Vocational Training system (NVTS). But the system primarily caters to need of the firms at skilled worker (e.g. machinist) level only. In general, the thrust of system is on skill creation before employment vis-à-vis skill development after the employment. There is virtually no policy for incentives to employee or the employers to emphasize on skill development of employees. Besides, there is lack of private sector participation or public-private partnership both in education- and training system. Moreover there are no perceptible differences in the policy framework between pre-liberalization and post-liberalisation era, unlike the other dimensions like investment and technology.

4.2.5 Market Development Policy

First of all, the policy framework on market development could be disaggregated in terms of *domestic*- and *export market* as they address different issues although interrelated. We will discuss both one by one. Second, they appeared in both *explicit* and *implicit* form. As regards to the domestic market, some of the explicit policies are: purchase- and price preferences in the public procurement or multilateral aided projects; lease financing/ hire-purchase scheme for purchase of machinery; scheme for technology upgradation that includes modernization of plant & equipment; various marketing assistance programs for the small-scale enterprises (SSEs) and recently launched cluster development program. However, it is worth mentioning the implicit form of policy that has been instrumental in market development, particularly in the pre-liberalisation period. The first and the foremost was the policy of import substitution. It

[58] It could be gauged from low rate of enrolments for vocational training, density of scientists & engineers involved in R&D and ratio of scientists to engineers. An international comparison reveals that the vocational training enrolment as percentage of population is only 0.09% compared to Korea 1.72%, Hungary 3.13% and Spain 3.31% (Najmabadi & Lall, 1995). Similarly the number of Scientists and engineers in R &D per million populations is also quite low. It is just 149 as against 454 in China; 2,193 in Korea and 4,909 in Japan (World Bank, 2000). The ratio of engineers (manpower for industries) to scientists (manpower for basic science), the former lags behind. It is rather worsening overtime from 0.63% in 1985 to 0.49% in 1996 (Mani, 2001).

induced firms to use locally available raw material, components and machinery and hence developed domestic market for the same. The condition for progressively increased localization of raw material/ components required in the case of FDI or FC agreements was another measure. Thus the protection at the level of production i.e. protection against imports and at the level of technological learning i.e. protection against a strong foreign presence and excessive imports of technology, provided the two basic measures for the development of domestic market. However, the prolonged protection induced complacency and created a high cost industrial structure leading to technological backwardness and lack of international competitiveness. In the post-liberalisation period, withdrawal of these policy measures has induced competition in the market, which in turn is acting as a market development measure.

The export market development policy has always been mentioned explicitly in policy pronouncements of the government. Nevertheless, there has been an implicit impact also. In the pre-liberalisation era, the policy of import substitution and self-reliance generated pessimistic approach to exports. But, the government did realize the importance of exports for its endeavor for the process of industrialization and took steps for promotion of exports through various cost-neutralisation- and developmental measures. It had two objectives: first to provide compensation for disincentives implicit in the adopted import substitution (IS) policy and to provide incentives for product and market development (Kathuria, 1995; Nayyar, 1988). It comprised of systems of duty drawback, cash compensatory support (CCS), duty free imports of industrial inputs against exports, import replenishment licenses (REP), interest subsidy on export credit and fiscal concession on exports etc. In the post-liberalization era export policy has been receiving prominent status in the policy framework to encourage rapid and sustained growth of exports and integration with the global economy. The cost-neutralisation measures provide monetary benefits primarily to compensate the cost disadvantage suffered by the domestic firms vis-à-vis the imports where as the developmental measures have more promotional connotation. The cost-neutralisation measures include exemption/ refund on indirect taxes on imported inputs, exemption on corporate taxes, special import license (SIL), and provision of deemed exports etc. The developmental measures cover status certificate, market development assistance (MDA); export promotion capital goods scheme (EPCG), and establishment of export processing zone (EPZ) or special economic zone (SEZ) etc.

4.2.6 Policy on Industrial Governance

As mentioned in our earlier discussions, industrial governance primarily concerns with aspects like formulation and implementation of policies, building institutions and improved flow of information among various stakeholders. In this way it helps in mitigating the various sources of government failure. After the independence the government sincerely made efforts to build institutions in most of the functional areas such as policy making (Planning commission, and various ministries), technology (series of national laboratories and research institutions), finance (both at central and regional level), education and training (Universities, colleges and institutes) and marketing (Trading corporation and Marketing board). There has been positive outcome of these developmental efforts but their performance were not up to the mark. But the complex and complicated system of regulation and control were marred with administrative delays, lack of coordination among different agencies, duplication of work, system of ad hoc decisions, inflexibility and lack of information. Bhagawati and Desai (1970) aptly puts it, as "Ad hocism at the top and corruption at the bottom might have been an apt description of the state that administrative machinery . . . was to reach eventually . . .". They failed to achieve the goals due to lack of required linkage between the government, institutions and industry.

In the post-liberalization period there has been marked improvement in all the three elements of governance compared to the earlier era. Due to the abolition of the most of the regulatory and control measures such as industrial licensing, import licensing, and regulation on FDI/FC etc. the whole system has become more transparent. One can see less administrative delays and ad hoc policy decisions. But a lot more is needed at the provincial and local administration level. There have been some improvements in involvement of industry associations and chambers of commerce and therefore the linkage between the government and industry has improved considerably. Nevertheless there is still lack of adequate linkages among various stakeholders. Moreover there is a need for improving accountability, reducing the element of discretion, infusing transparency, minimizing response time and implanting the system of self-regulation etc. in the existing institutional framework so that the various sources of the government failure could be redressed effectively.

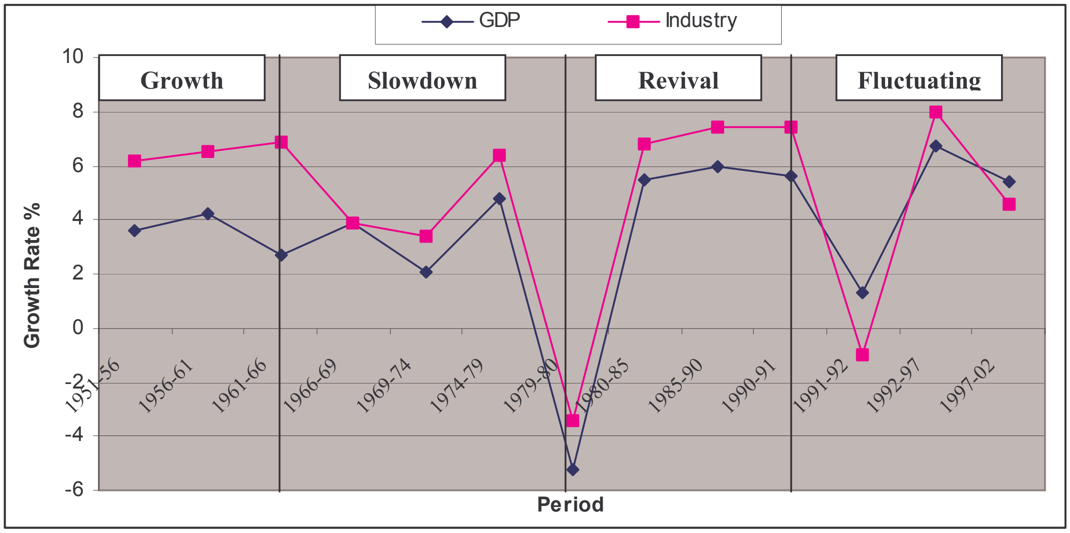
4.3 Growth performance

The growth performance of the industrial sector could be broadly gauged from annual average growth rate of real value added in industrial sector and real GDP. Figure 4.1 and Table 4.1 presents the same in respect of various Five Year Plans (FYP) and annual plans in chronological order. It may be seen that during the first three FYPs periods i.e. 1951-66 industry experienced reasonably good growth rate and it was higher than growth of overall output. It even excelled the target growth rate in the first FYP (1951-56). But the period during 1966-80 saw stagnation or even decline sometimes. However, it recovered to some extent during the first half of eighties (the fifth FYP) and attained a reasonable level in the second half (the seventh FYP). In the early nineties i.e. in 1991-92 it dipped again. But during the eight FYP, it again exceeded the target growth rate but subsequently lost its vigor in the ninth FYP. In view of the above the growth performance could be segmented into four periods: 1951-66, 1966-80, 1980-91 and 1991 onwards.[59] The four phases as identified may be named as: *growth phase: 1951-66*; *slowdown or decline phase*: *1966-80; revival phase: 1980-91* and *Fluctuating phase*: *1991 onwards*. The first three phases are in pre-liberalization era, while the last one is in the post-liberalization era. The annual average growth rates for all these periods are also shown in Table 4.1. In the following section we will discuss each of the phases.

[59] Period 1951-66 indicates financial years of 19**51**-52 to 1955-**56**. All other periods also follow the same practice.

Figure 4.1: **Annual av. Growth rate of Real GDP and Industry**

(*at 1993-94 prices* in **%**)



Source: Based on Economic Survey 2002-03 and RBI (2001).

Table 4.1: Annual av. Growth rate of real GDP, Industry & GDCF

(*at 1993-94 prices* in %)

	Period	**GDP**		**Industry**		
		Target	**Actual**	**Target**	**Actual**	**GDCF**
First FYP	1951-56	2.1	3.6	7.0	6.2	10.4
Second FYP	1956-61	4.5	4.2	10.5	6.5	7.1
Third FYP	1961-66	5.6	2.7	11.0	6.9	7.5
Annual plans	1966-69		3.9	-	3.9	-1.7
Fourth FYP	1969-74	5.7	2.1	12.0	3.4	7.3
Fifth FYP	1974-79	4.4	4.8	8.0	6.4	6.9
Annual plan	1979-80		-5.2	-	-3.4	-11.6
Sixth FYP	1980-85	5.2	5.5	8.0	6.8	4.0
Seventh FYP	1985-90	5.0	6.0	8.7	7.4	9.0
Annual Plan	1990-91		5.6	-	7.4	13.7
Annual Plan	1991-92		1.3	-	-1.0	-12.3
Eight FYP	1992-97	5.6	6.7	7.0	8.0	9.6
Ninth FYP	1997-02	6.5	5.4	7.0	4.6	7.1
Tenth FYP	2002-07	8.0	-	10.0	-	
Growth phase	1951-66		3.8		6.5	8.3
Stagnation phase	1966-80		3.4		4.1	3.9
Revival phase	1980-90		5.9		7.1	6.5
Fluctuating phase	1992-02		6.1		6.3	8.7

Source: Based on Planning Commission (2002) and RBI (2001).

4.3.1 Pre-liberalisation era

4.3.1.1 *Growth phase***: 1951-66**

The initial results of the policy-induced process of industrialization were definitely positive. It is evident from rapid increase in share of industry in respect of output and labour, higher growth rate of industrial production and investments as well as increased diversification in industrial structure. The share of industry in gross output increased rapidly from 13.6% in 1951-52 to 20.2% in 1965-66. The increase was rapid during the first fifteen years 1951-66 but it slowed down thereafter. Similarly, the share of employment in the industrial sector also increased from 10.7% in 1951 to 11.6% in 1971 and 13.9% in 1981, albeit with a slower pace (Table 4.2). The increase in share of industrial sectors in gross output and employment confirms our proposition, that industrialization at the national level may be seen as the shift from agriculture to industry with respect to output and labour.

Table: 4.2 Composition of GDP *(at 1993-94 prices)* and Distribution of Employment (%)

Year	GDP			Employment*		
	Agriculture	**Industry**	**Services**	Agriculture	**Industry**	**Services**
1951-52	58.9	13.6	27.6	72.1	10.7	17.2
1965-66	47.2	20.2	32.6			
1970-71	48.1	19.9	32.0	72.1	11.6	16.3
1980-81	41.8	21.6	36.6	67.1	13.9	19.0
1990-91	34.9	24.5	40.6	63.5	16.5	20.0
1995-96	30.6	25.5	43.9			
1999-00	27.5	24.6	47.9	60.4#	17.6	22.0

*Employment figures are as on 1 April of the year; #: for 1997.
Source: Planning Commission (2000)

Industry also experienced rapid diversification in the industrial base due to adoption of import substituting strategy and emphasis on heavy industries during this period. At the time of independence there were only a few cotton textile mills, jute mills, sugar mills, steel plants, engineering workshops and assembly plants.[60] Within a span of 15 years a well-diversified manufacturing sector developed. The emphasis on heavy industries resulted in establishment of basic goods industries such as steel, fertilizer, and cement etc.; capital goods industries like electrical machinery, machine tools, transportation equipment, railway coaches etc.; and intermediate goods industries e.g. petroleum refineries, chemicals and pharmaceuticals, nylon & viscose filament yarns etc. as revealed from the data on the weights of use-based sectors in the index of industrial production (Table 4.3) and their average annual growth rates (Table 4.4). Simultaneously the consumer good industries such as textile, sugar, tea, and cigarettes etc. also developed but their growth was rather slow vis-à-vis other industries. Nevertheless, these developments underlines our proposition regarding process of industrialization at the *industry level* i.e. occurrence of structural shifts within manufacturing sector by way of moving up the ladder from labour-intensive to capital & technology intensive products.

[60] Cotton textile mills contributed 46% of value added and 44.4% of industrial employment; and Jute textile mills contributed 17.5% of value added and 22.2% of industrial employment (Bhagawati & Desai, 1970).

The underlying driving force behind the growth during this period was sustained emphasis on investment. The first FYP (1951-56) was primarily based on Harrod-Domar model, which emphasized the role of savings and hence investment. The second FYP (1956-61) was modeled on Mahalanobis model that provided the analytical foundation for the planning for industrialization in India. It proposed that a higher allocation of investment into the investment goods sector would mean a higher investment rate at the margin and a greater rate of growth of output. Accordingly, ample investment in heavy industries, took place from mid-fifties particularly in the public sector, as it was believed that the dependence on market force may not be desirable and private sector may not be willing or able to invest in such capital-intensive industries with long gestation period (Ahluwalia, 1985, 1991; Bhagawati & Desai, 1970; Srinivasan, 2000). The massive investment done in such a way, no doubt culminated in industrial growth but non-availability of adequate financial resource perpetuated macroeconomic and balance of payments crisis subsequently. This in turn resulted in slowdown in the next fifteen years (1966-80).

Table 4.3: Diversification within the Industrial sector based on Use-based classification **(%)**

	1956	1960	1970	1980	1990	2000
Basic goods	22.3	25.1	32.3	33.2	39.4	35.6
Intermediate goods	24.6	25.9	20.9	21.3	20.5	26.5
Capital goods	4.7	11.8	15.2	15.0	16.4	9.3
Consumer Goods	48.4	37.2	31.5	30.5	23.7	28.7
Consumer Durables	-	5.7	3.4	3.8	2.6	5.4
Consumer Non-durables	-	31.6	28.1	26.6	21.1	23.3
Total	100	100	100	100	100	100

Source: Ahluwalia (1991) and RBI (2001).

4.3.1.2 *Slowdown phase*: **1966-80**

The macroeconomic imbalance saw the deceleration of both growth and employment in general and the industry sector in particular. During 1966-69 the gross output grew by just 2.2% and it hovered around this figure till early eighties. The performance of industrial sector was no better. Initially it was 2% (1966-69) only that improved slightly during fourth (1969-74) and fifth FYP (1974-79) to 4.7 and 5.7% respectively, but dipped down to negative figure of –1.4% in 1979-80 (Table 4.1). Consequently the growth of share of industry in overall output and employment stagnated during this period (Table 4.2). There was considerable slowdown in growth across the board in different industrial sectors. Major slowdown vis-à-vis the initial phase was in Capital Goods (from 16.2% to 3.1%) and Consumer Durable Goods industries (from 16.2% to 6.5%) as revealed from Table 4.4.

The slowdown was due to combination of factors both exogenous and endogenous. The exogenous factors were: unexpected foreign exchange crisis in late 1950s, which prolonged during sixties and seventies as well; the war with China in 1962; the two wars with Pakistan in 1965 & 1971 and subsequent reduction in foreign aid; severe drought conditions between 1965 and 1967; and the oil crisis in 1973 and 1979. Moreover, the prevailing political situation induced Mrs. Indira Gandhi, the then Prime Minister, under the influence of left-radicals to initiate populist policies of increased government interventions such as nationalization of banking & insurance sector, coal industry and taking over of private sick manufacturing units, particularly in textile industry etc. Such factors increased pressure on domestic resources considerably (Joshi & Little, 1994; Rosen, 1992). These combined with ideological reasons as stated earlier pushed India towards more regulations & controls in all areas through industrial licensing, monopoly control, import licensing, foreign exchange control and draconian rules on foreign investment and transfer of technology culminating to stringent import-substituting industrialization strategy. Its consequences were low rate of industrial growth, low productivity and lack of international competitiveness.

Table 4.4: Annual average Growth rates of Industrial sectors: 1951-2001 (%)

	1951-66	1966-80	1980-91	1992-97	1997-01
Basic Goods	8.8	6.0	7.9	6.8	4.5
Intermediate Goods	6.5	3.5	5.9	8.5	6.9
Capital Goods	**16.2**	**3.1**	**11.5**	**8.9**	**6.8**
Consumer Goods	5.0	3.5	6.7	6.6	5.4
Cons. Durables	16.2	6.5	13.9	3.4	10.5
Cons. Non-durables	3.8	3.2	5.5	4.8	3.8

Source: Desai (1981) and RBI (2001).

The endogenous factors were the concern for raising the levels of savings and investment in the economy based on Harrod-Domar and Mahabalonis models rather on efficient utilization of resources, which resulted in lower productivity and efficiency (Ahluwalia, 1991; Bhagawati, 1993; Kaplinsky, 1997; Mookherjee, 1995) as well as continued reliance on import-substitution strategy. The results of studies on Incremental Capital-Output ratio (ICOR) for the overall economy by Drabu (1992) and Total Factor Productivity Growth (TFPG) for manufacturing sector by Ahluwalia (1985, 1991) and other researchers empirically substantiate the above notion. The ICOR is commonly measured as the ratio of rate of investment to output growth rates. It implies that the lower the ICOR the better is the productivity of investment. It is a summary expression for the existing technical conditions and structural configuration of the economy that captures the relationship between investment and additional productive capacity. The ICOR in 1964-65 was 8.4; 6.4 in 1970-71; 6.9 in 1974-75; and 5.0 in 1979-80. It was on higher side compared to other industrializing countries in Asia such as Korea (3.89), Thailand (3.48), Malaysia (3.55), Indonesia (2.70) and Philippines (4.57) during 1974-80 (Drabu, 1992; Mookherjee, 1995). It indicated declining efficiency in the use of scarce capital resources. However, it may be mentioned that ICOR ignores the contributions of other factors of production such as labour and technology. Moreover, it assumes no lag between investment and setting up of additional capacity and full capacity utilization that seldom happen in reality. A more versatile measure is the concept of Total Factor Productivity (TFP), which reflects their contribution as well. It captures the residual factors responsible for growth of output over and above the growth of input factors such as labour and capital. The residual factors are attributed to technological changes due to use of better technology, in terms of technology of product, process and management (Ahluwalia 1991; Trivedi et al., 2000). Ahluwalia's study reveals that TFPG for overall manufacturing in India declined at the average rate of 0.2% per year during 1959-79. The only consolation was increase in TFPG for non-electrical- and electrical machinery sector at the rate of 0.6% and 1.2% respectively due to special emphasis given on capital goods sector during that period.[61] An international comparison also reveals that India's TFPG was lagging behind other industrializing developing countries during sixties and seventies in general and Korea, which was industrializing rapidly during that period, in particular (Table 4.5).[62]

Table 4.5: Total Factor Productivity growth (TFPG) in Manufacturing

Country	Period	Overall	Non-electrical machinery
India[#]	1959-79	-0.2	0.6
	1980-88	2.8	-
India	1970-89*	0.5	
	1973-98[$]	3.7	3.8
China	1957-83	-0.4	-
Thailand	1963-77	1.5	1.2
Korea	1970-75	5.3	5.7
	1980-85	5.1	
	1966-90	1.7	-
Taiwan	1970-80	0.1	-
	1980-90	2.8	-
	1966-90	2.1	-

#: Ahluwalia (1991); *: Balakrishnan & Puspangadan (1994); $: Trivedi (2000)
Source: Based on Ahluwalia (1991); Kaplinsky (1997) and Trivedi (2000).

The continued stagnation vis-à-vis success of newly industrializing countries of East Asia forced the political leaderships and bureaucrats to recognize the fact that the complex and restrictive framework adopted so far was leading towards low growth, stagnation, lack of productivity, inefficient allocation of resources and lack of international competitiveness. Thus, in the second half of the seventies number of studies such as Alexander (1978), Dagli (1979), Tandon (1980), and Pande (1980) etc. were initiated by the government to review different aspects of industrial and trade policies (Ahluwalia, 1991, Marathe, 1986). These recommendations along with other political factors became instrumental for reorientation of policies in the early eighties, which gave somewhat positive results.

4.3.1.3 *Revival phase*: **1980-90**

The performance during this period was positive and encouraging, particularly when we compare with the previous phase of slowdown. Table 4.1 suggests that the industrial growth rate increased to 5.9% during 1980-85 and 8.5% in 1985-90. Notably, the increase was in the manufacturing sector. Within manufacturing, the Capital Goods and consumer durables had higher growth (Table 4.4). The results were also encouraging in respect of productivity. Ahluwalia (1991) study shows that the TFPG increased to 2.8 during this period (Table 4.5). In

[61] Subsequently Balakrishnan & Pushpangadan (1994), Goldar (2000) and Trivedi (2000) etc. have arrived at different figures. The difference primarily arises due to variations in calculation methods for real value added (single- and double deflection) and base year of price-index. In the case of former both nominal material inputs and nominal output are deflated by output price index only, while in the later respective price indices are taken into consideration. Therefore the double deflection method is considered to have better explanatory power.

[62] It is difficult to compare different studies on TFPG in different countries due to differences in methodologies and assumptions. Nevertheless it gives some broad indications (Kaplinsky, 1997; Marjit & Singh, 1995).

the export front also, the growth almost doubled from 3% during the earlier years to 5.9% and the share of manufactured goods increased from 56% to 73% in value terms (Table 4.6).

Table 4.6: Composition of Exports in 1960 to 2000 selected years (%)

Product	1960-61	1970-71	1980-81	1990-91	1995-96	2000-01
Agriculture & Allied products	44.2	31.7	30.1	19.4	19.9	13.5
Ores and Minerals	8.1	10.7	6.2	4.6	2.9	2.6
Manufactured goods	**45.3**	**50.3**	**55.8**	**72.9**	**75.4**	**78.0**
Crude and Petroleum products	1.1	0.9	0.4	2.9	1.7	4.2
Total exports ($ billion)	1.4	2.0	8.5	18.1	31.8	44.6

Source: Planning Commission (2002).

In the early 1980s when Mrs. Gandhi returned to power after a brief ouster of three years, she introduced the sixth FYP (1980-85) that emphasized the need for increased industrial productivity. The year 1982 was declared as '*National Productivity' year*. Considerable steps were taken to reduce the rigidity of the system of controls through introduction of scheme of broad banding of industries to provide flexibility in manufacturing to produce range of products; certain measures of liberalization in respect of industrial licensing and restriction on large industrial houses; thrust on new technological areas like electronics, computers & telecommunications etc. There was some liberalization for imports of Capital Goods as well. These measures also served the purpose of appeasing large industrial houses to increase her political as well as the IMF, with whom loan worth SDR 5 billion was negotiated. In order to appease SSEs, more fiscal incentives were offered and product reservation list expanded from 500 to over 800 without adequate economic rationality (Ahluwalia, 1985; Joshi & Little, 1994; Rosen, 1992). However, there was no change in the basic framework of control and in some respect it become more stringent even.

The reorientation of policies got more thrust during 1985-86 when Mr. Rajiv Gandhi came in power. He set the goal of entering the 21st century as economically strong technologically advanced country and therefore emphasized on efficiency and modernization. There were considerable efforts towards liberalization in respect of industrial regulations, import regulations, export promotion, exchange rate policy, financial liberalization and corporate taxation, etc. as well as thrust on new technological areas such as electronics, telecommunications, and biotechnology etc. But unfortunately due to lack of enough support within the own Congress party that preferred continuity with the socialist ideology of the past; pressure groups (e.g. large industrial houses and SSEs that feared increased competition); and bureaucracy, which did not like to give up the administrative control, the implementation was quite slow. Thus, it failed to take off properly (Mookherjee, 1995; Rosen, 1992).

Moreover, the better performance during this period did not come without any tag. It was accompanied with bad consequences of unsound macroeconomic policy pursued particularly on the fiscal front. By 1990, there was severe balance of payment problem, high inflation (over 10%), very high domestic debt (54.6% of GDP) & foreign debt ($64.4 billion) and cutoff of foreign commercial lending due to collapse of international confidence. The total debt-to-GNP ratio and debt-service ratio reached 24.5% 27% respectively, which was unprecedented. The change in political leadership in 1989 and subsequent political instability also made the situation worse. Moreover, the Gulf war in August 1990 worked as fuel in the fire (Ahluwalia & Little, 1998; Joshi & Little, 1994). In 1991-92, the growth of output was just 1.3%, while industrial growth rate and investment rate were negative to the tune of 1% and 12.3% respectively (Table 4.1).

4.3.2 Post-liberalization era

4.3.2.1 *Fluctuating phase*: **1991 onwards**

In order to bale out from severe macroeconomic crisis in 1990-91, the international financial institutions came forward but imposed conditionality for speedy reforms. As a consequence in July 24, 1991 a liberalized new industrial policy was announced under the leadership of Mr. Narasimha Rao as Prime Minister and since then there has been no turn around. It is rather deepening with the passage of time irrespective of changes in political leaderships. The economic philosophy of self-reliance that guided the process of industrialization into an inward oriented, public sector driven industrialization for more than four decades has been disowned and steps have been initiated for proper integration with the global economy. The reforms were sweeping in its scope because it has shifted the driving force of resource allocation in favour of the market rather than the government (Ahluwalia & Little, 1998; Forbes, 1999; Kaplinsky, 1997). On the overall, the policy framework has been moving away from Structuralist paradigm on the continuum of Structuralist-Neoclassical paradigm.

The initial response of liberalization had been reasonably well. But the overall results are *mixed and fluctuating*. The growth of output initially increased but it appears to be slowing down, nevertheless in general it is better than the pre-liberalisation era. Similarly the industrial growth rate during 1992-97 (Eight FYP) has been 8% that exceeded the target growth rate of 7% but came down to 4.6% during 1997-02 (Ninth FYP). The gross domestic capital formation (GDCF) is also showing similar trend. It has experienced much more fluctuations on year-to-year basis in the post-liberalisation era. It reached as high as 23% in 1994-95 but dipped to –0.8% in 1996-97 and 2.3% in 1998-99. However, it is again displaying an increasing trend as it attained 9.4% in 1999-00 (see Table 4.1). As a consequence the ICOR is also fluctuating. During 1992-97, it was 3.43, while in 1997-02 it increased to 4.53, which imply decline in efficiency of investment and capacity utilization. The tenth plan document suggests that at the end of the Ninth FYP the level of excess capacity in manufacturing sector was about 21% of actual production (Planning Commission, 2003). This will further reduce the role of investment as a component of aggregate demand.

The CG sector also performed better during the initial period i.e. 1992-97 compared to latter half as evident from the growth rates 8.9% and 6.8% respectively (see Table 4.4). The share of CG within the manufacturing sector also declined from 16.4% in 1990 to 9.3% in 2000. The impact of liberalization is somewhat more visible in respect of growth of exports and composition of manufactured exports. The annual average rate of growth during nineties was 11.3% as against 3% during the sixties & seventies and 5.9% during the eighties respectively. In 2000-01 India has been able to export 11% of its GDP, which was much on higher side than the pre-liberalization period of 4-6% only. The share of manufactured goods in overall export basket is increasing. It has reached to 78% in 2000 showing a marked increase from 1980 and

1990 figures of 56% and 73% respectively (Table 4.6). Moreover, the share of engineering goods and chemical & allied products increased from 16.3% & 8.9% in 1990-91 to 17.0% and 13.1% in 1999-00 respectively indicating gain in international competitiveness in value-added products (RBI, 2001). The share of Hi-Tech products in total manufactured exports has also increased from 4% in 1990 to 6.6% in 1997 (Mani, 2001).

The most significant impact of liberalization could be seen in increased flow of FDI and FC agreements. The liberalised policy environment has been instrumental in increasing the confidence of foreign investors thus FDI inflows have increased substantially (Table 4.7).

Table 4.7 Actual inflow of FDI (million $)

	Economy		Industry		Machine Tool Industry	
YEAR	**Value (Mill. $)**	**Annual Growth (%)**	**Value (Mill. $)**	**Annual Growth (%)**	**Value (Mill. $)**	**As % of Industry**
1991	109		109		0.13	0.12
1992	264	142.2	262	140.4	0.23	0.09
1993	608	130.3	566	116.0	0.27	0.05
1994	1090	79.3	1035	82.9	2.00	0.19
1995	2209	102.7	1745	68.6	2.00	0.11
1996	3023	36.8	2609	49.5	21.70	0.83
1997	4579	51.5	4107	57.4	10.30	0.25
1998	3377	-26.3	2326	-43.4	6.48	0.28
1999	4016	18.9	3200	37.6	2.38	0.07
2000	4498	12.0	3487	9.0	2.41	0.07
2001	4281	-4.8	3187	-8.6	3.04	0.10
Total	**28054**	**54.3**	**22633**	**50.9**	**50.94**	**0.23**

Note: Figures rounded off for easier readability.
Source: DIPP (2002)

During the last ten years (1991-2000) almost 12,000 FDI proposals worth Rs 2,405 billion have been approved (DIPP, 2002) as against just 2000 in the eighties and 386 proposals in the seventies (Debroy, 1998). The actual inflow of FDI has increased from mere $109 million in 1991 to $4.3 billion at an average annual growth rate of 54.3%. The corresponding increase in the industry sector has been from $109 million to 3.2 billion at an annual growth rate of about 51% (Table 4.7). However, the data suggests that the share of industry sector in overall FDI is decreasing (about 75% in 2001) compared to initial period of liberalisation (100% in 1991 and 90% in 1997). Similarly, there has been increasing trend towards more mergers and acquisitions (M&A) in place of fresh investments. The number of M&A by foreign firms has increased from virtually insignificant level to 297 in 1997 (Mani, 1998). India has still to go long way in order to attract substantial FDI in comparison to other industrializing countries. India could attract only $2.3 billion in 2000, whereas China got $38.4 billion, Brazil received $32.8 billion and Korea attracted $9.3 billion (World Development Report, 2003).[63] A recent study by McKinsey (2001) has anticipated that with the right policy framework and environment, India may be able to attract FDI over $43 billion during the next five years.

[63] Developed countries like USA, Germany and UK attracted FDI to the tune of $288, $189, and $134 billion respectively (World Development Report, 2003).

4.4 Summary and Conclusions

4.4.1 Summary

The genesis of the Industrial policy framework lies in the long drawn freedom struggle for independence from the British colonial rule. The core could be identified in the '*swadeshi*' i.e. buy-Indian goods movement in 1920s that echoed the importance of industrialization along with policy of self-reliance, which essentially meant adoption of import substitution strategy. After independence the policy framework reflected the same two virtues for more than four decades. It was in concurrence with the contemporary intellectual thinking and international developments. There was a broad consensus among all the stakeholders on this issue. Thus the planned economy approach in a framework of *'mixed economy*' with an increasing role of public sector and a government-regulated private sector was adopted to achieve the goal of self-reliance.

The initial result of the policy-induced process of industrialization was encouraging. There was rapid increase in the share of industry in the gross output and diversification in the industrial structure during the first three FYP periods i.e.1951-66. The underlying driving force behind the growth was emphasis on investment. But it could not be sustained any longer due to various exogenous and endogenous factors. There was considerable slowdown across the board during 1966-80. The lack of emphasis on efficient utilization of resources and continued reliance on import-substitution policy were the major endogenous factors for the slowdown. These factors combined with prevailing political situation and ideological stances pushed India towards a more stringent system of regulation and controls. During the late seventies it was recognized that development was not taking place as expected. Countries that started late and had less resource were going ahead due to their pragmatic policies while development in India was stagnating. Thus the decade of eighties experienced some winds of change. The emphasis on increased industrial efficiency and technology up gradation along with introduction of some measures of liberalization led to better performance vis-à-vis the earlier period. But, most of the policy changes were done on an ad hoc basis under the influence of various pressure groups. Thus by 1990, there was severe macroeconomic and BOP crisis. It is worth noting that the policy framework in the post-independence phase revolved around the basic idea of self-reliance and import substitution.

It was only in 1991 that a sweeping reform was undertaken, although at the behest of international development agencies to bale out India from acute BOP crisis. Nevertheless, the point to be recognized is that the new policy framework turned apart from the policy of '*self-reliance'* i.e. 'closed economy model' to *'integration with the global economy'* i.e. 'open economy model' and has never turned back from the same, as yet. It is gradually moving towards the neoclassical end on the Structuralist-Neoclassical continuum. The initial response of liberalization had been reasonably well. But the overall results are *mixed and fluctuating*. It is evident from the data in respect of overall growth, industrial growth, diversification, international trade, composition of export basket, and actual flow of FDI etc.

The various aspects of the policy framework, their characteristics and overall impact on performance in the two phases (pre-liberalisation and post-liberalisation) could be summarized as in the Table 4.8. The impact has been shown qualitatively in terms of positive and negative signs. In the case of mixed results, both positive and negative signs have been indicated.

Table 4.8: A comparative view of policy framework in the two phases

Sl No	Parameters	Pre-liberalisation (1947-91)	Impact	Post-liberalisation (1991 onwards)	Impact
1	**Policy Goal**	Self-reliance	+/-	Integration with the global economy	+
2	**Investment policy**	Regulatory	+/-	Promotional	+
i.	Industrial Licensing	High	-	Virtually abolished (Now 6 industries only)	+
ii.	Reservation for Public sector	Rigorous	+/-	Virtually abolished (Now 3 industries only)	+
iii.	MRTP & FERA	Highly restrictive	-	Abolished	+
iv.	Reservation for Small-scale sector	821 items reserved	-	Reservation still exists	-
v.	Foreign Direct Investment	Restrictive	-	Liberal & promotional	+
vi.	Regulation on Imports	Pervasive	-	Nominal	+
vii.	Import Licensing	Rigorous	-	Virtually abolished	+
viii	Tariff	Very high	-	Relatively low	+
3	**Technology policy**		-		+
i.	Foreign Technology import	Restrictive	-	Liberal & promotional	+
ii.	Promotion of In-house R&D	Adaptation	+/-	Assimilation & improvement	+/-
4	**Education & Training policy**	Nothing specific	+/-	Nothing specific	-
5	**Market Development policy**		-		+
i.	Domestic Market	Policy induced	-	Spontaneous	+
ii.	Export Market	Pessimistic	-	As a priority	+
6	**Governance**	Bureaucratic	-	Towards simplification & transparency	+

4.4.2 Conclusions

The tale of process of industrial development in India empirically corroborates the notion of linkage and interactiveness of policy and performance as mentioned in our methodology chapter section 3.2.1.2. It is established that policy influences performance and based on the performance reorientation of policy takes place. It is a different story, whether appropriate policies are framed and implemented in the right time and proper way. Policies are often made on adhoc basis and are heavily influenced by various domestic and international pressure groups. They create distortions and deviations. Thus policy falls short of the best choice in the existing circumstances for achieving national welfare. It is evident from the Indian evidence. The policy of self-reliance and import substitution after the independence was the outcome of prevailing situation at that time and the contemporary intellectual climate. The initial performance was somewhat positive. But the failure to change with the emerging realities and bowing down to various pressure groups pushed the performance in decline. When most of the developing countries attuned their policies as per the emerging realities of openness towards trade and investment, India continued to hang around policy of import substitution and the misplaced notion of self-reliance.

From the policy-making perspective, initially policies are formulated on the experimental basis. The policy framework during the first phase of growth resembles this situation. If it is successful, the policies are made more rigorous and implemented vigorously to achieve more success. However, the failure to change with emerging realities and recognition of the ill effects of earlier policy ends up with negative performance. This is what happened in the second phase. Then the search for realities begins and policies are reoriented. If the reorientation is limited to cosmetic changes, the disaster appears as happened in India in 1990. Such disasters lead to complete overhauling and sweeping reforms. The post-liberalization policy framework conforms to this situation. Here attention is drawn to the fact that the ensuing phase is again an experimental phase. The results are also similar to the first phase i.e. reasonable industrial growth and diversification in the initial years but decline in productivity. It suggests that for sustained development policy framework needs to be attuned to emerging realities and continuously reoriented.

Chapter Five

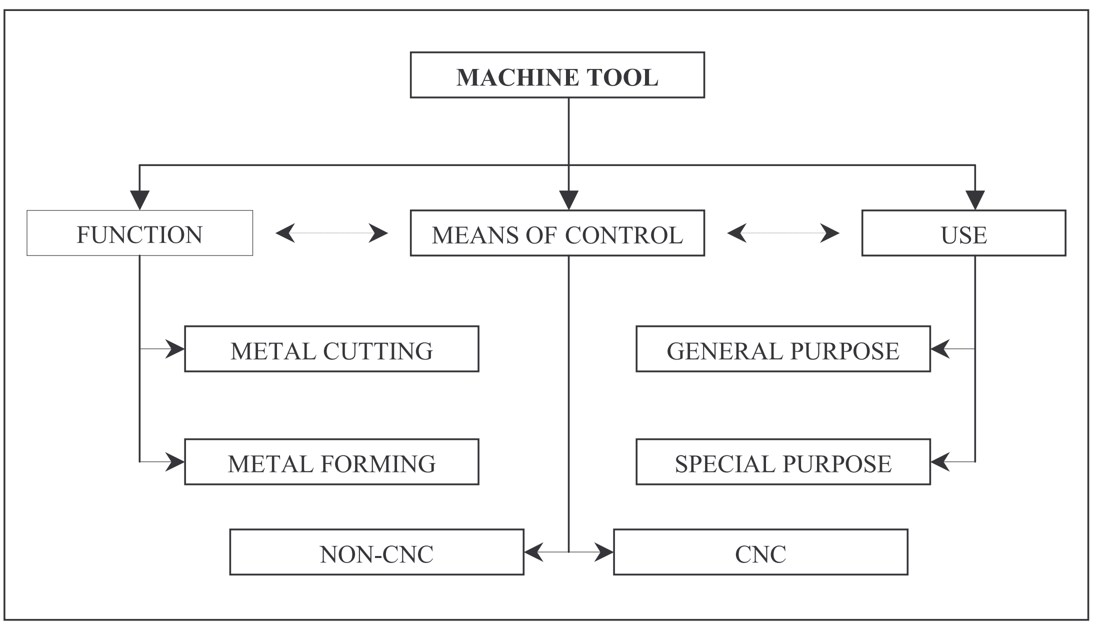
MACHINE TOOL INDUSTRY

In this chapter we describe machine tool industry. It begins with a brief introduction to machine tool followed by discussion on the evolution & structure of the world machine tool industry. The following section analyses structure and growth of Indian Machine Tool industry in general and CNC segment of the industry in particular vis-à-vis policies in vogue. It is supplemented with assessing Indian Machine Tool industry in the international perspective. The last section presents the conclusions.

5. 1 Machine Tool: An Introduction

A machine tool, a power driven mechanical device, changes the geometry of a metal workpiece by removing excess material *by* cutting, forming, physico-chemical processing or a combination of these techniques (Groover, 1987; Krar & Check, 1997). Some common machine tools are lathe, drilling machine, grinding machine, milling machine, machining center, press, and bending machine etc. Figure 5.1 depicts the classification[64] in terms of *function* (metal cutting, metal forming), *means of control* (conventional, numerical) or *use* (general purpose, special purpose).

Figure 5.1 Classification of Machine Tool



[64] As regards to industrial and trade classifications, Machine Tool is classified under serial no. D 2922 of the International Standard Industrial Classification (ISIC); serial no. 73 " Metal working machinery' in the Standard International Trade Classification (SITC) Revision 3 and serial 8456 to 8466 of International Harmonised Commodity Description and Coding system ITC (HS).

A metal cutting machine tool[65] shapes or surfaces a metal work piece by removing metal e.g. lathes, drills, milling m/c etc. These account for over 80% of the machine tools in use worldwide. *A metal forming machine tool* shapes metal without the use of a cutting tool either by pressing, forging, punching, shearing or bending etc. A *general purpose machine tool* (GPM) could machine a variety of different shapes, sizes and materials in any sequence either in batches or as one-off piece e.g. lathes, machining centers and grinders etc. Whereas a *special purpose machine tool* (SPM) can machine economically a specific work piece or a family of work pieces or perform a specific precision job. They are less flexible than the general-purpose machines due to their dedication.

A machine tool, which is essentially controlled by an operator, is known as *conventional machine tool*. Here a skilled machinist manually feeds control information e.g. speed, feed and depth of cut etc. to the machine; does the selection of tool based on his interpretation of the drawing and loads or unloads the tools and workpiece manually. When all these operations, which are done manually by operators in a conventional machine tool, are performed automatically with the help of electronic controls and computers, then such machine tool is often known as *computer numerical controlled (CNC) machine tool*. It uses a program of instructions that is electronically transmitted to the machine to regulate its operations. It saves time[66]; imparts accuracy, efficiency & flexibility to the process and lesser reliance on scarce skilled labour. For the ease of understanding we nomenclature conventional machine tool as non-CNC machine tool in our discussions. A metal cutting/ metal forming machine tool or a GPM/ SPM may be either conventional i.e. non-CNC or numerically controlled and therefore depicted through two-way arrow in Figure 5.1. These days CNC machine tools are increasingly being preferred worldwide due to the inherent advantages of computer numerical controls.

5.2 The World Machine Tool Industry

5.2.1 Overview

World wide the machine tool industry is a small part of national manufacturing sector, but widely regarded as an industry of strategic importance due to its major role in the improvement of overall industrial productivity through supplying embodied technology. In 1990, the year of the highest production in the history of machine tool, the world production was only $45.3 billion, whereas electronics industry in the same year figured as $445 billion and automobile industry output was more than $400 billion (American Machinist, 1993). In 2001 the world production was $36.2 billion only. The countries with long traditions of manufacturing

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[65] A metal-cutting machine tool, in the simplest way could be categorised by the relative motions of the workpiece and cutting tool. A lathe does the operation of turning. In turning the workpiece is rotated and the cutting tool remains stationary, producing the desired cylindrical shape. In drilling, the cutting tool is rotated while the workpiece remains stationary; the tool moves in a spiral, thereby cutting a hole in the workpiece. In milling, the workpiece is traversed by a rotating tool. Milling machine typically make the cuts on all flat-sided metal stock. In grinding, a rotating abrasive wheel removes metal. Grinders are used to remove small amounts of material after milling or so. In planing a stationary cutting tool is traversed by the workpiece, much as cheese is pulled along a grater (Groover, 1987; Holland, 1989).

[66] It mainly reduces the non-productive time in manufacturing, which is more than 75% of total time, through reduction in time taken for workpiece handling, set up of the job, tool change and operators delay. Its contribution is little in reducing in-process time relative to non-CNC machine tools (Groover, 1987; Buffa & Sarin, 1998).

machine tool namely the USA, Germany, Japan, Switzerland and Italy dominate the world market. Among the developing countries China, Korea, and Taiwan are the main.

5.2.2 Evolution

The roots of machine tool industry could be traced in the late 18th century (in 1774) when John Wilkinson- a British iron master, developed a new type of boring mill to bore cylinders for James Watt's improved steam engine. Since then many typical machine tool e.g. lathe, shaper, planer, boring-, drilling- and slotting machine were developed in the UK. The process of specialisation in its design and manufacture, and application to mass production in industries like firearms, sewing machine and bicycle etc. started in the 1840s in the USA where labour was comparatively scarce (Sciberras & Payne, 1985). By the beginning of the 20th century automobile industry became its major user. Since 1913, Ford's moving assembly line stimulated the demand for special purpose machine tool (SPMs). Automobile and armament industry continued to be the main driving force till 1940. During the World War II aircraft industry became the key driver for innovation in the industry and led to the introduction of numerical control (NC) machine tool in 1948 in the USA. Kearney and Trecker, USA was the first to introduce the first Machining Center[67] in 1958. The German and Japanese industry also emerged in the fifties. The USA was the undisputed market leader till the eighties. Then Japan took over the leadership with the introduction of low cost, standardized and reliable microprocessor based CNC machine tool in the eighties. The eighties also saw the emergence of developing countries mainly catering to the lower end needs of automobile and general engineering industries. In the nineties electronics and consumer goods industry became the main driving force for technological innovation (Arnold, 2001; Sciberras & Payne, 1985). The evolution of the industry is summarized in Table 5.1.

Table: 5.1 Evolution of Machine Tool Industry

Era	Country's position	Period	Main consumer industry
I	British dominance	Before 1840	Textile, Locomotive
		1840 - 1850	Firearms
II	American emergence	1850 - 1870	Sewing Machine, Firearms
		1870 - 1900	Bicycle (Ball bearing, Chain), Firearms
III	American dominance	1900 - 1940	Automobile, Defense
		1940 - 1950	Aircraft, Defense
IV	Japanese and German emergence	1950 onwards	Space, Aircraft, Automobile, Defense
V	Emergence of developing countries viz. Taiwan, Korea, and China etc.	1980 onwards	Automobile, General Engineering
VI	Japanese and German dominance	1990 onwards	Aerospace, Electronics, Consumer goods

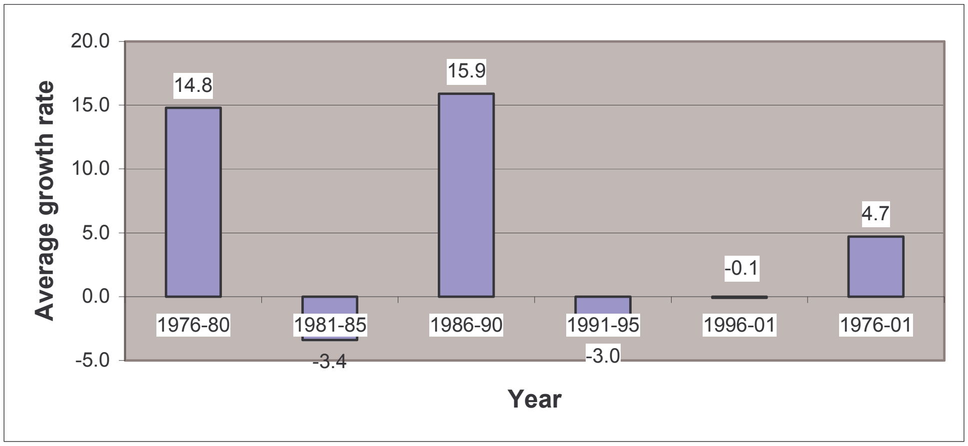
Source: Based on Sciberras & Payne (1985) and Rosenberg (1976).

[67] Machining Center undertakes several machining operations like drilling, milling, boring, tapping and facing etc. on a workpiece in one setup in the same machine under program control (Groover, 1987).

5.2.3 Production and Trade

World Machine Tool production has grown from $13.6 billion in 1976 to $36.2 billion in 2001 at an average annual growth rate of 4.7%. The growth has been more or less cyclical (Figure 5.2), as its demand is derived demand. It is the first industry to go into recession and the last to come out of it. Its production reached the peak of $45.3 billion in 1990. Then it declined continuously to $28.3 billion by 1993 due to recession in the world and disintegration of the former Soviet Union and other East European market since 1990. However, since 1993 there has been some improvement and production increased to $38.3 billion in 1996. In 2001 the world production stood at $36.2 billion, less by 1.5% from 2000.

Figure 5.2: Average annual growth rate of World Production 1976-2001 ***(%)***



Source: Based on Alcorta (1998) and Gardner Publication various issues.

In 2001, the industrialised countries accounted for almost 84% of the world output. As a group, the CECIMO[68] – the west European consortium of machine tool industry is the largest, producing 49% ($17.7 billion) of the world output, followed by Asia 40% ($14.6 billion) and Americas 10% (3.6 billion). The share of East Europe has dropped from 15% in 1990 to less than one percent (0.3 billion) after the disintegration of the Eastern block. The developing countries have increased their share to almost 18% in 2000, although it came down to 15% in 2001. In terms of individual country performance, Japan topped the list ($9.4 billion), followed by Germany ($7.7 billion), Italy ($3.8 billion), USA ($2.9 billion) and China ($2.6 billion). Japan has retained the top position since 1982 except in 1999, when Germany was at the top (Gardner Publications, 2003).

The production indicates the health of machine-tool industry of a country, but it is the volume of machine-tool consumption[69] that reflects the status of industrialisation of a country or the health of the broad manufacturing economy (American Machinist, 1993). It is seen that the leading producers of machine tools are also among the leading consumers as well. In 2001,

[68] CECIMO: the 15 members: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden, Switzerland, Turkey, and United Kingdom.

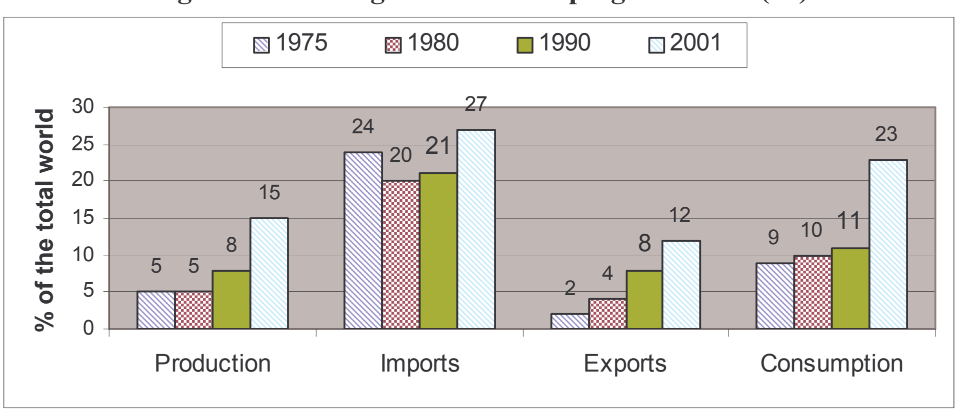
[69] Apparent consumption = Production + Import – Export.

Germany topped the list by consuming about 16% ($5.7 billion) of the total world output, closely followed by Japan ($5.3 billion) and the USA ($5.2 billion). China stood fourth with $4.7 billion. In terms of groupings CECIMO again came out as the largest consumer with 43% share followed by Asia 36%, and Americas 20%. In terms of per capita consumption, Switzerland topped the list with $93.5 followed by Germany $67, Italy $65 and Taiwan $47 (Gardner Publications, 2002, 2003).

The countries with higher production are also the big exporters as well importers of machine tool. Japan and Germany dominate in exports capturing almost 45% of the world market. As a group, the CECIMO is the largest accounting for almost 58% ($11.7 billion) of the market. As regards to imports, the US topped the list with $3.4 billion (65% consumption) followed by Germany ($2.3 billion) and China ($2.4 billion). The three countries accounted for 43% of the world imports. The main reason for this phenomenon is specialization. USA specializes in high productive high performance machines. Japan is in mass produced high productive CNC machines, Germany in high precision SPMs and the Eastern bloc countries in low cost heavy duty high production GPMs. Switzerland specializes in high precision machine tools and SPMs for watch industry etc. This type of interdependence is a special feature of this industry. Thus the domestic firms across the world depend on the external market for sustained growth.

Machine tool industry, previously a forte of industrialised world, is gaining importance among the developing countries that adopted industrialisation for growth and economic prosperity in the post-war period. Countries like Brazil, China, South Korea, Taiwan, and Singapore are prominent among them. The share of developing countries in world production has increased from five percent in 1975 ($0.45 billion) to 17% in the year 2001 ($5.5 billion). Similarly, the share in world exports has gone up from 2% to 12%. The share of consumption has reached 23% from 9% during the same period. Now China is the third largest consumer in the world just after the US and Germany. The countries like Korea, Taiwan and Brazil also figure in the top 10 consumers of the world. Figure 5.3 depicts the progression of developing countries in terms of percentage share of the total world for the year 1975, 1980, 1990 and 2001.

Figure 5.3: Emergence of Developing countries (%)



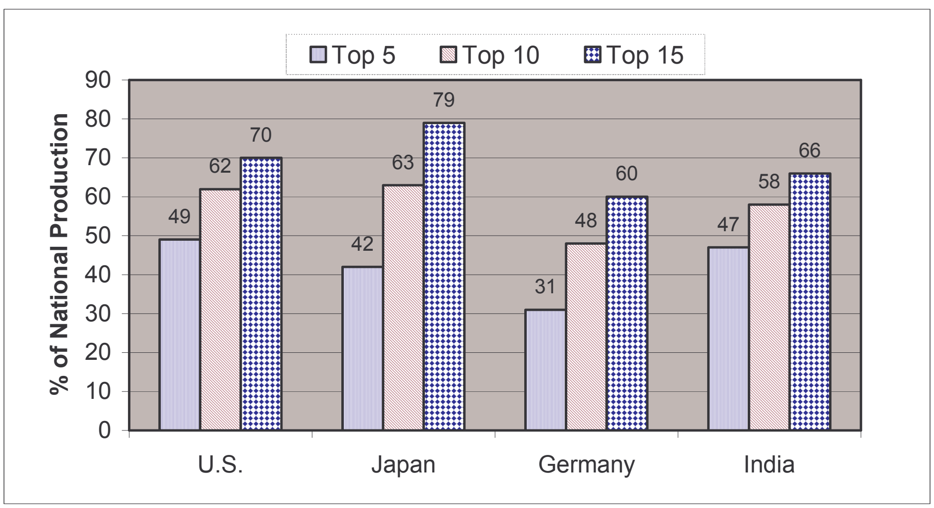
Source: Based on Alcorta (1998) and Gardner Publications (2003).

5.2.4 Structure

Machine Tool industry is a *small industry.* It is seen at all the three levels: international-, industry- and firm level. At international level we have seen that the absolute size of the world machine tool industry is comparatively quite less than other industries. At industry level, its lower economic size i.e. contribution to GDP and MVA substantiates our proposition. Even in the industrialized countries it accounted for less than one per cent in GDP (e.g. USA 0.05%; Japan 0.17%, Germany 0.37%) and less than two per cent in MVA (e.g. USA 0.28%; Japan 0.72%, Germany 1.55%; exception Switzerland 3.56%) in 2000. As regards to the firm level, the largest firm in the industry Italy based Comau Group had a turnover of $2.24 billion[70] only accounting for about six per cent of world market in 2000, whereas the largest firm in electronics industry the IBM had annual turnover of $88.4 billion and 15% of world market share. The smallness of firms' size could be attributed to higher variety of products and diversity of manufacturing technology involved.[71] It leads to higher product differentiation at the cost of economy of scale. The small size also leads to low bargaining power vis-à-vis the users. The firms of main users viz. automobile, aircraft and defense industry are comparatively much larger in size compared to machine tool firms.

The industry is known for its dualistic structure i.e. a small number of large firms coexist with a large number of SMEs. The logical offshoot of presence of small number of large firms in the industry is concentration. A few firms account for a major share of national production as evident from concentration figures of countries like Japan, USA and Germany (Figure 5.4).

Figure 5.4: Share of the Top firms in National Production



Source: Finegold et al (1994) for U.S., Japan and Germany; for India: based on IMTMA data for 1994.

[70] The Japan-based Amada ($1.95 billion) and Yamazaki Mazak ($1.43 billion) ranked third as per the AMT survey of worldwide sales of machine tools and related equipment (Mazak, 2001).

[71] The CECIMO identifies about 34 broad categories and approximately 380 subcategories of machine tools. The production technology and design features differ for each type of product groups.

Similar situation exists in developing countries like Korea, Taiwan, China and India as well. Mergers & acquisitions seems to be common mode of expansion in the USA and Europe e.g. Cincinnati Milacron, Litton & Unova; Giddings & Lewis, Cross & Trecker and Fadal finally merged with Germany based Thyssen Krupp; Maho, Deckel and then Gildemeister & Traub (Germany) etc. In Japan, Korea, or India the mode of internal expansion is more common.

The developments in microelectronics and telecommunications have rejuvenated this industry, which was otherwise on decline.. It has brought significant changes in controls and overall environment of the machine tool. The introduction of numerical controls has facilitated the combination of several cutting processes into one machine with higher flexibility. Now drilling, planning, boring and milling operations could be performed on one machine like Machining center. Similarly operations like turning and grinding could be done on Turning centers. The convergence of technology of the three separate areas: machine tool, computers, and communication technology have forced a significant shift in the boundaries of the markets and technology. With these developments the market for non-CNC machine tool has shrunk to less than 20%. Nowadays in the developed countries the firms are identified more as a supplier of industrial automation systems rather than machine tools. Therefore the importance of R&D has increased even more compared to earlier years. A study done by Arnold (2001) indicates that worldwide firms spend 4-10% of annual sales on R&D. Volume producers of standardized machine tools spend less compared to producers of high-end SPMs and system providers.

The higher level of technical intensity induces the requirement of higher technical interactions within as well as across the firms i.e. entire supply chain as well as support institutions and therefore geographical proximity is encouraged. The closeness within the firm entails close proximity of both R&D and manufacturing. Thus internationalization of capital is less and mostly limited to the industrialised countries like USA, Japan and Europe. This explains the reason of lower level of foreign direct investment in developing countries. As regards to close relationship across the firms, the process of geographical concentration is self-reinforcing. It creates a chain of component suppliers, machine tool manufacturing firms, supporting & related industries like various metal processing firms, and users of machine tools as well support institutions. It may be seen across the world e.g. Germany (Baden-Wittenberg, North Rhine), Italy (Lombardi, Pie Monte), Japan (Honshu), USA (Los Angeles and several areas of Midwest), Taiwan (Taichung) and Bangalore (India) etc. Another associated feature of the industry is prevalence of subcontracting. In order to gain competitiveness most of the manufacturers across the world rely quite heavily on subcontracting. It ranges from 40% (Europe) to 60% (Japan). The tendency is to increase subcontracting through the greater use of component specialists (Finegold et al., 1994). In addition to the above, large firms derive competitive advantage through economy of scale or economy of scope, whereas, SMEs primarily rely on development of cooperative networks.

5.3 Machine Tool Industry in India

5.3.1 Overview

India, where machine tool production dates back to late nineteenth century, started production in an organized manner after independence in the mid 1950s as a result of the thrust given by the government on the development of heavy industries. After the independence this industry has largely grown under a protected environment to achieve the national objective of self-reliance. As a result the industry recorded significant growth and diversification. However, the prolonged protection has hampered innovation and international competitiveness. Now a wide range of relatively less complex non-CNC and CNC machine tools are manufactured in the country. The industry has been able to absorb and adapt technology for wide range of relatively less complex GPM and SPMs. Thus, dependence on import still exists for precision, and high-speed machine tools. In the year 2001, the imports were 39% of total domestic consumption. The total production stood at $111 million (3051 units) and ranked 21st among the machine tool producing countries in the world. The export was miniscule to the tune of 7% of production only. The apparent consumption amounts to $170 million (0.5% of world consumption) with per capita consumption being $0.19 only, which is one of the lowest in the world (Gardener Publications, 2003). The year 1996 was the best year for this industry when it had achieved production of $249 million (Gardener Publications, 1997). An emerging positive feature is the increase in share of CNC machine tools in total production during the last few years both in terms of quantity as well as value. In 2001 it reached 51% in terms of value and 40% in terms of numbers (1235 units). The majority (approx. 80%) of the machine tools produced are of metal cutting type (IMTMA, 2002).

There are over 400 firms in this sector with a total investment in plant & machinery to the extent of $300 million. The industry provides direct employment to about 60,000 people and generates indirect employment for almost 100,000 people (IMTMA, 2001). About 50 to 55 firms are engaged in production of CNC machine tool and its parts/ components. Firms are mostly SMEs except a few. Three firms are in the public sector. Geographically, the industry has mainly emerged around main manufacturing centers in the country such as Bangalore-Coimbtore-Chennai (South); Mumbai-Pune (West); Delhi-Faridabad (North); Batala-Ludhiana (North) and Rajkot-Surat (North-West) area. The production of CNC machine tool is concentrated in the first three regions. The later two regions locate predominantly small firms manufacturing non-CNC machine tool.[72]

5.3.2 Evolution and Growth

The evolution and growth of machine tool could be divided into three eras: pre-independence (1890-1947); post-independence (1947-1991) and post-liberalization (1991 onwards) for the purpose of our discussion.

[72] Most of these firms are either not the members of IMTMA or do not report production. Thus their contribution is not accounted for in the reported national production. It is estimated that these firms account for about 20 per cent of production (IMTMA, 2001).

5.3.2.1 *Pre-independence:* **1890-1947**

The origin of machine tool production in India could be traced in late eighteenth century in the northern part of India in the region of Punjab. Later in late 19th century the establishment of Jute and Cotton industry provided impetus to this industry. By 1930s quite a few firms were manufacturing variety of machine tools such as sliding/screw-cutting lathes, simple drills, shapers and hacksaws etc. But the British Government in India gave the main thrust during the Second World War through promulgating the Machine Tool Control order, 1941 to provide secured supply of machine tool for the ordnance factories and other war-related industries. The existing manufacturers were asked to boost up their production and other engineering industries were also encouraged to take up production of machine tool. They were supplied with new machinery, design and drawings from abroad, particularly from the USA under the American Lend-lease scheme. The British Government also deputed teams of machine tool experts, mainly from Alfred Herbert Limited that supplied the basic designs of lathes and drilling machine (Patil, 1985; Gandhi, 1991). As a consequence of these efforts the industry made a good progress. The production increased from Rs 0.6 million in 1942 to Rs 9 million in 1946. It had reached to the peak of Rs 11 million (3699 Nos.) in 1945 (Table: 5.2).

Table: 5.2: Machine Tool Production & Trade 1941-1947 (*million Rs at current prices***)**

Year	Production (P)		Import (M)	Export (X)	Consumption (C)
	Qty. (Nos.)	Value			
1941			7	0	7
1942	273	0.6	6	0	7
1943	1713	6	5	0	12
1944	2170	8	15	0	23
1945	3699	11	18	0	29
1946	2820	9	18	0	27
1947	1400	5	37	0	41

Note: Figures rounded off to the nearest integer for the ease of reading.
Source: Patil (1985).

In the post-independence period the industry made steady progress with the continued government support. The analysis of the post-independence phase may be further segmented into three time periods in concurrence with the segmentation done in the previous chapter to analyze the developments in machine tool industry vis-à-vis overall industrial development of the country. The three phases are: infancy phase (1947-66); growth phase (1966-80) and transition phase (1980-91). It may be mentioned that the nature of development of this industry during the different time periods differed from the nature of overall industrial development of the country and therefore we have named them accordingly.

5.3.2.2 ***Infancy:*** **1947-66**

The dawn of independence in 1947 witnessed the collapse of this industry due to permission for free imports as well as withdrawal of other engineering industry from production of machine tools due to lack of proper incentives (Gandhi, 1991; Patil, 1985). However, the industry started growing after the Government decided to re-establish the industry to speed up the process of industrialization and achieve the objective of self-reliance. To begin with in 1949 the Government planned to set up a modern machine tool factory itself. M/s Hindustan

Machine Tool (HMT) Limited was established in 1953 in technical and financial collaboration (10% equity) with Oerlikon, Switzerland in Bangalore (Desai et al., 1999; Mascarenhas, 1982; Patil, 1985). During the first FYP (1951-56), the growth was slow as the industries both in the public and private sector were being set up. The output increased from Rs 2.9 million in 1950 to Rs 6.6 million only in 1955. It got momentum after 1956 when M/s HMT Ltd. and other private sector firms commenced commercial production.

The Government gave adequate support to this industry by way of restricting imports of machine tools, which are produced in the country and allowing liberal imports of technology and machinery to acquire modern designs & technical know-how from abroad during the first three Five Year Plans (1951-66).[73] Quite a few FC agreements with manufacturers from Europe, USA and Japan were signed. Moreover, the firms were discouraged to take up the manufacturing of the same machine tool, which were already produced and therefore perpetuated product monopolies. The government also encouraged existing firms to diversify in new type of machine tools. As a consequence large numbers of firms were established during this period to manufacture a wide range of machine tools[74] although with fragmented capacities. Firms, which were earlier import agents of foreign firms, also started setting up manufacturing facilities (Desai et al., 1999; Patil, 1985). During this period the government had set up three large-scale PSEs. Simultaneously 15-20 medium & large-scale private firms and over hundred SSEs in private sector also emerged.[75] The large and medium scale firms had to be primarily vertically integrated due to absence of supporting industries. They banked mainly on imported technology and their R&D efforts were mainly directed towards adaptation of technology as well as localization of parts & components. SSEs primarily relied on copying through reverse engineering and manufactured cheap crude products. Although the numbers of firms increased, the production remained concentrated. In 1964, five firms produced 72% of the total output, with HMT cornering the share of 44% (Desai et al., 1999).

With the competition restricted both form the international and domestic perspective as well as buoyant domestic demand, it was virtually a sellers market. Firms could sell their products irrespective of cost, quality, delivery schedule and after-sales service. The constant price index of output increased by more than ten folds in between 1956 to 1966 (Desai et al., 1999). In ten years from 1956 to 1965 the production increased from Rs 11 million ($2.3 million) to Rs 285 million (approx. $57 million). There were some efforts in export front as well since 1962, although the quantum was very low (about 1% of production only). The share of domestic production in overall consumption increased from 11% in 1956 to 42% in 1965 (Table 5.3).

[73] The industry received special attention through Directorate General of Technical Development (DGTD), under the Ministry of Industry, which closely monitored the growth of the industry and provided necessary assistances.

[74] Mostly general-purpose conventional machine tools such as turret lathes, single & multi spindle automats, gear shapers & hobbers; boring machine, broaching machine, hydraulic press and simple special-purpose machine tools etc. (Patil, 1985).

[75] Such evolution was in concurrence with the objective of the Industrial Policy Resolution of 1948 and 1956. As per these, machine tool industry was classified as *Schedule B* industry i.e. the industry intended to be progressively under public sector, though private sector were also allowed to exist and expand.

Table: 5.3 Production and Trade: 1950-65 *(Millions of rupees at current prices)*

Year	Production (P)	Imports (M)	Exports (X)	Consumption (C = P+M-X)	Domestic market share (P-X)/C in%	Import penetration (M/C) in%	Exports as% of Prod. (X/P)
1950	2.9						
1951	4.7	25.0		29.7	16	84	
1952	4.4	22.1		26.5	17	83	
1953	4.4	31.3		35.7	12	88	
1954	4.7	38.6		43.3	11	89	
1955	6.8	52.9		59.7	11	89	
1956	10.8	83.7		94.5	11	89	
1957	23.5	146.4		169.9	14	86	
1958	34.1	144.2		178.3	19	81	
1959	41.6	163.3		204.9	20	80	
1960	58.6	209.4		268.0	22	78	
1961	73.3	242.2		315.5	23	77	
1962	104.0	260.4	1.1	363.3	28	72	1.1
1963	167.8	315.0	1.0	481.8	35	65	0.6
1964	209.8	344.4	1.2	553.0	38	62	0.6
1965	254.8	349.3	1.4	602.7	42	58	0.5

Source: Based on Patil (1985).

5.3.2.3 *Growth:* **1966-80**

During the next 15 years till 1980, when the overall economy, industrial sector and even the capital goods sector experienced slowdown (see Table 4.4), the growth of machine tool industry was unabated at an average annual rate of 16% under the blanket protection provided by the government. The basic characteristics of the industry remained unchanged vis-à-vis the earlier period. The source of technology and the firms' conduct regarding technology development continued the same way. There was addition of a few more large, medium, and small-scale private firms. The degree of concentration remained more or less the same. The top five accounted for 73% and the top ten 80% in 1980 (Gandhi, 1991; Wogart et al. 1993). The data on production and trade (Table 5.4) reveals that the output increased from Rs 285 million in 1966 to Rs 1860 million in 1980. Only the initial four years (1966-69) were relatively bad for the industry due to economy wide recession. The recession was rather a blessing in disguise to some extent. It forced the firms to look for the exports, which was otherwise neglected till then due to readily available domestic market. The firms started participating in major foreign exhibitions to explore new markets. By 1969 almost 11% of production were exported. Although the same tempo could not be maintained thereafter, it had set the tone for exports. Subsequently, in the second half of 1970s the exports again picked up as other engineering firms including the HMT got substantial number of turnkey projects in the Middle east and Africa, which included supply of machine tool along with supply of engineering & consultancy services (Lall, 1987; Patil, 1985; Wogart et al., 1993).

Table: 5.4 Production and Trade: 1966-80 *(Million of Rupees at current prices)*

Year	Production (P)	Imports (M)	Exports (X)	Consumption (C = P+M-X)	Domestic market share (P-X)/C in%	Import penetration (M/C) in%	Exports as% of Prod. (X/P)
1966	284.8	429.9	6.6	708.1	39	61	2
1967	254.7	394.0	6.7	642.0	39	61	3
1968	206.3	362.5	18.6	550.2	34	66	9
1969	266.8	189.9	29.5	427.2	56	44	11
1970	372.3	183.0	27.9	527.4	65	35	7
1971	502.5	217.0	30.5	689.0	69	31	6
1972	494.6	236.4	21.0	710.0	67	33	4
1973	622.6	286.7	36.9	872.4	67	33	6
1974	884.4	294.6	71.2	1107.8	73	27	8
1975	1040.3	440.4	81.8	1398.9	69	31	8
1976	1168.5	444.9	169.2	1444.2	69	31	14
1977	1095.7	357.2	136.6	1316.3	73	27	12
1978	1210.5	400.0	105.9	1504.6	73	27	9
1979	1558.2	787.7	182.3	2163.6	64	36	12
1980	1859.5	1048.6	169.5	2738.6	62	38	9

Source: Based on Patil (1985).

However, the prolonged protection generated complacency in this industry. In the scenario where the Government had taken the job of marketing for domestic firms by way of checking the indigenous availability and directing the prospective buyers to them, it was virtually monopoly situation for the manufacturers. High prices, long delivery schedule, low technology, poor after sales service and lack of tooling-up were the typical characteristics of the industry. There was also lack of required technological pull from the domestic user industries as they themselves were reaping the rent of prolonged protection and hence efforts for modernization of their products & process were not receiving due attention. Mascarenhas (1983) mentions that CMTI brought in the first NC machine in 1964 and tried to popularise it among the users but had little success. There were efforts to develop NC machine tools and accessories by M/s HMT Ltd. in collaboration with CMTI and KTM, UK. HMT had exhibited the first indigenously developed NC Milling machine in EMO, Hanover in 1970 and NC system in Asia 72, Delhi in 1972. But due to lack of interest from domestic users, it took almost 10 years to develop demand for the same (Gandhi, 1991; Mascarenhas, 1983; Patil, 1985). All these were instrumental for increase in the domestic market share from 39% in 1966 to 62% in 1980. It had reached as high as 73% in 1977 and 1978 (Table 5.4).

In order to avoid dependence on the complacent domestic manufacturers and the vagaries of imports some of the large firms in automobile sector started development of machine tool in-house. It also helped them in incremental improvement, tooling up, better maintenance, faster implementation of project, improvement in other machinery and encouragement to innovate. These firms manufactured for captive use only so it did not figure in official production figures. Such developments resulted in the loss of opportunity and lack of interactions with users for the machine tool firms restricting further technological development (Gandhi, 1991; Wogart et al., 1993).

5.3.2.4 *Progression towards CNC:* **1980-90**

It was only in the late seventies when the government recognised the importance of productivity & efficiency of investment, the scenario started to change. The government encouraged firms to modernize by way of importing disembodied and embodied technology. There was move towards switching over to tariffs from QRs. More and more machine tools were placed under open general license (OGL) list i.e. no requirement of import license. The number increased from 24 in 1972-82 to 128 in 1982-85 and 300 in 1985-88 (Desai, 1999; Wogart et al., 1993). The main users automobile, consumer goods and other engineering industry started to modernise. Although the domestic firms were not able to supply the required machine tools, they were reluctant to accept the reality. Wogart et al. (1993:71) notes, *"The situation changed dramatically when the Japanese automobile firm Suzuki decided to invest in a joint modern plant* [Maruti: a joint venture between the GoI and Suzuki motors, Japan for manufacture of small cars]*, and refused to buy even those Indian machine tools which the domestic companies maintained that they were perfectly able to provide."* Initially most of the demands were met by imports. As a consequence, the share of imports in domestic consumption increased from 27% in 1978 to 46% in 1983. The increase was mainly due to rise in imports of CNC machine tools and precision machines. These machines were costly as well as the rate of tariff imposed was also higher. Nevertheless, the rise in investment in the user industry also helped in the increase in demand for domestic machine tools and hence the output of domestic industry (Table 5.5).

Table: 5.5 Production and Trade, 1981-1990 *($ millions at current prices)*

	Production	Imports	Exports	Consumption	Dom. Mkt. Share%	Imports Share %	Exports Intensity	Exchange Rate#
Year	P	M	X	C	(P-X)/C	(M/C)	X/P	$1=Rs.
1981	269.4	149.2	21.6	397.1	62	38	8	8.69
1982	280.8	186.1	20.8	446.1	58	42	7	9.49
1983	271.5	208.5	23.8	456.1	54	46	9	10.14
1984	263.1	171.8	15.5	419.4	59	41	6	11.37
1985	245.2	125.4	23.9	346.7	64	36	10	12.36
1986	294.9	163.6	36.7	421.8	61	39	12	12.61
1987	189.4	91.1	45.7	234.8	61	39	24	12.96
1988	197.8	93.4	21.6	269.6	65	35	11	13.91
1989	209.1	93.6	30.4	272.3	66	34	15	16.22
1990	236.1	194.5	46.2	384.4	49	51	20	17.50

#: Exchange Rate taken as average of the year (RBI, 2001).
Source: Based on Gandhi (1991) and Alam (1998).

The positive outcome was the increased efforts by the industry for stepping up the production of CNC machine tools. There were series of FC agreements for CNC machine tools in the eighties. Data on FC maintained by DIPP, GoI reveals that during 1980s more than 50 FC agreements were approved for various types of CNC machine tools. There was multiplicity of collaborations as well. Two items, Machining center and CNC lathes accounted for about 60% of agreements. Initially the production was low. Only 58 machines were produced during 1980-84. In 1985, the number rose to 65 worth Rs 129 million i.e. 7% of total production. It increased to 550 numbers worth Rs 1375 million and 33% of total production in terms of value in 1990. Out of this 281 (44% of value) were CNC lathes and 105 (30% of value) were machining centers. The rests were CNC Milling, Drilling, Grinding, EDMs, Boring & Milling and SPMs etc. Table 5.6 presents the production of CNC machine tool and its share in total machine tool production during 1985-90.

Table 5.6: Production of CNC Machine Tools: 1985-1990

Year	Quantity (Nos.)	Value ($ Million)	% of Total value (%)
1985	65	10.4	7
1986	88	13.9	8
1987	200	37.0	20
1988	282	48.3	24
1989	457	64.9	31
1990	550	78.6	33
2000#	1383	68.7	51

#: The values for the year 2000 shown for the purpose of comparison.
Source: Based on Gandhi (1991)

Although there were certain moves towards liberalization, the basic premise of the policy framework had remained unchanged. There were efforts to induce competition by way of progressive switching over from QRs to tariffs, but the industry received adequate protection due to gradual increase in tariffs. During 1972-82, there were only two tariff bands for machine tools: 25% (27 items) and 48% (all others). It was increased to 35% (35 items) and 85% (all others) respectively in 1982-85. In 1986-89, it was further raised to four bands 35% (35 items), 55% (85 items), 115% (29 items) and 95% (all others). The objective of such segmentation was to offer higher protection to more sophisticated machine tools. A study undertaken by BICP had concluded that in 1985, the effective protection (ERP) on Non-CNC lathe was just 9%, whereas for CNC lathe, it was 83%. The nominal rate of protection (NRP) on CNC lathe output was 96% and on input was 106% (Desai, 1999; Wogart et al., 1993). It encouraged the existing firms to continue with the old practice of identifying such machine tools (mostly CNCs), which were imported or likely to be imported, obtaining the industrial license and start manufacturing the same regardless of the market size, primarily with imported technology. Firms were allowed to import 2 prototypes for design & development and in the first year of production upto 80-90% of components/ sub-assemblies could be imported under the phase manufacturing program without much of hassles. These helped the firms to introduce new items/ models quickly in the domestic market without adequate absorption of technology.

The policy of '*broad banding*'[76] introduced in 1983 and relaxation in technology import policy helped the firms in their endeavor to capture rent created from tariffs on the pretext of building domestic capability and attaining self-sufficiency. It may be mentioned that the objective of such liberalization in the policy was to improve efficiency of manufacturing sector but it encountered such negative effects as well. All these firms had the history of manufacturing machine tools as foreign technology supplier preferred to collaborate with the experienced

[76] The policy of "Broad-banding" enables the firms to manufacture new article/ new model within their licensed capacity without obtaining any further permission.

firms. It led to diversification for the existing firms into the production of CNC machine tools. In majority of the cases it culminated in over-diversification with very little output. Further, the industry was delicensed in 1985. It eased the entry of new firms as well as further diversification by the existing firms without the need of any industrial license. The intensity of diversification could be illustrated through a glance on the diversified product range of five prominent CNC machine tool manufacturers in 1989 (Table 5.7).

Table 5.7: Intensity of diversification in CNC Machine Tool Firms in 1989

Type of CNC Machine Tool	MTM1#	MTM2	MTM3	MTM4	MTM5
Lathes/ Turning center	x	x	x	x	x
Machining center	x	x	x	x	x
Milling machine	x	x	x	x	x
Boring & Milling Machine	x	x	x	x	x
Gear cutting machine	x	x		x	
Grinding machine	x	x		x	x
EDM	x				
Flexible machining system/cell	x				
Special Purpose machine (SPM)	x		x	x	x

MTM: Machine Tool Manufacturer. 'x' indicates Yes and blank indicates No.
Source: Based on IMTMA (1989) and industry data.

The list is just for illustration and does not claim exhaustiveness. The HMT limited, which is the largest firm is in almost all area of machine tool manufacturing and is the trendsetter of the industry. In the process the CNC machine tool industry became quite diversified & fragmented and therefore uncompetitive like the Non-CNC machine tool industry. It could be gauged from the fact that in 1985 the entire production of 15 firms manufacturing CNC machine tools was just 65 units and in 1990 about 40 firms produced just 550 CNC machine tools of more than 30 different types. It may be mentioned that within the individual product groups there are lot of subgroups. In a survey of 75 producers covering relatively small manufacturers of customized machine tool in Japan, the average monthly production was 45 Machining center equivalent (WS Atkins, 1990) that means 540 machines per year per firm.

With the import-substitution policy in vogue, export took the back seat. There has been a very limited effort for export by this industry. Exports hovered around 10-15% of production (Table 5.6). It was predominantly composed of conventional machine tools. Whatever increase was seen in the late eighties was mostly due to increase in exports to erstwhile Soviet Union and other east European countries under bilateral rupee trade. After the collapse of Soviet Union, these markets vanished and exports went down drastically as the opportunities available in the international market were not explored properly. The data on exports of CNC machine tools during 1986 - 89 reveals that it accounted for 9, 13, 6 and 7% respectively of the total exports of machine tools from India (Gandhi, 1991). India faced stiff competition from Korea, Taiwan and China in the international market on account of price, quality, features, delivery, after sales-service and brand-image.

Based on the aforesaid discussion, the salient features of machine tool industry in general and CNC machine tool industry in particular in the beginning of the nineties i.e. just before the sweeping reforms of 1991, may be summarized as follows:

- After the independence the Government gave special emphasis on the development of heavy industries to achieve the objective of self-reliance. As a consequence, a well diversified but fragmented industry (both non-CNC and CNC) evolved.

- With annual average growth rate of 15% during 1966-90 catering almost 60-65% of domestic demand, the industry found itself in a very comfortable position under the protectionist environment and failed to undertake requisite step to increase its competitiveness in spite of signals of proposed liberalization by the government.

- The industry structure was dualistic: a few large firms coexist with large number of SMEs. The degree of vertical integration was rather high due to lack of supporting industries.

- There seems to be high level of industry concentration. Ten major firms account for 70 to 80% of output during the period. M/s HMT Ltd.- the largest firm accounted for more than 30% of national production since its inception in 1956.

- Firms mainly depended on imports of technology from abroad, particularly from countries like USA, Japan and Europe. In-house R&D was focused on adaptation of technology and indigenisation program rather than new product development. Overall R&D intensity was quite low i.e. less than 1% of turnover.

5.3.2.5 *Aftermath of the liberalization:* **1991 onwards**

The sweeping liberalization in 1991 onwards that dismantled all entry barriers, abolished QRs for machine tools and industrial inputs, abandoned the system of progressive increase of local content (PMP) and gradually brought down tariffs[77] gave a shock to this industry, which was habituated of protection, particularly from imports. Consequently, the production went down, while the share of imports in overall consumption rose from 35% to 60% (Table 5.8). However, the demand generated by expansion of automobile and auto-component industry in the mid-90s gave some respite to the industry. There was an increase in production as well as imports during 1995 and 1996. But, the later half of the 90s again saw shrinkage in demand due to slow down of economy. The apparent consumption reduced to almost one fourth from $649 million in 1996 to $170 million in 2001, which culminated in reduction of production by more than half. It has brought more plights for domestic manufacturers in terms of loss of domestic as well as export market share. At present quite a few large firms both in public and private sector are in the red.

[77] The maximum rate of tariffs has been cut down from 170% in 1992 to 90% in 1993, 65% in 1994, and 50% in 1995 (Desai et al., 1999). It has further come down to 35% in 2000 and the recent budget of 2002-03 has proposed to reduce it to 25%.

Table 5.8: Production and Trade: 1991-2001 *($ million at current prices)*[78]

Year	Production	Imports	Exports	Consumption	X Ratio %	M Share %	Net X Ratio
	P	M	X	C	X/P	M/C	(X-M)/(X+M)
1991	221.6	109.9	19.7	311.8	9	35	-0.7
1992	203.4	181.4	17.3	367.5	9	49	-0.8
1993	155.9	185.4	17.2	324.1	11	57	-0.8
1994	180.4	212.7	19.9	373.2	11	57	-0.8
1995	218.0	303.0	13.7	507.3	6	60	-0.9
1996	249.3	413.9	14.1	649.1	6	64	-0.9
1997	219.3	198.9	8.8	409.4	4	49	-0.9
1998	162.0	254.5	14.7	401.8	9	63	-0.9
1999	138.7	109.8	8.9	239.6	6	46	-0.9
2000	132.8	105.2	8.5	229.5	6	46	-0.9
2001	111.7	65.8	7.8	169.7	7	39	-0.8

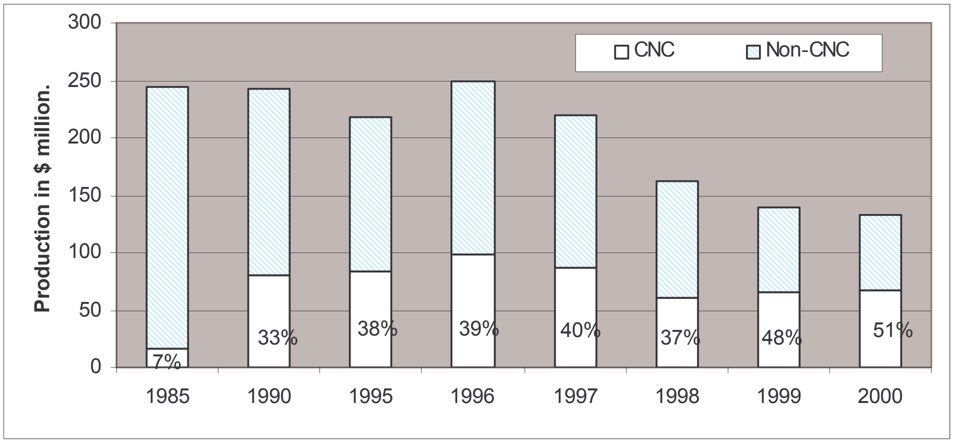
Source: Based on American Machinist and Gardener Publications various issues.

The disturbing consequence of shrinkage in demand is creation of overcapacity. In such situation firms are refraining from further investment. Interviews with firms suggest that there has been very little investment by the existing firms, particularly the larger ones. Even firms that want to invest in modern machinery are not able to do so as financial institutions are not eager to provide adequate funds due to their low profitability. It is leading towards the vicious circle of low demand- low investment- low profitability – low growth. Due to low demand potential foreign investors are also shying away. During the last ten years only 207 FC approvals (88 Technical and 118 Financial) worth $90 million (about Rs 4 billion) have been granted (SIA, 2001). It may be mentioned that out of 207 proposals only twenty-four are for complete machine tools and interestingly enough none of them involve any FDI. The rests are for either cutting tools/ accessories or marketing & after-sales service activities.

The consolatory development is the steady rise of CNC machine tool in terms of production, domestic market share and to some extent in exports as well. The production data of last ten years (Figure: 5.5) reveals that the overall share of the CNC segment has grown both in terms of value (from 33% to 51%) as well as in quantity (from 15% to 28% or from 550 nos. to 1382 nos.) notwithstanding with the decrease in the absolute value of output from $78 million in 1990 to $69 million in 2000. The decrease in absolute value can be attributed to primarily three factors: reduction in per unit price of CNC machines due to reduction in tariff on imported inputs; devaluation of rupee from Rs 17.50 to Rs 45.68 per dollar; and increase in production of standardized machine tools by some of the proactive firms. There has been progressive increase in domestic market share that came down to 43% in 1998 from 72% in 1990. It increased to 66% in 2000. Similarly there has been rise in share of exports from 20% in 1990 to 38% in 2000. A positive trend could also be seen in respect of export ratio as well.

[78] Due to devaluation of Rupee in 1991 by more than 20% and its further weakening, the performance figures in Rupee and dollars terms differ little bit. However for international comparison, dollar values have been preferred in our discussion particularly for the post-liberalization period.

Figure 5.5: Share of CNC Machine Tool in Production 1985-2000



Source: Based on IMTMA, American Machinist and Gardner Publication various issues.

The structure of CNC machine tools industry is almost same as overall machine tool industry i.e. few large firms coexist with large number of SMEs.[79] The existing structure may be better expressed as, a few proactive SMEs coexist with some large firms. The level of concentration is still high. The top ten firms account for about 70% of production. The partial abolition of barriers to entry in the eighties, which has been reinforced in 1991 sweeping reforms has seen emergence of quite a few techno-entrepreneurs setting up SMEs with proactive approach adopting modern business practices. They have been comparatively more successful and gaining market shares primarily at the cost of large firms. Out of the five top firms in 1989-90 (Wogart et al., 1993) only one, the HMT has been able to hold its position. The proactive medium sized firms have replaced the rests. Nevertheless, the HMT is again the largest one manufacturing wide range of CNC machine tools in five different plants accounting for almost 40 % market share. There has been efforts for restructuring in the HMT as well.

Firms have been mainly dependent on import of technology from abroad, mainly from the USA, Europe and Japan. Interviews with firms suggest that the liberalization of imports and abolition of local content requirement clause (PMP), have induced marked shift in the focus of in-house R&D. Now it is more focused on absorption of technology and incremental development rather than adaptation and indigenization program. However, it will require some time to move towards new product development as overall investment on R&D is still far below from the required level. The techno-entrepreneurial firms primarily depend on own design & development. A few firms have adopted the strategy of selecting standardized products and targeting export market. Another group has established close relationship with the larger users to develop machines as per their specific requirements. These firms are introducing

[79] It may be mentioned that it may not be possible to segregate CNC machine tools from overall machine tool industry as all firms manufacture both non-CNC and CNC machine tools with varying degree except a few. As a matter of fact most of the firms have graduated from non-CNC machine tool production and they still continue to produce the same. The firms do not report data separately. The available industry level data invariably includes both the segments. This phenomenon is in vogue worldwide.

modern business and manufacturing practices. A notable evolving feature is the efforts towards building networks and formation of consortiums particularly for marketing activities.

A common constraint faced by all the firms is the scarcity of skilled human resources both in R&D and manufacturing that also affect marketing and after sales-service functions. The problem emanates from the national system of education, which churns out more generalist than specialist. Moreover there is lack of specialized industry specific institutions. It induces anti-manufacturing bias among the students and job aspirants. Even for the computer software skills, the industry is facing problems, as existing institutions imparting training in this field do not cater to the requirements of the industry. The inadequate linkage between the existing institutions and industry aggravates the problem further. Such situations create pressure for imparting enhanced in-house training both on-the-job or off-the-job by the firms. But they face difficulty in doing so due to array of reasons. Since most of the firms are SMEs, they do not have adequate fund, infrastructure and incentives for the same. Moreover, they face problem of poaching by better paying firms from across the manufacturing and service sectors. The larger firms sometimes repent as their trained personnel leave their jobs for better job prospects or those who are more enterprising set up their own firms and start competing with them. It is interesting to note that their ex-employees have set up most of the new SMEs.

5.3.3 Indian Machine Tool industry in the international perspective

So far our discussion has been skewed towards national perspective. However, in this era of liberalization and globalization it is imperative to analyze the performance in the global context. It should not be seen in isolation. In order to do so we have attempted to analyse the performance in terms of domestic market share and revealed comparative symmetric advantage (RSCA) of main machine tool producing countries in the developed as well as developing world (Table 5.9) based on methodology presented in WS Atkins (1990) for ascertaining comparative advantage of national industry.

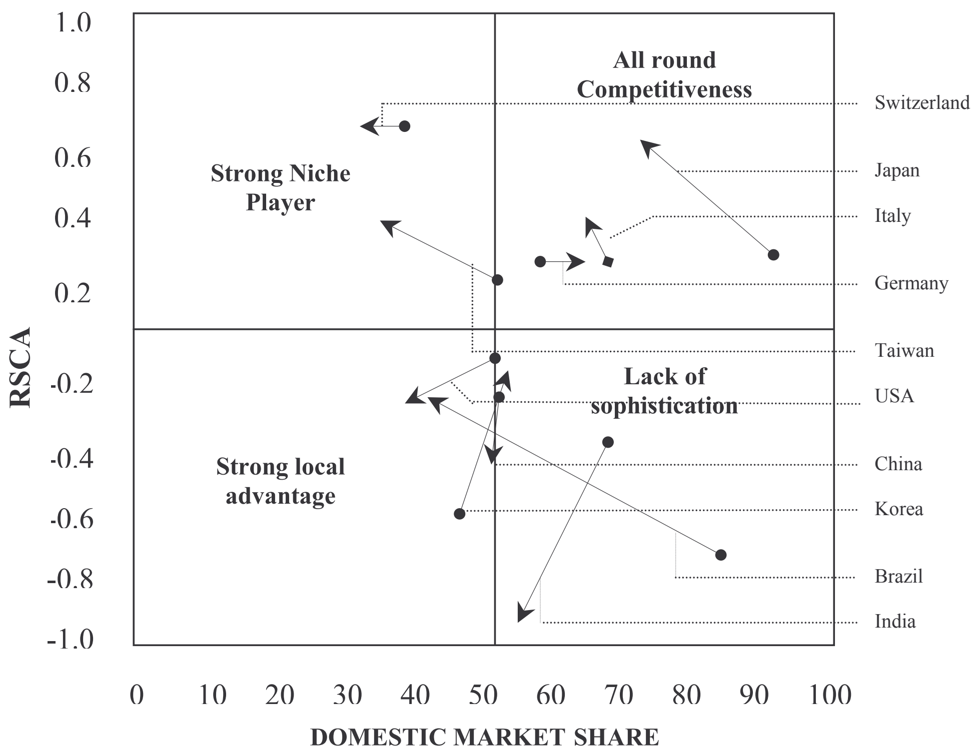
Table 5.9: Indian Machine Tool industry in International perspective

	Country	1990			2000		
		(P-X)/C	RSCA	X/P	(P-X)/C	RSCA	X/P
1	Japan	91	0.3	36	71	0.6	77
2	Germany	58	0.3	57	61	0.3	53
3	USA	51	-0.2	31	39	-0.3	31
4	Italy	65	0.3	47	63	0.4	45
5	Switzerland	32	0.7	87	30	0.7	86
6	Taiwan	51	0.2	68	28	0.4	76
7	China	51	-0.3	30	50	-0.5	14
8	Korea	45	-0.6	11	51	-0.2	27
9	Brazil	82	-0.7	9	41	-0.3	23
10	India	65	-0.4	12	54	-0.9	6

(P-X)/C: Domestic market share; X/P: Export ratio; RSCA = (RCA-1)/(RCA+1);
Note: The figures are rounded for easy readability.
Source: Based on American Machinist (1992) and Gardner Publications (2002).

The *domestic market share* indicates the ability to defend the domestic market against international competition. The *RSCA* measures comparative advantage in export market (see 3.2.1.1.4). In other words, the first measure indicates competitiveness in the domestic market and the second reflects competitiveness in the export market. We have also indicated export intensity for a better understanding. The two measures when coupled with each other present overall picture of competitiveness of the national machine tool industry (Figure 5.6). We put the domestic market share on the x-axis and RSCA on y-axis.

Figure 5.6: Degree of International Competitiveness



In order to present a synoptic view we have considered five top ranking machine tool producing developed countries: Japan, Germany, USA, Switzerland and Italy as well as five developing countries - India, China, Taiwan, Korea and Brazil in two points of time, the year 1990 and 2000 to gauge the shift in performance (Table 5.10). The year 1990 has been selected since it was the best year of production of machine tool and the year 2000 is the best year after the recovery so far. The countries are positioned as per the data for the two years 1990 and 2000. The starting point of an arrow depicts data for the year 1990 and the end point for 2000 to indicate the relative movement of country's position in the last decade. Based on the above the countries could be grouped in four groups as under.

- *Group-I:* High domestic market share /positive RSCA: *All round competitiveness*

The three dominant manufacturers of machine tool*: Japan, Germany and Italy* belong to this group. They are competitive in both domestic as well as export market. The large and advanced domestic markets help to attain leadership positions through economies of scale and sophisticated demand culminating in all round competitiveness.

- *Group-II:* Low domestic market share/ positive RSCA: *Strong niche player*

Two countries *Switzerland* and *Taiwan* appear in this group albeit for different reasons. For Switzerland, the small but advanced domestic market enables it to attain leadership positions based on specialization (high precision SPMs). It consistently exports more than 80% of production. As against this, Taiwan with small domestic market adopt export led growth strategy based on cost effective standardized machine tools. It exports were 68% and 76% of production during the two periods under consideration respectively.

- *Group-III:* Low domestic market share/ negative RSCA: *Strong local advantage*

The USA and Brazil fall in this group. They have large domestic market but low export orientation, although for different reasons. The US is the largest consumer in the world with a highly sophisticated market. It provides avenue to stay at the frontier of technology but hampers export orientation. The less sophisticated machines are imported that affect the overall domestic market share. Brazil's domestic market is small and unsophisticated. Due to liberalized policy import penetration is more.

- *Group-IV:* High domestic market share /negative RSCA: *Lack of sophistication*

Korea, China and *India* fall in this group. In 1990 *Brazil* was also in this group but now it has moved to group-III. For Korea and China the domestic market is large but less sophisticated. They produce matured technology products that are not competitive internationally as seen from their low export intensity and negative RSCA (Table 5.10). However, Korea appears to be improving its international competitiveness. It is evident from increased level of exports from 11% to 27% and improvement in RSCA from -0.6 to -0.2. In case of India, the domestic market is neither large nor sophisticated. In 1990 it had comparative advantages in domestic market due to protection. Its position has moved from bad to worse during the last ten years i.e. 1990 to 2000 among all the countries. On the one hand one can see decrease in export intensity from 12% to 6% as well as diminishing RSCA from -0.4 to -0.9and on the other it has not been able to defend its domestic market. It has reduced from 65% to 54%.

It may be mentioned that there is considerable internationalisation of trade (intra-industry trade) in this industry due to its feature of *specialisation*. No country has a machine tool sector, which has a breadth in its product and technology, which can satisfy the entire local demand. The concept of total self-sufficiency is unviable as well as economically undesirable. Local industries therefore rely on external markets for their sustained growth. This is evident from the figures of domestic market share and export ratio of major machine tool producing countries in the world (Table A-5.1). Therefore in order to increase international competitiveness India needs to increase export substantially as imports cannot be reduced below a certain level. The target level of exports may be about 40 to 50% of the national output.

5.4 Conclusions

World wide the machine tool industry is a small manufacturing sector, but widely regarded as a strategic industry as it improves overall industrial productivity through supplying embodied technology. The developments in microelectronics & telecommunications in general and introduction of CNC in particular during the last two decades have rejuvenated the market. The production and trade have been mostly concentrated in industrialised countries accounting for more than two-thirds of share. However, it is gaining importance among developing countries. The production of high-end machines is concentrated in the USA, Germany, Switzerland and Japan. In the mid-range segment Japan is the market leader. In the low-end segment NICs like Taiwan and Korea are predominant. The industry is highly fragmented primarily due to higher variety of products, diversity of manufacturing technology involved and different types of users. The level of intra-industry trade is high due to its feature of *specialisation*. No country has a machine tool sector that can boast of breadth in its product and technology to satisfy the entire local demand. Firms therefore rely on external markets for sustained growth. The industry is known for its dualistic structure: a small number of large firms coexist with a large number of small and medium firms. The industry concentration is high. On an average top 5 firms account for more than 40% of market. Large firms derive competitive advantage through economy of scale or economy of scope. SMEs concentrate on a few products and primarily rely on development of cooperative networks.

In India this industry has largely grown under a protected environment to achieve the objective of self-reliance. As a result it recorded significant growth and diversification but a fragmented industry evolved. The industry has acquired technological capability in relatively less complex non-CNC and low-end of CNC machine tools. The notions of diversification and fragmentation are common for both non-CNC and CNC segment of the industry. The prolonged protection induced higher input cost, high tariff on imported components, low volume of production, lack of standardization, lack of efficiency and technological backwardness etc. The recent liberalization since 1991 has highlighted the problems of this industry particularly in respect of lack of technological capability, international competitiveness and capability to satisfy the needs of domestic engineering industry. It is evident from the continuously declining domestic market share and low level of exports. The slow down of economy in the later half of the nineties has added fuel to the fire by causing shrinkage in overall demand. As a consequence there is overcapacity in the industry and firms are shying away from further investment inducing further technological laggardness. The industry has failed to attract FDI. At present quite a few firms both in public and private sector; particularly the larger ones are facing hardships.

The basic structure of the industry is similar to the world machine tool industry i.e. coexistence of a few large firms with large number of SMEs. However, the underlying reason for such similarity is quite different. The liberalization has induced reorientation in structure of the industry. Now a small number of proactive SMEs coexist with a few large firms and large number of technologically laggard small firms. The level of concentration is still quite high. The analysis of national comparative advantage and RCA vis-à-vis main machine tool producing countries reveals that, India's position is moving from bad to worse. On the one hand it is not able to defend its domestic market and on the other it is losing export competitiveness. The industry is operating under the constraint of both supply side factors i.e. lack of technology, human skills, capital, supporting & related industries and higher cost of inputs as well as demand side factors. It is facing stiff competition from other developing countries like Korea, Taiwan and China in terms of price, quality and delivery schedule.

The consolatory development is the steady rise of CNC segment in terms of production, domestic market share and to some extent exports. However, the structure of this industry segment is almost same as overall industry i.e. a few proactive SMEs coexist with some large firms. Nevertheless the level of concentration is still high. It may be mentioned that it may be difficult to isolate this segment from the overall industry as majority of the firms manufacture both non-CNC and CNC machine tool and do not report data individually. In fact most of the firms have graduated from non-CNC to CNC segment and still continue to produce the same. The progressive abolition of barriers to entry has led to emergence of quite a few techno-entrepreneurs setting up SMEs with proactive approach adopting modern business practices. They have been comparatively more successful and gaining market shares primarily at the cost of the large firms. These firms are trying to build capability in the standardized CNC machine tools in line with the practices adopted by Japan and later in Taiwan or Korea. A notable features, which is evolving is the efforts towards building networks and formation of consortiums. However for sustained development the industry needs to build technological capabilities through higher emphasis on product & process R&D, new skills, fresh investments, system integration component of machine tool building, higher networking and integration with the global market. These could be achieved through combined and coordinated efforts of both the industry and the government.

Table A-5.1: World Machine Tool Production & Trade, 2001 ***(Million US $)***

Sl. No	Country	Production	Imports	Exports	Consumption	Consp/ capita	X/P (%)	M/C (%)
1	Japan	9390.7	660.1	4796.7	5254.1	41.52	51	13
2	Germany	7732.2	2268.7	4288.5	5712.4	68.99	55	40
3	Italy	3794.5	1227.0	1942.0	3079.5	53.43	51	40
4	United States	2853.5	3411.3	1033.7	5231.1	18.98	36	65
5	China, P. Rep.	2624.0	2406.0	290.0	4740.0	3.76	11	51
6	Switzerland	2046.7	426.0	1755.9	716.8	98.71	86	59
7	Taiwan	1634.9	845.5	1362.7	1117.7	50.37	83	76
8	Korea, Republic of	803.9	931.0	411.0	1323.9	27.89	51	70
9	France	813.5	1188.5	485.9	1516.1	25.55	60	78
10	Spain	886.0	470.7	476.1	880.6	22.02	54	53
11	UK	824.3	780.9	708.4	896.8	15.07	86	87
12	Brazil	307.3	506.1	118.1	695.3	4.02	38	73
13	Canada	406.8	739.3	212.0	934.1	29.86	52	79
14	Netherlands	297.1	479.7	368.7	408.1	25.68	124	118
15	Austria	275.6	302.5	308.8	269.3	33.12	112	112
16	Czech Republic	279.2	313.2	276.5	315.9	30.72	99	99
17	Finland	196.9	118.1	165.6	149.4	28.91	84	79
18	Belgium	159.3	550.4	563.8	145.9	14.25	354	377
19	Sweden	177.2	226.4	151.2	252.4	28.45	85	90
20	Turkey	159.3	206.7	71.6	294.4	4.48	45	70
21	India	111.7	65.8	7.8	169.7	0.17	7	39
22	Russia	180.7	162.7	82.8	260.6	1.78	46	62
23	Denmark	57.3	143.2	66.2	134.3	25.17	116	107
24	Romania	44.4	92.3	60.2	76.5	3.41	136	121
25	Portugal	35.8	109.2	19.7	125.3	12.47	55	87
26	Croatia	22.7	28.4	17.0	34.1	7.96	75	83
27	Argentina	15.4	87.7	10.9	92.2	2.49	71	95
28	South Africa	2.2	41.5	0.7	43.0	0.99	32	97
29	Australia	102.7	155.1	89.3	168.5		87	92
World Total		**36235.8**	**18944.0**	**20141.8**	**35038.0**		**56**	54
Developed Country		30488.6	13777.0	17780.6	26485.0			
% of World		84.1	72.7	88.3	75.6			
Developing Ctry.		5499.4	4883.6	2201.2	8181.8			
% of World		15.2	25.8	10.9	23.4			
Transition Eco.		247.8	283.4	160.0	371.2			
% of World		0.7	1.5	0.8	1.1			
CECIMO		17734.9	8811.2	11648.9	14897.2			
% of World		49	47	58	43			
Americas		3583	4744	1375	6953			
% of World		10	25	7	20			
Asia		14565	4908	6868	12605			
% of World		40	26	34	36			

Source: Based on Gardner Publications (2003).[80]

[80] The Gardner survey for the current year (say 2003) presents the estimated data of the last year (i.e. 2002) and revised data for the year before last year (i.e. 2001). We have used revised data only and cited accordingly.

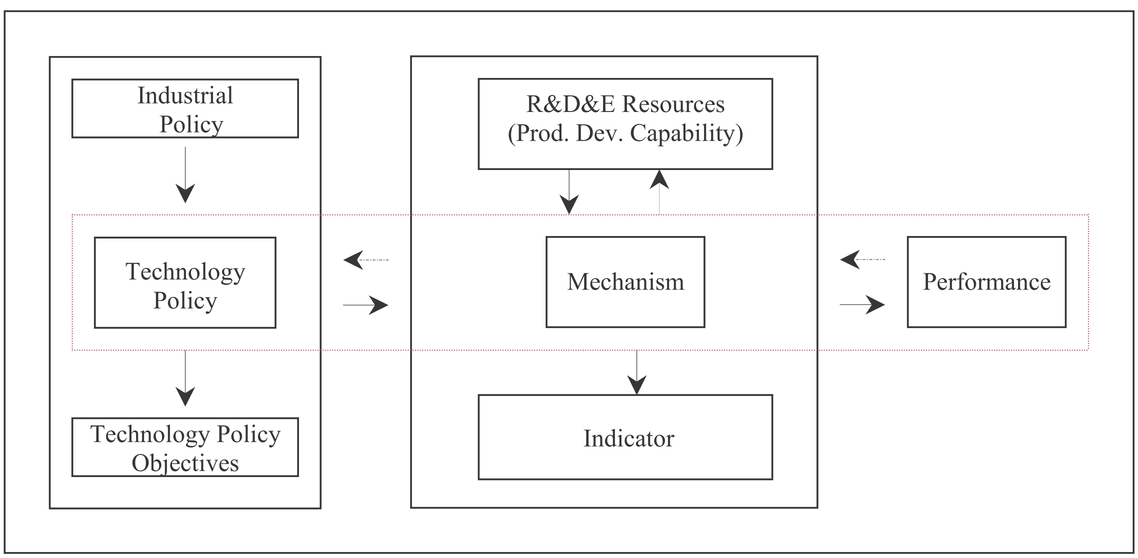
POLICY AND PRODUCT DEVELOPMENT [81]

This chapter endeavors to analyse the policy-performance causation in respect of Technology policy vis-à-vis R&D&E resource of the firms based on the general framework for analysis developed in the methodology chapter. It is presented in two distinct but interrelated steps. First, we analyse evolution and present status of the two main Technology policy measures: Foreign collaboration (FC) policy and policy for promotion of in-house R&D in the firms. Then we analyse as to how the firms adopted various mechanisms independently or in different combinations to leverage the policies in force that finally culminate in firms' performance.

6.1 Introduction

This chapter endeavors to analyse the *policy - resource - performance causation* in respect of technology policy i.e. the influence of technology policy on performance through technology resources of the firms. As stated earlier, since the technology dimension of industrial policy i.e. technology policy has direct impact on technology resource of products of the firms, we are concentrating on the analysis of interaction of these two. Based on the general framework for analysis of the causation (see figure 3.9), the specific framework is depicted in Figure 6.1.

Figure 6.1: Policy–Performance Causation: R&D&E Resources



[81] This chapter is based on Kumar, A., 2003, *Dynamics of building technological capability in firms: The case of CNC Machine Tool Industry in India*, paper presented in Network of Industrial Economist (NIE) conference on 'Challanges of Asian Technological Development' held at London School of Economics (LSE), London on 31.05.2003.

In the context of developing countries, technology policy primarily concerns with access to new technology, its adaptation to local conditions, assimilation, absorption, improvement and to some extent innovation of new products & processes. It mainly constitutes of four policy measures: import of technology, promotion of in-house R&D, provision of technology infrastructure and supply of skilled personnel. In this chapter we will focus on the first two policy measures i.e. import of technology and promotion of in-house R&D policy only. The third one will be discussed while analyzing the linkage resources as it contributes more to coordination and cooperation of firms with industry specific institutions and various stakeholders. The fourth one will be analyzed while discussing human resources since it relates to skill creation & skill development aspects of the policy.

The policy for import of technology could be further subdivided into two policy measures: technology licensing, which is popularly known as Foreign Collaboration (FC) policy[82] in India and import of embodied technology i.e. import of capital goods (CG) and foreign direct investment (FDI). In this section we will concentrate on FC policy as it concerns with regulation on imports of technology that provides the ability to bargain for various conditionality by the domestic firms. The policy for import of CG and FDI will be discussed under the aegis of investment policy. For an easier understanding we present the analysis in two steps. We begin with analysis of evolution and present status of the two technology policy measures. Then we analyse the causal interactions i.e. impact of these measures on performance of the firms through analysis of various mechanisms and attributes. The empirical evidence will be presented through relevant case studies.

6.2 Policy framework

6.2.1 Policy for import of Technology: FC policy

The genesis of FC policy could be traced back to import control order of 1939, for goods & services that was extended to this new type of import transaction in 1946, when the first case of import of technology was given approval. But no specific policy was laid down for FC approval till the late sixties. It was governed through administrative orders only (Cooper, 1988; Desai, 1988). The policy took shape during the second phase of development i.e. 1966-80. Nevertheless, it was still governed through administrative guidelines rather than legislation. The salient features of the policy evolved during the period are (Bell & Scott-Kemmis, 1988; Cooper, 1988; Desai, 1988; Lall, 1984, 1987; Mascarenhas, 1982):

- Restrictions on imports of technology available in the country,
- Emphasis on progressive import substitution of components,
- The upper threshold limit of royalty payment limited to 5% for domestic sales and 8% for export sales and subject to tax. The royalty payment to start from the date of commencement of production rather than the date of agreement,
- Lump sum payment for technology transfer to be paid in minimum three installments,
- The permitted duration of agreement limited to five years in stead of 10 years,

[82] Import of technology or foreign collaboration should not be confused with technology collaboration. While the former involves only one way transfer of knowledge from technology supplier to recipient, the latter involves two way exchange of knowledge (Alcorta, 1998 et al.; Mascarnehas, 1982).

- The acceptable geographical limitation for exports imposed by the collaborator limited to countries where the collaborator had subsidiaries, affiliates or licensees,
- No permission for the use of brand name/trade mark of the collaborator,
- No restrictions allowed on the firm's right to sell/sub-license the imported technology,
- Restrictions on extension of collaboration period,
- Restrictions on import of technology for similar products,
- Packaged import of technology or import-tying clauses discouraged,
- Emphasis on training of personnel in India and abroad by the collaborator,
- Project execution services (engineering consultancy) to be provided by Indian firms or at least be under Indian prime consultants.

The FC policy became progressively more restrictive. In 1969, the government segmented the industries into three categories based on perceived complexity of technology:

- Industries where no foreign technology or investments were considered necessary;
- Industries where only technology could be imported but not foreign investments; and
- Industries with complex technology where both foreign technology and investments to be encouraged known as *'high priority'* industries.

Machine Tool was put in the category of 'high priority' industries. In1978 the list was again updated. Such segmentation imparted protection to domestic firms, particularly those in the small-scale sector as no FC or FDI was allowed in this sector. However, with the passage of time the distinction between industry groups got progressively diluted and import of technology in almost all industries were allowed (Lall, 1984, 1987).

Although the primary concern of FC policy ought to be to facilitate access to new technology, its quick adaptation and assimilation, but it was used more as a measure to conserve foreign exchange, achieve self-reliance and protect domestic industry (Bell & Scott-kemmis, 1988; Desai, 1988; Lall, 1984, 1987). The conservation of foreign exchange was effected by way of imposing cutoff limit on the rate of royalty payment, controlling outright payment for technology, restricting duplication of import for the same item, and limiting the duration of agreement etc. How far the said objective was achieved is debatable but these measures restricted the ability to assess modern technology considerably. The conditions pertaining to progressive import substitution of components, restrictions on duration on agreements, retaining the right to sell or sublicense the imported technology as well as emphasis on training of personnel acted for attaining the objective of self-sufficiency. The competition was restricted through segmentation of industry into different categories for the purpose of import of technology and FDI, restricting duplication of imports for the same item and use of brand name/trade mark of the collaborator. These objectives were achieved to a large extent although with negative impacts. In this context, the observation of Rosen (1988) is worth mentioning, "*it was thought that protection at the level of production (protection against imports) and at the level of technological learning (protection against a strong foreign presence and excessive imports of technology), provided to domestic industry would stimulate them to expand, to become more cost effective, to narrow the gap between domestic products vis-à-vis imported products in terms of cost, quality and technology and eventually to reverse the trend. Then, protection could be* *reduced or eliminated. In the process the country would achieve overall industrial growth and attain a high degree of economic independence. It is ironical that it did not happen in reality"*. Nevertheless, one would agree that the objectives were consistent with the overall national goals and dominant issues recognized at the time of independence.

In the post-liberalization period the FC *policy* has been substantially liberalized in concurrence with the re-defined national objective of integration with the global economy. In order to inject the desired level of technological dynamism in Indian industry, now import of foreign technology is encouraged both through foreign technology collaborations and FDI. The major bottlenecks as perceived by the foreign collaborators and WTO such as condition of progressive increase of local content requirement, restrictions on the use of brand names/ trademarks, conditions on territorial restrictions for exports, firms right to sell or sub-license and compulsory training of personnel in India or collaborator's plant etc. have been dispensed off. Now these conditions could be negotiated between the buyer and seller of technology without any interference from the government. As regards to royalty payment, outright transfer fee and duration of agreement etc., the policy has remained more or less the same but procedure has been considerably simplified. Now the Reserve Bank of India, through its regional offices, can accord automatic approval to all industries for foreign technology collaboration agreements subject to (i) the lump sum payments not exceeding US $ 2 million; (ii) royalty payable being limited to 5% for domestic sales and 8% for exports, subject to a total payment of 8% on sales over a 10 year period; (iii) the period for payment of royalty not exceeding 7 years from the date of commencement of commercial production, or 10 years from the date of agreement, whichever is earlier; and (iv) items do not fall under the list of compulsory licensing or reserved for development in small-scale sector. It is important to note that now no fee is payable and approvals are available within 2 weeks of submission of complete application. The government considers only those cases, which do not fall under the purview of automatic route. A time frame of 60 days has been stipulated for expeditious action. It may be mentioned that in the post-liberalization period, although the basic objective of FC policy has remained the same i.e. to facilitate access to new technology, its quick adaptation and assimilation, but the implicit objectives of conserving foreign exchange, achieving self-reliance and protecting domestic industry have been dispensed off to bring consistency with the re-defined national objective of integration with the global economy.

6.2.2 Policy for promoting in-house R&D

The government gave adequate thrust on in-house R&D from the very beginning through various measures both implicitly and explicitly to build up technological capability in the firms. Its root could be traced back to the Statement of Industrial Policy 1945, which recognized scientific and industrial research as one of the prerequisites of industrial progress and emphasized on maintaining it at a high level (Marathe, 1986). A policy document was announced in 1958 in the form of Scientific Policy Resolution, 1958. The Resolution emphasized the responsibility of the government "*to foster, promote and sustain, by all appropriate means, the cultivation of science and scientific research in all it's aspect: pure, applied and educational*" (Mani, 2001). In general, the Resolution stressed on three broad aspects: building in-house R&D capability in the firms, creation of technology infrastructure and supply of scientific & technological skills. Further in the seventies, the enactment of Indian

Patent Act, 1970[83] gave significant boost to domestic technological development activity, particularly in drugs & pharmaceuticals and food industries.

In 1971, the government established the National Committee on Science and Technology (NCST) to formulate comprehensive S&T plans on sustainable basis. Based on its recommendation, in 1973 a scheme for the recognition of in-house R&D units was introduced to encourage firms to pursue in-house R&D to successfully adapt and assimilate imported technology, introduce new products and processes, and develop import substitutes (DST, 1999). It provided various fiscal and non-fiscal incentives such as exemption from QR for import of equipment, prototypes, raw material, components and consumables; concession on import tariffs; 100% tax deduction on expenditure incurred on approved scientific research programs; and excise duty exemption on products based on in-house R&D as well as preference in import of technology and capital equipment. Further, accelerated depreciation on equipment and special investment allowance were also added in the list of permissible incentives in 1977. Royalties earned by the firms on account of export of indigenous technology were given complete exemption from tax and those earned within the country were allowed 40% rebate. The government reiterated its commitment to promote domestic technological capability through announcement of another policy document in the form and style of Technology Policy Statement (TPS), 1983. It stated, "*there shall be a commitment to ensure an adequate scale of investment in R&D for the absorption, adaptation and, wherever possible, improvement on and generation of new technology*." Further, to inculcate technological entrepreneurship in the country, the government proposed to launch Venture Capital Fund (VCF). The R&D Cess Act 1986 was introduced to generate funds for the same. It empowered the government to levy cess at the rate of 5% on all payments made for imports of technology from abroad. It was initially operated through Industrial Development Bank of India (IDBI), the largest state-owned institution for providing industrial finance in the country. But later transferred to newly established Technology Development Board (TDB) in 1996 (TDB, 2002).

In the post liberalization period, some of the important policy documents announced are CSIR 2001 Vision & Strategy, 1996; Venture Capital Funds Regulation, 1996; amendment of Indian Patents Act 1999; TIFAC 'Vision 2020' and New Millennium Indian Technology Leadership 2000. Among the recent five-year plans, the ninth FYP, 1997 elaborates in detail the plan for thrust on building technological capability. The latest document: the approach paper to the tenth FYP (2002-2007) states *"The approach to technology will go beyond technology import, absorption, adaptation or assimilation . . . Technology will be used as a tool to give India a competitive position in the new global economy . . . increasing India's share in high-tech products, deriving value from technology led exports and export of technology will be given a major thrust."* The overall approach seems to be creating enabling environment for R&D in terms of improving technology infrastructure, enhancing industry-institution linkages,

[83] It did not grant product patents for pharmaceuticals, agro-chemicals and food products and reduced the life of process patents from 16 to 7 years. It helped domestic firms to reengineer products through alternative processes in a cost-effective way.

development of science & technology manpower and providing fiscal incentives for encouraging in-house R&D. The main incentives are (DST, 2000; Mani, 2002):

Direct tax incentives:

- 100% write off of revenue and capital expenditure for in-house R&D. The deduction for capital expenditure has been raised to 150% for certain specified industries such as drugs & pharmaceuticals, electronic equipment, telecom equipment industry etc. but Machine Tool industry does not fall in the list.
- Weighted tax deduction of 125% for the financial contribution by the firms for sponsored research in approved national labs, universities etc.
- Income-tax exemption of 125% of donations made to approved scientific and industrial research organizations,
- Accelerated depreciation allowance for investment on plant & machinery based on indigenous technology,
- 10 years tax holiday to the firms created exclusively for R&D activities.

Indirect tax incentives:

- Exemption from Custom duty for recognized in-house R&D units on import of capital equipment, instruments, spares, accessories and consumables,
- Exemption from Custom duty on imports made for R&D projects funded by the government in industry,
- Exemption from Excise duty for 3 years on goods designed and developed by a wholly owned Indian company and patented in any of the two countries out of India: USA, Japan and European Union.

It may be noticed that in the pre-liberalization period the approach of policy revolved around adaptive R&D and supports for the same. It was induced mainly through measures like imposing conditionality on FC agreements, development of technology infrastructure and latter various fiscal & non-fiscal incentives. In the post-liberalization period the driving force for in-house R&D is need for survival in the unprotected market. The main instruments for inducing in-house R&D are provision of adequate institutional support and fiscal & non-fiscal incentives.

6.3 Policy-Performance Causation

6.3.1 Foreign Collaboration Policy

6.3.1.1 Framework for analysis

The data on surveyed firms reveals that 70% of the firms had imported technology (FC) through product/model specific FC agreements from abroad at some point of time. The rest (30%) banked on own technological efforts for technological development. During the interviews, firms were asked as to how FC policy affected their performance through development of their technological capabilities or in other words how the firms leveraged the FC policy to develop their technological capabilities? The various elements of policy performance causation in respect of FC policy are depicted in Table 6.1.

Table 6.1: Constituents of Policy-Performance Causation framework: FC Policy

Policy	Mechanism	Indicator	Performance
FC policy *(Adaptation/ Absorption)*	-Transplanting Product concept & design -Adaptation of product & process -Improvement of product & process -Continuous interaction with the Collaborator	-No of products introduced in market based on last FC -R&D intensity -No of QSE - Use of modern technology	- Sales -Export ratio

6.3.1.2 Empirical evidence: Case illustrations

In this section we will explain the manner in which the policy-resource-performance causation takes place through illustration of case studies. The firms have been chosen from across the spectrum of the CNC machine tool industry. However, most of the case studies pertain to the firms with relatively better performance due to two reasons. First, illustrations from successful firms give glimpses of the best that has been achieved so far but as we know still these firms are not competitive internationally. Second, it was difficult to get data from firms with poor performance. To start with, we present six case studies:

- F_A: a large-scale government owned firm with FC
- F_B: a medium sized private sector firm with FC and Foreign equity participation
- F_C: a medium sized private sector firm with FC
- F_D: a medium sized private sector firm without any FC
- F_E: a small-scale private sector firm with FC
- F_F: a small-scale private sector without any FC

F_A: Building on FC

The firm F_A is a large multi-product & multi-location public enterprise established in 1953, as a consequence of special emphasis given on establishment of Capital Goods industry by the government. Due to overall lack of technological capability in general and project execution capability in particular in the country at that time, the firm was set up in technical collaboration and minor equity holding with a leading machine tool firm of Europe on a turnkey basis. Since then, FC has been the major source of technology for the firm. Over the years the firm has entered into more than 40 FCs with leading manufacturers of Europe, USA and Japan for manufacture of various types of machine tools to build its technological capability.

The firm sincerely thrived for assimilation, adaptation and absorption of imported technology from the very beginning. It had formed special task force to work in tandem with the foreign experts from the execution stage of the project. It generated competency in equipment procurement, detailed engineering, basic process engineering, plant layout etc. It inculcated confidence to run the plant independently subsequently. Therefore, after the commencement of commercial production, the collaboration was terminated, as it was perceived that the objective of the collaborator and the firm were not matching, although with mutual consent. The collaborator's role remained just as a technical consultant and that too for a limited period. However, adequate emphasis was given to get continuous flow of tacit knowledge from them. Their experts were stationed to advise on all aspects from design to manufacturing and impart training to the employees. Employees were also sent to collaborator's plant to learn the intricacies of design and operations. The culture of consciousness about quality and training, which came from the collaborator, is still the mainstay of the firm. The firm claims that the emphasis on training as one of the conditionality in the FC agreement created awareness for the same and fortunately the collaborator extended wholehearted cooperation to achieve it.

The firm has always been a trendsetter in the industry. It was the first to develop a NC milling machine and exhibit the same in the early seventies in EMO, Hanover. Subsequently it introduced series of CNC machine tools of different product family and varying degree of complexity based on imported technology combined with own technological efforts. Although the firm continuously depended on imports of technology for introducing most of the new products i.e. in Mytelka's (1987) word: '*a psychological environment of dependence'*, sufficient efforts were undertaken to absorb the technology and introduce different variants of the products by way of improvement in existing ones and incorporating new features as per the demand as well as using the knowledge gained to design & develop new machine tools on its own. A corporate level manager of the firm remarked, *"We have availed the facility of foreign collaboration policy of the government in a good way since inception. Foreign collaborations were useful not for the product for which we entered into the agreement only but for building our overall technological capability. Each FC agreement enabled us to develop about two to ten variants from one basic configuration and we also used the knowledge gained, for developing other varieties of machine tool."* The firm claims that FC was used as a strategy to introduce latest technology in the least time and cost under the constraints of demand (it forced the firm to diversify in different family of machine tools) as well as supply side.

The recent liberalization in the FC policy, particularly in respect of non-financial conditionality and ease of procedure, has enabled the firm to leverage it for quick negotiation of FC agreement. The latest FC, which has been approved recently, took about half of the time vis-à-vis pre-liberalization period from the date of commencement of negotiation to approval and incorporates all the clauses necessary for transfer of technology. Commenting on these developments one corporate manager remarked, *"During the earlier days our decision on choice of technology were dictated by the government regulations and not by business acumen.*

Now technology import has become more like a 'make or buy' decision based on our own requirement and competencies rather than the government dictates." It may be mentioned that ease of getting approval for FC has not influenced the firm to go for flurry of FC. In the span of ten years after the liberalization, the firm has signed just one FC agreement. The liberalized policy framework has facilitated easier acquisition, adaptation and assimilation of technology. It has been achieved through increased technological effort as reflected in the data for R&D intensity of the firm (1.55%), which is higher than the industry average (1.27%) and manpower in R&D department, which hovers around 950. It is also manifested in term of new products introduced in the market. The firm has been able to introduce at an average of five new products every year, which have the roots in technology imported earlier. The case of F_A leads us to conclude provisionally that *policy framework facilitated the imports of technology by the firms to build technological capability and imports of technology help in building technological capability in the firms.*

F_B: Banking on FC

The firm F_B is a mid-sized company in private sector established with FC as well as foreign equity participation from one of the world-renowned machine tool manufacturer of USA to manufacture 30 numbers of CNC heavy duty lathes in 1985. It commenced commercial production in 1987. It belonged to a large engineering conglomerate with interests in industries like power, construction, mining, agriculture, industrial machinery, transport and machine tools etc. The group had considerable interest in machine tool business. The flagship company of the group was one of the oldest and second largest machine tool manufacturers in the country. The size of the group in general and their experience and market share in machine tools in particular, were the attractions for the technology supplier for collaborating with the firm. The firm was set up separately to produce CNC machine tool.

The main factor that contributed in the process was experience of the parent company in acquisition and absorption of imported technology. It enabled the firm to identify & selection of technology and technology supplier, successfully negotiate with the collaborator, develop organizational system by way taking the services of key persons with experience in the technology transfer process and other critical areas and quickly identify vendors for supplying parts & components from domestic as well as imported sources. The firm was able to attract equity participation from the collaborator, thus the collaborator extended continuous support to safeguard their assets devoted for the venture, keep up their brand image and get foothold in the domestic market, which otherwise was difficult in the protected environment. The firm was able to adapt product concept and design, and do product & process engineering based on the availability of raw material and components from domestic sources as well as the requirements of the domestic buyers. It enabled the firm not only to introduce the product based on FC but also to develop twelve other variants of the product in different spindle size and power despite of the fact that the firm had only 3 persons in its R&D department and spent 0.38% of its annual turnover. In this way the firm was able to manufacture 15 to 20 CNC machines every year, maintain positive net profit ratio and declare dividend every year for ten years since commencement of the production.

The healthy performance of the firm and perceived growth of Indian market generated more interest of the collaborator in the firm. In 1999 the firm was taken over by the collaborator.

The objective of the takeover could be gauged from their comments "*Acquiring majority interest in the [firm's] operation broadens our access to the growing Indian market . . .Our new majority position expands our presence in India and enables us to establish a growth platform for the production of lathes and vertical machining centers for that market."* The liberalization of FC policy facilitated the process of increase in equity share. However, the continued shrinkage of domestic market in the recent past and the firm's lack of export capability put the firm in the red. Such developments dampened the interest of the collaborator in the firm. Now bulk of share holding has been transferred to another Indian firm. It has interest in machine tool component manufacturing and also has experience with dealing foreign technology and technology supplier. Thus it is expected that the firm will be able to regain its lost ground. It leads us to conclude provisionally that i*Imports of technology help firms to achieve better performance level in shorter period of time but own technological efforts are essential for sustained development.*

F_C: Supplementing with FC

The firm F_C is a mid-sized firm in private sector initially established without any FC, but subsequently entered into collaboration to enhance the quality and productivity. Now the firm is the largest manufacturer-exporter of CNC electrical discharge machining (EDM)[84] in the country. In the scenario when the overall manufacturing sector in the country is facing recession and domestic machine tool demand is shrinking, the firm has been able to maintain sustained growth both in the domestic as well as export market. From a single product company in the early seventies, today it has become a multi-product, multi-location company. Its corporate philosophy is to achieve growth through quality and productivity.

Initially it started manufacturing simple non-CNC EDM based on its own efforts. In order to enhance the quality and reliability of its product, it entered into technical collaboration with one of the best European manufacturer in the late seventies and successfully assimilated/ absorbed the imported technology. It gave adequate emphasis to gain tacit knowledge from the collaborator. The emphasis on training of employee in FC policy helped the firm to include the clause explicitly in the agreement. Employees were sent to collaborator's plant to learn the intricacies of design and operations. Experts from the collaborator visited India to impart training and guidance on various aspects. The conditionality of time bound indigenization with simultaneous restriction on imports on raw material & components, had induced them to give adequate thrust on product & process engineering to manufacture critical parts in-house as well as to outsource simple fabrications etc. from local vendors. The collaborator's attitude towards technology in terms of quality and precision created a general awareness in the firm and acted as platform for further development. Subsequently, the firm developed and introduced quite a few variants from the basic configuration based on its own efforts.

The firm integrated the knowledge gained through the FC with its own in-house efforts, and developed the CNC version of EDM in the mid eighties. It enabled the firm to capture the domestic market as well as to enter into export market. In order to improve the product further,

[84] Electrical discharge machining, commonly known as EDM, is a process that is used to remove metal through the action of an electrical discharge of short duration and high current density between the tool or wire and the work-piece. It is useful for machining intricate shapes that would be impossible to produce with conventional machine tools (Krar & Check, 1998).

it entered into two new FCs: one with an US firm for CNC controller for the EDM and other with a Japanese firm. The first FC was just for some critical components and that too limited to import of design and drawings. Therefore the firm had to pay less for the FC and it received the approval from the government relatively quickly as the agreement was within the preferred parameters of FC policy. Similarly the second collaboration was for performance enhancement of the product through emphasis on integration of design & manufacturing, which involved exchange of tacit knowledge. The emphasis on training in FC policy helped the firm to include the clause explicitly in the agreement. Employees were sent to collaborator's plant to learn the intricacies of design and operations. Experts from the collaborator visited India to impart training and guidance on various aspects. The policy of staggered payment of lump sum fee kept the continued interest of the technology supplier in transfer of technology.

In the post liberalization period, the firm has not entered into any FC for the above product line as such, but its sister concerns did enter into a few collaborations for diverse related products/ instruments. The liberalization of FC policy has facilitated the process of entering into collaboration agreement. The firm used indirectly the knowledge gained through those recent collaborations in improving the existing product line further. Such efforts contributed in introduction of new improved version of the product periodically in the market. It launched new versions of the products in the last three successive EMO at Hanover. The products got widely noticed, resulting in confirmed orders. The firm has been able to sell more than 400 machines during the last two years in 14 different countries. It has been able to do so as it has built organized set up for in-house R&D. It has a team of about 40 qualified designers for product & process development. Its R&D intensity is approx 1% of annual sales and it regularly invests in building R&D infrastructure particularly CAD/CAM facilities. It is a typical example of supplementing in-house efforts with imports of technology. It leads to conclude provisionally that firms' o*wn technological efforts with imports of technology is likely to help firms in building technological capability and achieve better performance level.*

F_D: Master of own destiny

The firm F_D is a mid-sized firm in private sector established without any FC. Its vision is to be the large-scale producer world-class machines. It belongs to a small group of firms run by techno-entrepreneurs. Initially it came into being as a machine tool designing Service Company in the late seventies. A few years later the firm stepped into manufacture of simple SPMs for auto industry and then introduced CNC lathes by mid of the eighties. Now the firm is the largest manufacturer and exporter of CNC lathes in the country. With a very strong background in Machine Tool design and integrated manufacturing facilities, the group is geared up for large volume production of machine tools and is known for its ability to provide cost effective solutions to customers. It is an ISO 9001 certified company. It primarily caters to the need of auto industry and general engineering industry. In the scenario when the overall manufacturing sector in the country is facing recession and domestic machine tool demand is shrinking, the firm has been able to maintain sustained growth both in the domestic as well as export market.

The firm is a unique example of technology spillover and techno-entrepreneurship. All promoter directors of the firm are ex-employee of the CMTI, a government R&D institute dedicated to machine tool manufacturing technology in technical collaboration with

Czechoslovakia.[85] They had acquired the expertise in design, controls and tooling while working there on various projects, which were usually undertaken in collaboration with HMT and other foreign manufacturers/ agencies. In this way they got exposed to wide spectrum of machine tool technology. Thus the basic culture of design and development of machine tools has the roots in their parent organisation. Further, the firm hired skilled and experienced people working in firms having FC or foreign equity participation, which strengthened their technological capability. Learning from products developed by the competitors with FC also helps them to benchmark their own products.

The firm dovetailed its core strength of design capabilities with modern business practices in bringing out cost-effective products in the market. It adopted the product strategy of manufacturing simple and reliable product in order to offer value for the money to the customers. Apart from continuously developing new products, it adopted the mechanism of "Continuous Improvement Process" i.e. constantly upgrading the machines through incorporating feedbacks from the customers. The firm sends a team comprised of technical personnel from design, manufacturing and marketing periodically to meet customers to understand their needs, interact closely with the manufacturing personnel and collect vital feedback on the machines they are using. The information is used to design and incorporate value-adding features into its existing product line as well as new product development. The interactions with customers also help them to design and manufacture completely tooled up machines built to specific customer needs. Moreover, machines are updated continuously and kept current with machines of the developed countries. The product development team also keeps themselves abreast of the international trends in manufacturing & machines by participating and visiting most of the well-known manufacturing technology shows around the world. These initiatives result in introduction of a variety of new machines regularly with a short gestation period. The average gestation period for product development is just six months for the firm. It has been possible because the firm keeps a team of 25 qualified engineers in the core product/ process development group and 90 engineers in the cross-functional group. Its R&D intensity is approx 1%. It is one of the first firms to use CAD system.

The firm believes that FC is not essential for new product/ process development as it creates an attitude of technological dependency and inhibits innovativeness. The firm has been able to bring out cost effective products as it did not spend on technology import and imported components as per the dictates of FC agreements. With its sustained performance in domestic as well as export market, the firm has proved that it is a success story. It leads to conclude provisionally that *firms' own technological effort is the key to build technological capability and achieve better performance.*

F_E: Enjoying technology spillover

The firm F_E is a small firm in private sector initially established without any FC in the early sixties but subsequently resorted to FC for introducing CNC machine tools in the early

[85] CMTI: Central Manufacturing Technology Institute earlier known as Central Machine Tool Institute. It was established in 1962 for industry-oriented research and development in respect of machine tools by the government of India in technical collaboration with Czechoslovakia. Now its scope of activity has been enlarged to cater for the needs of metal-based manufacturing industries. Consequently it has been renamed as Central Manufacturing Technology Institute.

nineties. It manufactures both simple non-CNC and CNC machine tools. Most of its buyers are domestic SMEs in auto and general engineering industry. The firm has been benefited by FC both directly and indirectly.

In the beginning it started manufacturing jigs and fixtures as an ancillary unit to HMT at its behest in order to satisfy the conditionality of local content requirement of FC agreements. Within a few years the firm graduated to manufacture simple non-CNC machine tools. All the promoter directors were earlier working in HMT and had gained wide experience in design and manufacture of machine tools. They had brought the culture of quality and precision with them from there. Therefore the firm started getting recognized in the market in a short span of time. It also inculcated confidence among some of the big buyers particularly from auto/ auto component industries, which asked the firm to develop simpler version or replica of imported machine tools. The firm did the job through reverse engineering based on design & drawings as well as guidance given by the buyers at a considerable cheaper price than the imported one. The firm used these opportunities to develop the products for the other buyers also. Within the span of 37 years the firm developed 46 products/models, including a few CNC machines for various buyers. It developed the first CNC machine tool for an auto component industry in the late eighties. Although the firm considered even minor incremental development or change of specification in its list of product development, nevertheless it reflects its ability to design & develop marketable products. In quite a few cases, the firm took help of outside design consultants for product development. It is gathered that most of the design consultants are the ex-employees of HMT or other large firms with FC or CMTI.[86] Such initiatives helped the firm to develop its technological capability as well as growth.

The substantial liberalization of FC policy encouraged the firm to look for necessary technology from abroad. The firm entered into FC with a European manufacturer in the early nineties for a component of CNC machine tool. The liberalized scenario helped the firm to give thrust on adaptation of product concept & design, and product engineering rather than emphasizing on development of local substitutes. The firm could import necessary components without any hassles and therefore did not face much difficulty in assimilation/ adaptation of technology. It received continued guidance from the collaborator in the process. To facilitate quicker assimilation and adaptation of technology, the firm took help of outside design consultants. The firm does not have any organized set up for R&D and necessary manpower. The investment in R&D department is negligible and there are just two persons assigned for the purpose. It spends about 0.85% of its annual sales on R&D out of which a big chunk goes for outsourcing design capability as fees to design consultants. Nevertheless, the acquisition of technology from abroad has been instrumental in increasing its turnover by double fold within a span of six years. The case of F_E leads us to conclude provisionally that t*echnology spillovers have been instrumental in building technological capability in the firms and increasing firms' performance.*

F_F: Facing drawbacks of small size

The firm F_F is a small firm in private sector, which has never ventured to import technology from abroad so far as it feels itself too small to do so. It was established in the early sixties as

[86] For instance one of the sample firms (Firm_D) started its operations as design consultants.

an ancillary to HMT to supply sheet metal fabrications. Gradually it started manufacturing small simple non-CNC machine tools. In the late eighties it took up the job of retrofitting existing non-CNC machine tool to convert them into CNC machine tools. It employs less than 50 persons and its annual turnover is about Rs 15 million. It caters to domestic small job-shops in auto and general engineering industry. The capital investment in R&D is negligible and recurring investment amounts to just 0.25% of annual sales. One of the partners manages the design and development work.

Like the earlier case, the two promoter directors of this firm were also ex-employees of HMT. They took the advantage of import-substitution program of HMT and floated their own firm to become job-processor of HMT. They received all assistances from HMT in terms of raw material, design & drawings, quality inspection and periodic training. After some time another technocrat from a private sector firm manufacturing non-CNC machine tools under FC, joined their team. Thereafter they started assembling small simple machine tools copying the design of their parent company. Due to low overheads and simple design, the firm was able to create a niche for the buyers whose requirements are met by cheap low quality simple machines. With gradual diffusion of flexible automation, the firm also entered into activity of retrofitting existing non-CNC lathes and milling machine first with digital readouts (DRO), and programmable logic controllers (PLC) and then simple CNC systems on job processing basis i.e. the buyers provide major inputs and the firm undertakes the job due to lack of adequate capital. The firm was in opinion that small size is the big deterrent in their progress. It is equally applicable for their buyers as well. They would have been more successful, had the government provided adequate incentives to the users to convert their existing non-CNC machine tools to CNC versions. Therefore it does not get consistent order for such jobs and hence poor performance. The case of the firm F_F leads us to conclude provisionally that s*mall size acts as a deterrent for building technological capability and achieving better performance.*

6.3.1.3 Causal interactions

In order to draw insights from the case studies, we have presented the findings under three broad headings: mechanisms adopted to leverage the policy framework by the firms (Table 6.1); general observation regarding FC policy framework (Table 6.2), and its spillover effect (Table 6.3) It may be noted we have mentioned only the illustrative cases during the discussion but findings in respect of all the sample firms have been presented.

6.3.1.3.1 *Mechanism, Indicator and performance measures*

It is seen that the firms, in general, adopted four mechanisms to adapt and absorb imported technology that culminated in building their technological capability. They are: *transplanting product concept & design (M_1); adaptation of product & process (M_2); improvement of product & process (M_3); continuous interaction with the Collaborator (M_4)*. The result of adoption of these mechanisms are reflected in the *indicators* like: *numbers of products/variants developed based on the last FC (I_1)*; *R&D intensity* (I_2) in %; *number of QSE in R&D (I_3)*; and *use of modern technology such as CAD in design & engineering (I_4)*. It may be mentioned that all these mechanisms are interlinked with each other and quite a few elements of each mechanism overlap with each other as well. Thus it is difficult to isolate indicators i.e. intermediate performance measures for each of the mechanisms individually. These ultimately culminate in the performance of the firms, which has been measured in terms of *relative* *annual sales* (P_1);[87] and *export ratio* in % (P_2). Table 6.2 presents the snapshots of mechanisms, indicators and performance measures in respect of the sample firms.

Table 6.2: Mechanism, Indicator and Performance measures

Firm	Mechanism				Indicator				Performance	
	M_1	M_2	M_3	M_4	I_1	I_2	I_3	I_4	P_1	P_2
F_A	x	x	x	x	6	1.6	950	1	686.3	2.0
F_B	x	x	x	x	4	0.4	3	0	25.7	Nil
F_C	x	x	x	x	5	1.0	36	1	75.9	9.7
F_D	na	na	na	na	na	1.0	25	1	84.9	4.0
F_E	x	x		x	1	0.9	2	0	4.4	Nil
F_F	na	na	na	na	na	0.1	1	0	0.4	Nil
F_G	x	x	x	x	2	1.1	18	1	36.5	1.4
F_H	x	x	x	x	2	1.5	8	1	5.1	2.8
F_I	x	x	x	x	4	1.5	30	1	95.1	3.1
F_J	na	na	na	na	na	1.4	50	1	52.6	0.2
F_K	x	x	x	x	3	1.2	45	1	98.7	Nil
F_L	x	x	x	x	4	2.9	383	1	292.3	9.1
F_M	x	x	x	x	2	2.1	26	1	87.4	0.4
F_N	x	x	x	x	3	3.1	4	1	21.0	12.0
F_0	na	na	na	na	na	1.9	15	1	29.9	Nil
F_P	na	na	na	na	na	2.1	15	1	14.8	Nil
F_Q	x	x	x	x	3	0.3	35	1	89.1	1.0
					Mean	1.42			100.0	

Abbreviations: 'x' : indicates adoption of the mechanisms by the firms and blank: non-adoption; na: Not applicable (The mechanisms indicated are not relevant for the firms having no FC)
Mechanisms: M_1: Transplanting Product concept & design; M_2: Adapting product & process; M_3: Improving product & process; M_4: Continuous interaction with Collaborator.
Indicators: I_1: No of products/variants developed based on the last FC; I_2: R&D intensity (%); I_3: No of QSE in R&D; I_4: Use of modern technology (e.g. CAD) in design and engineering.
Performance measures: P_1: Relative annual sales; P_2: Export Ratio (%).

- *Transplanting product concept & design (M_1)*

The process of transplanting product concept and design is the first step in the transfer of technology after entering into agreement with the technology supplier. It concerns with transplantation of design & engineering specifications of the product supplied. During the process understanding is developed regarding design standards, basic configuration, final specification, and other necessary details. The basic documentation regarding various parts, sub-assemblies and assemblies of the product in terms of part list, engineering drawings, material specifications, tolerances, bills of material and customer & service support data etc. are prepared. Simultaneously necessary information on product catalogues, operating manuals, and other related documentations for marketing are also developed.

Our data suggests that all firms having FC adopted this mechanism invariably since there is no alternative or short cut for this process. The policy framework has also been quite particular about this mechanism. Any FC agreement has to clearly stipulate the supply of design & engineering specifications and other necessary details by the technology supplier and

[87] The performance measure: annual sale has been indicated in relative terms considering the mean sales of the sampled firms as 100 to retain confidentiality of the data.

developing understanding about the same by the firms. Nevertheless, there had been certain differences in modes of implementation. The large and medium sized firms undertook this activity totally in-house. While small firms (e.g. F_E) also took help from outside design consultants for the process as it did not had requisite expertise in-house. Similarly most of the large and medium firms have started using modern drawing & drafting equipments such as graphic plotter or CAD etc. About 80% of sampled firms have such facilities in-house, although sophistication and use of the system do vary. Small firms usually do not possess such systems due to lack of capital, incentives and initiative except a few like F_H, which has recognized the importance of building the design capability to achieve better performance.

- *Adaptation of product and process (M_2)*

The adaptation of product & process design to local conditions helps in understanding the 'know-how' of the technology. It requires considerable technological effort by the firms and leads to building technological capability. In the initial stage of technology transfer process, adaptations in product design for physical conditions e.g. electricity supply, dust, humidity; local availability of raw materials & components; and simplification of certain systems as per customer requirements become the necessity. Certain other adaptations in terms of scale, scope, quality and sophistication of the product based on the market size, sophistication of the domestic buyers, competitive environment, price levels etc. also are need to be undertaken. The adaptations of former type are sometimes referred as 'technical' and the latter 'economic' adaptation in literature (Fransman, 1984; Lall, 1987). Like the product design, the process design supplied by the technology supplier is also transposed and the details regarding as to how, by whom, and where the products are produced in the shop floor are finalized. It establishes links between design and manufacturing activity of the firm. In the initial stage it concerns with design of plant-layout; selection of equipment and operations; size and skill of labor; tooling, jigs & fixtures, methods & standard operating procedures etc. It may be mentioned that credence is given to various aspects of 'economic' adaptations while transposing the process design.

Interviews with the firms suggest that all of them adopted this mechanism, albeit with varying degree. In order to bring out product in the market quickly, initially firms undertook only the essential adaptations necessary to manufacture the products and afterwards increased the degree of adaptation with passage of time & requirement. The process of adaptation of product and process design requires considerable technological effort. The firms that put more emphasis on this mechanism have relatively performed better. It is reflected in R&D intensity (I_2); number of QSE in R&D department (I_3) and use of modern technology such as CAD in design & engineering functions (I_4). Narrating the experience of the adaptation process, the chief executive of a mid-sized firm mentioned, "*Successful adaptation of product and process design wins half of the war. It not only helps in producing the current machine in question, it creates technological capability for future also. The sincere effort certainly pays off. The knowledge gained (learning) during the process of adaptation from the first technical collaboration was very helpful in further development of the product as well as while dealing with the second collaboration.*"

- *Improvement of product and process (M_3)*

In product-centered industry such as machine tool, improvement of product & process is become mandatory to optimize the product and process design for easier manufacturability, minimizing production cost and improving quality. It is undertaken through simplification of design, standardization of parts, design of interchangeable/ modular parts, improvement in existing process design and introduction of modern manufacturing systems etc. The efforts are undertaken by R&D department of the firms in close coordination with manufacturing and marketing discipline for desired results. It requires considerable in-house technological effort by the firms and culminates in building technological capability for understanding the 'know-why' of the technology.

Industry data suggests after the establishment of basic production process, majority of the firms initiated efforts to improve product and process design with varying success. The firms that undertook the process with the required technological effort on sustained basis faired better than the others. F_A, F_C and F_I etc. represent this category. F_A is a typical example of improving product and process based on imported technology with own technological efforts. The firm consistently endeavored to rationalize components and processes. In one of the example reported by Lall (1987), for a product originally developed on the basis of FC, the firm reduced the number of heavy castings from 72 to 25, manufactured components from 950 to 450 and bought-out components from 661 from 330. It reduced cost of production and increased efficiency of production process. Similarly, process improvement through redesigning the plant layout by producing components with similar machining requirement at one place led to saving on material movement, and increase in productivity. The firm operates a separate cross-functional team for undertaking improvement on product and process design. F_C is another unique example. The firm had assimilated the basic technology of the product on its own efforts. It complemented it through imports of technology from one of the best European manufacturer and successfully absorbed the technology. The absorption of technology led to development of CNC version of the product and its various variants on its own efforts through incremental developments. In order to improve design & aesthetics of its product, it replaced sheet metal fabrications by FRP molded. The use of FRP in the place of sheet metal brought down the number of components from 37 to seven. The control panel was modified, made user-friendly and positioned where the worker could access it and operate with ease. The filtration system on a two-tier configuration has been so designed that instead of its earlier 25 square meter space, the machine occupies only 12.1 square meter now. Such improvements increased aesthetics, reduced assembly time, lowered installation time. The firm can now assemble 43 machines per month in place of eight with no additional investment. It has further enhanced sales, profitability and exports on a sustained basis.

- *Continuous interaction with the Collaborator (M_4)*

It has been well recognized that for successful adaptation and absorption of technology by the recipient firm, continued inflow of both non-tacit and tacit knowledge from the collaborator during the entire period of collaboration is essential. The non-tacit knowledge may be transferred easily, as documentations in respect of design & drawings, specifications, operating systems & procedures, databases, and computer software etc. But the transfer of tacit knowledge embedded in human skill and organizational system of the supplier firm, which is difficult to codify, cannot be materialized successfully without continuous interaction with the collaborator. Even for information that is well documented, the recipient firms need continuous interaction for successful adaptation and absorption.

Therefore the firms invariably endeavored to interact with the collaborator throughout the period of collaborations. In order to learn tacit elements of technology employees were sent to collaborator's plant to learn the intricacies of design and operations. Experts from the collaborator were invited India to impart training and guidance on various aspects at different point of time. In few instances F_A, F_C and a few others sent their employee to technology supplier's plant for training even before unpacking the design & drawings sent by them. They were of the opinion that just transfer of design & drawings does not bear fruits. The interactions at human-level are the key to success. To ensure such type of interactions, FC policy initially gave much importance to training of employee at collaborator's plant and continued guidance by their experts. The staggered payment of lump sum fee and royalty payment are also intended for the same. However, the firms opined that more important aspect for continued support from collaborator is the building of rapport & trust between the firm and the technology supplier rather than the government induced conditionality. F_A was in the view that the most effective way is to establish communication between experts of both firms on personal basis. Another firm felt that the key to the success for an effective transfer of technology is the healthy interaction between project managers of both the sides. Small firm like F_E goes one step further in stating that the entire process of transfer of technology is not based on the FC agreement but on mutual trust of both the CEOs.

A glance at the Table 6.1 shows that the mechanisms adopted by the firms seems to be the same for majority of them but indicators and performance measures differ from firm to firm. The plausible reason for these differences lies to be the variations in scope, depth and implementation of those mechanisms. Unfortunately it has not been possible to capture such variations quantitatively due to limited time, budget and willingness of the firms to provide such data. Thus we have taken recourse to qualitative illustrations. Nevertheless, it may be docketed for future research. However at the same time the data reveals that there are some differences in mechanisms adopted by the large & medium firms and the small firms (e.g. F_E or F_H). The small firms are not able to give proper emphasis on improvement of product & process design. The reasons extended by the firms are limited resources, lack of incentives and as well as lack of initiative. Such findings have been substantiated in earlier research in Indian context as well (Aggarwal, 2000; Katrak, 1997). It confirms our provisional conclusion that s*mall size acts as a deterrent for building technological capability and achieving better performance level.*

The qualitative differences in adoption of mechanisms could be presented through illustrating the cases of two medium sized private firms: F_B, which started well but ultimately is in the red and F_C, which has been successful even during the recession. The subsequent down fall of the F_B could be attributed to its lack of proper absorption of technology. The firm could learn from the collaborator the 'know-what', which gave them success in the initial period but could not acquire the actual 'know-how' and 'know-why'. It is reflected in the firm's low level of R&D intensity and less manpower in R&D department. Thus the firm was not able to adapt and absorb technology properly and therefore could not develop cost-effective product either for domestic market or export market. In the late eighties and early nineties when the overall level of investment was favorable, the firm was able to sell its product but it could not do so during the period of recession. Another explanation may be the strategy of the collaborator (based on its strength of equity participation) to not enable the firm to absorb the technology completely. It just wanted to use the firm as a channel to capture the domestic market, when direct exports to India of such machine tools would not have been possible due to protection provided to other domestic manufacturers. Now in the liberalized scenario since they can export directly, they do not find it viable to maintain production facility in India considering the low domestic market. The firm could not export, as from the beginning the target market was the domestic market and therefore international competitive product was not developed. The lack of export orientation is reflected even in the remarks of the collaborator at the time of increasing its stake in the firm. The variations in mechanisms will be elaborated more while discussing in-house technological effort in the section.

6.3.1.3.2 *General observation regarding FC policy framework*

In order to ascertain general observations of the firms regarding FC policy framework, their views have been summarized under five headings (O_1 to O_5) in Table 6.3:

- O_1: Has the FC policy been favorable?
- O_2: Has FC been important source of technology?
- O_3: Whether the financial conditionality deterrent for imports of technology?
- O_4: Whether the non-Financial conditionality deterrent for imports of technology?
- O_5: Whether abolition of non-financial conditionality in the post-liberalization era facilitated FC agreements?

There has been consensus among the firms that the FC policy framework has been more or less favorable throughout as the government had given special emphasis on development of heavy industries in general and machine tool industry in particular from the very beginning. Machine Tool was put in the category of 'high priority' industries where both imports of foreign technology and investments were to be encouraged. Therefore FC acted as a major source of technology even during the period when it was highly restricted. Most of the medium and large firms had entered into several FC agreements. The largest firm in the industry has more than 40 and the second largest had 10 FCs for various CNC and non-CNC machine tools. Data on FC maintained by GoI suggests that during the last two decades more than 125 FC agreements have been signed for an array of CNC machine tools. As regards to the importance of FC as source of technology, a corporate level manager of a firm commented, "*It has been a win-win situation for both foreign collaborators and us. It benefits the collaborators as they get foothold in the domestic market without the risk of investment. They were benefited more during the protected regime when import of was very difficult otherwise and that too without any risk of competition from our side for their own market due to our low technological capability. On the other hand we could introduce a new product quickly. We get technology as well as brand image for a lower cost, effort, risk and time vis-à-vis new product development on our own.*"

Table 6.3: General observation: FC policy framework

Firm	O_1	O_2	O_3	O_4	O_5
F_A	Yes	Yes	At times	At times	Yes
F_B	Yes	Yes	No	At times	Yes
F_C	Yes	Yes	No	At times	Yes
F_D	Yes	No	NA	NA	NA
F_E	Yes	Yes	Yes	At times	Yes
F_F	No idea	No	No idea	No idea	No idea
F_G	Yes	No	NA	NA	Yes
F_H	Yes	Yes	No	No	Yes
F_I	Yes	Yes	At times	No	Yes
F_J	NA	No	NA	NA	NA
F_K	Yes	Yes	At times	At times	Yes
F_L	Yes	Yes	At times	At times	Yes
F_M	Yes	Yes	At times	At times	Yes
F_N	Yes	Yes	No	At times	Yes
F_0	NA	No	May be	May be	Should be
F_P	NA	No	May be	May be	Should be
F_Q	Yes	Yes	At times	At times	Yes

The firms expressed their reservations regarding various conditionality imposed on FC agreements depending upon their individual situation and experience. As regards to the financial conditionality of FC, a corporate level manager of one firm commented, *"The restriction on lump sum- and royalty payment usually helped us to bargain with the technology suppliers. But at times we failed to shop the best technology due to the low limit of royalty (just 5%) and the cap on duration of agreement (5 years) set by the government as collaborators found it uneconomical considering the small market in India. Sometimes the collaborator reduced the technology content to be transferred"*. The chief executive of a small firm quipped, *"The royalty paid to our collaborator can not buy them a cup of coffee as it is payable on indigenous value added only and that too subject to taxes. The collaboration stood just due to our personal friendship."* Similar views were expressed regarding payment of lump sum fee in installments, particularly when the amounts were less. My own experience in evaluation of FC applications suggests the same. The criteria for evaluation were primarily based on price rather than the technological content, particularly in the pre-liberalization period. It used to be very tough for the firms to convince the government for higher payments and due to the delay in the process, at times collaborators used to loose interest in the deal. In the post-liberalization period these hassles have been reduced considerably.

Among the non-financial conditionality, particularly the conditions regarding progressive import substitution of components, firm's right to sell or sub-license the imported technology, and project execution by domestic engineering consultancy firms had major implications both positive as well as negative. On the positive side, these enhanced technological capability of the firms. The condition of progressive import substitution of components induced firms to expedite and achieve the required level of indigenization in the stipulated time period either through in-house production, or developing reliable component suppliers and vendors. Firm's right to sell or sub-license technology also contributed in the latter. F_A is an illustrative example of positive impact of non-financial conditionality. The conditionality of time bound indigenization with simultaneous restriction on imports on raw material & components, in the scenario when supporting & related industries were not developed in the country, induced the firm to give proper thrust on product & process engineering to manufacture critical parts in-house as well as to develop ancillary firms for non-critical items. It helped in developing technological capability all through the value chain of manufacturing from project preparation, project execution, product & process engineering, manufacturing to technology transfer etc. As a positive consequence, the firm became the market leader in a short span of time and still sustains the position. It was able to undertake expansion plan and build new plants on its own under the diversification program as well as become one of the first technology exporter among the third world by the late seventies. Moreover, it was able to understand the intricacies of transfer of technology. All further FCs were limited to selective purchase of know-how only with adequate safeguards on technology content.

On the negative side, such measures induced the firms to pursue R&D primarily for adaptation crowding out the efforts for new product development. It forced the firm to channel its efforts for substituting imported components with local sub-quality components and raw materials. The lack of reliable suppliers forced the firm to create economically unviable facilities in-house particularly for critical components. The conditionality regarding firm's right to sell or sub-license the imported technology inculcated fear of passing on the technology to other firms without receiving any price for the same and inhibited transfer of complete know-how and proprietary technology by the collaborators creating substantial technological gap. It has also been empirically substantiated by Scott-Kemmis & Bell (1988:81) in a study of technological content of collaboration quoting a technology supplier *"... What was transferred were dies, drawings and specifications, not 'know-how' let alone 'know-why'. They acquired a tiny fraction of the technology*." All these put the firm in a disadvantageous position particularly in the international perspective.

The abolition of all non-financial conditionality and streamlining of the procedural hassles in the post-liberalization period, have enabled the firms to introduce new products based on FC in a shorter period in a more cost effective way. They mentioned that the mechanisms adopted for adaptation and absorption of technology such as understanding the concept and design of machine, designing and engineering the machine, adapting them to local conditions by necessary material substitution and incorporating the necessary changes etc. have remained more or less the same but it is more based on economic and technological considerations rather than government regulations. They could import those components without any hassles of indigenization in the first instance, which otherwise had to be developed either in-house or subcontract locally. A chief executive of a mid-sized firm commented, "*Earlier we were pursuing R&D for indigenization targeting protected domestic market only, and now we are doing it to remain competitive in the market*." He further mentioned that it is misleading to presume that firms would undertake R&D only if forced by the government through various regulations. If firms have to survive, they will have to increase their technological capability by undertaking requisite R&D. Such findings confirm our provisional conclusions: *Policy framework facilitated the imports of technology by the firms to build technological capability; and Imports of technology help in building technological capability of the firms.*

6.3.1.3.3 *Technology spillover*

The industry data reveals the inflow of technology through FC has contributed considerably in the development of the industry indirectly through technology spillover (TS). The firms identified following seven possible forms of TS as tabulated in Table 6.4:

- TS_1: Ex-employees setting up the firm;
- TS_2: Using design consultancy services of ex-employees;
- TS_3: Movement of skilled personnel;
- TS_4: Reverse engineering imported products or products manufactured with FC;
- TS_5: Benchmarking against products out of FC;
- TS_6: Job processing or product subcontracting;
- TS_7: Transfer of technology to subcontractors/ vendors.

Table 6.4: Forms of Technology Spillover

Firm	TS_1	TS_2	TS_3	TS_4	TS_5	TS_6	TS_7
F_A			x		x		x
F_B			x		x		x
F_C		x	x	x	x		x
F_D	x		x		x		na
F_E	x	x	x	x	x	x	x
F_F	x	x	x	x	x	x	na
F_G	x		x	x	x		x
F_H	x		x	x	x		x
F_I			x		x		x
F_J	x		x		x		na
F_K	x		x		x		x
F_L			x		x		x
F_M			x		x		x
F_N	x	x	x	x	x	x	x
F_0	x		x	x	x		na
F_P			x	x	x	x	na
F_Q			x		x		x

'x': adoption of the mechanisms by the firms and blank: non-adoption; na: not applicable.
TS_1: Ex-employees setting up the firm; TS_2: Using design consultancy services of ex-employees; TS_3: Movement of skilled personnel; TS_4: Reverse engineering imported products or products manufactured with FC; TS_5: Benchmarking against products out of FC?; TS_6: Job processing or product subcontracting; TS_7: Transfer of technology to subcontractors/ vendors.

The most crucial technology spillover has been seen in terms of ex-employees of firms having FC and research institutes setting up manufacturing firm (TS_1) or design consultancy or other manufacturing based service activities (TS_2). Nine out of fourteen SMEs in our sample have been set up in this manner. The larger firms with FC or research institutes have worked as breeding pond of techno-entrepreneurs. In some cases firms themselves (e.g. F_A, F_L or F_Q etc.) have encouraged employees to set up firms to become subcontractor for them. Some of the technocrats have become design consultants. They work for either SMEs (e.g. F_E) that do not have adequate design & engineering capability in-house or for such firms that use their expertise to improve product & process design to become internationally competitive (e.g. F_C). The promoters of F_D also started as design consultants. In a broader sense the movement of skilled personnel from the FC-based firms to other firms have facilitated flow of tacit knowledge (TS_3) among the firms. The SMEs in the private sector have been the main beneficiaries. However the phenomena has been common across the industry.

Reverse engineering of the machine tool that has been manufactured based on FC (TS_4) is found to be another major spillover effect of FC. This phenomenon is more prevalent in the SMEs. HMT lathes or Kirloskar lathes have been widely copied by small firms of Punjab and Rajkot. Similarly technology spillover in terms of benchmarking against the products of competitors having FC (TS_5) is found to be quite common. All sampled firms agreed to this fact. More than 85% of the firms rated the products of competing firms as a major source of information. Another major spillover effect has been through job processing or product subcontracting (TS_6 and TS_7). Particularly the SMEs appreciated its importance as they gained the most. This phenomenon has been presented in two perspectives. The first one (TS_6) is from the perspective of machine tool firms being receiver of the technology and second one (TS_7) as the firms having FC as transmitter of technology by way of getting work done by subcontractors and in the process transmit technology gained from FC. These findings confirm our provisional conclusion that *Technology spillovers have been instrumental in building technological capability of the firms and increasing their performance level.*

6.3.1.4 Summary

- Firms adopted primarily four mechanisms to build their technological capability viz.: *transplanting product concept & design; adaptation of product & process; improvement of product & process; continuous interactions with the Collaborator*.
- The mechanism adopted by the firms although seems to be similar in nature, varied in its scope and implementation culminating to variations in performance of the firms.
- Imports of technology helped in building technological capability of the firms.
- Complementing imports of technology with own technological effort has been crucial to build technological capability and achieve better performance level.
- FC policy worked differently for different firms depending on the firms' characteristics and strategy of firms to leverage the policy.
- Policy also worked with a lag. The inflow of technology through FC contributed considerably in the development of the industry through spillover effect even for the firms that did not import technology from abroad.

6.3.2 Policy for promotion of in-house R&D

6.3.2.1 Framework for analysis

The elements of policy performance causation in respect of in-house R&D policy are presented in Table 6.5.

Table 6.5: Constituents of Policy-Performance Causation: In-house R&D policy

Policy	Mechanism	Indicator	Performance
Promotion of in-house R&D policy Assimilation/ Improvement	-Assimilation of technology -New Product Development -Continued up gradation of technology	-No of products developed based on own R&D -R&D intensity -No of QSE	- Sales -Export Intensity

6.3.2.2 Empirical evidence: Case illustrations

In this section we introduce two more case studies to illustrate the policy-performance causation. They are:

- F_G: a medium scale private sector firm with recognized R&D set up
- F_H: a small-scale private sector firm with recognized R&D set up

F_G: Relying on own efforts

The firm F_G is a mid-sized firm in private sector established in the early seventies as a small tool room to cater to the needs of the local engineering industries by two techno-entrepreneurs, who came out from the premier R&D institution dedicated to machine tool manufacturing technology. Within a span of four years the firm designed and developed its first cylindrical grinder that won the best design award and best product award in the international machine tool exhibition IMTEX 1979. In 1986 it introduced the first CNC grinder for automobile industry. As on date the firm manufactures a wide range of CNC and non-CNC cylindrical grinders primarily based on its own technological efforts. After 26 years of its inception the firm has imported technology from a renowned European company to increase international competitiveness. The firm's vision is to grow and ensure total customer satisfaction through design, development and delivery of world-class grinding machines and services that are reliable and technologically advance at competitive price. The firm has received ISO-9001 certificate in 1995.

Since inception, the firm had relied on its own technological efforts. The expertise gained by the two promoter directors in design, controls and tooling in machine tool technology while working in the R&D institution on various projects had given them confidence to undertake design and development of machine tools on their own. It helped the firm to develop and introduce 5 types of non-CNC grinding machine within a span of seven years after introducing the first one. By 1986 the firm was able to introduce the first CNC version as well on its own efforts. The sustained investment in R&D facilities facilitated recognition of its R&D center by the government way back in 1982. The recognition enabled the firm to take advantage of various schemes of the government for promoting in-house R&D. The net investment on R& D facilities is to the tune of Rs 3.3 million. Apart from other equipment, CAD station and solid modeling software have also been installed, which helped the firm to introduce products quickly. The average gestation period is about eight months only. Its recurring expenses on R&D activity works out to more than 1 per cent of annual turnover. A team of 18 dedicated qualified scientists and engineers works in R&D center in addition to several engineers assisting from manufacturing and marketing disciplines. So far the firm has introduced 14 different types of grinders out of which 5 are CNCs based on its own technological effort. The firm introduced four types of CNC grinders during the last four years only. It may be mentioned that each type of machine tool has several models. Thus actual number of products introduced in the market works out to be substantial. It leads us to conclude provisionally that *the firms relying on their own technological effort and using FC to supplement are able to build technological capability and achieve better performance level.*

F_H: Small in size big in heart

The firm F_E, a small firm in private sector, came into being as an ancillary to HMT for manufacture of precision machined components and accessories in the mid sixties. The promoter director was earlier working in HMT and had gained wide experience in design and manufacture of machine tools. Another partner, who joined him later, also had long experience in design & development of machine tools in a pioneer company of the industry. Initially the firm developed its technological capability on its own technological efforts.

The firm is recognized in industry circle as a manufacturer of high precision grinding spindles. It simultaneously developed a special purpose non-CNC Grinding Machine for automobile industry based on reengineering imported machines and information on public sources on its own effort. It also successfully developed another special purpose CNC grinding machine through reengineering at the behest of a large auto component firm established in joint venture (both foreign collaboration and foreign equity). In post-liberalization period it entered into technical collaboration with a renowned European company for manufacture of another version of grinding machine. Although small in size, the firm recognized the importance of quality and organized technological effort. In pursuit of the same, it established a separate research and development wing recognized by the government. The firm gives ample importance on to skill intensity of labour thus more than 85% employees are skilled. There are 10 QSEs engaged in research and development activity. Its recurring expenses on R&D activity are higher than industry average. It works out to be 1.44 per cent of annual turnover. The net investment on R& D facilities is to the tune of Rs 0.9 million. It may be mentioned that although the figures are small in absolute terms due to overall small size of the firm, they are well comparable in percentage terms. The case of F_H leads us to conclude provisionally that *notwithstanding the size, firms emphasizing on their own technological effort are able to build technological capability and achieve better performance level.*

6.3.2.3 Causal interactions

For a meaningful illustration we propose to present the discussion under two broad headings: mechanisms adopted to leverage the policy framework by the firms and general observation regarding policy for promotion of in-house R&D in the firms.

6.3.2.3.1 Mechanisms and Indicators

The main mechanisms adopted by the firms to assimilate and improve technology are: *assimilation of technology*, *development of new product, continued upgrading of product & process technology*. The third mechanism is same as improvement in product and process as mentioned in the earlier section as M_3. As stated earlier all these mechanisms are interrelated with each other and quite a few elements of each mechanism are usually adopted concurrently. The extent of adoption of these mechanisms are reflected in *indicators* like: *number of products developed based on in-house technological efforts* during the last three years (I_5), *research intensity* and *number of qualified scientists & engineers* in R&D department. The last two indicators have already been mentioned in the previous section as I_2 and I_3 respectively.

- *Assimilation of Technology (M_5)*

With the term assimilation of technology we mean acquisition of new knowledge from different sources and integrating them with what is already known by the firms. A successful assimilation helps the firms in moving upwards on technological ladder towards absorption and upgrading of technology. It creates the capability to understand the know-how and know-why of the technology. The new knowledge is usually acquired through various sources such as technology licensing, acquisition of machinery/ instruments, interaction with buyers & suppliers, technical literature & trade journals, patent disclosures, products of competing firms; interaction with R&D institutions; technical consultants and visit to industry & trade fairs etc. These can be either foreign or domestic. The use of two other sources such as collective research and strategic alliances in the context of developing countries is relatively limited. Certain internal sources like workers' suggestions also contribute in the process of assimilation of technology. Table 6 overleaf presents the ranks attributed to each source of technology by the firms, the summation of these ranks (ATOT), indicators (I_5 and I_3) and the performance measure P_1 i.e. relative annual sales.

It is seen that the firms use most of these sources albeit with varying degree of scope and sophistication. The various sources of technology used for assimilation (A01 to A12) have been ranked on a five-point scale, ranging from 1 (not important) to 5 (crucial). Notwithstanding with the fuzziness of such ranking and perceptual differences of firms, it may be interesting to note that variations in the use of these mechanisms are reflected in number of products/ models developed during the last 3 yrs (I_5); number of QSE employed in R&D department and performance measure relative annual sales (P_1). In other words, firms having higher score on assimilation of technology (e.g. F_A, F_C, F_D, F_I, and F_L etc.) have performed better. It is also substantiated through positive correlation between the summations of the ranks and I_5, I_3 and P_1. The correlation coefficients work out to be 0.83, 0.49 and 0.59 respectively.

As regards to the individual source of technology, the data reveals that the firms' own technological effort has been ranked as the most important factor for assimilation of technology. It seems to be logical. Whatever the source be, it is the firms' own technological effort that ultimately translates into actual performance. Hence over 90% of the firms rated it as 5 or 4. One medium sized firm, which had recently signed FC and was in the process of adaptation of technology under the guidance of the collaborator rated FC as 5 and in-house technological effort as 3 only. The second most important source seems to be interactions with domestic buyers both before the purchase and after the sales. On contrary, interaction with foreign buyers has been ranked quite low i.e. 9th as most of the firms do not export and therefore have less interaction with the foreign buyers.

Table 6.6: Assimilation of Technology

Firm	Source of Technology													Indicator		P
	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	A12	ATOT	I_5	I_3	P_1
F_A	5	4	5	4	3	4	3	4	3	3	3	1	42	9	950	686
F_B	5	4	4	5	2	4	1	4	1	1	1	1	33	4	3	26
F_C	5	5	4	3	4	3	3	3	4	2	2	4	42	8	36	76
F_D	5	3	3	3	4	3	3	1	4	3	3	3	38	4	25	85
F_E	4	4	4	3	3	2	2	3	1	3	2	4	35	1	2	4
F_F	4	5	1	3	1	3	2	1	1	2	1	4	28	0	1	1
F_G	5	4	4	3	3	4	2	1	3	3	3	2	37	7	18	37
F_H	5	5	3	3	1	3	2	3	2	2	1	1	31	2	8	5
F_I	5	5	4	3	4	3	3	4	4	2	2	1	40	6	30	95
F_J	5	3	3	2	3	2	4	1	4	3	2	2	34	4	50	53
F_K	4	4	4	4	4	3	3	3	2	2	2	3	38	7	45	99
F_L	4	5	4	4	3	3	4	4	3	3	3	1	41	12	383	292
F_M	4	5	4	5	2	3	3	3	2	2	2	2	37	4	26	87
F_N	3	4	4	4	5	1	2	5	4	2	3	1	38	4	4	21
F_0	5	5	5	3	3	3	3	1	2	3	1	1	35	4	15	30
F_Q	4	3	4	4	3	2	3	1	1	3	3	1	32	3	15	15
F_Q	3	5	4	4	3	3	3	3	3	2	3	1	37	5	35	89
Mean	4.41	4.29	3.76	3.53	3.00	2.88	2.71	2.65	2.59	2.41	2.18	1.94	36.35			100
Std. Dev	0.71	0.77	0.90	0.80	1.06	0.78	0.77	1.37	1.18	0.62	0.81	1.20	3.92			
Rank	1	2	3	4	5	6	7	8	9	10	11	12				
					Significant Correlation Coefficient of ATOT w.r.to									0.83	0.49	0.59

A01: In-house technological effort; A02: Interaction with Domestic Buyers; A03: Imported products;
A04: Domestic products; A05: Visit to international/national Industry fairs; A06: Technical literature & Trade Journals; A07: Workers' suggestion; A08: Foreign Collaborator; A09: Interaction with Foreign buyers; A10: Suppliers of parts & components; A11: R&D Institutions; A12: Industrial Consultants.
ATOT: Summation of ranks of A01 through A12
I_5: No. of products/ models developed during the last 3 yrs; I_3: No of QSE employed in R&D department.
P_1: Relative annual sales (The figures are truncated for easier readability).
Scale: 1= Not important; 2= Slightly important; 3= Important; 4= Very important; 5= Crucial.

A major deviation has been found regarding imports of technology. Although FCs have been important source of technology from the very beginning in India, it ranks 8th in the list. The plausible reasons of its lower ranks are: first, 35% of sample firms do not have any FC and therefore they ranked it at the minimum (also the cause of higher standard deviation); and second, even firms having FC consider in-house technological effort as a priori for technological development rather than import of technology from abroad. It could be attributed to egoistic view of the firms to show off their technological capability as well to some extent.

Another reason could be the substantial decrease in FC agreements in the post-liberalization period. The interaction with R&D institution has also been ranked quite low by the firms. It was a general observation that there has been very low interaction with the CMTI: the only research institute dedicated to manufacturing technology. The larger firms have some interaction and joint research programs but majority of firms find very limited use. Similarly the role of industrial consultants has been ranked quite low. We found only two types of the firms taking the services of industrial consultants small firms and a few pro-active medium sized firms. The small sized hire them as they do not have sufficient in-house capability. On the other hand some of the progressive firms like F_C and F_L engaged them to increase aesthetics, enhance modularity and ease of assembly etc. Such practices are quite common in developed countries, but still to pick up in developing countries. Nevertheless firms have started to recognize the importance of industrial designers for achieving better performance.

- *Development of new product (M_6)*

As stated earlier, in the context of developing countries, development of new product does not mean development of new-to-world products or products at the frontier of technology. It simply means development of products new to the firm. In the present case it means development of a machine tool of a specific product-family, developing new models, repositioning product for new market segment, diversification in different product-family (e.g. from lathe to grinding or press), or diversifying into different industry segment etc. It may be mentioned that the degree of technological efforts varies for different options. Minor incremental improvement requires less effort compared to developing new models or entering into different product-family or industry segment. A glance on the industry data reveals that the firms undertook new product development with a varying degree of success (see Table 6.7). The difference could be seen in terms of span of new product development as well as total number of new products developed during the last three years.[88] The span of new product development constitutes of various forms of product development activity, which may be seen as subset of the mechanism new product development and designated as SM1 through SM5. Whereas the number of new products developed is considered as an indicator of in-house technological efforts of the firms irrespective of the source of the technology.[89]

As regards to the span of new product development, development of specific product and development of new models have been found common among all. The forms of new product development requiring higher technological effort varied depending on the size and technological capability of the firms. Medium and large-scale firms having better resources faired better than small firms as seen from the performance of the three small firms F_E, F_F and F_H. However, as mentioned earlier F_H gave adequate emphasis on in-house R&D efforts and therefore has been able to develop new model of machine tools as well, unlike other small firms. Between the medium and large-scale firms, the firms that emphasized more on strengthening in-house R&D performed better than the others. The large firms F_A and F_L have been more successful both in terms of span as well as absolute number of new products

[88] The number of new products developed is adjudged from the number of new models developed by the firms. Minor incremental development for the same model has not been accounted for.

[89] Since no new-to-world products or products at the frontier of technology are developed, there has been no registration of patents either in India or abroad by the sample firms during the period. Therefore we are not considering it as an indicator of in-house technological efforts of the firms.

developed. The medium scale firms undertaking broader span of new product development activity are seen to be performing better than the others (e.g. F_C & F_I). The ultimate performance could be gauged through relative annual sales (P_1), which also gives a picture of their domestic market share.

Table 6.7: Forms of New Product Development

Firm	SM1	SM2	SM3	SM4	SM5	I_5	I_2	I_3	P_1
F_A	x	x	x	x	x	9	1.6	950	686.3
F_B	x	x				4	0.4	3	25.7
F_C	x	x	x	x		8	1.0	36	75.9
F_D	x	x	x			4	1.0	25	84.9
F_E	x					1	0.9	2	4.4
F_F	x					0	0.1	1	0.4
F_G	x	x	x			7	1.1	18	36.5
F_H	x	x				2	1.5	8	5.1
F_I	x	x	x	x		6	1.5	30	95.1
F_J	x	x	x			4	1.4	50	52.6
F_K	x	x		x		7	1.2	45	98.7
F_L	x	x	x	x	x	12	2.9	383	292.3
F_M	x	x		x		4	2.1	26	87.4
F_N	x	x				4	3.1	4	21.0
F_0	x	x	x	x		4	1.9	15	29.9
F_P	x	x				3	2.1	15	14.8
F_Q	x	x		x		5	0.3	35	89.1
								Mean	100.0

SM1: Development of specific product; SM2: Developing new models;
SM3: Redesigning product for new market segment;
SM4: Developing prod. of different product-family;
SM5: Diversifying into different industry segment.
I_5: No. of products/ models developed during the last 3 yrs; I_2: Research Intensity (%):
I_3: No of *QSE employed in R&D department.*

6.3.2.3.2 General Observation regarding Policy to promote In-house R&D

In order to ascertain the role of in-house R&D policy framework, the firms were asked two questions:

- To rate the importance of tax incentives for the R&D activity of the firms on a four point scale 1 (not important) to 4 (very important); and
- The impact on the level of R&D activity had there been no tax incentive or if the tax incentive is withdrawn in future in qualitative terms i.e. whether it would be at reduced level or same level or not applicable.

Unlike the FC policy, the overall reaction regarding the policy framework for promoting in-house R&D in the firms has not been encouraging as evident from Table 6.8. It is seen that on the overall the firms were not optimistic about tax incentives provided by the government. They rated it quite low. The mean works out to only 1.88 i.e. in between not important to slightly important. The plausible reasons are: first, tax incentives are available to only those firms having in-house R&D setup recognized by the government. About 30% of the sample firms do not have recognized R&D setup as yet. Second, the average expenditure on R&D in terms of percentage of annual sales (R&D intensity) is relatively low (1.42%). However, it is observed that firms having higher R&D intensity accord higher rating to the relative importance of tax incentives compared to those with lower R&D intensity. The larger firms rated relatively higher compared to medium and small firms. Third, the bureaucratic hurdles in claiming the tax benefits create deterrence in availing the scheme.

Table 6.8: General observation: In-house R&D policy framework

Firm	Recognized In-house R&D	Importance of Tax-incentives#	Impact of non-availability of tax incentives
F_A	X	3	B
F_B		1	C
F_C	X	2	B
F_D	X	3	B
F_E		1	C
F_F		1	C
F_G	X	2	B
F_H	X	2	B
F_I	X	2	B
F_J		1	C
F_K	X	2	B
F_L	X	3	B
F_M	X	2	B
F_N		1	C
F_0	X	2	B
F_P	X	2	B
F_Q	X	2	B
	Mean	1.88	
	Std. Dev.	0.70	

Abbreviation: x = Recoginsed; A: Reduced level of R&D; B: Same level; C: Not applicable.
#: Scale: 1= Not important; 2= Slightly important; 3= Fairly important; 4= Very important.

A corporate manager of medium sized firm, commented, "*we got our R&D unit recognized to avail the facilities extended by the government, but we find lot more difficulty with the tax authorities in finalizing our claims . . . It is due to ambiguity in accounting practices and environment of mistrust.*" As regards to the response to the second question: what would be the impact on the level of R&D activity had there been no tax incentive? There seems to be near consensus that the firms R&D activity would continue at the same level irrespective of tax incentive, as in-house technological effort is essential to survive in the competitive environment. Rather, a few firms opined other way round: that introduction of more attractive tax incentive system with less bureaucratic hurdles may give boost to firm level industrial R&D activity.

6.3.2.4 Summary

- The firms adopted primarily three mechanisms to assimilate and improve technology: *development of new product, assimilation of technology, continued upgrading of product & process*.
- The mechanism adopted, although similar in nature, varied in its scope and implementation culminating in differential performance of the firms.
- The effectiveness of adoption of the mechanisms are gauged through *indicators* namely number of products developed based on in-house technological efforts, research intensity and number of QSE in the R&D department.
- Firms' own technological effort is seen to be the basis of creation of technological capability irrespective of source of technology.
- The variation in performance could be attributed to variance in technological effort, technological capability, size of the firms and strategies adopted by the firms.
- Unlike the FC policy, the overall response regarding the policy framework for promoting in-house R&D in the firms has not been encouraging. There is a need of introduction of more attractive tax incentive system with less bureaucratic hassles.

6.4 Synthesis and Conclusions

6.4.1 Synthesis

Our analysis has brought out two mutually interrelated sets of conclusions. The analysis of causal interactions in respect of FC policy points out that:

- Imports of technology helped in building technological capability of the firms,
- Imports of technology on its own are not sufficient to build technological capability. It has to be complemented with firms' own technological efforts.

On the other hand the analysis of causal interactions in respect of policy on in-house R&D suggests that:

- Firms' own technological effort has been the basis of creation of technological capability irrespective of the source of technology,
- Firms' own technological effort is an essential but not the sufficient condition for building technological capability. It might be necessary to supplement with imports of technology.

In both the cases we are coming across two constructs: technological capability (TC) and technological effort (TE) that finally culminate in performance of the firms. Thus it may be pertinent to revisit the meaning of these two terms in the context of building technological capability of products of firms. In general *TC* may be understood as the ability to make effective use of technological knowledge (Kim, 1999; Westphal et al., 1985**.** Extending the above notion and drawing upon researchers like Bell (1984); Figueiredo (2001); Fransman (1984); Kim (1998, 1999); Lall (1984, 1987, 1992); and Katz (1987) etc. *TC* may be viewed as the capacity to select, acquire, assimilate, imitate, adapt, absorb, and improve upon *given or known technologies* as well as introduce own ideas/ concepts into final product or process. The given technology may be either imported from abroad or acquired from other external sources such as government laboratories, large firms, reverse engineering or reengineering of products of competitors, trade journals, and trade shows etc. The development of such capability requires in-house *technological efforts*, which is nothing but earnest and conscientious activities undertaken by the firms using human capital, plant & equipment and organizational routines intended to develop such capacity that translates into technological capability. It may be mentioned that it is difficult to draw distinctions between TE undertaken in respect of different sources of technology, as significant degree of complementarities exist between them. Therefore for the purpose of our discussion we consider TE as means to build up TC irrespective of the source of technology. For easier understanding we will also treat the terms technological efforts and in-house R&D the same and use them interchangeably.

With this background, when we look back to the analyses of our causal interactions and case studies we find that the firms undertook TE in respect of various activities like identification-, acquisition-, assimilation-, adaptation-, absorption of technology, incremental improvements, innovative use of the technology in related products, and development of new products based on known technology. In addition to the above there could be certain additional activities (e.g. innovation of new technology and innovation of new products based on new technology) that could be undertaken by the firms. Although, these are more concerned with firms operating at frontier of technology, which is not applicable in the present scenario, we include them in our discussion to present a complete overview of technological activities pertaining to the product development. Further, all these activities although seem to be distinct are interrelated with each other and quite a few elements of each activity overlap. Therefore they may be seen in terms of continuum rather than in isolation. The various activities as indicated above could be understood as follows:

i. *Identification:* identification and evaluation of relevant technology and its sources.

ii. *Acquisition*: entering into agreement with the technology supplier that requires knowledge about technology and capability to negotiate for technological contents and mechanism of transfer details.

iii. *Assimilation:* acquisition of new knowledge from various sources and integrating them with what is already known by the firms.

iv. *Adaptation*: adaptation of product & process design to local conditions. It may be in two forms: *technical adaptation* (based on inputs availability, physical conditions and local requirements); and *economic adaptations* (e.g. size of the domestic market, sophistication of buyers, competitive environment, local price etc.).

v. *Absorption*: development of proper understanding of why the products or processes work as they do.

vi. *Incremental improvement*: optimization of the product and process design for easier manufacturability, incorporating minor modifications and improving features etc.

vii. *Innovative use of technology in related product*: use of technology or its elements in development of other product of same product family or other products.

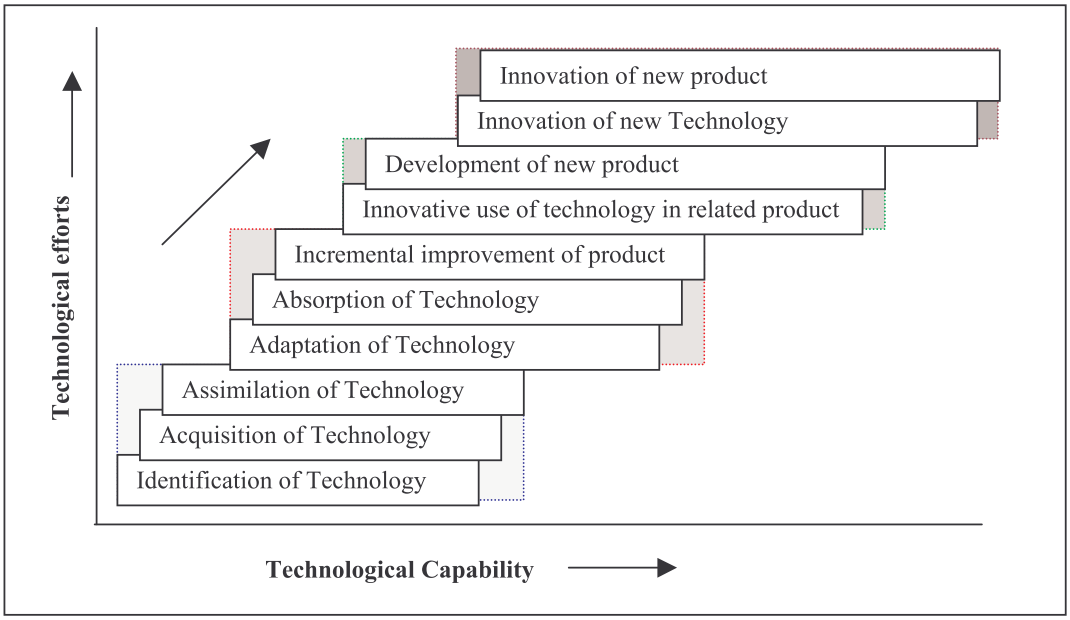
viii. *Development of new product:* development of products new to the firm e.g. developing new models, new product, repositioning product for new market segment, diversification in different product-family (e.g. from lathe to grinding) etc. It does not mean development of new-to-world products or products at the frontier of technology.

ix. *Innovation of new product & process:* development of new product or process at the frontier of technology.

x. Innovation of new technology: development of new technology all together.

A close scrutiny of above description of activities suggests that there seems to be some similarity in respect of nature of technological effort, human skills, infrastructure requirement and linkage with various stakeholders for certain activities. Accordingly these activities could be aggregated in four broad groups namely *acquisition*, *integration*, *development* and *generation.* The first three activities identification-, acquisition- and assimilation of technology require technology efforts in respect of collection of knowledge/ technology from various sources and creating understanding about the same and therefore could be termed as *acquisition of technology*. The next three activities i.e. adaptation-, absorption of technology, incremental improvement of products require technological efforts to translate the technology collated into physical form and generate understanding about know-how and know-why of the technology. The TEs are primarily in the area of engineering and development. Thus these three activities could be grouped together and named as *integration of technology*. The next grouping could include the activities of innovative use of the technology in related products, and development of new products based on known technology, as these require technological efforts to create deep understanding about the technology. The prime thrust is on developmental efforts as well as some research initiatives are also essential. This grouping could be termed as *development of technology*. The last group, *generation of technology* encompasses innovation of new technology and innovation of new products based on new technology. As mentioned earlier, it requires much higher level of TE and TC. Here technological efforts for research play the prime role. These aggregated four groups i.e. *acquisition*, *integration*, *development* and *generation* could be considered as building blocks for establishing technological capability for product development in the firms. The interrelationship between firms' TE, TC and various activities may be depicted graphically as in Figure 6.2. It may be mentioned that the simple graphical presentation is just for illustration and does not suggest any linear relationship between these parameters. It is beyond the scope of this research to establish the exact nature of relationship. Nevertheless, it may be considered as an agenda for future research.

Figure 6.2: Dynamics of building Product Development Capability



6.4.2 Conclusions

- The firms adopted various mechanisms to leverage the policy to build technological capability. The mechanism adopted, although similar in nature, varied in its scope and implementation culminating in differential performance of the firms. The firms with pragmatic attitude have been able to leverage the policy in a better way.

- Firms' own technological effort is seen to be the basis of creation of technological capability irrespective of the source of technology. It is an essential but may not be sufficient condition for building technological capability. It might be necessary to supplement with imports of technology.

- The process of building TC for product development constitutes of several distinct but interrelated steps namely *acquisition*, *integration*, *development* and *generation.* The requirement of TE increases as firms move up the ladder as well as move across translating into higher technological capability.

- FC policy also worked with a lag. It had substantial spillover effect that helped the industry to grow.

- The response regarding the policy for in-house R&D has not been encouraging. There seems to be a need of more attractive tax incentive system with less bureaucratic hurdles.

Chapter Seven

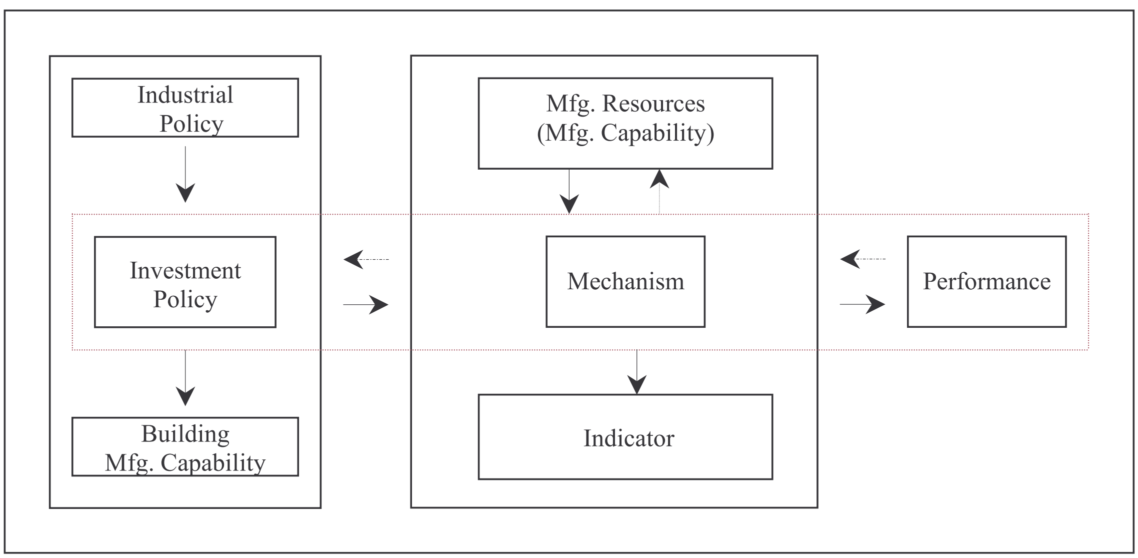
POLICY AND MANUFACTURING

This chapter attempts to analyse the policy-performance causation in respect of Investment policy vis-à-vis Manufacturing resource of the firms. Like the earlier chapter, we first analyse evolution and status of the two main policy measures affecting investments: regulations on entry & expansion (i.e. Industrial licensing policy & FDI policy), and regulations on imports (i.e. Import licensing policy). Then we analyse as to how these policy measures influenced in building the firms' manufacturing capability. At the end the findings are synthesized and conclusions are drawn.

7.1 Introduction

This chapter endeavors to analyse the policy - performance causation in respect of investment policy i.e. the impact of investment policy on firms' performance through manufacturing resource of the firms. Our earlier discussion points out that the investment dimension of industrial policy has direct impact on manufacturing resource i.e. manufacturing capability of the firms. We propose to concentrate our analysis on the interactions of these two as per the framework depicted in figure 7.1.

Figure 7.1: Policy–Performance Causation: Investment



7.2 Policy framework: Investment Policy

The investment policy has primarily hovered around regulations on entry and expansion, and restrictions on imports. In this section, we will elaborate on these policy measures.

7.2.1 Regulations on entry and expansion

The regulations on entry & expansion could be explained in terms of regulations on investment (overall) and regulations on foreign investment (FDI). The regulations on investment could be further subdivided into three measures: industrial licensing applicable to all industries, MRTP Act applicable to large industrial houses, and reservations of items for exclusive development in small-scale sector. However, for machine tool industry the latter two played only minor role therefore we will emphasize on industrial licensing policy and slenderly mention the others.

7.2.1.1 Regulations on investment: Industrial Licensing

At the time of independence it was believed that in a resource-scarce economy like India, there was a need to direct investments in particular sector or industry for sustained economic growth. Industrial licensing was used as the main instrument for regulating entry and expansion of firms. Based on Industrial Policy Resolution of 1948, the Industries (Development & Regulation) Act of 1951 was enacted that provided the basic legal framework for the same. It stated that an enterprise must obtain permission in the form of a license from the government to undertake any of the following activity:

- Manufacture of any item
- Manufacture a new article in an existing firm
- Expand capacity
- Producing any item which was subsequently brought under licensing
- Change location
- Import Technology or
- Import of Capital (FDI)

The Licensing policy was also used to reserve the production of certain items for public sector or small scale; and subsequently to limit monopolistic tendencies in the private sector by preventing entry of large firms for taking up manufacture of such items through the Monopoly and Restrictive Trade Practices (MRTP) Act of 1969.[90] However, two categories of firms were exempted from industrial licensing procedure: small-scale firms and such medium-scale firms having investment in fixed assets below Rs150 million[91] provided their annual requirement of imports of raw material & components does not exceed 15 % of ex-factory value of the output and do not attract other conditions of industrial licensing. It may be mentioned that, a private

[90] A firm or a group of related firms with gross assets worth more than Rs 200 million (Rs 1,000 million since April 1985) or a 'dominant undertaking' (controlling more than one third of the market till 1982 and one fourth of the market since then) with assets of the value not less than Rs 10 million came under the ambit of this Act.

[91] Initially the limit was just Rs 0.1 million. It was progressively increased to Rs 1 million in 1960, Rs 30 million in 1978, Rs 50 million in 1982 and Rs 150 million in 1988. These firms had to register with the Directorate General of Technical development (DGTD), Govt. of India.

sector firm cannot manufacture items reserved for production in public sector irrespective of the size. But as regards to items reserved for small-scale sector, medium or large-scale firms in private sector are allowed to manufacture such items provided they apply for an industrial license and guarantee to export 50% of annual production. However, those medium and large-scale firms who had been manufacturing reserved items prior to date of reservation or those small-scale firms who grew due to natural growth could continue to do so with the capacity pegged at the existing level after obtaining carry-on-business (COB) license, which is nothing but a kind of industrial license.

Although Machine tool was not reserved for public sector or small-scale sector, in majority of cases firms had to obtain industrial license, as investments used to be usually more than the exemption limit or imports of technology, FDI or raw material/components more than 15% of ex-factory value of annual production were required. The licenses were issued with the exact description of machine tool to be manufactured and specific annual capacity. It was only in the 1980s, that some indications of liberalization could be sensed for this industry. In 1980, automatic approval for increase in licensed capacity up to 25 % was introduced, which was extended as general scheme of re-endorsement of capacities in 1982. In 1985, the industry was freed from the shackles of industrial licensing procedure (de-licensed) i.e. no requirement of obtaining industrial license, nonetheless the firms had to register with the DGTD. In order to provide flexibility in manufacturing to produce range of products, the scheme of broad banding (extension of product range) was made applicable to this industry as well in 1986. However, it was only in 1991 that, the all barriers on entry and expansion have been virtually abolished through introduction of New Industrial Policy of 1991 and subsequent liberalization undertaken thereafter. Now industrial license is required for the following only:

- Six industries of strategic, social or environmental concern.[92] All other industries are exempt from licensing subject to the locational restrictions.
- Two industries (atomic energy and railway transport) reserved for the pubic sector. A number of areas that had earlier been reserved for public sector, such as arms & ammunitions, steel, telecom, and oil refining, have now been made open to all.
- Industries reserved for the small-scale sector. The list of items reserved for development in small-scale sector is also being pruned.

The industrial undertakings exempt from obtaining an industrial license are required to file an Industrial Entrepreneur Memoranda (IEM) to the Government of India. It is a post-scrutiny measure only. This is complete departure from the earlier norm. Now there is no restriction on capacity, product specification or location. The firms are free to determine type of product or product range, installed capacity, technology and location based on their business acumen. There is no restriction on further enhancement of capacity or change of location so far it conforms to the location criteria. Moreover, the MRTP Act 1973 has been scrapped. Thus no permission is required for the large firms for undertaking manufacture of new items or expanding existing capacity. In this way all regulations on entry and expansion have been virtually abolished in general and for machine tool industry in particular.

[92] Electronic Aerospace & defense equipment; Industrial explosives; Hazardous chemicals; Drugs & Pharmaceuticals; Distillation and brewing of alcoholic drinks; Cigarettes & other tobacco products (SIA, 2002).

7.2.1.2 Regulations on foreign investment: FDI Policy

The second major policy measure that influenced investments in machine tool industry has been the FDI policy. It has kept changing as per the passage of time. It could be segmented in four distinct phases with the following nomenclature: *receptive phase*: 1948-late sixties; *restrictive phase*: late sixties to 1980; *rapprochement phase*: 1980s and *renaissance*: 1991 onwards. It may be interesting note that they more or less correspond to the four phases of overall industrial performance (see section 4.2.2).

Receptive phase: 1948-late sixties

The roots of FDI policy could be traced to the Industrial Policy Resolution of 1948, which gave proper credence to foreign investment for securing much needed technology, capital and management skill, although it was conspicuous about competition from resourceful foreign firms in line with the sentiments of then private business. However, in the absence of enactment of any legislation thereafter, the policy of foreign investment was governed for quite some time on the basis of the policy statement tabled in the Parliament by Mr. Nehru in April 1949, which created environment of assurance to the foreign investors. Its major points were (Bhagwati & Desai, 1970; Kumar, 1996):

- Existing foreign interests to be accorded 'national treatment',
- New FDI to be encouraged on mutually advantageous terms & conditions,
- Repatriation of profits and dividends to be allowed,
- Fair compensation to be paid to the firms 'compulsorily acquired in national interest',
- Although majority domestic ownership preferred, majority foreign holding for a limited period to be allowed if deemed necessary,
- Hiring of foreign technical skills/ experts not to be objected by the government in absence of Indians with requisite qualifications.

In order to promote FDI, in 1961, the government set up the Indian Investment Center, with offices in major investor countries like UK, Germany, USA and Japan. Further, a list of industries was issued in which FDI were to be welcomed. It included some of the industries earlier reserved for public sectors as well. In sum, during this period the attitude of the government towards FDI was quite positive and receptive.

Restrictive phase: late sixties to 1980

The macroeconomic imbalances and acute balance of payment crisis during the second half of the sixties changed the attitude of the government towards FDI from *receptive to restrictive*. FDI was seen more as a drain to foreign exchange by way of repatriation of profits, dividend, and royalty rather than vehicle for infusing new technology and foreign capital. Restrictions were imposed on FDI sans technology transfer. Industries were identified where FDI was considered unnecessary on the erroneous notion of domestic capability and protection to small-scale sector. A new agency: Foreign Investment Board (FIB) was created to scrutinize FDI applications. A Cabinet Committee started screening the proposals above 40% equity. All these were over and above the fleet of conditionality imposed for FC cases as mentioned in section 6.2.1. In 1973 a new act: Foreign Exchange Regulation Act (FERA) was enacted that laid down quite restrictive guidelines for foreign equity participation. It pegged equity participation to 40 % except for export oriented units and high-priority industries. The implementation of policy was much more restrictive than the policy itself. These restrictions created a negative environment unlike the previous period and culminated in acute stagnation in FDI and growth.

Rapprochement phase: 1980s
The continued stagnation of India vis-à-vis exemplary success of NICs led to realize the policy makers the rigidity of the existing policy framework and its ill effects. Thus steps were initiated to reorient the policies. It was reflected in Industrial Policy Statements of 1980 and 1982. Considerable relaxations were extended to multinational companies and NRIs in terms of cap on equity, scope and operations of FERA particularly for export-oriented units. Policy guidelines were issued to make the system of FDI and FC approvals more transparent. Procedures for remittance of profits and dividends were streamlined. Emphasis was given on expeditious clearance for proposals from major investing countries. In sum, it may be said that the focus of policy moved from *restriction to rapprochement*.

Renaissance: 1991 onwards
With the sweeping reforms introduced in 1991, the FDI policy also turned a full circle from regulation to promotion, with most of the regulatory measures withdrawn. Now FDI is considered as vehicle for injecting the desired level of technological dynamism in Indian industry. The highlights of new FDI policy are (SIA, 2002):

- FDI freely allowed in almost all sectors subject to sectoral caps,
- Majority ownership by foreign companies permitted (earlier only 40%),
- Automatic approval[93] for equity up to: 74% in 9 high priority industries; 51% in 36 specified industries,
- 100% equity also allowed on case by case basis by the government,
- 100% equity allowed for power, road, port, tourism, petroleum and VCFs,
- FDI allowed in small-scale sector subject to maximum equity of 24 %
- Non-resident Indians (NRIs) permitted for 100% equity through the Automatic Route
- Abolition of the requirement of the Phased Manufacturing Program,
- Abolition of Dividend balancing condition,
- No restriction on foreign brand names and trade marks,
- Permission to raise equity and debt in the Indian capital markets,
- 100% equity allowed in case of inability to identify suitable domestic partner, subject to condition of 26% divesture in favour of domestic company within 3-5 years
- No prior permission for hiring foreign technicians and
- No prior permission for sending abroad the new product for testing / certification
- Automatic approval for joint ventures abroad if the Indian contribution in cash is up to US $ 0.5 million and in-kind up to US $ 2 million.

[93] Automatic approvals are the approvals accorded by the Reserve Bank of India (RBI) under delegated powers. Only those cases, which are not falling under the purview of automatic route, are to be dealt with the Government of India. These are dealt expeditiously within a stipulated time frame of 30 days only.

Such measures have given an increasing degree of confidence to foreign direct and portfolio investors and subsequently the inflows have jumped quite substantially. It is considered to be one of the most significant indicators of the impacts of liberalization.

7.2.3 Regulations on imports

Investment in machine tool industry has been affected due to regulations on imports through imposition of quantitative restrictions (QR) and tariffs. The QR was first introduced in May 1940 during the Second World War to conserve foreign exchange and shipping for the war and the practice continued even after getting independence (Bhagwati & Desai, 1970). Although it was initially introduced to conserve scarce foreign exchange, the basic objective transformed to provision of protection to domestic industry from foreign competition. The Imports and Exports (Control) Act of 1947 and Import Trade Control Order of 1955 provided the legal framework for QR. These Acts brought all imports under the ambit of QR i.e. the need of import license for importing any item whatsoever unless until specified. Imports were segmented into four categories: *prohibited* i.e. items not allowed for imports under any circumstances; *restricted* i.e. items require import license and includes majority of items, *canalized* i.e. imports allowed only through designated government agencies and *open general license* (OGL) i.e. items allowed for import without import license.

The import-licensing regime was quite cumbersome and non-transparent. The imports of an item were allowed on 'actual user (AU)' basis (i.e. for the self-use of the entity) for specified value, quantity and designated currency area. Any third party was not allowed to import for stock & sale in order to prevent profit making by intermediaries. Moreover, for each application the AU had to obtain two certificates: first, '*indigenous clearance*' (i.e. non-availability of similar items from domestic manufacturers) from the technical wing of the ministry of industry (i.e. DGTD), which invariably used to ignore the aspects of quality, cost and delivery schedule and second, '*essentiality certificate'* from respective sponsoring authority that the items sought are essentially required for production by the applicant firm.

These regulations were applicable to imports of all material inputs: Capital Goods, equipment. However, there was an operational distinction between capital goods & equipment (*CG license*) on the one hand and raw material, components, & consumables on the other *(Supplementary license*). The criterion of '*indigenous availability'* in particular, was instrumental in providing blanket protection to domestic manufacturers of machine tool from imports. Such blanket protection culminated in proliferation of diversified machine tool industry during the pre-liberalization period. The protection so provided to capital goods and intermediate goods industry raised the prices of material inputs across the board creating a high cost industrial structure and technological backwardness. It also created bias against exports due to ready availability of profitable domestic market as well as lack of export competitiveness.

The *import tariffs* are levied under the India Tariff (second amendment) Act, 1954; Customs Act, 1962 and Customs Tariff Act, 1975. It has usually four components: *basic duty* usually levied on *ad valorem* basis,[94] serves as the statutory MFN tariff; *special duty* levied on the

[94] Virtually all tariffs (99.8 % of the tariff lines) are levied on the ad valorem basis (Panangariya, 1999).

basic duty; *special additional duty*[95], having regard to the maximum sales tax, local tax or any other charges imposed on a like article on its sale or purchase in India; and *countervailing duty* (CVD) or *additional duty* equal to the excise duty on similar, domestically produced goods as well as any surcharge thereon. The tariff structure was quite complicated and had cascading effect. The custom classification used to be quite ambiguous with high degree of anomaly. Even at the end of 1990, the simple average of all tariffs was 79%, the highest being 355% (Pangariya, 1999).

In the *post-liberalization period* these draconian regulations on imports have been relaxed considerably ensuing competition. The new policy framework has removed most quantitative restrictions on imports, and made significant reductions in the tariffs levels on all items. The salient features of the new policy framework are:

- No import-license required for imports of Capital Goods,
- No import-license required for imports of any other material inputs,
- No requirement of *'AU condition'*,
- No requirement of '*indigenous clearance'*,
- No requirement of '*essentiality certificate'*,
- Imports allowed for stock and sale by intermediaries,
- No restrictions on quantity of imports,
- The structure of effective tariffs streamlined and reduced considerably as evident from Table 7.1 and 7.2:

Table 7.1: Structure of 'Effective' Tariffs in India, 1990-91 to 1997-98 (%)

Tariff (Average Unweighted)	1990-91	1993-94	1995-96	1996-97	1997-98
Agriculture	113	43	27	26	26
Mining	100	70	30	26	25
Manufacturing	126	73	42	40	36
Economy-wide	125	71	41	39	35
Coefficient of Variation	32	42	47	49	42
Maximum Tariff rate	355	85	50	52	45

Note: These are effective MFN rates i.e. actual applied rates after basic rates have been reduced through exemption notifications. The Special Duty of 5 per cent is included.
Source: Based on Panagariya (1999): Table 2.

Table 7.2: Structure of 'Effective' Tariffs by Processing Stage, 1990-91 to 1997-98 (%)

Tariff (Average Unweighted)	1990-91	1993-94	1995-96	1996-97	1997-98
Unprocessed	107	50	27	25	25
Semi-processed	122	75	44	38	35
Processed	130	73	43	42	37

Note: These are effective MFN rates i.e. actual applied rates after basic rates have been reduced through exemption notifications. The Special Duty of 5 per cent is included.
Source: Based on Panagariya (1999): Table 3.

[95] The *special additional duty* is applied to the landed price plus the basic and special duty.

- For compatibility with the world trading regime 8 digit harmonized classification system (HS) for import and export items introduced.
- Peak customs duty reduced from 150% (1991) to 125% (1992), 85% (1993), 65% (1994), 50% (1995), 40% (1996), 35% (2001) to 30% (2002).
- To encounter dumping of any specific product from any specific country anti-dumping and safeguard duties introduced.
- In order to comply with the tariff binding[96] of WTO only two basic rates of customs duty proposed by 2004-2005:
- 10 % for raw materials, intermediates, & components; and
- 20 % for final products
- Existing rates to be subsumed under the above rates.
- Under the WTO regime, 62% of industrial goods lines have been bound. The tariff bound rates for finished goods and intermediate inputs, machinery & equipment are 40% and 25% respectively. Prior to the WTO regime, only six per cent of the tariff lines were bound.

7.3 Policy - Performance Causation

7.3.1 Regulations on entry & expansion

7.3.1.1 Framework for analysis

The various elements of policy performance causation in respect of regulations on entry & expansion are depicted in Table 7.3.

Table 7.3: Constituents of Policy-Performance Causation framework

Policy	Mechanism	Indicator	Performance
Industrial Licensing & FDI Policy Dismantling Entry barriers	-New investments & modernization -Outsourcing/ Subcontracting	- Manufacturing capacity - Plant efficiency -ISO-9000 certificate	- Sales -Export Intensity

7.3.1.2 Empirical evidence: Case illustrations

In this section we introduce two more case studies to illustrate the policy-resource-performance causation. They are:

- F_I: a medium scale private sector firm set up just before the post-liberalization era
- F_J: a medium-scale private sector firm set up in the post-liberalization era

[96] *Tariff Bindings:* The import tariff on the manufactured products cannot be increased more than the bound rates of 25 % on raw material & intermediate goods and 40 % on finished goods unless until it is negotiated with trading partners by the year 2005. (WTO, 2001)

F_I: Relying on in-house manufacturing

F_I, a mid-sized private sector firm and part of big conglomerate with prime interest in engineering industry, was established in the dawn of the post-liberalization era in 1988 in technical collaboration with one of the world-renowned machine tool manufacturer of Japan to manufacture CNC machine tool. Its vision is to provide quality goods and services at reasonable prices in the global market continuously aiming at excellence. In pursuit to achieve the same, it has been investing regularly develop its technological capability leveraging properly the liberalized industrial policy of the government.

It is one of the few firms established exclusively to manufacture CNC machine tools to cater the growing demand unlike others that graduated from manufacture of non-CNC machine tool. As on date it is manufacturing wide variety of CNC machine tools viz. CNC lathes, Machine Centers and CNC universal boring and milling machine and drill tap center etc. It is widely recognized in the market for its quality and supplying tooled up machine tool. Upon expiry of the first FC, it further stepped its own R&D activities. New products arising out of such R & D activities have since been released at regular intervals. New product development (minimum two new product/ model per year), upgrading existing product, design optimization and improvement of aesthetics are the major thrust areas of the firm's R&D efforts. The firm's R&D center has received recognition from the government. In the post-liberalization period it again joined hands with a world-renowned European manufacture of CNC machine tool. Considering the firm's technological capability the collaborator agreed for a buy-back arrangement for European market. The firm successfully exported until recently, when the buy-back agreement was terminated due to change in design at the collaborator's end. Now the firm is trying to market the product on its own. The firm is an idle example of blending of foreign technology and in-house technological effort.

The firm has made large-scale investments in the state of art manufacturing facility with very high proportion of imported CNC machinery. It continuously invested in modern machinery and modern manufacturing techniques. In order to maintain quality standards, the firm believes in creating in-house facilities rather than outsourcing locally. Only non-critical items are procured locally. It prefers either to manufactures the critical items in-house or imports from abroad. The firm is thriving for manufacturing 300 machines per year with approximately the same number of people, which if attained would be worth appreciable. At present its installed capacity is 250 machines per year to manufacture three types of CNC machine tools. Due to proper thrust on total quality management, the firm found no difficulty in obtaining ISO-9001 certification. The firm is widely recognized amongst users for quality, supplying tooled up machines and prompt after sales service. This case leads us to conclude provisionally that*: Firms investing in building in-house manufacturing capability are likely to perform better.*

F_J: Believing in companions

This mid-sized company has been set up in 1994 by a pro-active machine tool firm owned by a group of techno-entrepreneurs with the support of a public sector venture capital fund. It is also one of the few firms set up primarily to manufacture CNC machine tools to encash the opportunities provided by the liberalization of Indian economy. Within a span of seven years of its inception, the firm has become the largest manufacturer of vertical machining center in India based on its own technological effort i.e. without any FC. It has the distinction of introducing machining center for Rs 1.55 million only that was hitherto sold for about Rs 3 million, in order to compete with low cost machines of Taiwan and Korea both in the domestic as well as international market. Its strength lies in introduction of cost-effective reliable product specifically suited to the SMEs. The firm's vision is to be a large-scale producer of world-class machine tools.

Unlike F_I, this firm operates primarily on the basis of outsourcing and undertakes only final assembly and painting operation in-house. It also undertakes the basic design and engineering job in-house. The firm also participates in design and development activity of its suppliers and undertakes quality checks during their manufacturing process. Such measures insure quality as well as keeps the firm's own investment on machinery and other overheads to the minimum. In fact the firm's investment in plant & machinery is still below the maximum investment permissible for small-scale sector. Since, other medium scale firms own the firm, it is not considered as a small-scale but a medium scale firm. With the existing infrastructure, the firm has capacity to produce 100 machines per year, which has almost been achieved. In order to meet the production target of 150 to 180 machines, the firm is planning additional investment to the tune of Rs 10 million in plant & machinery as well as in CAD & MRP infrastructures. In order to become globally competitive, the firm uses modern manufacturing techniques like JIT, TQM and MRP etc. It has initiated the process for obtaining ISO-9000 certificate. The firm has already obtained CE certificate.

The continuous interaction with the suppliers and customers helps the firm to continuously improve its existing products and broaden the range of the product. In order to grow, the firm has given special emphasis on exports. It is targeting at an export volume of about 30 per cent of their product by the year 2004. Apart from contemporary design, it is giving special attention to aesthetics and safety features of machines. It is regularly participating in international industry fairs like IMTS & EMO as well as business trips to European market. Such efforts are giving rich dividends. On the basis of the case of F_J, we may conclude provisionally that*: developing good network of subcontractors helps firm in achieving better performance level.*

7.3.1.3 Causal Interactions

Our findings reveal that the firms adopted mechanisms like *new investments, and outsourcing/ subcontracting* to leverage the liberalization in regulations on entry & expansion. These mechanisms are found to be reciprocally connected with each other and quite often adopted concurrently. The adoption of these mechanisms are reflected in the *indicators* such as *level of investment*, *manufacturing capacity, breadth of products, plant efficiency and ISO-9000 certification*.

- *New investments*

In order to build manufacturing capability the firms invested in creation of fixed assets and manufacturing systems, which we term as *new investments*. The mechanism of *new investments* has been adopted by the firms primarily in four ways: fresh investment to establish a new set up by an existing or a new firm to manufacture CNC machine tools (SM_1); investments in existing firm to modernize plant & equipment either for increasing capacity (SM_2) or manufacturing new items (SM_3) or enhancing the overall quality of manufacturing system (SM_4). The adoption of these mechanisms is reflected in *level of investment* in plant & machinery in relative terms (I_1),[97] economy of scale or *size of output* or i.e. the capacity to manufacture CNC machine tools in terms of numbers (I_2);[98] *breadth of product line i.e.* economy of scope (I_3);[99] plant efficiency measured in terms of ratio of annual sales to fixed assets, which indicates how successful the firm is in generating sales from the use of fixed assets (I_4); and ISO-9000 certification (I_5) reflecting the emphasis given by the firms in establishing quality system. As mentioned earlier, adoption of these mechanisms ultimately translates into performance as measured in terms of *relative annual sales* and *export ratio*.

Table 7.4 presents the snapshot of mechanisms including sub-mechanisms of new investments, indicators and performance measures. It reflects that only few firms have gone for fresh investment to establish a new set up to manufacture CNC machine tools (SM_1) in the post liberalization period, while majority of the firms have opted for investments for expansion in capacity (SM_2) or for extending the breadth of product line (SM_3) or enhancing the overall quality of manufacturing system (SM_4). In an isolated case we also found evidence of investments in creation of manufacturing capacity abroad by the firm F_A.[100] But it was for non-CNC machine tool in the pre-liberalisation era. Therefore we are not including this sub-mechanism in the Table.

It may be mentioned that due to paucity of data, the actual amount and scope of investment by the firms could not be presented. It varied from firm to firm and the variations in quantitative terms are not captured in the data presented as above. Nevertheless, the data reflects that the firms that invested more have better performance indicators (e.g. F_A, F_C, F_D, F_I or F_L etc.) and vice versa (F_B, F_E, F_F etc.). The level of investment could be gauged through the absolute level of investment in plant & machinery as indicated by I_1. Investment in plant & machinery culminates in increased manufacturing capacity, addition in breadth of product line, establishment of quality management system and ultimately to annual sales of the firms. The data also shows positive correlation between levels of investment to manufacturing capacity (0.68); breadth of products manufactured (0.95); receipt of ISO-9000 certificate (0.25) and annual turnover (0.97) as well as exports (0.12). The plausible reason for relatively lower correlation coefficient in respect of manufacturing capacity could be switching over to outsourcing (as facilitated by post-liberalization policy) for having access to complementary assets, cost reduction and increased flexibility rather than creating unviable in-house manufacturing capacity. Considering the importance of ISO-9000 certification for emphasizing on exports in particular and establishing quality system in the plant in general, 65 % of sample firms have obtained the certificate so far and others are in process.

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[97] The figures have been indexed to keep confidentiality of the data.

[98] Although, the numbers do not indicate the type and complexity of machine tools manufactured, it is preferred since the alternative to this i.e. capacity in terms of value is much more vulnerable to exogenous factors such as prices of inputs, inflation, exchange rates, and tariffs etc.

[99] The increase in breadth of product line allow the firms to achieve synergy from the existing facilities if the products belong to same family otherwise it reduces the economy of scale.

Table 7.4: Mechanisms, Indicators and Performance measures: Manufacturing

Firm	Mechanisms					Indicators					Performance	
	M_1				M_2	I_1	I_2	I_3	I_4	I_5	P_1	P_2
	SM_1	SM_2	SM_3	SM_4								
F_A		x	x	x	x	679.0	350	20	1.7	1	686.3	2.0
F_B				x	x	11.2	30	5	3.8	1	25.7	Nil
F_C	x	x	x	x	x	47.0	300	2	2.7	1	75.9	9.7
F_D	x	x	x	x	x	39.7	300	4	3.5	1	84.9	4.0
F_E				x	x	1.8	10	4	4.1	0	4.4	Nil
F_F					x	0.7	5	3	0.9	0	0.4	Nil
F_G		x	x	x	x	26.0	20	5	2.3	1	36.5	1.4
F_H			x	x	x	8.7	13	3	1.0	0	5.1	2.8
F_I		x	x	x	x	243.4	250	3	0.6	1	95.1	3.1
F_J	x			x	x	12.3	100	3	7.1	0	52.6	0.2
F_K			x	x	x	93.2	50	6	1.8	1	98.7	Nil
F_L			x	x	x	296.3	300	13	1.6	1	292.3	9.1
F_M			x	x	x	63.7	35	6	2.3	1	87.4	0.4
F_N			x	x	x	15.9	20	2	2.2	0	21.0	12.0
F_0	x	x	x	x	x	28.1	20	3	1.8	1	29.9	Nil
F_P			x	x	x	17.4	30	5	1.4	0	14.8	Nil
F_Q			x	x	x	116.0	40	6	1.3	1	89.1	1.0
					Mean	100.0			2.3		100.0	
	Correlation coefficient w.r.t. P_1					0.97	0.68	0.95				

Note: "x" indicates yes and blank indicates no.
Mechanisms: M_1: New investments; M_2: Outsourcing/ subcontracting
Sub-mechanisms (of M_1): SM_1: New investment, SM_2: Investments for capacity expansion,
SM_3: Investments for manufacturing new item/model,
SM_4: Investments for improving quality of manufacturing systems.
Indicators: I_1: relative level of investment in plant & machinery; I_2: manufacturing capacity for CNC machine tools; I_3: Breadth of product-line in numbers; I_4: Plant efficiency in terms of ratio of annual sales to fixed assets; I_5: ISO-9000 certification.

As regards to the exports, it may be mentioned that a firm can export if it can manufacture cost-effective quality products. Interviews with the firms and data suggest that the industry has yet to gain export competitiveness. The correlation coefficient between the investments in plant & machinery and exports is positive albeit quite low (0.12). Similarly the correlation coefficient between manufacturing capacity and level of exports is also positive but relatively low (0.46). These facts illustrate that how adoption of mechanisms of investment is reflected into intermediate performance measures and ultimately translates into performance of the firms. It confirms our provisional conclusion that the f*irms investing in building in-house manufacturing capability are likely to perform better.*

Interviews with the firms suggest that policy measures introduced by the government in 1991 to dismantle barriers to entry and expansion have created a positive atmosphere for investment. Although the level of investment (both domestic as well as foreign) is relatively inadequate due to various other reasons, the policy environment has been conducive. As regards to domestic investment, the firm F_I that manufactures vertical machining centers is an illustrative example of new investment in the post-liberalization era. The parent company F_D, which manufactures CNC lathes decided to set up this unit taking note of market demand of machining centers both

[100] Details could be seen in Lall (1987).

in foreign and domestic market. The firm opined that had there been obstacles in getting licenses as prevalent in pre-liberalization era, they might not have been able to set up the firm or implementation might have been delayed considerably. Similarly the policy of *broad banding* is also a positive step to create conducing environment for industrialization. Earlier an item specific IL with fixed annual capacity used to be issued that always acted as deterrent in taking decisions for related diversification as per the market needs, which allows achieving economy of scope and synergy. Now the firm is able to undertake manufacturing of vertical-machining centers or horizontal machining centers or drill-tap centers under the same heading of machining centers (ITC code 84579100) without requirement of any further endorsement in the existing IEM even. Another major liberalization is in terms of relaxation on expansion of capacity. Now there is no restriction in expansion of capacity. One needs to just inform the government for undertaking expansion for statistical purpose. When the firm planned to double its annual capacity from 100 to 200 units, it just sent one letter regarding its intention and that was taken into record without any hassles.

F_O, a manufacturer CNC grinding machine located in north India, is another demonstrative example of new investments in the post-liberalization era. Sensing the technology trend towards hard turning and high rigidity machining, which will eventually reduce the overall scope of grinding operation, the firm is diversifying into CNC Lathes and machining centers. Grinding machines constitute only 2% of market whereas CNC lathes and machining centers constitute 25% each. Moreover in the north India there is no manufacturer of these items whereas 45% of market is there. The firm could undertake this diversification easily as there has been no government imposed barriers to entry.

As regards to FDI, it is observed that inspite of conducive policy environment none of the firms in the sample has been able to attract any foreign investment in the post-liberalization period. It is true for CNC machine tool industry in general. Out of 207 FC/FDI agreements approved in the post-liberalization period, only 24 pertains to complete CNC machine Tools and interestingly enough none of them involve in any FDI. Most of the investments are in the area of cutting tools and accessories as well as setting up of after-sales facilities by the foreign manufacturers. The overall FDI in this sector is quite low. It amounts to just 0.23% of total FDI in industry sector (Table 4.7).

The interviews with the firms suggest two panoptic reasons for lack of FDI. The first one relates to industry structure i.e. small domestic market, lack of sophisticated demand, low growth, low profitability, and lack of quality component suppliers etc. The second one concerns with the open policy environment i.e. with no barriers to import, foreign manufacturers find it more profitable & easier to export rather than FDI for manufacturing locally considering the low domestic demand and higher specialization of the products. In the pre-liberalization period the FDI and FC were used as mode of entry in the domestic market by the foreign investors. However, FDI in manufacturing cutting tools, R&D set ups and after-sales service establishments are encouraging signals for possible FDI as an extension of present activities in future as the market grows.

- *Outsourcing and sub-contracting*

Outsourcing implies obtaining goods or services from an outside supplier. Although outsourcing may be possible across the value chain of the firm, we will limit our scope of discussion to manufacturing only for the sake of simplicity and better clarity. In the context of machine tool manufacturing, firms usually resort to outsource such items that require specialized technical knowledge & manufacturing facilities, cost reduction, increased flexibility in the case of uncertainty of demand or rapid changes in technology as well as for having access to complementary assets, rather than creating economically unviable in-house facilities. Outsourcing is considered as a means for complementing own production process. As regards to s*ubcontracting,* it may be understood as a *sub-set of outsourcing.* It implies *procurement* of goods (e.g. components/ subassemblies) or services (activities or operations) *from domestic sources* i.e. *to contract work out*. The decision to subcontract is taken primarily based on "*make or buy*" criteria and level of development of the supporting and related industries etc.

In machine tool manufacturing several material inputs and operations are required that could be either undertaken in-house or outsourced. The material inputs could be raw material, components/ subassemblies, spares, accessories, or consumables etc. The major components/ subassemblies in respect of CNC machine tool are: CNC control (C_1), electric/ hydraulic/ pneumatic components (C_2); cutting tools (C_3); mechanical components (C_4); fixture & fittings (C_5); metal fabrications (C_6); and castings & forgings (C_7). The main operations could be identified as: rough machining (A_1), final machining (A_2), final assembly (A_3), painting (A_4) and computer interfacing (A_5). Usually certain items like CNC controls (C_1), servomotors, drives, relays, hydraulics etc. (C_2); cutting tools (C_3), and precision bearings, ball screws, spindles (C_4) that require specialized technical knowledge and facilities are procured from outside. These items are normally known as standard bought-out items and usually imported or bought from domestic sources. Table 7.5 gives an overview of status of outsourcing adopted by the firms in qualitative terms in respect of various types of components/ sub-assemblies, operations and source of procurement (imported, domestic or in-house manufacturing).

A glance at the Table suggests that all firms resort to outsourcing/ subcontracting albeit with a varying magnitude. With respect to individual groups of components/ subassemblies, it may be observed that items related to electronics/electrical/ hydraulic/ pneumatics (C_1 to C_3) are either imported or procured from domestic sources except for a few firms (e.g. F_A, & F_C etc.) that manufacture simple models of CNC controls. In case of mechanical components/ subassemblies (C_4), relatively simple items are manufactured in-house otherwise outsourced from domestic or imported sources. A few firms have established facilities in-house to manufacture certain complex components such as ball screws (F_A), and spindles (e.g. F_A, F_D, F_I, F_K, F_L) etc. Nevertheless, they also import the sophisticated ones. It is for the items pertaining to C_4 to C_7, where *subcontracting* plays a major role. As regards to the operations, firms usually undertake final machining (A_2), final assembly (A_3), painting (A_4) and computer interfacing (A_5) in-house and subcontract operations like rough machining (A_1). In a few cases where firms do not have adequate facilities for final machining, particularly the small-scale firms, the operation is also subcontracted.

Table 7.5: Outsourcing: An overview

Firm	Components/ Sub-assemblies#							Operations#				
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	A_1	A_2	A_3	A_4	A_5
F_A	M/I	M/D	M/D	M/D/I	I/D	I/D	I	I/D	I	I	I	I
F_B	M	M/D	M/D	M/D/I	I/D	D	D	D	I/D	I	I	I
F_C	M/I	M/D	M/D	M/D/I	I/D	I/D	D	I/D	I	I	I	I
F_D	M/D	M/D	M/D	M/D/I	I/D	I/D	D	I/D	I	I	I	I
F_E	M	M/D	D	M/D/I	I/D	I/D	D	I	I/D	I	I	I/D
F_F	M	M/D	D	M/D/I	I/D	I/D	D	I	I/D	I	I	I/D
F_G	M/D	M/D	M/D	M/D/I	I/D	I/D	D	I/D	I	I	I	I
F_H	M/D	M/D	D	M/D/I	I/D	I/D	D	I/D	I	I	I	I/D
F_I	M	M/D	M/D	M/D/I	I/D	I/D	I	I	I	I	I	I
F_J	M	M/D	M/D	M/D/I	I/D	I/D	D	D	I/D	I	I	I
F_K	M	M/D	M/D	M/D/I	I/D	I/D	I/D	I/D	I	I	I	I
F_L	M/D	M/D	M/D	M/D/I	I/D	I/D	I/D	I/D	I	I	I	I
F_M	M	M/D	M/D	M/D/I	I/D	I/D	I/D	I/D	I	I	I	I
F_N	M	M/D	M/D	M/D/I	I/D	I/D	D	I/D	I	I	I	I
F_0	M	M/D	M/D	M/D/I	I/D	I/D	D	I/D	I	I	I	I
F_P	M/D	M/D	M/D	M/D/I	I/D	I/D	I/D	I	I	I	I	I
F_Q	M/D	M/D	M/D	M/D/I	I/D	I/D	I/D	I/D	I	I	I	I

Components: C_1: CNC control, C_2: electric/ hydraulic/ pneumatic components;
C_3: cutting tools; C_4: mechanical components; C_5: fixture & fittings;
C_6: metal fabrications; C_7: castings & forgings.
Operations: A_1: rough machining; A_2: final machining; A_3: final assembly;
A_4: painting; A_5: computer interfacing.
Source of procurement: M: imported; D: procured domestically; I: undertaken in-house.

Interviews with the firms suggest that in the post-liberalization period the scope and extent of outsourcing depends primarily on the strategy of the firms unlike pre-liberalization period, when it was mainly policy induced. The liberalization has given them the required flexibility for making appropriate business decisions. The level of outsourcing depends on level of investment in in-house manufacturing or vice versa. Firms depending on higher level of outsourcing, usually have less investment in in-house manufacturing facilities, increasing their efficiency of investment as measured in terms of ratio of total sales to fixed assets. The firms F_J and F_B pursue vigorously the mechanism of outsourcing. They outsource majority of components and undertake primarily final machining and final assembly operations only. It is reflected in the firms' lower investment in plant & machinery and higher level of fixed asset turnover ratio (see I_1 & I_4 in Table 7.1).

Commenting on level of outsourcing, the chief executive of F_J observed, "*We have modeled our business based on outsourcing. Although the core business of the firm has been defined as design, manufacture and after sales-service of CNC machine tool. But our key strengths lie in design, assembly, testing, installation and after sales-service. If you ask, what we do in terms of manufacturing, then my answer is just final assembly, part of precision machining and painting . . .Physically also the design department is double in terms of space occupied as well as manpower. Outsourcing helps in achieving cost competitiveness and flexibility.*" The firms F_D, F_E and F_L also show similar characteristics. The firms F_D and F_J have used outsourcing for their strategic advantage to make use of policy of freedom of expansion of capacity. Similarly, F_C and F_O are exploiting the policy relaxation on diversification through outsourcing majority of components for manufacturing CNC lathes and machining centers, although their basic line of activity is different i.e. EDM and grinding machines respectively. Such actions have improved the firms' performance. These findings substantiate our provisional conclusion that *developing good network of subcontractors helps firm in achieving better performance level.*

7.3.1.4 Conclusions

- Firms used mainly two mechanisms to leverage the liberalized regulations on entry & expansion to build their manufacturing capability viz. *new investments, and outsourcing*.
- The adoption of these mechanisms is reflected in the *indicators* namely *level of investment*, *manufacturing capacity, breadth of products, plant efficiency and ISO-9000 certification*.
- The mechanism adopted by the firms although sounds same; there have been differences in its scope and implementation and therefore variations in the performance of the firms.
- Evidences suggest that the firms investing in building in-house manufacturing capability performed better.
- Firms resorted to outsourcing/ s*ubcontracting i.e.* procurement of goods (components/ subassemblies) or services from external sources in order to achieve cost effectiveness, increased flexibility, and complementing own production process.
- The decision to outsource/ subcontract is taken primarily based on "*make or buy*" decision and the level of development of supporting industries etc. Firms usually undertook manufacturing of high value added items and critical operations in-house.
- The mechanism of outsourcing has become quite beneficial for the firms to supplement their manufacturing capability in the liberalized scenario. However, *in-house manufacturing* and *outsourcing* may be considered as two extremes on the same continuum rather than as 'either-or' dichotomous construct. Although the extent and scope of these two may differ, actual manufacturing *worldwide can be traced lying at some point of this continuum.*
- Evidences suggest that in the protected market there has been greater role of in-house manufacturing and as the market opens and supporting & related industry develop, there is a movement towards outsourcing extreme on the continuum but not reaching there.

7.3.2 Regulations on imports

7.3.2.1 Framework for analysis

The various elements of policy performance causation in respect of regulations on imports are depicted in Table 7.6.

Table 7.6: Constituents of y Performance Causation: Regulations on Imports

Policy	Mechanism	Indicator	Performance
Import Policy ***Inducing modernization***	-New investments/ Modernization -Importing components	- Manufacturing capacity - Plant efficiency -ISO-9000 certificate	- Sales -Export Intensity

7.3.2.2 Causal Interactions

The main mechanisms adopted by the firms to leverage the policy on regulation of imports are: *new investments/ modernization, and importing components*. It may be interesting to note that these mechanisms are similar to the mechanisms adopted to leverage policy on regulation on entry and expansion. It reflects the importance of the mechanism as well as their use from different perspective. The adoption of these mechanisms is reflected in the *indicators* as mentioned in the previous section as well as *number of products introduced in the market as mentioned in chapter VI Table 6.4 as I_1*. We will discuss these mechanisms again one by one to get more insights.

- *New investments/modernization*

The liberalization on regulations on imports in the post-liberalization era for capital goods in general and machine tools in particular had impacts on the firms primarily in two ways. First of all, it induced a sense of fear from competition from imports due to abolition of quantitative restrictions that made the overall procedure of imports much easier and progressive reduction in tariffs that brought down the prices. Second, the firms themselves found it relatively easier and cheaper to import machine tools for investments in their own plants. Thus firms resorted for capital investment either to establish a new set up to manufacture CNC machine tools (SM_1); investments in existing firm to modernize plant & equipment either for increasing capacity (SM_2) or manufacturing new items (SM_3) or enhancing the overall quality of manufacturing system (SM_4) as indicated earlier in Table 7.3. The consequence of the adoption of these mechanisms could be gauged through *level of investment* in plant & machinery, capacity to manufacture CNC machine tools; quantum of diversification; and plant efficiency measured in terms of ratio of annual sales to fixed assets. As a matter of fact the difference between two time periods (i.e. beginning of post-liberalization period and the present) of the aforesaid indicators would have reflected the impact of the policy measures better. But due to paucity of data, the absolute values of the present period could be considered as a proxy. It is indicated as I_1 to I_4 in Table 7.3. Moreover, capacity to manufacture CNC machine tool could also be adjudged from the industry level production data, which shows an increase from 550 numbers in 1990 to 1050 in 1996 and then to 1382 numbers in 2000. New investments/ modernization has been one of the reasons for this increase. However, interviews with the firms suggest that the overall investment is not up to the mark due to low domestic demand, and increased level of uncertainty due to stiff competition from imports. It may be noticed that only few firms have been very cautious regarding fresh investments. Majority of the firms have opted for expansion in capacity or investments in balancing equipment for extending the breadth of product line or enhancing the quality of manufacturing system.

It may be mentioned that the policy on regulation on imports in the pre-liberalization period also induced investment but unlike the post-liberalization period, the incentives for the firms for investments were different. In that period firms undertook investment to seek the rent created due to protection and not due to fear of competition. Firms were giving more emphasis in new investments or increasing breadth of product line compared to enhancing the overall quality of manufacturing system. It is reflected from the analysis of situation in the eighties. Two distinct situations could be noticed. In the early eighties, when there was progression towards CNC machine tools, firms targeted those machines which were imported in larger quantities or likely to be imported and started manufacturing regardless of market size. In order to bring out the products quickly in the market, the existing firms resorted to import of technology. More than 50 FC agreements were signed during the period and quite a few were for the similar products, particularly for CNC lathes and machining centers. Most of the FC were taken by the established firms as technology supplier preferred to collaborate with firms having prior experience in manufacturing and marketing machine tools. These firms resorted to mechanisms such as SM_2 and SM_3. There have been instances of new investments SM_1 as well like F_B. Such efforts by the firms helped in diversification but at the cost of innovation and technical progress per se. On the other hand there were handful of progressive techno-entrepreneurs, who established firms (SM_1) primarily on own technological efforts. Commenting on the protection, a promoter of such firm remarked, *"we came out of our parent organization to start our own company to convert our knowledge into a profitable business entity considering ample market opportunity provided by the protective regime. We were pretty sure that we would succeed. The initial protection helped us to build the base and now the open competition is giving us the challenge to go global*." Overall, the adoption of mechanism of new investments by the firms in the pre-liberalization era culminated in establishment of a well-diversified CNC machine tool industry achieving annual production of 550 units of 30 different types by about 40 firms in the 1990. Although the industry was well diversified, it was fragmented and internationally uncompetitive.

- *Importing material inputs*

Importing material inputs could be understood as *a sub-set of outsourcing.* It implies procurement of material inputs such as raw material, components, subassemblies, spares, or consumables from abroad in order to achieve cost effectiveness, increased flexibility, complementing own production process, and achieving quality. The decision to import is taken primarily based on availability of material inputs from domestic sources in required quantity, quality, time, and price as well as import policy in vogue.

A glance on Table 7.5, which gives an overview of status of outsourcing in qualitative terms in respect of components/ sub-assemblies in the sampled firms, reveals that the firms consider imports as prime option for sourcing critical components pertaining to C_1 to C_4 group.

Although a few firms manufacture simpler versions of these critical components such as CNC controls (e.g. F_A, & F_C etc.); ball screws (e.g. F_A); and spindles (e.g. F_A, F_D, F_I, F_K, F_L) etc. they are not in position to supply the industry requirement either on account of capacity constraints or quality constraints. Certain other critical items are just not manufactured in the country since they require huge investments, technological skill and economy of scale. Therefore almost all firms except for the smaller ones indicated imports (M) as a prime source of procurement. The smaller firms try to depend on domestic sources as their requirements are less sophisticated and they do not have proper expertise for importing from abroad. Industry data suggests that imported inputs constitute 40-50% of cost of CNC machine tools. CNC controllers alone cost around 20-25%.

In general the firms opined that liberalization in imports has become instrumental in keeping pace with contemporary technology and facing competition from imports. Now items could be imported without any hassles based on their strategic decisions. Although no firm-wise exact figures could be gathered but overall opinion suggests that the lead-time from concept development to commercial production has been reduced by 30-40 per cent. Its effect could be sensed from the design stage. With the confirmed availability of required components now it has been easier to design and develop new product/ models or add additional feature in the existing models compared to pre-liberalization period. It influences the quality of the products as well. During the pre-liberalization period one has to compromise on quality and cost. Sometimes non-availability of even a small component used to delay the schedule by six months as import substitutes had to be developed or some alternative had to be thought about. The design efforts were primarily devoted towards development of import substitutes irrespective of cost and quality crowding out new product development efforts. Although there is no conclusive evidence that new product development has improved in the post liberalization period, interviews with the firms suggest that there has been gradual change in mind set and efforts are being made in this direction to face the competition. It is also reflected in the number of products/ models developed by the firms during the last three years as mentioned in chapter VI Table 6.4 as I_1.

In manufacturing stage, the deregulation on imports has reduced the lead-time to imports. The items being 'A' item (high valued item), such reduction has reduced inventory carrying cost, risk of stockouts and requirement of working capital culminating to lowering of price of the end product and increased profitability. In general the inventory level has come down from 8-12 months to 1-3 months. In the pre-liberalization period, a firm had to apply for import license (commonly known as supplementary license) for importing raw material/ components stating the projected requirements. It used to be issued after assessing the essentiality by the sponsoring authority and indigenous availability by DGTD. The entire procedure was quite cumbersome and non-transparent creating an environment of uncertainty. Thus firms used to apply for higher quantity and always had to carry higher inventory level. The deregulation has given respite from those hassles. Further, the removal of AU condition for imports has facilitated imports of industrial inputs for stock and sale by third party facilitating the availability of required goods from domestic trading sources. It has helped particularly the smaller firms to source their requirement as well as to all firms for the items required in smaller quantity and not available locally in required quantity or quality.

Moreover the progressive reduction of tariffs has brought down the prices of imported inputs considerably enabling the firms to offer finished products at a relatively lower price. For instance, average price of CNC lathe produced by F_D has come down from Rs 2.5 million in 1992 to Rs 1.9 million in 1995 to Rs 1.6 million in 2000. Similarly the average price of vertical machining center manufactured by F_J has come down from Rs 3.1 million in 1996 to Rs 2.3 million in 2000. The import content of these firms hovers around 30% of material cost. It may be mentioned that these figures should be read with caution, as decrease in import tariffs is not the only cause for reduction in prices of machine tools. But the tariff structure is still at the higher side compared to international standards and cases of anomalies in tariff structure still persist. The inverted duty structure has been one of the main causes of lack of cost competitiveness of Indian machine tool industry.

The above discussion suggests that in general, the mechanism of importing material inputs from abroad in response to the deregulation on imports has helped in achieving cost effectiveness, increasing flexibility, complementing production process, and achieving quality.

7.3.2.3 Summary

- Firms adopted primarily two mechanisms to leverage the liberalized regulations on imports to build their manufacturing capability viz. *new investments, and importing material inputs from abroad*.
- The adoption of these mechanisms are reflected in the *indicators* such as *level of investment*, *manufacturing capacity, breadth of products, plant efficiency and ISO-9000 certification* and *number of products/ models introduced in the market*.
- The liberalization of imports provided incentives for *new investments* in two ways. First, it induced a sense of fear from competition from imports due to abolition of quantitative restrictions & need of indigenous angle clearance from the government as well as progressive reduction in tariffs that brought down the prices. Second, imports of machine tools become relatively easier and cheaper for investments for the firms themselves.
- *Importing material inputs* could be understood as *a sub-set of outsourcing.* It implies procurement of material inputs from abroad in order to achieve cost effectiveness, increased flexibility, complementing own production process, and achieving quality.
- Firms resort to imports in order to fill in the gap of availability of material inputs from domestic sources in required quantity, quality, time, and price.
- The progressive reduction of tariffs has brought down the prices of imported inputs considerably enabling the firms to offer finished products at a relatively lower price. But the tariff structure is still at the higher side compared to international standards and cases of anomalies in tariff structure still persist.

7.4 Synthesis and Conclusions

7.4.1 Synthesis

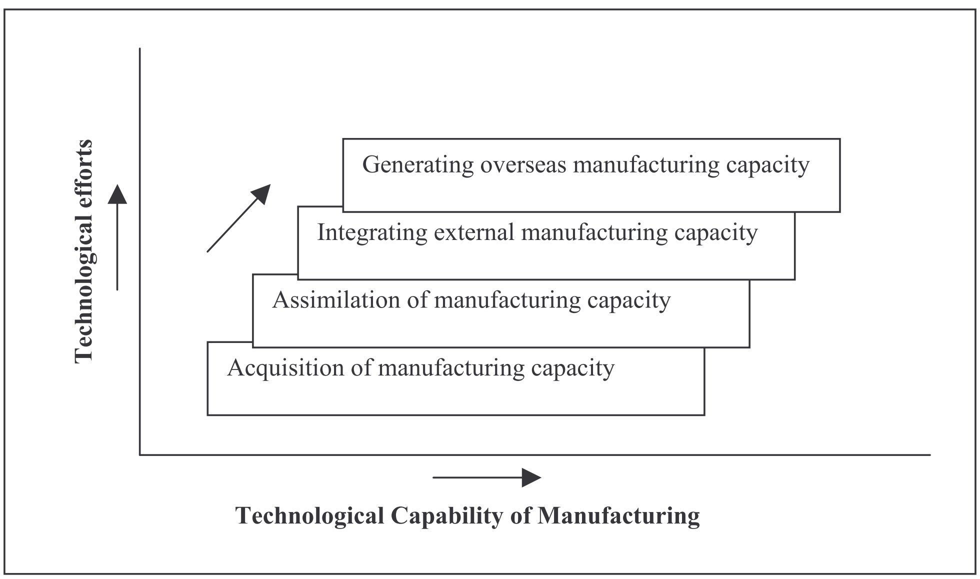
Our analysis of causal interactions has brought out certain interesting facts. The analysis in respect of regulations on entry and expansion suggests that investments in-house manufacturing facilities is the necessary but not the sufficient condition for building technological capability for manufacturing in the firms. It ought to be complemented with outsourcing/ subcontracting i.e. procurement of material inputs/ services from external sources. Firms resort to outsourcing to achieve cost effectiveness, increased flexibility, and to complement in-house manufacturing capacity. In practice none of the firms can either depend on in-house manufacturing i.e. cent percent vertical integration or complete outsourcing. There is nothing like a choice between total in-house manufacturing and total outsourcing.

Evidences suggest that during the initial level of industrialization and in the protected market there has been greater role of in-house manufacturing. It concerns with establishment of manufacturing facilities and related systems to manufacture goods in-house. It may relate to green-field investment, modernization for increasing capacity or enhancing overall quality of manufacturing system, manufacturing new product or diversification. As the industrialization proceeds, supporting & related industry develops, and policy environment liberalizes the firms adopt outsourcing more and more primarily through subcontracting or capacity sharing with other manufacturers and importing from abroad. Firms having a judicious balance of in-house manufacturing and outsourcing seem to have better performance. However, in majority of the cases the relationships in respect of subcontracting/ capacity sharing are on arms-length basis rather than the notion of interdependence and mutuality. It may be recognized that with the progress of industrialization more capital/ skill intensive activities are undertaken in technologically matured industrial sector, which results in increased specialization and higher use of intermediate products. These dynamic shifts reflect changes in both technology of products and processes that demand more division of labour. Moreover, the ongoing changes in technology in machine tool industry is changing the dynamics of manufacturing system and call for adoption of new forms of organizations, and work process in the firms and therefore require a more information flow based integrated supplier networks. It is seen that the firms are increasingly recognizing the importance of this notion and a few firms have made a move towards the process of integration.

A further step in creation of manufacturing capability is seen in the form of establishing overseas manufacturing capacity. Although we came across only an isolated case of such endeavor and that too for non-CNC machine tool in another developing country in the pre-liberalisation period, nevertheless it contributes in the building of technological capability in general and capability for manufacturing in particular. In fact due to increased integration of market and potential for global subcontracting such mechanism has to be given due credence. As mentioned earlier, firms in the developing countries in general and India in particular in CNC machine tool industry are yet to attain such level. Nevertheless, for attaining sustained development requisite efforts are required in this direction by the firms along with necessary policy supports from the government.

In view of the above the entire process of building technological capability for manufacturing could be disaggregated in four distinct but interrelated activities namely: acquisition of in-house manufacturing capacity, assimilation of manufacturing capacity, integrating external manufacturing capacity, and generating overseas manufacturing capacity. The acquisition of in-house manufacturing capacity concerns with establishment of manufacturing facilities in-house. Assimilating manufacturing capacity means complementing firms manufacturing capacity with outside sources through subcontracting or capacity sharing with other manufacturers. Integrating external manufacturing capacity signifies deepening of the preceding process of assimilation of manufacturing capacity in terms of more information flow and shared responsibility. Generating overseas manufacturing capacity signifies establishment of manufacturing capacity across the national boundaries. The requirement/ intensity of technological efforts increases as firms move up the ladder as well as move across (i.e. move horizontally within each activity) translating into higher technological capability. The interrelationship between firms' technological effort, technological capability *in respect of manufacturing* and various activities may be depicted graphically as in Figure 7.2.

Figure 7.2: Dynamics of building Manufacturing Capability



7.4.2 Conclusions

- Firms used mainly two *mechanisms* viz. *new investments, and outsourcing* to build manufacturing capability in response to the liberalized regulations on entry & expansion and deregulation on imports. The adoption of these mechanisms is reflected in the *indicators* such as level of investment, manufacturing capacity, breadth of products, plant efficiency and ISO-9000 certification and number of products introduced in the market.
- Evidences confirmed our provisional conclusion that the firms investing in building in-house manufacturing capability are likely to perform better.
- Firms resorted to outsourcing *i.e.* procurement of goods (material inputs) or services (operations) from external sources in order to achieve cost effectiveness, increased flexibility, and complementing own production process.
- *In-house manufacturing* and *outsourcing* could not be considered mutually exclusive. They are to be considered as the two extremes on the same continuum rather than as 'either-or' dichotomous construct. There is nothing like a choice between total in-house manufacturing and total outsourcing. Although the extent and scope of these two may differ, firms lie at some point on this continuum.
- Subcontracting and importing from abroad are the two subsets of outsourcing.
- Firms usually undertake high value added and critical operations *in-house* and *subcontract* non-critical operations. Firms resort to imports in order to fill in the gap of availability of material inputs from domestic sources in required quantity, quality, time, and price.
- The entire process of building technological capability for manufacturing could be disaggregated in four distinct but interrelated activities namely: *acquisition of in-house manufacturing capacity, assimilation of manufacturing capacity, integrating external manufacturing capacity*, and *generating overseas manufacturing capacity*. The requirement/ intensity of technological efforts increases as firms move up the ladder as well as move across (i.e. move horizontally within each activity) translating into higher technological capability.

Chapter Eight

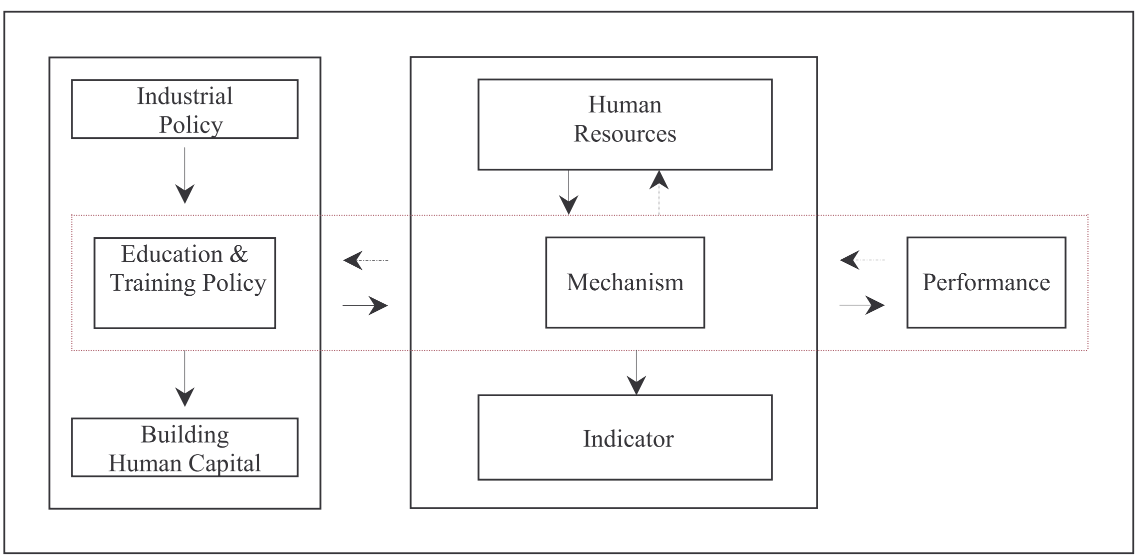
POLICY AND HUMAN RESOURCES

This chapter attempts to analyse the policy-performance causation in respect of Education and Training policy vis-à-vis Human resources of the firms. The analysis is presented in two distinct but interrelated steps. First, a brief overview of education & training policy is given. It is supplemented with discussion as to how these measures influenced in developing the firms' human resource capability through analyzing linkages between various mechanism, indicator & performance of the firms. At the end the findings are synthesized and conclusions are drawn.

8.1 Introduction

In the last two chapters we saw that how technology and investment policy influence building technological capability of product & process and in turn determine the performance of the firms. One of the underlying factors in this policy-performance causality is the people or employee of the firms. *This chapter endeavors to analyse the role of education and training policy of the government in creating and developing employees' skill in the firms, which plays a primary role in the execution of firms' strategy and performance*. We propose to analyse the causation on the similar lines as carried out in earlier two chapters. The framework is depicted in figure 8.1.

Figure 8.1: Policy – Performance Causation: Education and Training



8.2 Policy framework: Education and Training (E&T) Policy

In the policy framework, Education in India is considered as a social policy that basically acts at the macro level. It is segmented in terms of primary-, secondary-, tertiary- (higher) and adult education. Tertiary education is further divided as technical and non-technical education. Technical education includes vocational training as well. A glance of policy framework reveals that there is no specific policy directed towards industrial development in the country as such. Thus we will present an overview of overall education & training policy and *devote greater attention to the aspects that concern industry*. It will consist of a brief description of overall policy, policy regarding higher education, technical education, vocational education and the system of industrial training. Highlights of facilities available for industrial training pertaining CNC machine tool industry will also be presented.

8.2.1 Education Policy

The commitment of the government towards the spread of education among its citizens is reflected in the Directive Principle contained in Article 45 of the Constitution *" the State shall endeavor to provide within a period of ten years from the commencement of this Constitution, for free and compulsory education for all children until they complete the age of fourteen years*" (DoE 2002). Under the Constitution, "*education*" is in the concurrent list, implying joint responsibilities of both the central- and provincial government. The central Government accepts a larger responsibility to reinforce the national and integrated character of education, in general, and to promote excellence at the tertiary level of the educational pyramid throughout the country in particular. The Ministry of Human Resource Development is responsible for the Educational policy formulation. It is guided by the Central Advisory Board of Education (CABE), a national level advisory body, which has, amongst others, the education ministers of all the provinces as members. However, in the area of overall planning for the country of which the educational planning is a part, the National Development Council (NDC) with the Prime Minister as the Chairman is the apex level body (DoE 2002).

The educational structure in India is generally referred to as the Ten + Two + Three (10+2+3) pattern. The first ten years impart undifferentiated general education for all students. The +2 stage, also known as the higher secondary, provides for differentiation into academic and vocational streams and marks the end of school education. The higher education consists of three years of education leading to a bachelor's degree in arts and science and four years in professional fields like engineering and medicine. This is followed by two years of study for a Master's degree; and three years at least beyond the Master's degree for a PhD degree that generally takes longer. There are also postgraduate diploma programmes open to graduates, and certain professional programmes like those in education and law require a first degree as a pre-condition for admission in most places (INCC, 1998; Mishra, 1993).

The higher education in India is subject to multiple levels of governance and control. At the apex the Department of Education in the Ministry of Human Resource, Government of India is the acts as the coordinating and policymaking body responsible for co-ordination and determination of standards in institutions for higher education. The departments of higher education/ technical education at the state level are responsible for implementing the national policy at the state level. Further, the University Grants Commission (UGC) and the All India

Council for Technical Education (AICTE), established by Acts of Parliament, have the statutory responsibility of promoting, regulating and maintaining standards in teaching/ research/ examinations in universities and technical education, respectively. (AICTE) is responsible for coordination of technical and management education institutions. It supports engineering colleges, management of educational institutions and polytechnics engaged in training of technicians. There is overlapping of responsibilities as well. As regards to the funding, the Planning Commission plays the deciding role in all developmental funding under the Union Budget prepared by the Ministry of Finance and approved by the Parliament. Funds are released through the Department of Education, UGC or AICTE. In certain cases approval of the Union Cabinet of Ministers is also required for funding of schemes/programs beyond certain specified limits.

There has been adequate emphasis on higher education since independence. In 1947, a Commission under the Chairmanship of Dr. S. Radhakrishnan was set up to report on Indian university education, which is a part of higher education system. In its report, the Commission said: "*Democracy depends for its very life on a high standard of general, vocational and professional education. Dissemination of learning, incessant search for new knowledge, unceasing effort to plumb the meaning of life, provision for professional education to satisfy the occupational needs of our society are the vital tasks of higher education*." It sets out the main objective of the university education in India. It was recognized that sustained public investment in higher education would be necessary for the following reasons (INCC, 1998):

- Facilities for higher education available at the time of independence were insignificant that created increased social demand for higher education.
- Building up a new socio-economic system required large-scale manpower with varied skills; so the government had to increase investment in higher education.
- The adopted development models necessitated building up of huge social infrastructure for excellence in science and technology and high skilled labour force.
- The rapid growth of secondary education also pushed the demand for higher education.

Subsequently in 1968 and 1986 committees were set up to undertake a comprehensive review of the nation’s education policy. These committees also recommended the need of all-round improvement in system of higher education with proper emphasis on its consolidation and expansion. The salient features of the policy are:

- Education is a unique investment in the present and the future; education will be treated as a crucial area of investment for national development and survival;
- Steps will be taken to facilitate inter-regional mobility by providing equal access to every Indian of requisite merit, regardless of his origins for higher education in general, and technical education in particular;
- In the areas of research and development, and education in science and technology, special measures will be taken to establish network arrangements between different institutions in the country and participate in projects of national importance;
- Research in the universities will be provided enhanced support and steps will be taken to ensure its high quality;

- The reorganization of technical education and management education should take into account the anticipated scenario by the turn of the century, with specific reference to the likely changes in the economy, social environment, production and management processes, and great advances in science & technology;
- Excellence in performance of institutions and individuals will be recognized and rewarded;
- Networking systems will have to be established between technical education and industry, R&D organizations, programs of rural and community development, and with other sectors of education with complementary characteristics;

Such efforts had positive results. At Independence in 1947, there were only 20 universities and 500 colleges with an enrollment of about a hundred thousand students only in the country. In a span of 50 years by 1997-98, it increased to 229 universities,[101] 9264 colleges (general education 7199 and professional education 2075) with about 7 million students enrolled (DoE, 2002). The total stock of qualified scientific and technical manpower in India in 1997 was estimated to be about 6.5 million comprising of 1.1 million engineering diploma holders, 0.73 million engineering degree holders, 3.3 million science graduates, 0.66 million science post-graduates and 0.7 million other professionals. It has been estimated that about 190,000; 38,000; and 3,800 students receive degree at B.Sc., M.Sc. and PhD levels respectively every year (IAMR, 2002; World Bank, 2000). However, in spite of this phenomenal growth, the total enrolment is only about six percent of the relevant age-group (17-23) and amounts to 613 students per 100,000 of population. It is quite low as compared to other Asian countries viz. Philippines (27.8%), Thailand (19.0%), and Malaysia (10.1%).

As regards to investment, the actual expenditure on higher education increased by more than 100 times from Rs.140 million in the first FYP (1951-56) to Rs. 15,000 million in the eighth FYP (1992-97) at current prices, and 6.5 times in terms of real prices. But in respect of the share in total planned resources it could not keep the pace. It has decreased from 0.71% in the first FYP to 0.35% in the eighth FYP (DoE, 2002; INCC, 1998). From the financial point of view the investment is still regarded as much below optimum. The financial crisis is due to escalating costs and increasing needs, on the one hand, and shrinking budgetary resources, on the other. Recently, efforts are being made to mobilise additional resources. It has been recommended that while the government should make a firm commitment of funding higher education, due emphasis should be given on colleges/ universities making efforts to raise their own resources, encouraging private investments as well as public-private-partnership. Hence, despite the rapid expansion of the system in 50 years, access to higher education still remains an issue.

Technical education primarily a part of higher education[102] has also grown fairly large due to ample emphasis given on development of education since independence or even before the independence. Eisemon (1984) notes that the roots of emphasis on scientific and technical

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[101] While many universities provide general as well as professional education, there are some universities that exclusively provide professional education, and some exclusively general. By 1997-98 out of 229 universities, there were 116 general-, 12 science and technology-, 7 open-, 33 agricultural-, 5 women's-, 11 language-, and 11 medical universities (DoE, 2002; INCC, 1998).

[102] There are certain overlaps with secondary education as well, which will be illustrated in further discussion.

education in India could be traced back to thinking of Indian National Congress, formed in 1885, which proposed that '*the government be moved to elaborate a system of technical education*'. However, due to lack of any initiative by the colonial authorities in this regard, in 1904, Indian philanthropy took initiative to form the Advancement of the Scientific and Technical Education of Indians, which sponsored Indian students to study in Japan, the USA and Europe. Subsequently, industrialists and leaders of national movement started the first college of engineering and technology at Jadavpur, Calcutta. During the Second World War, the colonial authorities recognized the need of industrial planning to produce war material necessary for defense forces and consequently in 1942, the Council of Scientific Industrial research (CSIR) was established to foster and co-ordinate scientific and industrial research.

After independence in 1947, the first prime Minister of India Pandit Nehru, who had strong belief in importance of S&T education for sustained development, gave special emphasis for creating scientific training and research infrastructure (Eisemon, 1984). The emphasis on S&T education could also be gauged from the statement of the founding father of Indian Constitution Dr. B.R. Ambedkar, *"No plan for the future development of the country can be deemed to be complete which does not provide for technical and scientific training. This is the age of Machine and it is only those countries in which technical and scientific training has risen to the highest pitch that will survive in the struggle that will commence when the war is over, for maintaining decent standards of living for their people."* Such realisations became the basis of efforts undertaken during the last five decades. As a result there are about 550 engineering & technical colleges, 600 management institutions, 1100 polytechnics and 4500 industrial training institutes in the country now (DoE, 2002). It offers education and training in a wide variety of trades and disciplines at certificate, diploma, degree, postgraduate degree and doctoral levels in institutions located throughout the country catering to the various levels of knowledge, skills and competences required by the economy. To get an overall picture, it is important to discuss some of the major constituents of the system.

At the lowest level there are *technical industrial arts and crafts schools* that prepare students for the lower secondary stage examination (10^{th} grade). They are mainly located in the provinces of Maharashtra, Gujarat, Andhra Pradesh, Karnataka and Kerala. There are 37,20 such schools enrolling 314,104 students in 1987-88 (Mishra, 1993). In these schools students are offered one vocational subject (e.g. carpentry, blacksmithy, moulding, welding, fitting, turning, plumbing, building construction, rural technology, textile technology, wireman etc.), in addition to the general school's curriculum. These school more or less act as a feeder to industrial training institutes & polytechnics rather than for preparing young people for vocational fields. They continue today as an offshoot of the general schooling.

The *certificate course* was initially introduced by Directorate General of Employment & Training (DGET) in the Ministry of Labour, Government of India as Craftsmen Training Scheme (CTS) in 1950 by establishing about 50 *Industrial Training Institutes* (ITIs) for imparting skills in various vocational trades to meet the skilled manpower requirements for technology and industrial growth of the country. It aims to provide systematic training to potential workers and reduce unemployment among educated youth by equipping them with suitable skills for industrial as well as self-employment. It therefore reduces pressure from the tertiary education as well. At the end of November 2001 there were 4,499 ITIs (1,727 in

Government & 2,772 in Private Sector) spread across the country having a capacity of 657 thousand trainees (MoL, 2002). There are, in all, 67 trades of which 43 belong to the engineering group. The design of curricula consists of theory and practice relating to the vocational field. The ITIs offer both X+ and VIll+ level courses in nearly equal numbers. Most of the courses range in duration from one to two years. The curriculum is highly practice oriented and the elements of general education are kept at minimum. An ITI graduate is not eligible for university education. The ITIs are also used as basic training centers for the Apprenticeship Training Programmes under the Apprentices Act 1961. The National Council of Vocational Training (NCVT) under the Ministry of Labour is the apex coordinating and policymaking body (MoL, 2002).

The *diploma courses* are offered in the polytechnics affiliated to the respective State Boards of Technical Education that is responsible for policy planning and funding of polytechnics at the state level. The Boards lay down in general the levels and standards of the courses and guide the system of evaluation of the students appearing at the examination. This provides broad based education in engineering as well as some non-engineering areas. The minimum qualification for entry into a polytechnic is class X. The courses are generally of three-year duration but a few range between two to four years. There are nearly 1,100 polytechnics (about 450 in private sector) with annual admission capacity of 100 thousand students (World Bank, 2000). The training is mostly institutional and theory oriented with little amount of industrial exposure. It creates manpower for skilled job at technician and supervisory level.

Several engineering colleges and technical universities offer four years degree courses in engineering. The minimum qualification for entry is class XII i.e. completion of senior secondary education. The Government of India initially established six Indian Institutes of Technology (IIT), one in each region of the country under international technical cooperation to offer formal programs in engineering and technology. There are also a few exclusive universities/ institutions for engineering and applied sciences education such as Indian Institute of Science, University of Roorkee, Jadavpur University, and Anna University etc. In addition to the above, 17 Regional Engineering Colleges (RECs) have been established in partnership with the states. Then there are about 500 State engineering colleges/government aided colleges as well as private engineering colleges. These institutions mainly offer courses in general disciplines of engineering like Civil, Mechanical, Electrical, Electronics and communication, Chemical, Textile, Metallurgy and Industrial engineering. The number of degree holders graduating per year has increased from few odd thousands to 65 thousands since independence.

Some of these institutions also offer *postgraduate* (Master's in engineering) *and doctoral courses* in various disciplines of engineering. Another one and half year is required for Master's in engineering degree after the degree course. A few institutions also offer a five year integrated program leading to a Master's degree in engineering. In postgraduate course there are few disciplines directly related to machine tool industry such as Design & Production Engineering Machine Tools, Foundation Engineering, Engineering Materials, Electronics Instrumentation, Mechanical Shaping of Metals (Rolling, Forging and Heat Treatment), and Industrial Physics etc. But very few colleges offer them. The doctoral degree course requires about four years. Unlike under graduate course, the postgraduate and doctoral courses are not able to attract sufficient students. A World Bank study notes that over 60% of some 19,000 seats approved in 191 institutions for post-graduate education in engineering colleges remain vacant and less than 400 research scholars complete their Ph.D. in engineering and technology. The low enrolment in post-graduate and research programs in engineering is a major cause of concern for the technical education system, which already suffers from about 10,000 vacant positions (World Bank, 2000). It also hampers industrial R&D programs in the country.

8.2.2 Industrial Training Policy

So far our discussion was concentrated on policy framework and structure of system of *education* in India. The following section presents a brief overview in respect of *training*. After independence, as the development proceeded, it was recognized that existing system of education should be supplemented with a system of appropriate industrial training for adequate practical exposure to cater the needs of industry and achieve sustained development. Consequently National apprenticeship scheme was started in 1959 on voluntary basis. In 1961, Indian Apprentices Act, 1961 was enacted and the National Vocational Training system (NVTS) was established under Ministry of Labour, Government of India. The unique feature of the system is, *while the overall program runs under the aegis of the government, the training delivery is totally by the firms*. The Act made obligatory for the firms in the organized sector (both public and private) to train a prescribed proportion of manpower as apprentices. The apprentices are to be treated as trainees and not as employees of the firms. The system works as an extension of the educational process as well as prepares candidates for subsequent employment. Initially the Act covered only 'Trade' apprentices primarily for graduates of ITIs. In 1973, the Act was amended to include training of Graduate and Diploma engineers as 'Graduate' and 'Technician' Apprentices. The Act was further amended in 1986 to extend the scheme for students passing out of the X+ vocational streams, as 'Technical (Vocational)' Apprentices. About 17,800 firms engage apprentices. The main schemes under the NVTS are (DGET, 2002; Dagaur, 1997; MoL, 2002, 2002a):

- 'Technical' Apprenticeship for the graduates of higher secondary vocational courses
- 'Trade' Apprenticeship for the graduates of ITIs
- 'Technician' Apprenticeship for diploma holders from polytechnics
- 'Graduate' Apprenticeship for engineering graduates
- Advanced vocational training scheme
- Craft instructors training scheme
- Part-time training for industrial workers

As per MoL (2002), the *trade apprenticeship* and *technician* apprenticeship are the major constituents of the system as they meet the basic requirements of skilled workers and technicians in industries. The *trade* apprenticeship programme has an intake capacity of over 190,000 in 138 apprenticeable trades and run for durations of six months to four years. The *technician* apprenticeship programme has 101 subjects and 12,000 seats. The duration of programme is one year. The *technical (vocational)* apprenticeship programme offers training in 94 subject fields. The *advanced vocational training scheme* caters the need of advanced level skills of industrial workers for which, the government has created facilities in 6 Advanced Training Institutes (ATI) and 30 ITIs in 15 states since 1977 in collaboration with UNDP/

ILO.[103] Under the scheme, training in selected skill areas is being imparted through short-term modular courses of one to six weeks' duration. Besides, two Foreman Training Institutes in Banglore and Jamshedpur has been established to train the existing and potential shop-floor foremen/ supervisors in technical and managerial skills through long-term and short-term courses. The *Craft instructors training scheme* provides training to instructors (trainers) of ITIs/ Apprentice training centres in the techniques of imparting industrial skills. It is undertaken in ATIs. The course duration is usually one year. Further, the Central Staff Training and Research Institute, Calcutta conducts refresher-training programmes for training executives of all the training centres run by the government or the firms. The Institute also undertakes R &D in the field of vocational Training. The *part-time training for industrial workers* provides opportunity for a vertical advancement of the personnel from one level of a technical education/training to the next higher one i.e. a worker with a National Trade/Apprenticeship Certificate can take on a diploma course and so on. Accordingly provisions have been made for admission in next higher level of course. A few centers have started part-time courses, evening courses, and tailor made courses etc. for this purpose. These are, however, offered at present on a limited scale. The overall policy support by the government to run the training system could be summarized as under:

- Formation/ implementation of policy and procedure under the Apprentices Act, 1961;
- Provision of loans for setting up of training centers by the firms;
- 100 per cent exemption from Income Tax for expenditure incurred by the firms for organizing training programme under the scheme;
- 100 per cent exemption from customs duty on imports of training equipment by the firms,
- Reimbursement of 50 per cent of the cost incurred on Diploma holder apprentice training,
- Reimbursement of 50 per cent of the cost incurred on fresh apprentice training scheme to the firms employing less than 500 employee,
- Development of curricula for different trades under apprenticeship training schemes;
- Monitoring and inspection of the training programmes conducted by the firms;
- Awarding of the diploma after successful completion to the apprentices by the Director General of Employment and Training (DGET);
- Conducting the regional and all India skill competition for craftsmen and apprentices;
- Running the six ATIs, the Central Staff Training & Research Institute, Calcutta and two Foreman training Institutes.

[103] Six ATIs are located in Chennai, Hyderabad, Howrah, Ludhiana, Kanpur and Mumbai. Some of the courses offered are particularly useful for Machine Tool industry such as Tool Design, Tool & Die-Making, Heat Treatment, Metallurgy, Machine Tool Maintenance, Micro computer/ Industrial control and Welding etc. (MoL, 2002).

The snapshot of the structure of E&T system so evolved in terms of level of education could be presented as in Table 8.1:

Table 8.1: Structure of Education & Training in India *(based on level of education)*

Level	Education	Training
Primary	Primary (Class V)	---
Secondary	Secondary (Class X) Senior Secondary (Class XII) Industrial Arts & Crafts School Industrial Training Institutes (ITI)	'Technical' Apprenticeship 'Trade' Apprenticeship Part-time training of workers
Tertiary	Undergraduate Diploma Degree Post Graduate Doctoral	Advanced Vocational Training 'Technician' Apprenticeship 'Graduate' Apprenticeship Craft instructor training Part-time training

8.2.2.2 Training facilities for CNC Machine Tool Industry

In addition to institutions as described before that impart training for machine tool as a part of their overall training activities, there have been efforts on the part of the Government to provide training specifically for machine tool. The institutions like the CMTI, ICAMT and IMTT render training services on CNC machine tool; whereas the series of Tool Rooms across the country provide training for design & development of tools & dies.

- *Central Manufacturing Technology Institute (CMTI)*

The CMTI is the main institution dedicated for R&D and training in machine tools. It was established in 1963 by the Government in technical collaboration with Institute for Machine Tools & Production Engineering (VUOSO) of erstwhile Czechoslovakia. In 1992, the institute broadened its scope of activity to entire engineering manufacturing sector and accordingly changed its name to Central Manufacturing Technology Institute from Central Machine Tool Institute (CMTI, 2002). Along with R&D activities, the institute renders training and consultancy services to industries in areas of:

- CNC Machines and Systems,
- Latest advances in tooling & machining technology,
- Precision engineering,
- Machine tool evaluation and testing,
- Application of CAD/CAM/CAE,
- Rapid prototyping,
- Precision measurements, metrology, and standardization,
- CNC retrofit and use of ERP/ TQM in SMEs.

In addition to the above, CMTI offers Technology Information services including patent information. It maintains a big library with an extensive collection of books, periodicals and reference handbooks and data bases both in electronic & non-electronic form for products and patents. The services can be availed through personal visits, regular mail, fax or e-mail. A handbook entitled "Machine Tool Design Data Handbook" compiled by CMTI has been well received both as good education material in the universities and by practicing designers. Recently it has published a database named as '*MTECH*' on CD. It is a rich bibliographic collection of 75,000 plus articles selected from 150 plus leading international journals in the field of manufacturing technology (CMTI, 2002). Smaller manufactures make good use of training and information services of this institution. Apart from R&D and training supports its contribution has been well acknowledged as a breeding pond of techno-entrepreneurs.

- *International Center for Advancement of Manufacturing Technology (ICAMT)*

The International Center for Advancement of Manufacturing Technology (ICAMT) is one of the novel initiative of international organization like UNIDO in cooperation of Government of India to bridge the technology divide by promoting technology as the means to industrial competitiveness in developing countries (ICAMT, 2002). Apart from other activities the ICAMT has initiated a course on CNC machine tool design in Banglore in collaboration with CMTI, IMTMA and the industry, which has been well appreciated by all.

- *Institute for Machine Tools Technology (IMTT)*

The Government of India in collaboration with the provincial government and UNIDO has established the Institute for Machine Tools Technology (IMTT), Batala, Punjab. It provides technical services in terms of new designs, precision engineering facilities, lab & testing, experts' advice and training to entrepreneurs and employees of small-scale units in Punjab. The training and technical assistances are primarily imparted in the field of:

  - Design & Development of Tools/ Jigs/ Fixtures/ Moulds & Dies/ Machine Tools,
  - CAD/CAM, CNC part programming, simulation and finite element analysis,
  - Metallurgical Testing and analysis of metals & alloys, polymers and non-metals etc.,
  - TQM, Pre-assessment Audit for ISO 9000 Quality Assurance System,
  - Computer and CNC Machines, and special programs on requests.

- *Tool Rooms*

The Government has set up series of Tool Rooms in various parts of the country to assist firms in their technical up gradation by providing training in the field of tool, dies & moulds making either on its own or with assistance of the developed countries namely Denmark & Germany or international organizations like UNIDO & ILO etc. These tool rooms are located at Indore, Ahmedabad, Ludhiana, Hyderabad, Bhubaneshwar, Jamshedpur, Calcutta, Jallandhar and Nagpur. Some of the provincial governments have also set up tool rooms at Lucknow, Delhi, Bangalore, Mysore and Goa etc. These tool rooms are equipped with modern equipment like CAD/ CAM and CNC machines like CNC milling, CNC copy milling, CNC EDM, Profile grinding, Jig boring, Jig grinding, Vacuum heat treatment etc. The tool rooms also develop tooling of international standards at competitive rates. Some of the main areas of training are:

  - Long-term training for in Designing & Manufacture of Tools, Dies & Moulds,
  - Short-term training for Design & Manufacture of dies, jigs, fixtures and gauges etc.,
  - Need based technical training for skilled workers/ tool makers/machinists,
  - Training in CNC technology, inspection, quality control testing etc.

8.3 Policy-Performance Causation

8.3.1 Constituents of Policy – Performance Causation framework

The elements of the three main constituents of the framework for analyzing policy-performance causation in respect of education and training policy viz. mechanism, indicator and performance measures as concluded on the basis of field work could be presented in Table 8.2.

Table 8.2: Constituents of the Causation Framework: Education & Training

Policy	Mechanism	Indicator	Performance
Education and Training Policy (*Building Human capital)*	-Recruiting educated/ skilled personnel -In-plant training -Periodic training	-Skill intensity -Turnover rate of employee -Industrial relations	-Labour Productivity

The main *mechanisms* adopted by the firms to leverage the policy on education & training are: *recruiting educated/skilled personnel; in-plant training; and imparting periodic training* to employees. In order to get a synoptic view of relative variation in use of these mechanisms, the firms were requested to rank the emphasis given on these mechanisms (coded as M01 to M03) on a five-point scale, ranging from 1 (nil) through 5 (very high). The logic for such qualitative assessment was based on feedback from the pilot study that firms might not be interested in giving quantitative information on such matters. Table 8.3 presents the result in terms of firm wise ranks attributed to each mechanism. Notwithstanding with the fuzziness of such ranking and perceptual differences of the firms, it may be interesting to note that variations in the use of these mechanisms are reflected in firms' performance level.

The adoption of these mechanisms is reflected in the *indicators* such as *skill intensity, turnover rate of employee; and industrial relations* coded as I-1 through I-3 in Table 8.3. *Skill intensity* refers to ratio of number of skilled persons employed to total number of regular employees in a firm. The total number of employee means all regular workers, staff and executives on the rolls of the firms. In order to arrive number of skilled employee we subtracted the number of unskilled employee[104] from total number of employee. This figure is taken as the nearest proxy for skilled employee. The *turnover rate of employee* indicates average of percentage of employee left during the last three years. We recognise that it is a crude approximation of the exact figure, but we have to use this as a proxy of the exact figure since firms did not like to devote time to dig out the details from the records. The overall situation of *industrial relations* in terms of ranking in five-point scale from 1 for very bad through 5 for excellent, captures the situation of working environment arising out of cooperation/ confrontation due to situation of labour unrest, strikes or lock-outs etc.

[104] Unskilled employee: All non-technical persons with formal education below secondary level.

Unlike previous chapters where we used production and export intensity as measure of performance, in this chapter we have preferred to use *labour productivity* as the measure of performance. It may be recognized that the consequence of use of human capital oriented mechanisms could be best captured through measures of performance related to human resources i.e. either labour productivity or total factor productivity. Considering the matter of measurability and availability of data rather than theoretical appropriateness in the choice as well as calculation, we have preferred to use labour productivity as the measure of performance in terms of output per unit of labour employed and presented as P-1. For expositional convenience P-1 has also been shown in terms of an index (P-1 index) considering the mean of P-1 as 100. Table 8.3 presents the data regarding mechanisms, indicators, performance measures and the significant correlation coefficients between them.

Table 8.3: Mechanism, Indicator and Performance measures

Firm	M01	M02	M03	I-1	I-2	I-3	P-1	P-1 index
F_A	4	4	4	75	1.0	4	0.36	56
F_B	4	4	4	74	5.0	4	0.75	118
F_C	5	4	5	90	2.0	4	1.11	174
F_D	5	5	5	95	5.0	5	1.53	240
F_E	3	3	3	62	15.0	3	0.31	49
F_F	3	4	2	50	10.0	3	0.08	13
F_G	4	4	4	87	5.0	4	0.57	89
F_H	4	4	4	78	10.0	3	0.33	52
F_I	5	4	4	87	10.0	4	0.98	154
F_J	5	5	5	93	3.0	5	1.50	235
F_K	4	4	4	92	3.0	4	0.63	99
F_L	4	4	4	78	4.5	3	0.53	83
F_M	4	4	4	85	1.0	4	0.41	64
F_N	4	4	4	73	5.0	4	0.39	61
F_0	4	4	4	73	5.0	4	0.82	129
F_P	3	3	3	74	3.5	3	0.31	49
F_Q	4	3	3	73	10.0	3	0.23	36
Mean				79	5.8		0.638	100
		SIGNIFICANT COEFFICIENT OF CORRELATIONS						
				I-1	I-2	I-3	P-1	
			M01	0.81*		0.75*	0.84*	
			M02	0.55		0.81*	0.74*	
			M03	0.83*		0.69*	0.78*	
			I-1		-0.55	0.71*	0.74*	
			I-2	-0.55		-0.54		
			I-3	0.71*	-0.54		0.84*	

Mechanisms (in Scale 1 to 5): M01: Recruiting skilled personnel;
M02: In-plant training; M03: Periodic training;
Indicators: I-1: Skill intensity (%); I-2: Turnover rate of employee (%) as average of last 3 years;
I-3: Industrial relations (in Scale 1 to 5).
Performance Measure: P-1: Productivity of labour (Output/ employee in Rupee million)
*- *Correlation* is significant at the 0.01 level in the other cases significant at the 0.05 level.

A scrutiny of Table 8.3 allows us to make the following observations:

- All the firms adopted the mechanisms as described above, although the emphasis differed.
- None of the firms gave less emphasis on this mechanism and therefore very few response in terms of 1 (Nil) or 2 (low). However, the overall rating appears to be slightly overstated, as the firms do not seem to admit that they give less importance on these mechanisms.
- Small-scale firms (e.g. F_E and F_F) appear to give less emphasis on these mechanisms compared to large and medium scale firms.
- Some of the medium scale firms (e.g. F_C, F_D, F_I, F_J) gave very high importance on some of these mechanisms vis-à-vis other firms and consequently performance measures of those firms are comparatively higher than others.
- Higher emphasis given on these mechanisms seems to improve skilled intensity as well as industrial relations in the firms. It is seen that there is significant positive correlations between various mechanisms (M01, M02, M03) and the indicator I_1: skill intensity (0.81, 0.55, 0.83) or I_3: industrial relations (0.75, 0.81, 0.69) respectively.
- Higher skill intensity in the firms also helps in creating better industrial relations as reflected in the significant positive correlation between recruitment of skilled personnel and level of industrial relations (0.71).
- The adoption of these mechanisms culminates in improved productivity as evident from the significant correlation coefficients (0.84, 0.74, 0.78). It may be mentioned that *we recognize the lack of explanatory power of these correlations due to small sample size (N = 17) and fuzziness of response nevertheless these are positive indications*.

8.3.2 The Causation

In the forthcoming discussion we would analyse how the firms used various mechanisms in response to the policy on education & training to build their organizational capability, and how the adoption of these mechanisms reflected in the various intermediate performance measures i.e. indicators and finally in productivity of the firms.

- *Recruiting educated/ skilled personnel (M01)*

It is being well recognized that as the process of industrialization proceeds and structural shifts occur[105], progressively higher level of technology, investment and human skills are required. Moreover, the ongoing changes in technology that is changing the dynamics of manufacturing system demands adoption of new forms of organizations, work process and workforce system in the firms also necessitate new and higher level of human skills (Lall, 2001; Tan & Batra, 1995). *The development of such human skills could be achieved through recruiting educated/ skilled persons[106] and imparting necessary training to them.* These two are complementary to

[105] The structural shifts occur at all the three levels: country, industry and firm level (see section 2.1).

[106] For expositional convenience, it may be important to differentiate between educated and skilled person. An e*ducated person* means person with formal education (technical or non-technical) of secondary level and above. *A skilled person* means educated person with specialised training or work experience or both.

each other. It has been well established in literature theoretically and empirically that educated/ skilled persons are better learners and training them lead to larger gain in productivity (Deolalikar et al., 1997; Lall, 2001; Tan & Batra, 1995). Moreover, there seems to be consensus on the fact that for sustained development predominance of skilled personnel through out the value chain of the firm has become a necessity. These phenomenon are being recognized by the firms manufacturing CNC machine tools in India and therefore they are giving due emphasis on the mechanism of recruiting educated/ skilled personnel. It is evident from the overall higher level of skill intensity (the average being 79%). The two small firms have skill intensity of 50% and 62%, while the rest of the firms have more than 73%.

Interviews with the firms suggest that they intend to recruit primarily skilled persons but they are always in short supply. Moreover, under the existing policy framework on education & training, the supply of skilled personnel particularly at the higher level is still limited. The extensive university system and higher/ technical education system provides scientists and engineers. But they lack industrial exposure and practical knowledge. A chief executive of a medium sized firm F_I rightly commented, *"There is no dearth of educated persons in India but finding skilled ones is problematic. Our education system produces students with engineering degree but not engineers or technologists. The creativity, analytical skill and aptitude for working in industrial environment are throttled in the existing system."* Therefore the firms have to primarily rely on recruitment of educated persons with or without any relevant experience or skill and train them accordingly afterwards.[107] The problem of finding skilled personnel at worker level seems to be less pronounced due to establishment of ITI as well as Trade Apprenticeship system, where people get adequate exposure to industrial environment besides the formal education. However, the firms felt that there is need for reorientation of courses to make them relevant for flexible manufacturing system. For instance, the present specified trades such as Machinist, Turner, Mechanic Machine Tools Maintenance, Tool & Die Maker, and Instrument Mechanic etc. are meant for non-CNC machine tools. Similarly Draughtsman (Mechanical) course should be reorganized for CAD and computer graphics etc. In absence of such courses, the firms have to spend time and money to train accordingly, which could be avoided otherwise.

Apart from structural shifts and emerging technological needs, recruitment of educated/ skilled personnel is required to fill in the gap created by turnover of employee. The average turnover rate for the sample firms works out to be 6% per year (range 1 - 15%). It is gathered that the incidence of turnover is more on executive level particularly in the technical stream. Within the technical stream, the exodus is more in respect of computer & IT related personnel. Moreover there have been incidences of interdisciplinary mobility also. Mechanical and electrical engineers after getting experience in CAD/CAM, CNC part programming and other IT related activities get better jobs in IT industry or elsewhere. Most of the medium and large firms faced this situation. It is more pronounced in Banglore, which is the hub of both software as well as CNC Machine Tool industry in India. The likely reasons extended by the firms are: they are not able to match the salary of IT industry, people are more fascinated to get white-collared job, foreign placement and better working conditions. One of the firms (F_L) reported that they lost 40% of technical executives during the last three years due to the aforesaid reasons.

[107] The aspect of training is considered separately under the mechanism of in-plant training and periodic training.

Moreover, the firms' location being far from metropolis was another plausible reason. In comparison to medium and large firms the smaller firms face higher turnover (more than 10%) as they are not able to offer higher salary and better career prospects. People who do not get suitable job elsewhere join the smaller firms initially and leave after gaining some work experience for a better prospect. Therefore, the smaller firms are not able to attract and retain better people.

Some of the private sector medium scale firms that are relatively younger (e.g. F_C, F_D, F_I, F_J) were in the opinion that recruiting educated/ skilled persons also helps in building better organizational culture and keeping healthy industrial relations. Overall also, there seems to be significant positive correlation (0.75). It ultimately culminates in better productivity. Since, these firms emphasized on this mechanism from the very beginning their overall skill intensity are higher compared to others. The firms have been able to develop and maintain cordial industrial relations and better work culture. They have not faced any labour unrest of great deal. They opined that educated employee understands better the gravity of situation and therefore reaching consensus on various issues is much easier. It has helped the firms to restrict the politicization of trade unions. The positive outcome could be seen in the better productivity level as reflected from the productivity index of 174, 240, 154 and 235 respectively. On contrary, public sector firms (F_A and F_Q) have higher proportion of unskilled workers as they are old and they have to employ unskilled persons due to political reasons. They face comparatively more labour unrest and find difficult to convince the positive impact of any steps taken by the management or to train unskilled employees. Narrating an experience on how unskilled employees are difficult to deal with, one corporate executive of F_Q mentioned that it took five days to a supervisor to let one unskilled workman understand how to remove a chip tray after sliding the chip guard door from a machining center, whereas for a skilled workman one demonstration was sufficient. The impact is visible in their industrial relations as well as productivity index that are below average (56 and 36 only respectively).

- *In-plant training (M02)*

In-plant training is the training imparted by the firms to prepare new incumbent for taking up the assigned job in the firm. It is primarily required for bridging the gap between education and employment. It usually consists of *induction training, and on-the-job training (OJT).* Whenever an employee joins a firm, he or she is imparted *induction training.* It implies familiarization of normal practices and method of work of different departments of the firm. The employee is exposed to different workplaces/ tasks and become acquainted with work culture of the firm. It may be structured or unstructured depending on size and practices of a firm. It is usually unstructured in smaller firms and becomes more structured as the size of a firm grows. The length of the training may extend from few hours to few weeks. In the structured program, employees are also given theoretical exposures relating to the activities of the firm. *On-the-job training* is the most common and effective method of imparting training to create necessary skills in employees. It means learning while working. An employee learns while working under the supervision of seniors or observing/ interaction with the seniors/ colleagues. Initially it concerns with operation and performance of specific task and gradually it gets focused on improving the quality of work and attaining specialization. The duration of the training may vary from few weeks to several months.

Industry data and interviews with the firms reveal that *in-plant training* has been the mainstay of skill development program of the firms to fill in the void created by the education & training system in India. It may be seen from Table 8.3 that all firms irrespective of size or ownership gave enough emphasis on this mechanism. It is gathered that the larger the firm, the better the training infrastructure and more structured the training programme. Most of the medium and large firms operate exclusive training department or training cells to coordinate the activities of training. The overall investment on training is about 2-3% of total wage bill. Although we could not gather concrete details about the investment on training by the firms, we were able to ascertain nice illustrations on various aspects of in-plant training programme that provide useful insights. As regards to training in small firms the chief executive of F_F did not hesitate in admitting that *"they do not spend more than few hours or maximum one day on induction training as there is not much to see and familiarize within a shed of 500 square meters. The person straight away goes on the job whether he is technical or administrative. So we can say that on-the-job training starts almost immediately. Even for the on-the-job we do not have any thing specific or structured. The person starts working for the post he has been hired for under the guidance of seniors. It is the supervision or guidance that matters."* We received similar reactions from other small-scale firms as well. However, the firms like F_E and F_H were more positive on on-the-job training. The firm F_H mentioned that, "*we try to develop understanding in the new employee about the work done in the assigned department both in theoretical and practical way. It is more on a personalized manner as there is only one or two trainee at a time. The job starts with simple assignments and as the person develops understanding he treads into the regular work*." The comparison of productivity index of the three small firms suggests that the better the in-plant training, the better the level of productivity.

As mentioned earlier, the medium and larger scale firms lay more emphasis on in-plant training and have better training infrastructure. We found more revealing information in the vivid description given by a corporate manager of a medium scale firm regarding the system of in-plant training in the firm, **"***We believe that human resource is the core asset of any organisation. This resource has to be properly groomed and nurtured if an organization has to grow on a sustained manner particularly in the scenario when our education & training policy leaves a void between education and employability of a person. Keeping this in mind the company has introduced a structured training system for all the levels of employee. For graduate trainees to start with we organize one week Induction Program. The objective of the Induction program is to familiarize the new comers with our activities, facilities, people and culture etc. The program is so designed that the trainee visits all key facilities and interact with all key people in the organization. Then we put them rigorous training, which includes theory and practical in a structured way. It consists of rotational assignments in different departments to develop a wider perspective. The duration is usually 12 to 18 weeks depending on our evaluation and requirement. Then the incumbent is put in the respective department of posting under direct supervision of the departmental head. After one year, the person is assigned for a specific task based on his aptitude, performance and our requirement. Similar procedure is adopted for technician level (diploma holders). In this case more thrust is given on practical training on machines/ shop floor. The training of skilled workers/ operators is undertaken as per apprenticeship programmes in accordance with the Apprentices Act, 1961. The duration of training is three years. In addition to basic training the apprentices undergo shop-floor* *training on different jobs under supervision of senior workers and supervisors."* He further added*, "The training prepares the incumbent to take up the job independently and bridges the gap between formal education and the skill required for work. The incumbent also starts getting embedded in the organizational culture. It ultimately leads to better industrial relations and higher productivity. It won't be an exaggeration if I say that the level of industrial relations and productivity in our firm are one of the best in the industry. Here I would like to mention that we take all these efforts on our own. There is no support from the government. Considering the social benefit to the society, the government should consider for some incentives at least for development of training infrastructure within the firm. It pinches when a trained staff leaves and we have to reinvent the wheel."*

Other medium and large firms also affirmed having more or less similar system of training, logic for establishing the system of in-plant training and impact of training (i.e. better industrial relations and increased productivity level). The claim regarding impact of training is substantiated by our data as well (see Table 8.3). There is significant positive correlation between adoption of this mechanism and level of industrial relations (0.81) and labour productivity (0.74). There was consensus among the firms that the government should support through fiscal and non-fiscal incentives for creation of requisite training infrastructure within the firms reckoning the externality generated by such training.

- *Periodic training*

In order to keep the pace with new development in technology and market demand, *periodic* training of employees (usually *off-the-job)* has become a common tool these days. It enhances knowledge/ skills of the employees and keeps them abreast with the contemporary development in the environment. It is usually offered to those employees who have acquired minimum necessary skills, and have aptitude for further advancement. Sometimes it is also offered to motivate those who are lagging behind to bring them to same level with others. Ultimately the mechanism of periodic training increases the level of productivity and performance of the firms. We found yet another variant of periodic training, which could be termed as *need-based training*. As the name suggests, such training is imparted to certain employees to cater specific need of the hour. The boundary between the periodic and need-based training is rather fine. When the firms assess the need of any specific training in advance and implement in a structured way than it appears as a periodic training. It depends on foresight as well as strategy of the firms, which pays them off accordingly.

Our interviews with various firms and the data reveal that the firms give less emphasis on this mechanism compared to the previous one i.e. in-plant training. The overall pattern of reactions had a note of skepticism. The smaller ones were more skeptics. But the firms with more pragmatic approach have performed better. Explaining the fallouts of further training to employees, the chief executive of small firm (F_F) mentioned, "*We cannot afford to train our employee further as we know that he would leave the moment he gets some better training. We have faced such situations. Three years before we had sent two technicians to ATI, Chennai for Machine Tool Maintenance course and within three months of training both of them left. Even if we pay higher, we cannot give them a future, as we are small so in any case the person is bound to leave. Further there is no system of incentive from the government or any other agency for training of existing employee therefore we try to avoid. Moreover there is lack of* *specialized institutions to provide appropriate training at an affordable cost or sometimes we do not have the requisite information regarding availability of training programs in such institutions. If at all some need for training arises, my partner and me attend the program. Once I attended training for CNC part programming offered by CMTI and my partner attended a program on industrial marketing, which we find quite useful."* However, another small firm F_H having more pragmatic approach claimed that they do send employees for Advance training courses in Foreman Training institute and CMTI Banglore for courses like manual part programming, maintenance of CNC machines, and machine tool inspection & testing etc. Two engineers had recently attended a course on Machine Tool design that has been recently started by IMTMA in collaboration with ICAMT, Banglore. But these are not in a structured manner. The reasons extended were: lack of incentive from the government, fear of poaching by other firms or employee leaving on their own and hampers regular production schedule since these training are mostly off-the-job. The turnover rate of employee for the firm is relatively high about 10% as against the average of 5.8%.

It was gathered that medium and large firms adopt the mechanism of periodic training comparatively in more structured way than smaller ones. Particularly certain firms like F_A, F_C, F_D, F_G, F_I, F_J and F_K etc. have some system of periodic training for all levels of employees. They organize training programmes either in-house by inviting external consultants or send their employees to various training institutes. Firms like F_B, F_L or F_I have training institutes run by their holding company also. Some of the firms like F_A and F_I claimed that they had also sent their employees abroad for training. These firms were of the view that such endeavors motivate the employee to take up more responsibility and create sense of belongingness with the firm. It helps in building better industrial relations. The significant positive correlation between emphasis on periodic training and industrial relations (0.79) substantiates the claim to a large extent. However, there were mixed reaction about turnover of employees. Majority of the firms felt that employees with better training and exposure are more susceptible to leave the company. It is more prevalent in executive level, particularly in R&D, manufacturing and marketing departments. Firms were in opinion that the turnover rate of qualified engineers is as high as 20-30 % as they get better opportunity elsewhere particularly in IT sector. The incidence of turnover is comparatively less in diploma holders and lower levels. One chief executive of a medium firm on the condition of anonymity mentioned that, *"there has been efforts to create an unwritten understanding for not hiring each other employee but that does not seem to be workable. We loose good employee to others and in turn we have to hire from others. But again it takes time and efforts to get the new person attuned to the functioning of the firm*." As regards to the government support the reaction was the same as mentioned earlier while discussing in-plant training. There was consensus among the firms that there is a need for requisite policy support for enhancing the level of training by the firms considering the social benefit generated due to such efforts.

As regards to the *need-based training*, the experience narrated by the chief executive of F_J is worth mentioning: "*One of the conditionality of CE certification for exports to EU states that the operating- and maintenance manuals of the equipment should be in local language of the country to which the equipment is being exported. For the first export order to Italy, they got the manuals translated from outside. Then they sent one engineer to learn Italian language and that was useful for the second export. Now they have sent six persons to learn Italian language* *since they are in the process of finalizing series of exports to Italy. It will help them for after-sales service and further marketing activity as well. They are planning to train people in German language as well*" This example demonstrates the fineness of boundary between the need-based and continuous up gradation of skills. The training of the first engineer was as per the need of the hour i.e. need-based, while subsequent efforts could be considered as continuous up gradation. In general it is seen that the firms that emphasize more (e.g. F_C, F_D or F_J etc.) on continuous up gradation of skill perform better and vice versa (e.g. F_E, F_F or F_Q etc.).

8.4 Synthesis and Conclusions

8.4.1 Synthesis

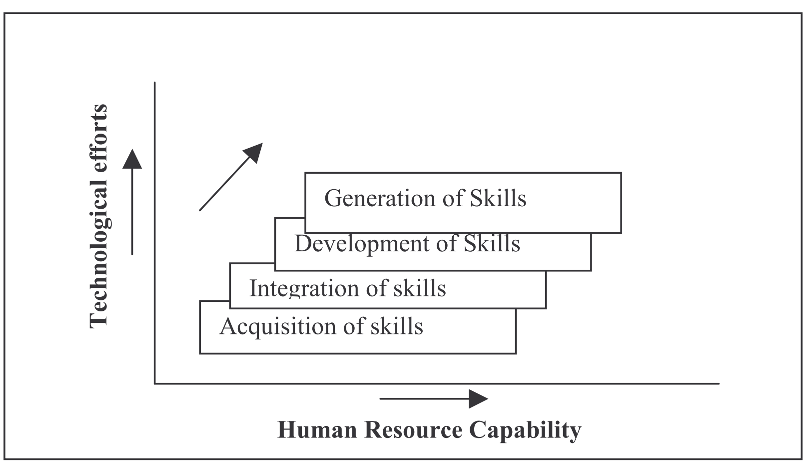
The above analysis prompts certain significant issues that may be summated as follows. The extensive E&T system in India generates scientists, engineers, and technicians but they lack adequate industrial exposure and practical knowledge. Thus the system generates educated person in place of skilled person creating a gap between education and employability. On the other hand, the manufacturing of CNC machine tool requires relatively higher level of technology, investment & management skills that necessitate new and higher level of human skills. In order to achieve these the firms adopted primarily three mechanisms namely *recruiting educated/ skilled personnel; in-plant training; and continuous up gradation of skill.* The *recruitment of educated*/ skilled persons is considered to be to the main mechanism to build human capital in the firms. It is evident from the overall higher level of skill intensity, the average being 79%. The firms recognize the fact that educated persons are better learners and training them lead to larger gain in productivity. It also helps in building better organizational culture and keeping healthy industrial relations that ultimately culminate in better performance. We also found significant positive correlation between skill intensity vis-à-vis level of industrial relations and labour productivity.

The second mechanism: in-plant training seems to be the main building block for formation of human capital in the firms. It prepares the new incumbents for taking up the assigned jobs in the firms. The views of the firms suggest that they have to emphasize more on this mechanism, as the existing education system does not generate the required skills necessary for the jobs inside the firm. This mechanism becomes instrumental in bridging the gap between education and employment. The comparison of productivity index of the firms suggests that the better the in-plant training, the better the level of productivity. There was consensus among the firms that the government should support for creation of training infrastructure within the firms reckoning the externality generated by such training. In order to keep pace with new developments in technology and market demand, *continuous up gradation of skill* become crucial for the firms. It enhances knowledge/ skills of the employees and motivates them that ultimately culminate in higher productivity. Our data reveals that the firms give less emphasis on this mechanism compared to the earlier ones due to lack of incentive from the government, fear of poaching by other firms, employee leaving on their own for search of better prospects and impact on regular production schedule since these training are mostly off-the-job. It is seen that the firms with more pragmatic approach are giving proper emphasis on this mechanism and perform better compared to the others.

If we see from the perspective of our four-stage model of acquisition, integration, development and generation as built in the earlier chapters then the mechanism of *recruitment of educated*/ skilled persons could be seen as *acquisition of skills* as firms essentially acquire the required skills from the labour market. Similarly the essence of the mechanism of *in-plant training* is *integration of skills* as it concerns with integrating the acquired human skills with the existing human resource capability of the firms. This becomes instrumental in getting the new incumbents embedded in the organizational culture. The mechanism of continuous up gradation of skill through periodic training of employees essentially signifies *development of skill* as it concerns with up grading knowledge and skills of the employees as per the firms' needs. It may be recognized that with the steady progression towards CNC machine tool manufacturing the need for higher skills and knowledge of contemporary technology is increasing. It also demands increased specialization. Thus enhanced thrust on development of skills is mandatory. A step further to all these could be visualised in the form of *generation of skill i.e.* development and generation of new skills. It can be only possible when firms reach the stage of innovation of new product/ process at frontier of technology and innovation of new technology. It requires simultaneous deepening of the earlier three processes. As mentioned earlier, firms in the developing countries in general and India in particular have yet to attain such level. These require much higher level of technological effort, technological capability and framework conditions. Nevertheless, for sustained industrial development in the environment of continuous technological changes and increasing competition it is essential that both firms and the government should take appropriate steps to move in this direction.

At the risk of oversimplification we can present the interrelationship between firms' technological effort, technological capability in respect of human resource development and various activities graphically as in Figure 8.2. The requirement/ intensity of technological efforts increases as firms move up the ladder as well as move across (i.e. move horizontally within each activity) translating into higher technological capability. It may be mentioned that although all these activities seem to be distinct are mutually dependent on each other and quite of few elements of each activity overlap.

Figure 8.2: Dynamics of building Human Resource Capability



8.4.2 Conclusions

- The extensive E&T system in India generates scientists, engineers, and technicians sans adequate industrial exposure and practical knowledge. There is perceptible gap between education and employability.
- The firms primarily adopted three mechanisms to build human capital: recruiting educated personnel; in-plant training; and continuous training. The first two mechanisms bridge the gap between education and employability and the third enables to keep pace with new development in technology and market demand.
- The mechanisms adopted by the firms although seem to be similar in nature, varies in its content, scope and implementation culminating to difference in performance of the firms.
- The variation in adoption of mechanisms is reflected in intermediate performance measures such as skill intensity, turnover rate of employee; and industrial relations, which ultimately culminates to productivity of the firms.
- The firms that took more pro-active approach have performed better.
- The dynamics of building human capital in firms could be visualized in terms of *four* distinct but interrelated activities namely*: acquisition of skill, integration of skill, development of skill and generation of skill.* The intensity of technological efforts increases as firms move up the ladder as well as move across (i.e. move horizontally within each activity) translating into higher technological capability.

Chapter Nine

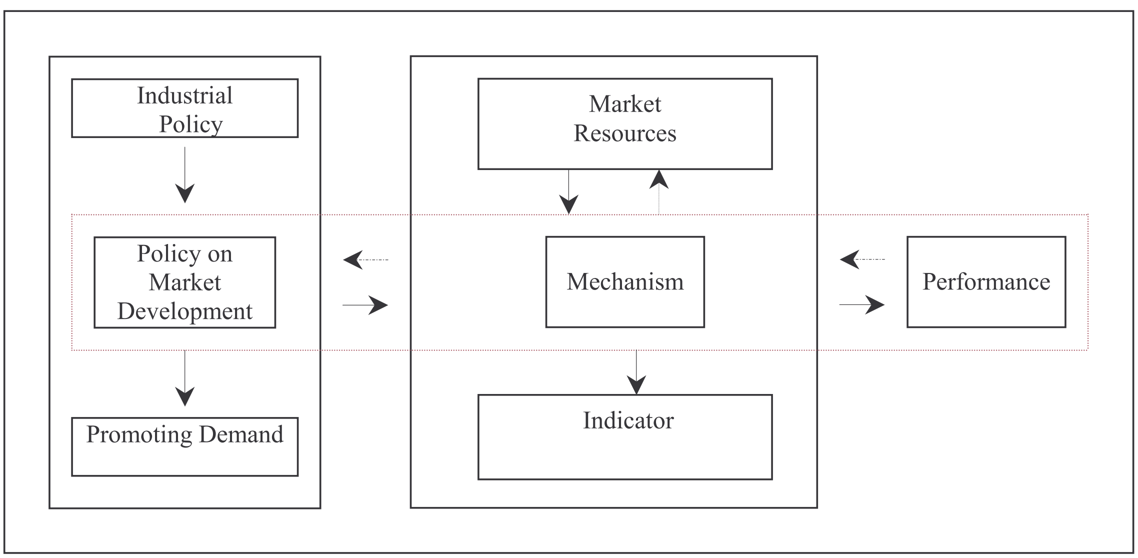
POLICY AND MARKET DEVELOPMENT

This chapter attempts to analyse the policy-performance causation in respect of policy on Market development vis-à-vis Market resource of the firms as per the analytical framework developed earlier. The analysis is presented in two distinct but interrelated dimensions of market i.e. domestic market and export market. The analysis begins with a brief overview policy measures. Then it is examined as to what mechanisms the firms adopted to leverage the policy that influenced firms' performance.

9.1 Introduction

In the last three chapters we saw that how policies on technology, investment and education & training influence building of technological capability of the firms and in turn determine their performance. But they address only supply side issues. It has been well recognised in literature that for arriving at the desired results addressing demand side issues are as important as the supply side. In this chapter our efforts are channeled to address the demand side issues through analysis of policy - performance causation in respect of policy on market development vis-à-vis marketing capability of the firms. The framework is depicted in Figure 9.1 for ready reference.

Figure 9.1: Policy–Resource–Performance Causation: Market Development



For an easier understanding and elaborate analysis, we disaggregate the policy on market development in terms of *domestic market* and *export market*. For each case, the analysis is undertaken as per the analytical framework depicted in figure 9.1. First we present the constituents of the analytical framework. It is followed by description of main policy measures and the general observation of the firms in respect of the policy measures. Then we examine the policy-performance causation. It concludes with a summary of the findings.

9.2 Domestic Market Development

9.2.1 Constituents of Policy–Performance Causation framework

The elements of the three main constituents of the framework i.e. mechanism, indicator and performance measures as concluded on the basis of fieldwork are presented in Table 9.1.

Table 9.1: Constituents of Policy - Performance Causation Framework

Policy	Mechanism	Indicator	Performance
Domestic Market development ***(Creating domestic demand)***	-Interaction with users -Creating awareness for use of CNC Machine Tool -Participation in Industry/ Trade fairs -Forming consortium for marketing	- No of products introduced in the market -Marketing intensity - No of Sales office & After-sales facility -Brand image in domestic market	- Annual Sales

9.2.2 Policy framework

9.2.2.1 *Domestic Market Development Policy*

The domestic market development has always been a part of various policy pronouncements both in explicit and implicit form. In order to present a synoptic view on policy framework attention is drawn to those micro level policies that directly or indirectly help in developing market for machine tool industry. They are:

Purchase/ Price preferences in public procurement

In order to provide market support to Public sector enterprises (PSE)/ small-scale enterprises (SSE), the government still extends certain purchase and price preferences in public procurements. The salient facets of the policy are as under:

- *Reservation of products for exclusive purchase from PSEs*: As on date only six products are reserved viz. coal, arms & ammunition, mineral oils, atomic energy, minerals related to atomic energy, and railway transport. Machine Tool is not included in this list.
- *Price Preference to the products of PSEs:*[108] The PSEs receive 10% purchase price advantage over private bidders, to compensate for the cost disadvantages of 'social responsibility'. If the price quoted by the PSE is within 10% of the lowest price in a tender, then other things being equal, preference may be granted to the PSE concerned.

[108] The policy was introduced in January 1992 for a period of three years only. But gradually it has been extended till March 2004.

- *Reservation of products for exclusive purchase from SSEs*: Altogether 358 items are reserved for exclusive purchase from the SSEs. Machine Tool is not included in the list.
- *Price Preference to the products of SSEs*: Price preference up to 15% over the lowest quotation of the medium & large-scale units is extended to the products of SSEs provided other things being equal. The benefit is intended to compensate the firms for non-availability of economies of scale, poor resource base, poor access to raw-material etc.

In addition to the above, the Single Point Registration Scheme of the NSIC provides certain additional benefits like free Tender sets, exemption from payment of earnest money and security deposit. The NSIC while registering a firm under this scheme obtains capacity assessment of the applicant through the institutional set up of the SISIs in the country as well as confidential report from the bankers of the firms about their credit worthiness.

Price Preference in International multilateral institution aided projects:
A price preference of 15% or customs duty,[109] whichever is lower, is allowed to domestic bidders of both private and public sector for the projects approved by the Government and financed by any international multilateral institution *like* United Nations, World Bank and ADB etc. The price preference is given to offset the various local levies that domestic industry is subject to vis-à-vis the overseas suppliers.

Lease Financing/ Hire-purchase scheme for Capital Goods purchase[110]
The basic purpose of these schemes is to assist firms to procure Capital Goods for setting up of new units, modernisation, expansion and diversification, which in turn culminates in developing market for the firms manufacturing Capital Goods. These schemes provide several benefits to the firms (lessees) like an alternative to bank/ institutional financing, 100% financing[111] at liberal terms with easy repayment schedule, simple formalities, 'Single window system' for imported equipment i.e. the lease financing company undertakes to complete formalities like procuring import license, if any, opening of Letter of Credit etc.; and tax rebate on lease rental etc. There are host of financial institutions both in private[112] and public[113] sector

[109] The budget 1999-00 imposed 5% custom duty along with CVD on such project imports.

[110] Leasing and hire purchase are essentially transactions in which possession of goods is handed over along with right of use but without the right of initial ownership, for a stated period and for consideration. The transactions are governed by the common law of contracts dealing with bailment transactions (Kothari, 2002; Reeder et al., 1991). In India, it is governed by Indian Contracts Act 1872. The scheme of lease finance and hire purchase differ only in terms of absence of option to buy in case of lease transactions otherwise both the schemes are more or less the same. However, in practice leasing has been usually adopted for plant & machinery, whereas hire purchase has mostly been used for vehicles.

[111] However, the firms have to pay about 7-8 % cost of the equipment to cover the insurance charges of the equipment for the lease period and administrative charges at the rate of 1 % of the price of the equipment.

[112] The financial institutions in private sector are often known as non-banking financial companies (NBFC*)*.

[113] The IDBI provides this facility to large firms for minimum aggregate lease assistance of Rs.100 million with individual equipment costing not less than Rs.2.5 million (IDBI, 2002). The NSIC extends this facility to small-scale firms. The minimum assistance provided is Rs 100,000 and maximum subject to SSI ceiling of Rs.10 million. The lease period varies between 3 to 10 years (NSIC, 2002).

offering these services in the country. In the post-liberalization era the entry of foreign financial institutions has given further boost to the leasing business. The Security and Exchange Board of India (SEBI) regulates these schemes under the overall guidance of the Reserve Bank of India (RBI).

Financing for Technology Upgradation/ Modernization

In order to encourage existing SSEs to modernise their production facilities and adopt modern technology, the SIDBI operates the 'Technology Development and Modernisation Fund' for providing assistance to purchase capital equipment, acquisition of technical know how, and acquisition of ISO-9000 series certification etc. The existing exporting SSEs or the potential exporters to the tune of 25% of the output are eligible for the assistance provided they are in operation for at least 3 years and have not defaulted to bank/ financial institutions. The minimum assistance under the scheme is Rs. 1 million (SIDBI, 2002).

Marketing assistance program for SSEs

The NSIC operates various marketing support programmes to facilitate market development efforts by the SSEs. Some of the important initiatives in this regard are (NSIC, 2002):

- *Consortia approach*: The NSIC explores market and secures orders for bulk quantities and distributes the order as per the production capacity of the firms. It also undertakes discounting of bills, and releases 80-85% payment upon receipt of proof of dispatch.
- *Tender Marketing*: It identifies items required in bulk by the government departments/ PSEs and obtains orders. It gets the items made by small firms under its own supervision and ensures timely delivery and proper quality.
- *Agency*: The NSIC also markets machinery and machine tools on agency basis. In a few cases these machinery are designed & developed in NSIC prototype development centers.
- *Marketing Development Centers*: It provides permanent show room facilities in main cities all over the country known as '*NIC Shoppe'* for display and sale of SSEs products.
- *Exhibition/ Trade Fairs*: It organises exhibitions/ trade fairs to display SSEs products as well as participates in various industrial/trade fairs organised in the country as well as abroad to exhibit the SSEs products under its banner. It also organises buyer-seller meets as well as workshops/ seminars during the fairs.

- *Cluster Development program*

The Government of India in association with the UNIDO and others[114] have initiated the Cluster Development Programme for machine tool industry to support market development initiative of the firms. One of the main objectives of the programme is to sensitize and facilitate the firms, particularly the SMEs in various regions in the country to form consortium to achieve international competitiveness. Two pilot projects have been undertaken in Banglore region, one with the medium & large firms and another with small & medium firms. Actions have been initiated to emulate the experiences in other regions as well.

[114] The other partners of the programme are the International Center for Advancement of Manufacturing Technology (ICAMT), IMTMA, CMTI, and financial institutions like SIDBI and EXIM Bank of India.

9.2.2.2 ***General observations regarding the Policy***

In order to present a synoptic view, we will discuss observations of the firms in general for each of the policy measures as described in the preceding section in brief.

- There seems to be divergence of opinion between the PSEs and private firms regarding 10% price preference given to PSEs on government purchases. The private firms were in the view that it is sheer discrimination. Where as the PSEs justified it as compensation for cost disadvantage suffered by them for bearing 'social responsibility'.
- The purchase preference policy in respect of PSEs or SSEs is ineffective, as machine tool is not included in the list reserved for exclusive purchase either from PSEs or SSEs.
- The 15% price preference given to SSEs over medium & large scale firms does not affect much to the firms as the main buyers in the government/ PSEs i.e. defense and railways mostly buy sophisticated CNC machine tool that is not offered by SSEs.
- The price preference of 15% allowed on multilateral agency aided projects becomes redundant due to the exemption of customs duty for such projects since 1997. The price preference is given to offset the additional domestic levies, lack of infrastructure and higher cost of financing for domestic firms vis-à-vis the overseas suppliers. A study by CII (1998) indicates that domestic firms face about 22 to 34 % cost disadvantage, therefore the government should levy 15% custom duty as admissible by the World Bank on such projects so that domestic firms could get level playing field.
- Lease Financing/ Hire-purchase scheme for Capital Goods purchase, although available to the user firms do not stimulate them to purchase CNC machine tool due to high rate of interest and cumbersome procedure.
- The 'Technology Development and Modernisation Fund' of SIDBI for financing SSEs to modernize does not stimulate SSEs to buy CNC machine tool as the fund is available for profit making and exporting SSEs only. Moreover, the eligible firms also desist from availing the scheme due to high bureaucratic attitude and cumbersome procedures.
- There has been no concerted effort to stimulate demand for domestic CNC machine tools either in terms of fiscal incentives or promotional activities.
- The market support programmes operated by NSIC to facilitate market development efforts by SSEs are basically for small simple items which are required in bulk therefore does not help CNC machine tool firms in SSI sector.
- The firms appreciated the new initiative of Cluster Development Programme but it is in its infancy and more targeted towards SSEs.

These observations indicate that the domestic market development policy are not enough to stimulate sufficient demand for CNC machine tools in the country and do not provide adequate support for market development function. It may be mentioned that in the pre-liberalization era the protection imposed through quantitative restrictions as well as high tariffs on imports (see section 7.2.3) were acting as inbuilt market development measures for creating demand from the domestic users.

9.2.3 The Causation

In response to the existing policy framework the firms primarily adopted the following *mechanisms* to leverage the policy: *interaction with users* (M1), *creating awareness for use of CNC Machine Tool* (M2; *participation in Trade fairs* (M3); *forming consortium for marketing* (M4). The mechanism M1 has been further disaggregated in terms of *sub-mechanisms* namely *regular interaction with the users before the sales* (M1_1)*, regular interactions after the sales (M1_2), and imparting proper training to the users (M1_3)* for better understanding. The *indicators* considered are: *number of products introduced in the market* (I1); *marketing intensity* (I2); *number of sales office/ after-sales facility* (I3); and *brand image in the domestic market* (I4). The *performance measure* preferred is *annual sales* (P1). The snapshot of data on mechanisms, indicators and performance measure is presented in Table 9.2.

Table 9.2: Mechanisms, Indicators and Performance measure

Firm	M1			M2	M3	M4	I1	I2	I3	I4	P_1
	M1_1	M1_2	M1_3								
F_A	5	4	4	5	5	3	9	4	28	5	686.3
F_B	4	4	4	4	4	3	4	1	3	4	25.7
F_C	5	5	4	5	5	3	8	5	15	5	75.9
F_D	5	5	4	5	5	5	4	4	10	5	84.9
F_E	4	3	3	3	3	2	1	1	1	3	4.4
F_F	3	3	3	3	3	2	0	1	1	3	0.4
F_G	5	4	4	5	4	5	7	2	10	4	36.5
F_H	4	3	3	4	4	4	2	2	2	4	5.1
F_I	4	4	5	5	5	3	6	3	10	5	95.1
F_J	5	4	5	5	5	5	4	4	10	5	52.6
F_K	4	4	4	5	5	3	7	2	8	4	98.7
F_L	5	4	4	5	4	3	12	3	7	5	292.3
F_M	4	4	4	4	4	3	4	4	3	4	87.4
F_N	4	4	4	4	4	2	4	2	3	4	21.0
F_0	4	4	4	4	4	3	4	2	4	4	29.9
F_P	4	3	4	4	3	2	3	2	1	3	14.8
F_Q	4	3	4	4	4	3	5	4	7	4	89.1
Mean	4.3	3.8	3.9	4.2	4.2	3.2	4.9	2.7	7.2	4.2	100.0
					SIGNIFICANT CORRELATIONS						
							I1	I2	I3	I4	P_1
					M1-1		0.70	0.63	0.67	0.84	0.49
					M1-2		0.52	0.55	0.51	0.75	
					M1-3			0.51		0.65	
					M2		0.76	0.67	0.68	0.83	0.49
					M3		0.55	0.67	0.72	0.88	
					M4					0.55	
					I1			0.49	0.65	0.70	0.65
					I2		0.49		0.63	0.74	
					I3		0.65	0.63		0.70	0.82
					I4		0.70	0.74	0.70		0.50

Mechanisms (in Scale 1 to 5)*:* M1: Interaction with users; M2: Creating awareness for use of CNC Machine Tool; M3: Participation in Trade fairs; M4: Forming consortium for dom. marketing.
*Sub Mechanism*s of the Mechanism M1: (in Scale 1 to 5): M1_1: Regular interaction with the users before the sales, M1_2: after the sales, M1_3: imparting proper training to the users.
Indicators: I1: No of products introduced in the market; I2: Marketing intensity (%); I3: No of Sales office & After-sales facility and I4: Brand image in domestic market (in Scale 1 to 5).
Performance measure: P_1: Relative annual sales.

The data in respect of adoption of various mechanisms are indicated in terms of the importance given to the mechanisms by the firms in their business activity in the ascending scale of 1 to 5, with 1 signifying no importance and 5 as crucial. It may be mentioned that such responses have to be interpreted with caution as none of the firms want to admit that they give less importance to such mechanisms. The indicator I1 i.e. number of products introduced in the market has been mentioned earlier as well in our discussions. The indicator I2 i.e. marketing intensity is the ratio of expenditure on marketing activity to total annual sales. I3 indicates the number of sales office/ after-sales facility available in the country. I4 denotes the brand image of the firms in the domestic market as perceived by the firms in the ascending scale of 1 to 5 with 1 signifying nil and 5 as excellent. The performance measure P_1 i.e. annual sale is the same as mentioned in our earlier discussions.

- *Interactions with users (M1)*

In the pre-liberalization period it used to be sufficient to produce machine tools having normal business contacts with the users as the market used to be virtually sellers market well protected from imports. But in the post-liberalisation period the business environment has changed drastically. Now the firms are required to take pro-active approach and preempt the needs of users through establishing proper linkages otherwise there is every possibility that the order could be diverted to foreign manufacturer or other domestic competitors. The liberalization has also induced significant structural changes in the major user industries namely automobile, auto component, and consumer durables industry. They account for 50-60% of the market. Now these users require more flexibility, reduction in lead-time, faster processing time and higher tolerances etc. It also applies to the two major government sector users: defense and railways. Such developments have necessitated more interaction between the users-producers to manufacture as per the requirements of customers. We came across the following ways of interactions with users: regular interactions before the sales (M1_1), regular interaction after the sales (M1_2), and imparting proper training to the users (M1_3) etc. We propose to elaborate on these individually.

Our data suggests that the firms are giving ample emphasis on the mechanism of regular interaction with the users before the sales (M1_1). The underlying idea about this could be gauged through the comments of one of the CEO of a medium sized firm F_O: "*In the business of investment goods like machine tool, a regular interaction with users plays an important role for proper design & development and timely delivery. Whether it is a first time order or repeat order, most of the machines carry some unique features as per the specific requirements of the customers. It has become more crucial now as we try to supply tooled up machines. In order to understand customers' needs properly, the interaction is crucial. The users usually declare their intent to purchase through trade journals i.e. general tender, limited tender/enquiry or firm specific enquiry depending on complexity of machine tools or firms' purchase policy. Limited tender and firm specific enquiries are more common. The initial enquiry is serviced by the marketing department/ outfit of the firm or by the authorized dealer, if any. We maintain both types of distribution channel, direct as well as authorized dealership. The channel of authorised dealership is good for initial contacts/enquiries. But all further information exchanges are based on proper buyer-seller interaction, where design & engineering (D&E) department of the firms are amply involved. We operate on cross-functional team basis i.e. for* *each order a team comprising of marketing, D&E, production and customer services is responsible for servicing the order. It helps in creating proper coordination both within and across the firms in continuity. Such efforts also build confidence in the buyers that culminates in healthy exchange of information on long-term basis. It helps in timely production as per customer's satisfaction, introducing further improvement in product/ process as well as enhances good will of the company that also translates into repeat buying. We receive almost 40-50% repeat orders. In order to be near to the customers we are in process of opening sales office in all major manufacturing region in the country.* " It may be seen from Table 9.2 that the firms giving more thrust on this mechanism have performed better. It is reflected through the intermediate performance measure i.e. higher number of products introduced in the market (I1), higher marketing intensity (I2), more no of sales office (I3) and increased brand image (I4) that finally translate into the final performance measure i.e. annual sales (P_1). The positive correlation (mostly significant at 1% level) of M_1 with various indicators and performance measure also substantiate the same (see Table 9.2).

Another healthy development in respect of manufacturer-user linkage is being seen in terms of increased emphasis on *after-sales service activity* (M1_2) by the firms. Off late the firms have realized that the regular interaction with the users after the sales is as important as interaction before the sales. Now majority of the medium and large firms have specific customer service/ support cell along with their sales office particularly in the region where concentration of users are more. They also keep in stock the necessary spares to provide quick service. The firms also advise the authorized dealers to keep certain critical spares. Quite a few firms opined that through prompt after-sales service they have been able to face the competition from the imports, particularly from Taiwan. It also positively affects their brand image. One of the firms F_G mentioned that since the last three years they have gone one step further to bolster its linkage with the users by way of undertaking annual maintenance contract (AMC) for the machine being sold. The AMC includes both preventive- and breakdown maintenance. They have realized that certain fundamental concepts like '*prevention is better than cure*' do apply in their business also. The firm has signed AMC with an auto component manufacturer for all the 19 machines it supplied over the last 15 years. The efforts have shown dramatic results with machine uptime improving from 95% to 99.5%. Now the firm is extending the AMC concept with other users as well. Such initiative is paying rich dividends in terms of new orders, orders for refurbishing old machines, and enhanced brand image etc. In this case also we found positive correlation (mostly significant at 5% level) with the various indicators (Table 9.2).

The mechanism of *imparting proper training to the users (M1_3)* has been in vogue since long. It is a general industry practice to impart training to the users either in the user's premise or manufacturer's premise at the time of sale. In addition to increased emphasis on these, we also came across three initiatives. *First,* apart from training engineers/ supervisors of operations & maintenance department, some of the firms have started giving *emphasis on training to the machine-operators* of the users. Firms like F_D, F_I, and F_J etc. claimed that it increases process capability of the machines on the one hand and reduces the machine breakdown on the other. These in turn enhance overall reliability of the machines culminating in better brand image of the firms. *Second*, firms like F_K has started conducting fee-based CNC Machine Tools Maintenance Course periodically to provide training on CNC machine tool maintenance more systematically. The program has been well received by the users. So far, 191 participants representing 73 organizations have participated from all over India. *Third*, some of the firms like F_A, F_C, F_D, F_G, and F_I etc. informed that they invite regular users periodically to get acquainted with new developments and various aspects of machine tool maintenance. It also help them to gather feedback on existing machines running in their shop floor, which become very useful for further development. Such endeavor significantly increases marketing intensity and adds to improved brand image, which ultimately translates into better performance. The positive correlations between this mechanism and indicators I2 and I4 (see Table 9.2) also support the claim to some extent.

- *Creating awareness about use of CNC machine tools (M2)*

Stimulating new demand is one of the time-tested tools for increasing sales/ market share for the firms both in the consumer goods and industrial goods market (Kotler, 1990; Reeder et al., 1991). Industry data suggests that the main users of machine tool in India are: auto & auto components industry 40-50%, consumer goods industry: 10-15%; general engineering industry: 10-15%; aerospace & defense: 10-15%; and railways: 10% etc. Out of these, the share of SMEs is approximately 30-40%. It has been recognised that the majority of SMEs, particularly the second tier onwards suppliers still do not use CNC machine tool for variety of reasons e.g. lack of awareness, lack of proper incentives, lack of financing and initial inertia to change etc. However, with the liberalization the SMEs are under increased pressure from OEMs and other manufacturers to supply quality products in shorter time at competitive prices. Therefore it is imperative that these SMEs should be sensitized properly to switch over to CNC machine tool to enhance overall quality and productivity.

It is seen that some of the firms are taking initiatives to create awareness about use of CNC machine tool and potential economic benefits thereof among prospective SMEs through organising workshops/ seminars programmes either individually or in collaboration with IMTMA and other developmental agencies. A few firms like F_A, F_C, F_D, F_J and F_K etc. conduct such programs periodically for neighboring SMEs. Such efforts help the prospective users in recognizing the need of CNC machine tool on the one hand and get acquainted with the firms' products and capability on the other. One of the CEO of a medium sized firm remarked, "It is a very cost-effective way to reach to the buyers. Hiring one marketing executive costs about Rs 300,000 per annum, whereas to organise one such workshop with 20-25 participants does not cost even Rs 10,000. We are able to generate at least one new order out of one or two such workshops. We found that the absence of fiscal incentives for the SMEs to install CNC machine tool is the major deterrent. Moreover small firms are not able to get the refund of 16% excise duty under MODVAT scheme." Some of the firms like F_G and F_I informed that they also organise road shows while launching new models in various regions where they invite prospective users. They claim that such efforts have started giving results in terms of more enquiries and firm orders from SMEs. In this case also the positive correlations with various indicators and performance measure mostly significant at 1% level corroborate the assertion (see Table 9.2).

- *Participation in Trade fairs (M3)*

For industrial goods like machine tool, Trade fairs are the most convenient platform to show case the technological capability of the manufacturers on the one hand and to know the customers' demand/ preferences on the other within a limited time and concentrated space. It provides opportunity for buyer-seller interactions as well as benchmarking against competitors in a transparent way, which no other marketing media can offer. Therefore it is a general business practice to participate in such trade fairs organised periodically at regional, national and international level. In India, the IMTMA in collaboration with CII and ITPO organises international trade fairs devoted to machine tool 'Indian Machine Tool Exhibition (IMTEX)' every three years and Tooltech for machine tool parts/ accessories every eighteen months. Some of the other trade fairs where machine tool firms also participate are: Indian Engineering Trade Fair (IETF), Delhi; National Manufacturing Trade Show (NMTS), Banglore; INTEC, Coimbtore; and ACMEE, Chennai etc.

The IMTEX is the most popular trade fair among the firms. It is considered to be an ideal platform to promote new alliances & opportunities, global partnerships, development of market niche & brand equity, new technology developments and provide industry with a choice of manufacturing solutions. Most of the domestic firms and quite a few firms from abroad participate in the IMTEX exhibiting the latest developments in machine tool industry. For example the IMTEX 2001 attracted 510 domestic and 355 foreign firms from 24 countries. It generated direct orders worth Rs 2 billion ($41.6 million) and business enquiries worth Rs 16 billion ($333 million). 70,000 business visitors visited it. A survey by the organisers indicate that the main objectives of business visitors at IMTEX were: to gather overall information (80%), collect specific information (50%), make business contacts (30%), purchase equipment (20%), see overseas exhibits (30%) and look for technical know how (25%) (IMTEX, 2001).

Our data suggests that all sample firms regularly participate in the IMTEX except the two small firms, who abstain primarily due to the financial crunch. Nevertheless they visit IMTEX to get the feel of technological development and to make business contacts. Some of the firms informed that they contact their present and prospective users before hand regarding their new developments and invite them to visit their stalls during the exhibition for further discussion. They claim that such efforts pay rich dividends. A few firms also organise workshops or participate in seminar organised by IMTMA and other developmental agencies to get better visibility. Commenting on the importance of participation in IMTEX, the CEO of firm F_J remarked, "*The IMTEX is the most important platform to project one's technological excellence, which in turn translates into actual sales particularly from the domestic users. After inception we exhibited our first domestically designed & developed Vertical Machining Center in IMTEX'95. We won both CMTI-PMT Trust award for the best design and FIE foundation award for the best product. And since then there is no turning back. We are the first company winning these awards in three successive IMTEX. It won't be an exaggeration, if I say that our half of the sales generate through IMTEX.*" There was almost a consensus among the firms regarding the importance of IMTEX, although a few firms showed their reservation about the high cost of participation. It may be seen from Table 9.2 that the firms giving more thrust on this mechanism have performed better. It is also substantiated through the presence of significant positive correlation between this mechanism and various indicators and performance measure.

- *Forming Consortium (M4)*

In simple words, Consortium is an approach where a few like-minded firms come together to achieve synergy for some specific objective. For the purpose of our discussion, *we consider 'consortium' as a group of firms operating in CNC machine tool industry to foster collective efficiency through coordinated collective initiatives.*

Off late the firms in the industry have recognized the importance of formation of consortium to remain competitive in the present liberalized scenario. In the pre-liberalization era firms could sustain without it due to protected domestic market and limited technology dynamism. Evidences suggest that now the firms are taking effective steps to form consortium particularly for marketing activities (both domestic and export). Out of 17 firms in our sample, 10 firms are active in some sort of consortium formation. They also claim to give ample importance to this mechanism (see Table 9.2). Recently eight SMEs in Banglore region have promoted a consortium under UNIDO-ICAMT's cluster development programme as 'Bangalore Machine Tools Manufactures Network (BMTMN)'. One of our sample firms F_H is a member of this consortium. The firm opined that the consortium approach has started giving positive results but it requires lots of understanding and trust among the partners to sustain the endeavor in a meaningful way as well as facilitation by third party, which in the present case is done by the ICAMT and IMTMA. At the time of interview the firm was planning to participate in various industry fairs like INTEC 2001, Coimbtore; ACMEE 2002, Chennai, and NMTS 2002, Banglore as well as member of industry delegation to visit China under the banner of the newly formed consortium BMTMN. It is seen that the plans have been translated into reality and the BMTMN is being considered as role model to encourage firms in other machine tool clusters. The consortium has also appointed marketing agents at three places in the country, as well as hosted a joint website. They claim that individually they could not have done these due to prohibitive cost and lack of synergetic effect.

It may be mentioned that the consortium approach is not new for some of the firms. A few proactive SMEs have been adopting this approach since 1982. They had joined hands to start a sale & service outfit. In the post-liberalization period the firms are giving more thrust on this endeavor. As on date the consortium is one of the premier machine tool marketing firms in India representing seven SMEs. It operates from ten different locations with a battery of more than 100 well-experienced field engineers. It is able to offer its customers a wide range of CNC/non-CNC machine tools & accessories at one place notably CNC Turning Centers, Machining Centers, Cylindrical Grinders, Milling machine, SPMs, Tool Turrets, ATC for Machining centers, and copying attachments etc. Such venture helps the customers to get complete solution at one place as well as attains synergy for the machine tool firms. Three of our sample firms F_D, F_G and F_J are the members of this consortium. The firms opined that the strategy of common marketing has helped them to enhance their performance considerably particularly after the liberalization. They pointed out that the main underlying reasons in the success of the consortium are the trust among the partners for achieving a common cause and complimentary nature of product range of the firms. Although the testimonies of the firms confirm the positive influence of this mechanism on performance of the firms, we do not get statistically significant positive correlation between mechanisms and indicators. The plausible reason being this is a relatively new phenomenon that requires further deepening and adoption by larger number of firms.

9.2.4 Summary

- The domestic market development has always been a part of various policy pronouncements of the government both in explicit and implicit form. In the pre-liberalization era the protection imparted through QRs and high tariffs (see section 7.2.3) implicitly used to create demand from the domestic users. The liberalization in 1991 has annulled these measures.
- The views of the firms indicate that the policy framework is not conducive enough to stimulate sufficient demand for CNC machine tools in the country. It does not provide adequate support for market development functions for the firms as well.
- The firms primarily adopted following *mechanisms* to leverage the policy: *interaction with users*, *creating awareness for use of CNC Machine Tool*; *participation in Trade fairs*; and *forming consortium for marketing*. The first mechanism *interaction with users* is further disaggregated in terms of *regular interactions with the users before the sales, regular interactions after the sales, and imparting proper training to the users.*
- The adoption of these mechanisms reflect in *indicators* namely *number of products introduced in the market*; *marketing intensity*; *number of sales office & after-sales facility*; and *brand image in the domestic market*, which ultimately translates in the performance of the firms measured in terms of *annual sales*. The positive correlations between the various mechanisms, indicators and performance measure also substantiate the linkage between them to some extent statistically.
- The mechanisms adopted by the firms vary in scope and implementation resulting in divergence in performance. Some of the pro-active firms seem to be employing the mechanism more vigorously than others and reaping the dividends accordingly.
- In the present liberalized scenario *increased interaction with the users* have become sine-quo-non in order to remain competitive in the market. It is also reflected from positive correlation between the mechanism, various indicators and performance measure.
- The mechanism of *creating awareness about use of CNC machine tool among prospective SMEs* through organising workshops/ seminars either individually or in collaboration with other developmental agencies is increasingly being used by some of the firms. The firms claim that such efforts have started showing positive outcome.
- For industrial goods like machine tool, *Trade fairs* are the most convenient platform to show case the technological capability of the manufacturers. The firms participating in trade fairs in more professional way have performed better.
- The *consortium approach* is being experimented as new ammunition to fight competition. The critical success factors for this mechanism as identified by the firms are the trust among the partners, complimentary products and presence of a facilitator.

9.3 Export Market Development

9.3.1 Constituents of Policy – Performance Causation framework

The elements of the three main constituents of the framework for analyzing policy-performance causation in respect of policy on Export Market development as concluded on the basis of field work is presented in Table 9.3.

Table 9.3: Constituents of the Causation Framework: Export market development

Policy	Mechanism	Indicator	Performance
Export Market development ***(Promoting exports)***	-Participation in International Trade fairs -Forming consortium for Export Marketing - Use of e-commerce	- Marketing intensity - No of Sales & After-sales facility abroad	- Export intensity

9.3.2 Policy Framework

9.3.2.1 Export Market Development Policy

The export market development policy has always been mentioned explicitly in policy pronouncements of the government. In the post-liberalization period it has been receiving higher attention to encourage rapid growth of exports and integration with the global economy. The policy measures could be separated into two groups: cost-neutralization and developmental measures. The former provides monetary benefits primarily to compensate the cost disadvantage suffered by the domestic firms vis-à-vis the imports. It includes exemption/ refund on indirect taxes on imported inputs, exemption on corporate taxes, special import license (SIL), and provision of deemed exports etc. The latter has more promotional connotation. It includes status certificate, market development assistance (MDA); export promotion capital goods scheme (EPCG), and establishment of export processing zone (EPZ)/ special economic zone (SEZ).

- **Cost-neutralisation measures**

Exemption/ refund on indirect taxes

The exemption or refund on indirect taxes (i.e. custom/ excise/ and sales tax) is applicable *for imported inputs* as well as *export products*. All material inputs required for export production are allowed duty free subject to fulfillment of the stipulated export obligation and minimum value addition either through '*Advance License'* for import of inputs required for the manufacture of export goods, or under *'Duty drawback'* scheme i.e. post export remission of duty on imported inputs. The export products are also exempt from excise duty and sales tax.

Exemption on Direct Taxes

The profits from exports are exempted from corporate taxes under section 80 HHC of the Income Tax Act 1961. However, in compliance with the WTO obligations, the Finance Act of 2000-01 has stipulated progressive withdrawal of this benefit over a period of 5 years i.e. in the first year 20% of export earnings become taxable, in second year 40% and from the fifth year i.e. assessment year 2005-06 no tax benefits will be available.

Special Import Licenses (SIL)[115]

The Special Import Licenses (SIL) entitles the exporters to imports items that are not permissible for imports freely. The entitlement varies from 5 to 12% of exports value depending on status of the exporters (export house, trading house, star trading house or super star trading house). These licenses are freely tradable in the market and earn premium.

Deemed Exports

The '*Deemed Exports'* are those transactions in which the goods supplied by the domestic firms do not leave the country. The following categories of supplies are regarded as 'Deemed Exports', provided the goods are manufactured in India: supplies against Advance License under DEEC scheme; supplies to Export Oriented Units (EOU)/ units located in EPZ or SEZ etc.; supply of Capital Goods under the EPCG scheme; supplies to projects financed by multilateral or bilateral agencies under international competitive bidding or any project as notified by the Ministry of Finance, Govt. of India (e.g. Fertilizer, Power or Refineries etc.)

Availability of finance for exports activities

The Government provides various financial assistances to the firms for exports primarily through Export & Import Bank (EXIM Bank) of India. Certain commercial banks and other financial institutions also provide some of the services. The main schemes are pre-shipment & post-shipment rupee credit, foreign currency pre-shipment credit, foreign currency loan, lines of credit, advance payment guarantee, export marketing finance, lending for export oriented units and overseas investment finance for setting up joint ventures/ wholly owned subsidiaries abroad etc. (EXIM Bank, 2002).

- **Developmental measures**

Status Certificate

On achievement of certain threshold limits of annual export performance the recognized exporters are given status certificate such as: Export House- Rs 150 million; Trading House- Rs 1 billion; Star Trading House- Rs 5 billion; and Super Star Trading House- Rs 20 billion. The SSEs, firms located in certain difficult regions, and ISO 9000 series certified firms get the Export House status on achieving average export level of Rs.50 million only in place of Rs 150 million. These exporters are eligible for certain additional non-fiscal benefits such as:

- Self-declaration for Customs clearances/ Permissions for both imports and exports,
- Fixation of Input-Output norms on priority,
- Priority Finance for medium and long term capital requirement,
- Exemption from compulsory negotiation of documents through banks,
- 100% retention of foreign exchange in the export earning foreign currency account,
- Enhancement in normal repatriation period from 180 days to 360 days.

[115] In the new EXIM policy of 2002-07 this facility has been withdrawn as it became redundant due to total abolition of QR in compliance with the WTO obligations (DGFT, 2002).

Market Development Assistance (MDA) scheme

The Ministry of Commerce, Government of India extends partial financial assistance in the form of grants to the recognized exporters for export promotion activities like sales cum study tours abroad, participation in international fairs/exhibitions, advertising in foreign media, and production of material for overseas publicity, opening of foreign office & warehouses abroad, and research & product development activities primarily through the Federation of Indian Exporting Organisations (FIEO). The exporters, with aggregate export of Rs 20 million and above over the last three financial years (Rs 10 million for ISO 9000 certified exporters) are eligible for MDA grant (FIEO, 2002). A similar scheme has also been floated specifically for small-scale industries since August 2000 by the department of cottage and small scale (DC&SSI), Government of India (DC&SSI, 2002).

Export Promotion Capital Goods (EPCG) Scheme

The scheme allows firms to import both new and second-hand[116] Capital Goods including CKD/SKD thereof as well as computer software systems without payment of custom duty or at a reduced rate of Customs duty at 10% subject to an export obligation equivalent to 4 to 6 times CIF value of Capital Goods to be fulfilled over a period of 5 to 8 years as the case may be. The firms can also procure from domestic supplier under this scheme (DGFT, 2002).

Export Processing Zones (EPZ) and Special Economic Zone (SEZ)

The EPZ/ SEZ have been set up by the Government as enclaves separated from the Domestic Tariff Area to provide an internationally competitive duty free environment for 100% export production.[117] Some of the salient features and incentives available in EPZ are (DoC, 2002):

- Exemption from customs duty on industrial inputs,
- No license required for imports,
- Exemption from central excise duty on goods brought from the domestic tariff area,
- Exemption from State and Central Sales Tax on inputs on purchases made from DTA,
- Corporate tax holiday for a period of ten years on graded basis,
- Sub-contracting of production processes in the DTA,
- Unrestricted foreign shareholding and 100 % repatriation of export earnings,
- Exports allowed through third party,
- Simplified approval procedures,
- Built standard design factory (SDF) blocks, sheds, and developed plots,
- Reasonably developed infrastructure (Power, Water, Telecom, Postal services, Banking facilities, Security, and sewerage etc.)

In the year 2000, the Government launched the concept of SEZ on the Chinese pattern. The SEZs are duty free enclaves equipped with all necessary infrastructures for providing enhanced competitiveness for exports. SEZs also provide duty-free imports of capital goods and

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[116] The provision to import second-hand CG under EPCG scheme has been withdrawn since 01/04/1999. As per the 2002-07 EXIM policy it requires specific import license (DGFT, 2002).

[117] There are seven Export Processing Zones (EPZs), functioning at Kandla (Gujarat), Santa Kruz Mumbai (Maharashtra), Noida (U.P.), Madras (Tamil Nadu), Cochin (Kerala), Falta (West Bengal) and Visakhapatnam (Andhra Pradesh).

industrial inputs; tax holiday for a specific period and other preferential policies. Some of the EPZ has been converted into SEZs. A few SEZs are also coming up in the private sector.

9.3.2.2 ***General observations regarding the Policy***

Like the previous case of domestic market development policy, in this case also, we present the observations of the firms for each of the policy measures in brief.

- The cost-neutralisation measures provide level playing field to the domestic firms vis-à-vis the firms abroad. Without such supports the firms simply cannot compete in the international market. There is need for further streamlining of the procedures.
- The Special Import Licenses (SIL) scheme has little relevance in the present context as very few items are left in restricted list category.
- The exemption of taxes on export profit under Section 80 HHC of Income Tax Act has been a motivating factor for the exporters as it compensates the transaction costs for exports.[118] But the recent decision to phase out this incentive is demoralizing for the firms.
- The profits generated by the Deemed Exports are not considered as export profits under Section 80 HHC. The firms have to pay terminal excise duty and sales tax on such exports. Although these are refunded afterwards but it increases transaction cost unnecessarily.
- There has been availability of finance for exports activities but interest rates are quite high compared to international standards and the procedures are quite complicated.
- Although the MDA scheme is beneficial, most of the firms are not able to avail due to minimum requirement of aggregate export of Rs 20 million over the last three financial years (Rs 10 million for ISO 9000 certified exporters).
- The EPCG scheme does not seem to be favoured by the firms. It deprives the firms from the business opportunities. Moreover, the firms themselves as users are not able to take the benefits of the scheme due to low level of exports. The government also loose revenue due to poor monitoring of export obligation under the scheme.[119]
- The scheme of EPZ/ SEZ although good are not so much helpful as neither the firms are able to set up new plants in EPZ nor there has been adequate FDI.

The above observations suggest that the cost-neutralisation measures in vogue are the barest necessity for export promotion. However, there is need for amendments of certain existing anomalies and streamlining of procedural hassles. Most of the developmental measures have been more or less ineffective for the firms due to various reasons. In some cases although they are useful, the firms are unable to take advantage due to procedure hassles.

[118] The transaction costs arise from difficulty faced in each and every stage in exports activity namely high cost of finance, procedural difficulty in procurement of finance, various permissions, imports of inputs, blockage of funds till the receipt of direct/ indirect tax refunds, and delays in export receivables etc.

[119] A study by CII suggests that during 1995-96 to 1997-98,altogether 262 licenses were issued for Rs 192 billion against export obligation of Rs 1022 billion under the zero duty EPCG scheme but very little export obligation has been fulfilled. Under the 25%/15%/10% scheme since 1990-91 till 1997-98, the total number of licenses issued were 9474 for Rs 116 billion CIF with the export obligation of Rs 488 billion. In this case the shortfall in fulfillment of export obligation works out to 65% (CII, 1998).

9.3.3 The Causation

The main *mechanisms* adopted by the firms to leverage the policy on export market development are: *participation in Trade fairs abroad* (M01); *forming consortium for export marketing* (M02) and *use of e-commerce* (M03). The mechanism *participation in Trade fairs abroad (M01)* is further disaggregated in terms of *exhibiting in trade fairs abroad (M01a)* and *visiting trade fairs abroad (M01b)*. The *indicators* considered are: *marketing intensity* (I_1); and *number of sales office/ representatives abroad* (I_2). As regards to the *performance measure*, we have considered export intensity (P_2). However, we have also shown the relative annual sales (P_1) for ready reference and easier comparability. The snapshot of data on mechanisms, indicators and performance measure is presented in Table 9.4 below.

Table 9.4: Mechanism, Indicator and Performance measures

Firm	M01a	M01b	M02	M03	I_1	I_2	P_1	P_2
F_A	x	x	x	x	4	35	686.3	2.0
F_B		x			1	-	25.7	Nil
F_C	x	x	x	x	5	15	75.9	9.7
F_D	x	x	x	x	4	9	84.9	4.0
F_E					1	0	4.4	Nil
F_F					1	0	0.4	Nil
F_G	x	x	x	x	2	1	36.5	1.4
F_H	x	x		x	2	0	5.1	2.8
F_I		x	x	x	3	10	95.1	3.1
F_J	x	x	x	x	4	9	52.6	0.2
F_K		x	x	x	2	-	98.7	Nil
F_L		x	x	x	3	-	292.3	9.1
F_M		x	x		4	-	87.4	0.4
F_N		x			2	0	21.0	12.0
F_0		x			2	0	29.9	Nil
F_P		x			2	0	14.8	Nil
F_Q		x		x	4	-	89.1	1.0
							100.0	

Symbol 'x': Yes; Blank: No; and '-': Data not available.
Mechanisms: M01: Participating in Trade fairs abroad; M02: Forming consortium; M03: Use of e-commerce (website).
Sub-mechanism: M02a: Exhibiting in Trade fairs abroad; M02b: Visiting Trade fairs abroad.
Indicators: I_1: Marketing intensity; I_2: No of Sales office/ marketing agents abroad.
Performance measure: P_2: Export intensity.

Since we were not able to gather discreet data for the mechanisms in quantitative terms, which could be compared across the board, recourse has been taken to qualitative data in terms of adoption of the mechanisms by the firms. The symbol 'x' indicates adoption of the mechanism, blank denotes otherwise and '–' indicates non-availability of information. The indicator I_1 i.e. marketing intensity is the ratio of expenditure on marketing activity to total annual sales and I_2 indicates the number of sales office/ representatives abroad. The performance measures P_1 i.e. annual sales and P_2 i.e. export intensity.

- *Participation in Trade fairs abroad* (M01)

Like domestic trade fairs, the trade fairs abroad are the most convenient platform to project the technological capability of the firms, to get acquainted with the latest technological developments and to know about international buyers' demand within a short duration and at a specified location. It also provides opportunity to form new alliances as well as to benchmark against international competitors. Therefore, all industrialized and industrializing countries producing machine tool, organise international trade fair specifically at regular interval. Some of the popular fairs are: European Machine Tool Outil (EMO) Hanover, Milan & Paris in Europe;[120] International Manufacturing Technological Show (IMTS) in Chicago, USA; Japan International Machine Tool Fair (JIMTOF) Tokyo, Japan; Australian Technology Show (AUSTECH), Sydney, Australia; China International Machine Tool (CIMT) Show Beijing, China; and Seoul International Machine Tool Show (SIMTOS) Seoul, South Korea etc. The EMO fair is the most widely known and esteemed fair for machine tools worldwide. In the last EMO Hanover 2001,[121] altogether 2263 firms from 39 countries had participated. It had attracted about 200,000 visitors around the globe. There were 10 exhibitors from India including three of our sample firms and the IMTMA (EMO, 2001).

Although some of the firms have been participating in trade fairs abroad since the last thirty years,[122] it is in the post-liberalization period, that the firms have started considering this as an important mechanism to enhance their international competitiveness. Our data suggests that firms use this mechanism primarily in two ways i.e. *exhibiting products in trade fairs (M02a*) and *visiting the fairs only (M02b)*. It is evident that the former requires more involvement, technological capability and cost compared to the latter. So majority of the firms seem to have adopted the latter. It may not be worthwhile for the firms to exhibit their products without achieving a minimum standard to do so as the critical success factors for export market is different from the domestic market. In addition to price and quality, other factors like aesthetics, safety features, chips & coolant disposal system and overall dimension etc. also become important for the export market. In this context, an experience of the firm F_D while exhibiting its product in an international trade fair abroad as quoted by Desai et al. (1999: 42) is worth mentioning: *". . . In fact when [the firm] did show their machines in the EMO fair at Paris, many critics commented on the way they brought a machine which was not looking so good. One British visitor even commented, **'Do you want me to believe the machine functions better than it looks?'** After these disheartening remarks, [the firm] realized that for a real export effort one has to look inwards at the design, appearance of the machine, price and of course, basic quality aspects. [The firm] took the machine back to the drawing boards and set out to produce a machine which they would be ultimately proud of."*

It may be mentioned that as a result of such endeavor the firm has achieved positive growth rate irrespective of overall decline of the industry during the last ten years and has now become

[120] It is held in Hannover, Germany every four years as well as either in Milan or Paris every two years in rotation in between the Hannover fairs under the aegis of CECIMO. The last two fairs in Hannover were held in 1997 and 2001. The EMO 1999 was in Paris, France and in 2003 it is scheduled in Milan, Italy.

[121] The 14th EMO Hannover 2001 was held from September 12 to 19, 2001 in Hannover, Germany.

[122] The firm F_A had exhibited its indigenously developed NC milling machine in the EMO '70 at Hannover.

the largest manufacturer exporter of CNC lathe in the country. The firm now exhibits regularly in the EMO and is considered as role model for the industry. It is seen from the data (see Table 9.4) that not all firms could venture to exhibit in trade fairs abroad. The adoption of this mechanism leads to higher marketing intensity (I_1) due to higher cost incurred in market development activities. It also contributes to establishment of more number of sales office/ distributors abroad and these ultimately translate into better export performance i.e. higher export intensity (P_2) e.g. F_A, F_C, and F_D etc. However, it should not be construed that the firms that do not exhibit in trade fairs abroad cannot perform better in export market. The firms F_I, F_L and F_N have high export intensity by virtue of having buy-back arrangement with their foreign collaborators although they did not exhibit in trade fairs abroad. Another interesting fact is revealed that the firms that perform better in export market (P_2) also show better performance in the domestic market (P_1).

It is seen that most of the firms except the two small ones *visit trade fairs abroad* (M02b) particularly the EMO to gather information and create business links. The benefits of visiting trade fairs abroad is well summarized in the remarks of the CEO of a medium sized firms as: "*Trade fairs are an important source of technology. One can know in which direction the technology is moving. It helps in bench marking against competitors particularly from NICs like Korea & Taiwan and re-engineering our products based on knowledge gained from the visit. One should have an eye to see and you collect a great deal of useful information. We incorporate lots of incremental improvements in our design based on such information. It also helps in assessing market potential for our products and identifying agents overseas. We have appointed distributors in Germany and Italy based on the business contacts developed in the last EMO."* While discussing source of assimilation of technology in chapter six, we had also seen that the firms consider such visits as an important source of innovation (see Table 6.5).

- *Forming Consortiums (M02)*

In order to remain competitive the firms are taking initiatives to harness the benefit of synergy by way of adopting consortium approach for export marketing activities. Four medium & large firms in Banglore-Coimbtore region have formed a consortium for export marketing in the name and style of '*Vishwaroop*'.[123] All these firms happen to be our sample firms. Similarly five firms in Mumbai-Pune region have floated another consortium named '*Sahayog*'. One of our sample firms is a member of this consortium. In Mumbai region yet another consortium is under formation by the mid-sized firms. The BMTMN consortium of eight SMEs in Banglore region is also taking initiatives for export market development. Commenting on objectives and operations of consortium the IMTMA president Mr. Sirgurkar mentioned, '*the purpose of forming the business alliance is to face the global competition. The member companies, under the obligation of a memorandum of understanding, will take joint efforts to get international orders and help each other in capacity sharing.*' (Financial Express, 2000).

The Vishwaroop consortium has appointed a country coordinator[124] in each of the target markets: the UK and Germany. They have also invested Rs 2 million for conducting a joint

[123] These four firms belong to our sample firms. Another firm is a partner in the consortium 'Sahayog'.

[124] The country coordinator bridges the gap between the market and the firms. On the one hand he provides guidance on the market and distribution system of the country to the firms and on the other inculcates confidence among the buyers and the local distributors about the capability of the firms.

market study on the target market. Consequently the consortium bagged two orders of supplying machines in the European market. The BMTMN consortium that visited the last CIMT 2001, Beijing as part of delegation to evaluate market potential in China will be exhibiting in the forthcoming CIMT 2003 with the support of ICAMT-UNIDO cluster development program. With these developments other firms are also recognizing the importance of consortium approach and increasingly adopting it. While it is difficult to provide conclusive evidences, it is plausible to suggest that use of consortium approach has been acquiring greater significance in the present liberalized scenario.

- *Use of e-commerce (M03)*

In simple terms *e-commerce* means *'doing business electronically'*. It is a tool to transform the exchange of goods, services, information, and knowledge through the use of information & communications technologies (ICT) over a worldwide network called Internet. It could be business to business (B2B), business to consumer (B2C), or business to government (B2G) and vice versa. In all these cases there could be primarily three modes of transactions: offline, online and through shared or individual portals. The offline transactions is usually done through email, while online transactions take place through firm's website having online transaction facilities such as Active Server Pages (ASP) that allow online transactions (Bandyopadhyay, 2002; Coupey, 2001; Lal, 2002; Turban et al., 2000). At present in industrial marketing B2B transactions in offline mode is more prevalent in India.

Our data suggests that the firms are increasingly showing interest in establishing presence on the Internet and adopting it as a tool for market development. So far 11 sample firms (65%) have uploaded their own website (see Table 9.5), although with wide variations in sophistication/ complexity. A few sites show a high level of sophistication with all the necessary constituents such as corporate profile, products, services, sales network, financial information, referrals, related sites and search facility in detail whereas others appear to provide mere basic information. Majority of the firms use normal telephone lines for accessing Internet except a few who use 64 or128 kbps ISDN lines.[125] A few SMEs do not have website as yet, but they do use Internet for offline transactions and messaging.[126] *The bottom line of e-commerce in this industry at present is offline transactions through email*. Interestingly enough all firms who exhibit in trade fairs abroad or take part in consortium have their own website with a good degree of sophistication. It reflects the firm's strategic priorities.

Commenting on the status of e-commerce in machine tool industry one of the senior marketing executives of the firm F_D mentioned, *"Due to the inherent nature of this industry that demands high level of interactions between buyer and seller, the actual level of sales through online e-commerce is quite low rather negligible at present. There have been quite a few B2B portals for machine tool industry operational worldwide but they are not as successful as in other industries. Two portals have been established in India also but with little success. Nevertheless the concept is picking up. We have also started receiving three or four inquiries every week although in offline mode. Our website does not support online transactions as yet. I*

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[125] kbps: kilo bits per second; ISDN: Integrated service Digital Network.

[126] The researcher was able to fix appointment with the two small firms through email. Overall about 60% of appointments of the researcher were confirmed through email.

would say that Internet is a tool that has tremendous potential to facilitate not only the process of sales but total marketing function. It provides first hand preliminary information on firm's technological capability particularly for the buyers abroad. In this era of information age, having a website is the basic criteria to judge firm's potential and progressiveness. Internet helps in quick exchange of information with distributors or sales office abroad. It is also helping us in keeping close contact with various sales & service outfits and customers in our domestic market as well. It is reducing the time and cost of communication while increasing personal attention and therefore overall efficiency." The firms were in opinion that it was difficult to quantify the level of increase in exports or domestic sales due to the use of e-commerce. Nevertheless they were convinced about the potentials and possible pitfalls of not having own website and not adopting it as a mechanism to stay competitive in the market.

9.3.4 Summary

- In the post-liberalization period the export market development policy has been receiving prominent status in the policy framework to encourage rapid growth of exports and integration with the global economy.
- The views of the firms suggest that the *cost-neutralisation measures* are the barest necessity as they compensate part of the cost disadvantages suffered by them. The *developmental measures* have been more or less ineffective. In general there is a need for better policy support and streamlining of procedural hassles.
- The main *mechanisms* adopted by the firms to leverage the policy have been *participation in Trade fairs abroad*; *forming consortium* and *use of e-commerce*. The result of adoption of these reflects in indicators such as *marketing intensity* and *number of sales office abroad.* The performance of the firms is measured in terms of *export intensity*.
- The firms that *exhibit in trade fairs abroad* perform better in export market. However, it should not be construed that the firms that do not exhibit in trade fairs abroad cannot perform better in export market. A few firms do show high export intensity by virtue of having buy-back arrangement with their foreign collaborators. It suggests that the essential condition for success in exports is *establishing linkage with the foreign buyers*.
- The firms are increasingly showing interest in establishing presence on Internet and adopting *e-commerce* as a mechanism for market development. The firms that exhibit in trade fairs abroad or take part in consortiums have developed better websites than others.
- While it is difficult to provide conclusive evidences, it is plausible to suggest that adoption of mechanisms are acquiring greater significance in the present liberalized scenario as they have high potential for contributing in better performance of the firms.
- The firms that perform better in export market also show better performance in the domestic market.

9.4 Synthesis and Conclusions

9.4.1 Synthesis

The analyses of the policy framework on market development in terms of *domestic market* and *export market* development have brought out conclusions, that are distinct but quite a few elements seem to be common in both the cases. For example, the policy frameworks are not adequate to stimulate demand and fall short in supporting market development efforts of the firms. Moreover, they are vexed with the problems of procedural hassles. Further, the mechanisms adopted are also common in both the cases namely *interaction with the users*, *participation in trade fairs*, *forming consortium* and *use of e-commerce* etc.

It may be recognized that the essence of all these mechanisms in the first instance is *acquisition of customers* or in other words *acquisition of market*. It may be either domestic market or export market. The importance of acquisition of domestic buyers emanates from two reasons. First, for technology-intensive product like machine tool it is crucial to establish contacts with buyers and understand their needs. It is easier as well as cheaper to do so in the domestic market. In our earlier discussions also while analysing product development capability in chapter six we found evidence that the firms consider interaction with domestic buyers both before the purchase and after the sales as the second most important source for assimilation of technology (see Table 6.5). Second, it has become more essential in the light of stiff competition from low cost foreign manufactures from Taiwan and Korea etc. The low barriers to trade, ease of communication and transportation have facilitated the entry of foreign firms in the domestic market who offer better machines and a cheaper price.

The next step in building market development capability is *acquisition of overseas buyers.* This concerns with identification of overseas buyers, creating awareness about firm's products & capabilities, developing business contacts, and finally exporting as well as maintaining links with buyers for feedbacks/ further purchases. These are undertaken through mechanisms like participation in Trade fairs abroad; forming consortium and use of e-commerce. We see an increasing trend in exports of CNC machine Tools, particularly since 1997 (see Table 11.10) as the firms have started giving more emphasis on this to face gradual shrinkage of domestic demand and onslaught of competition from imports.

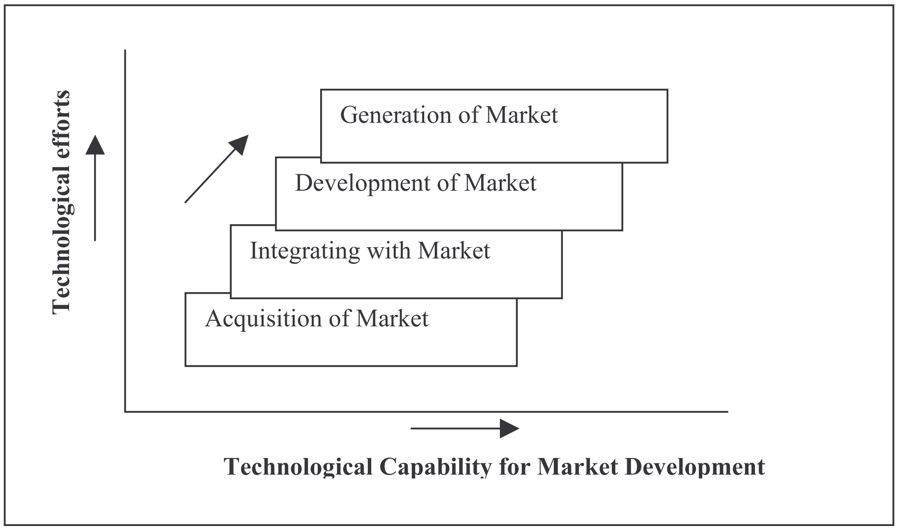
A further thrust on the aforesaid mechanisms leads to *integration with buyers*. It implies establishment of sustained producer-buyer interactions with recurrent transactions. There are ample empirical evidences in literature regarding the significant role played by the producer-user interactions in inducing technical changes around the world (Egan & Mody, 1992; Fransman, 1986; Hobday, 1995; Lee, 1996; Rosenberg, 1963, 1976). In our discussions also, while analysing product development capability in chapter six we found that the firms consider interaction with domestic buyers and foreign buyers as the second and ninth most important source for assimilation of technology (see Table 6.5) respectively that further culminates in better performance. The interaction with foreign buyers has been ranked low as most of the firms do not export and therefore have less interaction with foreign buyers. We do get isolated evidences *integration with foreign buyers* in various forms namely subcontractor of parts/components, supplying machine tool in semi-finished form or complete machinery to

OEM to be marketed under buyer's brand. Although adoption of this process is still in the emergent stage and rather isolated**,** firms are convinced about its potentials and possible pitfalls of ignoring this to stay competitive in the market.

In some isolated cases we found that the firms also adopted the mechanism of licensing and joint venture abroad to develop market across the national boundary. Such endeavor may be termed as development of market. It means creation of market abroad by way of licensing, joint venture, or FDI for the products for which the firm has developed sufficient technological capability and is in the position to transfer technology abroad. The product may not be necessarily at the frontier of technology or new to the world. The new market may be other less industrialised countries or in some cases industrialised countries as well. Such endeavor allows firm to generate market for firm's product as well as supply of components and other technological inputs. It helps to gain entry into the foreign market. It may also help to establish export platform to take advantage of low labour cost and other factor endowments. It differs from the previous process of integration with foreign buyers in respect of direction of flow of technology. In the former, material/ technology flows from buyer to firm, while in the current case the direction of flow is from the firm to buyer. Unfortunately, we did not get any evidence of adoption of this process as none of the firms have achieved such level of capability so far for CNC machine tool. However, in past there have been instances in case of non-CNC machine tool. **N**evertheless, for attaining sustained development efforts are required by the firms along with necessary policy supports.

As mentioned in the chapter 6 that at the helm of building technological capability in respect of product development, firms innovate new technology and new products at the frontier of technology. From the market development point of view, such activity could also be termed as *generation of market* and a step further in building market development capability of the firms. It concerns with creation of market at home as well as abroad by way of exporting, licensing, joint venture, or FDI. These require much higher level of technological effort, technological capability and framework conditions as well as deepening of earlier processes. As mentioned earlier, firms in the developing countries in general and India in particular are yet to attain such level. Still firms should endeavor and the government should provide required policy supports to create such capability. The four activities as described above could be considered as building blocks in dynamics of building technological capability in respect of market development in firms and could be depicted as in Figure 9.2.

Figure 9.2: Dynamics of building Market Development Capability



9.4.2 Conclusions

- The policy frameworks on domestic market as well as export market development do not stimulate sufficient demand of CNC machine tool. They are also vexed with the problems of procedural hassles.
- The firms adopted various mechanisms in response to the policy framework. The mechanisms namely *interaction with the users*, *participation in trade fairs*, *consortium approach* and *use of e-commerce* are found to be common for both domestic and export market development.
- The mechanisms adopted by the firms vary in scope and implementation resulting in divergence in performance. Some of the pro-active firms adopted the mechanism in a more planned manner than others and reaping the dividends accordingly.
- The firms that perform better in export market also show better performance in the domestic market. But the reverse does not seem to be true.
- The process of building technological capability in respect of market development could be viewed in terms of four distinct but interrelated steps namely *acquisition-*, *integration-*, *development* and *generation of market.*

Chapter Ten

POLICY AND LINKAGES

This chapter attempts to analyse the policy-performance causation in respect of policy on industrial governance vis-à-vis developing linkages for the firms. The analysis is presented in two distinct but interrelated steps. First, a brief overview policy on industrial governance is given. Then, it is supplemented with discussion as to how these measures influenced in developing the firms' linkage capability through analyzing the policy-performance causation.

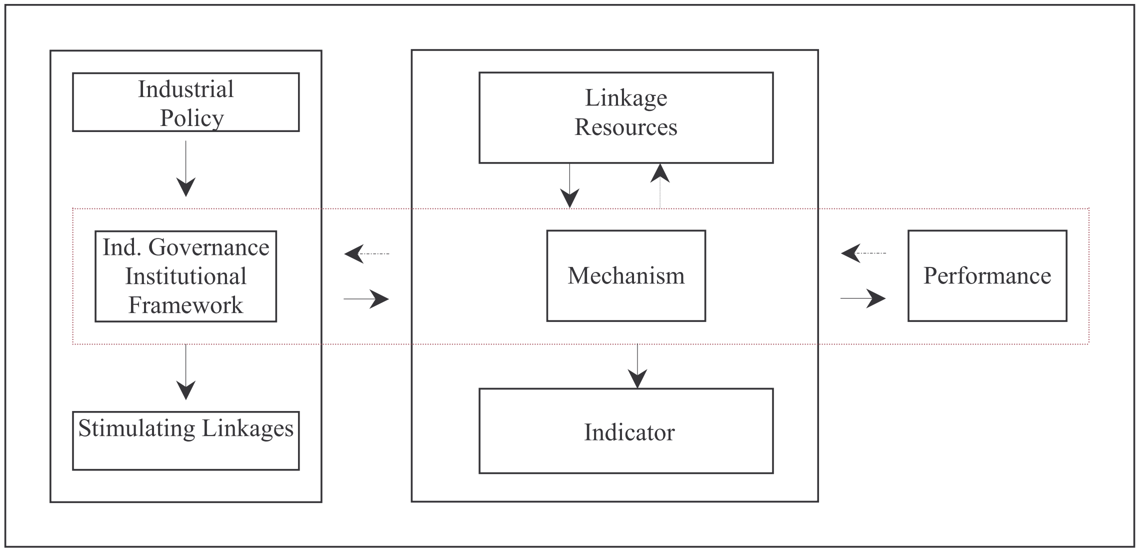
10.1 Introduction

In the last four chapters we discussed as to how policies on technology, investment, education & training and market development influence building of technological capability of the firms and in turn determine their performance. At the same time the discussions also suggested that certain deficiencies like poor implementation of policies, lack of necessary institutional support and coordination/ cooperation among various stakeholders hinder in achieving desired performance by the firms. This chapter endeavors to address these issues through *analysis of role of governance* that eventually influences the performance of the firms. As mentioned earlier, governance concerns with mitigating the various sources of the government failure. It draws attention on three aforesaid aspects: formulation & implementation of policies, building institutions and improved flow of information among various stakeholders. Eventually these require complex and dynamic *interactions* both within and between the various stakeholders: the Government, firms, supporting institutions and market. For the purpose of our discussion, we term such interactions as *linkages.* The term linkage means the act of fostering links between two or more stakeholders or entities.

From the firms' perspective, the development or augmentation of linkages among various stakeholders lead to increased coordination and cooperation that ultimately help in achieving better performance. But it is difficult to quantify the status of such linkages due to complex and abstract nature of the phenomenon. Therefore, in order to analyse the policy - performance causation, we propose to introduce little variation in the analytical framework. The variation is not in the framework as such, but in the overall analysis and understanding of the causation. For instance, in place of policy framework on governance we will describe institutional framework in respect of industrial governance. Similarly adoption of mechanisms by the firms is to be seen in response of existing institutional framework and so on. It will be clear as the discussion proceeds. The framework is depicted in Figure 10.1 overleaf for ready reference.

To start with we first elaborate on the institutional framework in respect of industrial governance. It is supplemented with analyses as to how the firms used various mechanisms in response to the institutional framework to build their linkage capability, and how the adoption of these mechanisms reflected in the various indicators and finally translated into performance of the firms. The last section concludes the discussion.

Figure 10.1: Policy–Performance Causation Framework: Industrial Governance



10.2 Institutional framework

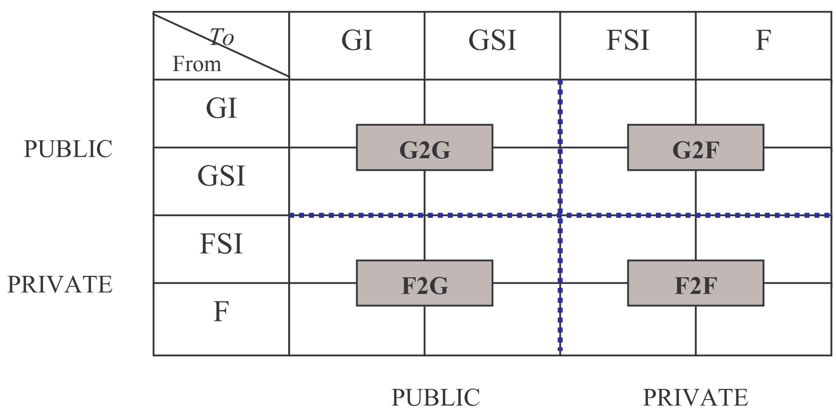
In order to present a synoptic view on institutional framework in respect of industrial governance it is pertinent that we first describe the typology of institutions and linkages as well as relationship between them. Attention will be given to the institutions that concern industry in general and machine tool industry in particular.

10.2.1 Typology of Institutions and Linkages

There are primarily three types of institutions namely public i.e. government, private and public-private partnership. *It would be more practical to view the public and private institutions as the two extremes of the same continuum*. The institutions floated in partnership of public and private lie somewhere on the continuum depending on their amount of involvement. The public institutions could be further segmented into two types based on functional criteria: institutions responsible for policymaking & implementation (e.g. Ministry of Industry, Planning Commission or Development Council for Machine Tool, ICAMT), and public funded supporting institutions established for capacity building of firms say for technology (e.g. CMTI, CSIR), finance (e.g. IDBI, SIDBI), education/ training (e.g. Engineering college) and market development (e.g. EEPC, NSIC). Similarly we can segment private institutions in two types: firms; and supporting institutions floated collectively by firms or private sector (e.g. industry association, educational institutions, test houses, tool rooms etc.). It may be mentioned in developing countries in general and in India in particular the supporting institutions in private sector or in private-public partnerships are yet to develop in a meaningful way. For the purpose of our discussion we can nomenclature these four types of institutions as: *government institutions* (GI); *public funded support institutions* (GSI); *institutions supported by firms* (FSI) that also include institutions in private-public partnerships; and *firms* (F).

As regards to *linkages among various institutions*, we can visualize mainly *three* forms of linkages. Taking the cue from typology of e-commerce, we can assign names to different types of linkages as G2G, G2F and F2F. The linkages among various government institutions (GI) and government support institutions (GSI) or vice versa can be understood as government-to-government linkages i.e. *G2G linkage*. The linkages between various GI & GSI with FSI & F or vice versa may be termed as government to firm linkage i.e. *G2F linkage*. Finally, linkages between firm-to-firm, or firm-to-FSI or FSI-to-FSI or vice versa may be termed as firm to firm i.e. *F2F linkage*. Here one point merit attention. Since the linkages are always interactive, we do not differentiate between the origins of initiative for linkages. For example, the linkages between GI to GSI or GSI to GI are considered as G2G linkage only. Similarly G2F and F2G linkages are considered to be the same and understood as G2F linkages and so on. The typology of institutions and linkages as described above is depicted in a matrix form in the figure 10.2.

Figure 10.2: Institution-Linkage Matrix



On the basis of the above typology we can describe the functions of some of the important institutions that concern to machine tool industry and their contribution to linkages to present a snapshot of institutional framework in India. In order to be precise and for easier readability, it is presented in tabular form in Table 10.1 overleaf.

Table 10.1: Institutions' functions and contribution to linkages

Institution	Main Functions	Contribution to linkage
i. Government Institutions (GI)		
Planning Commission	Hub of Industrial planning and policy formulation	**G2G and G2F**: Administrative and Economic ministries, Provincial Government, and Apex Industry Association etc.
Ministry of Industry (MoI), Govt. of India	Nodal agency for industrial development. Industrial Policy formulation, implementation and monitoring	**G2G and G2F**: Planning Commission, Adm. & Economic ministries, Development Councils, International investors, Industry Associations and Firms etc.
Ministry of Finance (MoF), Govt. of India	Policy formulation, implementation and monitoring Economic policies and programmes	**G2G and G2F**: Planning Commission, Adm. & Economic ministries, International investors, Industry Associations and firms etc.
Development Council for machine Tool industry under M/o Industry, Govt. of India.	Interface between the Government and industry/ firms Advisory service for overall development of machine tool industry	**G2G and G2F**: MoI, MoF, Planning Commission, Industry Associations, supporting institutions and firms etc.
Provincial Government Institutions	Interface between the Central, Provincial Government and firms Implementation and monitoring of policy and programmes	**G2G and G2F**: Central Government, Industry Associations, and firms etc.
International Center for Advancement of Mfg. Technology (ICAMT)	UNIDO initiative in collaboration with GoI, IMTMA and others. Technology up gradation through networking	**G2G and G2F**: Government, IMTMA, firms and support institutions etc.
ii. Government Support Institutions (GSI)		
Central Manufacturing Technology Institute (CMTI): T1	Prime R&D institution for manufacturing sector (originally established for R&D in machine tool). Provides specialized training also.	**G2F and G2G**: Firms, IMTMA and other support institutions etc.
Council of Scientific and Industrial Research (CSIR): T2	R&D institutions for scientific industrial R&D	-do-
Technology Development Board (TDB): T3	Providing subsidized financing and Venture capital for technology development	-do-
Technology Information Forecasting & Assessment Council (TIFAC): T4	Technology assessment and forecasting, and providing information on technologies.	-do-
Industrial Development Bank of India (IDBI): F1	Main financial institution for investment financing. Coordinates other investment financing institutions	-do-
Small Industries Development Bank of India (SIDBI): F2	Financial institution for financing and development of SSEs.	-do-
State Financial Corporations (SFC): F3	Financial institution for equity, and debt financing and other financing services.	-do-
Commercial Banks: F4	Provides mainly short term loan and working capital.	-do-
Export-Import Bank of India (EXIM Bank): F5	Promoting foreign trade through export finance and related services.	-do-

Venture Capital Funds (VCF): F6	VC financing mainly through equity participation.	-do-
Directorate General of Supplies & Disposals (DGS&D): Mk1	Procurement agency for the Central & State Government and PSEs.	-do-
National Small Industries Corporation (NSIC): Mk2	Providing marketing supports and lease finance/ hire-purchase for equipment purchase to SSEs.	-do-
India Trade Promotion Organisation (ITPO): Mk3	Promoting external trade through organizing industrial fairs/ exhibitions in India and abroad.	-do-
Federation of Indian Export Organizations (FIEO): Mk4	Export marketing supports to recognized exporters.	-do-
iii. Support institutions in the private sector (FSI)		
Indian Machine Tool Manufacturer's Association (IMTMA)	Firms' Association for Machine Tool Industry: Interface between firms and the Govt. Catalyst for development of the firms.	**F2F and G2F:** Government, firms, support institutions and international buyers/ investors etc.
Private Commercial Banks	Provides mainly short term loan and working capital.	**F2F and G2F:** Firms, and support institutions etc.
Venture Capital Funds (VCF) in private sector	VC financing mainly through equity participation.	**F2F and G2F:** Firms, and support institutions etc.
Consortium floated by the firms	Strategic Alliances by few firms for marketing and other activities	**F2F and G2F:** Firms, and support institutions etc.

10.2.2 Illustrative examples

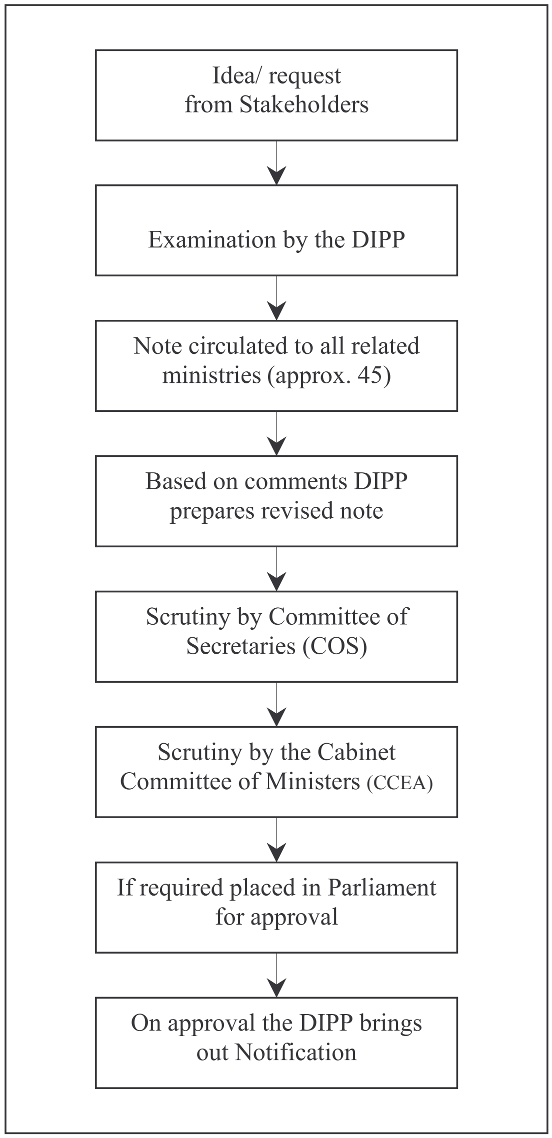
A glance on the above table suggests that institutions do not function in isolation. Linkages exist both within and across institutions as evident from presence of at least two types of linkages either G2G & G2F or F2F & G2F and vice versa in all the cases. However, the degree and scope of linkages may vary from institution to institution and their way of functioning. In this context it is pertinent to describe a few illustrative examples. We propose to describe three institutions:

- Ministry of Industry, Govt. of India *(primarily G2G)*
- Development Council for machine tool industry *(primarily G2F)* and
- IMTMA *(primarily F2F)*.

- *G2G linkages: Ministry of Industry (MoI), Government of India*

The Ministry of Industry is the nodal agency for industrial development in the country. As on date it is functioning in the name & style of Department of Industrial Policy & Promotion (DIPP) under Ministry of Commerce & Industry (MoC&I). Since the liberalisation, there has been a consistent shift in the role and functions of the DIPP. From regulation and administration of the industrial sector, it is being transformed to facilitation of investment and technology as well as monitoring industrial development. While the individual administrative ministries look after the production, distribution, development and planning aspects of specific industries allocated to them, the DIPP is responsible for the overall Industrial Policy (DIPP, 2002). The efforts of the DIPP to establish *G2G linkages* and *G2F linkages* could be illustrated through its various functions. In respect of policy formulation the linkages could be presented as flow chart in Figure 10.3.

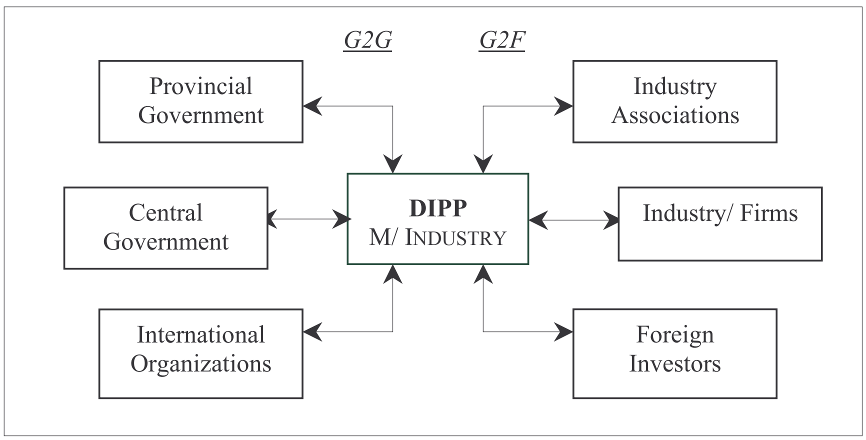
Figure 10.3: Policy formulation flow diagram



The idea or suggestion for policy formulation could generate from within the ministry or come from other stakeholders (e.g. suggestions regarding certain changes in FDI policy come from foreign investors or foreign embassies). For minor issues that do not concern other ministries, the DIPP is empowered to take decisions independently. However, for issues that involve others as well, the coordination between the various ministries is mainly undertaken through consultative discussions in inter-ministerial and inter-departmental committees. It is overseen by the Committee of Secretaries (CoS) and thereafter the Cabinet Committee on Economic Affairs (CCEA) takes the final decision that is placed in the Parliament for ratification if required. Finally, the DIPP issues the notification.

As regards to G2F linkages, for example the DIPP acts as a gateway to industrial investments in India. The Secretariat for Industrial Assistance (SIA) under DIPP provides a Single Window for entrepreneurial assistance, investor facilitation, and processing all applications that require Government approval. A new body has been set up as Foreign Investment Implementation Authority (FIIA) that facilitates quick translation of FDI approvals into implementation by providing proactive aftercare service to foreign investors to obtain necessary approvals, and sort out operational problems with various provincial Government agencies. Similarly DIPP also coordinates with apex industry/ trade Associations such as CII, FICCI, ASSOCHAM etc. apart from IMTMA for policy formulation & implementation matters as well as participate in their activities related to investment promotion, quality, and productivity development etc. It also acts as the nodal agency for coordinating and implementing programmes with international organizations like UNIDO, WIPO and APO etc. The figure 10.4 presents the overview of linkages of DIPP.

Figure 10.4: Linkages of the DIPP, MoI.

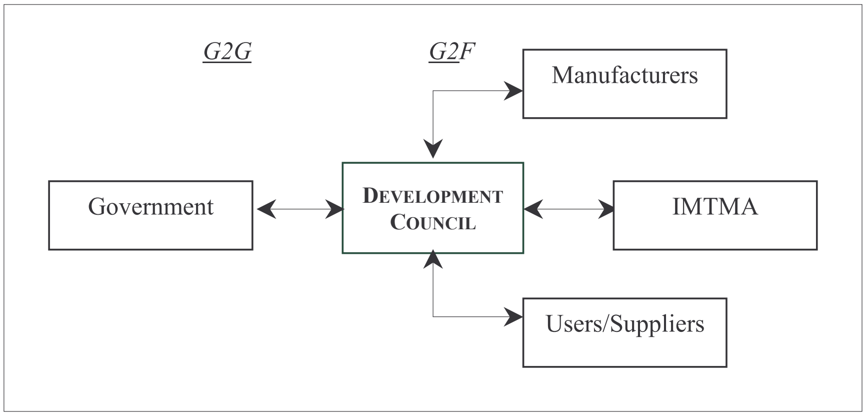


- *G2F linkages: Development Council for Machine Tool Industry*

After independence policy makers had recognized the need of organised machinery for enabling interactions with various stakeholders. Hence Development Councils were established for all the scheduled industry under the aegis of the respective administrative ministry under the ID&R Act, 1951. It acts as a true link between the industry and the government as its members are manufacturers, traders, users, suppliers, and related R&D institutions. Usually the chairperson of the DC is chosen from the respective industry to generate commitment of the industry. The administrative ministry provides the secretarial support. The member secretary of the DC is from the respective division of the administrative ministry. There is a specific Development council for Machine Tool industry under the Ministry of Heavy Industry (MoHI), Government of India. In the pre-liberalization period the Development Council used to be an important forum for exchange of views but its discussions and recommendations were mainly focused on providing protection to the industry. In the post-liberalization period, however, the focus has changed to increase the international competitiveness of the industry.[127] The figure 10.5 presents the overview of linkages of the Development council.

[127] During the last few years since 1997 onwards it was dormant. It is being revived again with more thrust on export promotion.

Figure 10.5: Linkages of Development Council



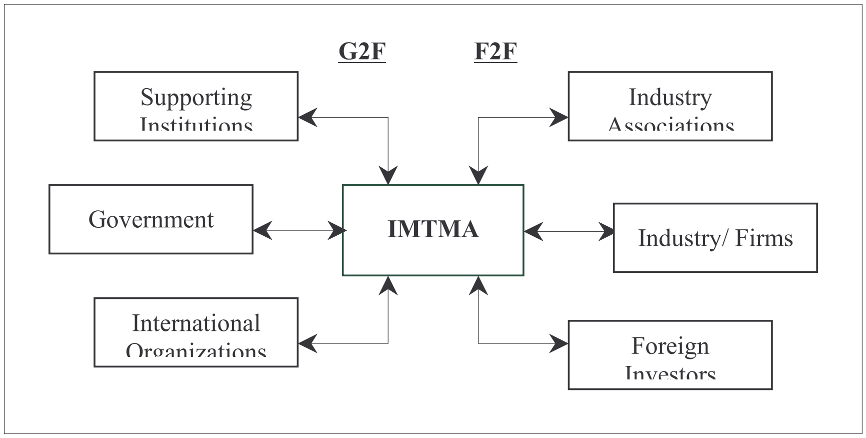
- *F2F linkages: Indian Machine Tool Manufacturer's Association*

In the previous two examples how G2G and G2F linkages are established. This case illustrates about the F2F and G2F linkages. The IMTMA acts as the main link between the industry, government, buyers, suppliers, international buyers & industry associations, international developmental agencies and its members. It is an exclusive association acting as a catalyst for growth and development of machine tool industry in the country since independence. It has a membership of over 400 firms that constitutes over 90 per cent of the industry in terms of annual turnover. The membership comprises manufacturers/ traders of non-CNC/ CNC machine tools, accessories for machine tools, cutting tools and metrology equipment etc. The linkages with various actors are reflected through its actions in respect of the following and depicted in Figure 10.6 overleaf:

- Interactions with the government and other stakeholders on behalf of the industry,
- Facilitating interaction of the firms with all major user associations and users, viz. automobile, general engineering, defense and railways, etc.
- Fostering international linkages through meetings with importers/ dealers of the main/ potential machine tool consuming countries,
- Organising participation of members at major overseas machine tool fairs,
- Promoting the capabilities of the industry through organizing exhibitions like IMTEX, ToolTech, NMTS and various seminars and workshops periodically on issues pertaining to technology, efficiency, productivity, competitiveness and reliability levels,
- Fostering partnership among manufacturers for marketing initiatives in India and abroad, common input sourcing, and capacity sharing etc. to derive cost effectiveness,
- Running the IMTMA Design Institute in collaboration with ICAMT-UNIDO for strengthening design skills of the industry,
- Interacting with various support institutions for overall development of the industry,
- Effective information dissemination through IMTMA website www.imtma.org
- Publishing newsletter and publications viz. Guide to Indian Machine Tools, Quality Manual for SSI, and Issues for First Time CNC Machine Tool Users etc.

- Promoting the concept of '*Buy CNC*', '*Buy Indian*' etc.

Figure 10.6: Linkages of the IMTMA



10.3 Policy–Performance Causation

10.3.1 Constituents of Policy – Performance Causation framework

The elements of the three main constituents of the framework for analyzing policy-performance causation in respect of policy on industrial governance (see Figure 10.1) as concluded on the basis of field work is presented in Table 10.2.

Table 10.2: Constituents of the Causation Framework: Industrial Governance

Policy	Mechanism	Indicator	Performance
Industrial Governance Policy ***(Stimulating linkages)***	-Liaison with the Government depts./ institutions -Creating linkage with support institutions -Creating linkages within supply chain -Forming consortium	Quantum of: - Liasioning with GI - Linkages with GSI - Linkages with suppliers - Linkages with other firms	- Sales - Export Ratio

10.3.2 The Causation

In the forthcoming discussion we would analyze how the firms used various mechanisms in response to the policy on governance to build their linkage capability, and how the adoption of these mechanisms finally translated into performance of the firms. The main mechanisms adopted by the firms are: *liaison with the Government departments* (M1); *creating linkages with support institutions* (M2); *establishing linkages within supply chain* (M3) and *adopting consortium approach* (M4). The adoption of these mechanisms is reflected in indicators like: *Quantum of participation in*: *Liasioning with the Government departments* (I_1); *Linkages* *with GSI* (I_2); *Subcontracting* (I_3); *Consortium* (I_4); *number of products introduced in the market* (I_5) and *asset-turnover ratio* (I_6). The F-GSI linkage (I_2) is further disaggregated in terms of *linkages with technology institutions* (I_2a), *linkages with financial institutions* (I_2b) and *linkages with marketing institutions* (I_2c). Here one point merits attention. It has not been possible to collect data on actual level of linkages that could be compared across the board due to abstract and complex nature of linkages. Thus, at the risk of over simplification and for ease of understanding we have taken recourse to qualitative comparison of the facts (Table 10.3).

Table 10.3: Mechanism, Indicator and Performance measures

	M1	M2	M3	M4	I_1	I_2			I_3	I_4	I_5	I_6	P_1	P_2
						I_2a	I_2b	I_2c						
F_A	x	x	x	x	3	4	3	4	4	4	9	1.7	686.3	2.0
F_B	x	x	x		3	2	3	3	4	2	4	3.8	25.7	Nil
F_C	x	x	x	x	3	4	4	3	4	5	8	2.7	75.9	10.7
F_D	x	x	x	x	3	4	4	4	4	5	4	3.5	84.9	4.0
F_E	x	x	x		4	2	3	3	3	2	1	4.1	4.4	Nil
F_F	x	x	x		4	2	3	2	3	2	0	0.9	0.4	Nil
F_G	x	x	x	x	3	3	4	3	4	5	7	2.3	36.5	1.4
F_H	x	x	x	x	4	3	3	3	3	4	2	1.0	5.1	2.8
F_I	x	x	x	x	3	3	4	4	4	4	6	0.6	95.1	3.1
F_J	x	x	x	x	3	3	4	3	5	5	4	7.1	52.6	0.2
F_K	x	x	x	x	3	4	4	3	4	4	7	1.8	98.7	Nil
F_L	x	x	x		4	4	4	3	4	3	12	1.6	292.3	10.1
F_M	x	x	x	x	3	3	3	3	4	4	4	2.3	87.4	0.4
F_N	x	x	x		4	3	4	3	3	2	4	2.2	21.0	12.0
F_0	x	x	x		3	3	3	3	4	3	4	1.8	29.9	Nil
F_P	x	x	x		3	4	3	3	4	2	3	1.4	14.8	Nil
F_Q	x	x	x		3	3	3	3	4	2	5	1.3	89.1	1.0
			Mean			3.18	3.47	3.06				2.3	100.0	
SIGNIFICANT CORRELATIONS (with respect to P_1)								0.52			0.67			

Mechanisms: *M1: Liaison with the Government departments; M2: Creating linkages with supporting institution; M3: linkages with suppliers; M4: Forming consortium.*
Indicators (in Scale 1 to 5): Quantum of participation in: Liasioning with GI: I_1; Linkages with GSI: I_2; Subcontracting: I_3; Consortium: I_4; and I_5: Nos. of products introduced; I_6: Asset-Turnover ratio.
Disaggregated indicators for I_2 (in Scale 1 to 5): I_2a: Linkages with Technology institutions; I_2b: Linkages with Financial institutions; and I_2c Linkages with Marketing institutions.
Scale: 1: Nil; 2: Low; 3: Average; 4: High; and 5: Very High.
Performance Measure: P-1: Relative annual sales and P_2: Export intensity (%)

Table 10.3 presents the data on the level of adoption of the mechanisms by the firms in the ascending scale of 1 to 5, with 1 signifying nil and 5 as very high. However, these figures have to be interpreted with caution as no one wants to admit that they are inferior compared to others. The performance measures are the same as described earlier i.e. relative annual sales (P_1) and export intensity (P_2).

- *Liaison with the Government departments (M1): G2F linkages*

Interaction with the Government departments and related institutions is an essential part of activity for the firms universally. It continues throughout the life cycle of a firm i.e. from the entry, project implementation, operation to winding up. However, the degree and mode of interaction may vary depending on the development of a country, bureaucratic system, diffusion of ICT in government set up i.e. the level of e-governance and attitude of people concerned etc. When these aspects are coherent to industrial development then a firm has to incur less transaction cost and time on such interactions, otherwise it affects firm's competitiveness. It suggests that interactions up to certain threshold level are essential. But anything above that level become unwarranted and therefore entails additional transaction cost and time. We refer such unwarranted interactions as liasioning. It has a negative connotation. *We define liasioning with the government departments as unwarranted interactions with government agencies that entail additional transaction cost in terms of money, time and lost opportunities to obtain some permission/ approval or submission of mandatory information.*

Our data suggests that this mechanism has been quite in vogue (see Table 10.3). All the firms invariably adopt this mechanism. The firms opined that the reasons/ compulsions for liaison with the government departments/ related institutions are different for different stages of the life cycle of the project. At the entry stage it is basically for the permission for setting up of new unit or expansion/ diversification. For medium & large-scale firms, this has been streamlined to great extent due to liberalization in industrial licensing and FC/FDI policy & procedures. Now firms are able to get the permissions without much of hassles and liaisoning in a stipulated time period. The simplified policies and procedures as well as use of computers have reduced the element of discretion and response time to a great extent. Commenting on such improvements, the firm F_O mentioned, "*they received the acknowledgement letter for Information memorandum (IEM)*[128] *for their new venture within seven days as stipulated. It was rather across the table, the same day. Thanks to the liberalization and computerization of the process. In the pre-liberalization period it might have taken several months.*" The firms F_C and F_G also reported that they received FC approvals within the stipulated period of 60 days without much of hassles. However, the small-scale firms did not seem to be convinced with these developments, as they have to deal mainly with provincial level authorities. F_E opined that there have not been major changes in policy/ procedure at provincial level. Even at the Central level it found itself in disadvantageous position vis-à-vis medium and large firms due to lack of financial and human resources to deal with information deficiency. The other two small-scale firms also voiced similar views as well.

The problems start with the implementation stage, which primarily attracts provincial level permissions/ clearances. Our interviews with the firms suggest that they have to face considerable hurdles due to numerous clearances/ certificates required from various authorities such as allotment of land, acquiring of land, construction of building, connection of water, disposal electricity, environment, registration as factory, trade certificate, sales tax registration etc. A study conducted by Prime Minister's Council on Trade & Industry also mentions that for setting up a typical medium or large manufacturing firm over 30 approvals from different authorities are required, involving significant time, paper work and transaction cost. In a few cases, documents and copies running into over 1,000 pages are to be submitted (PMCTI, 2000). In order to stream line the system the Central government and various State governments have initiated the so-called 'Single Window' system and 'Escort services' under respective Ministry of Industry. But unfortunately they are unable to break the ice. Such

[128] For delicensed industry only IEM needs to be filed and the acknowledgement issued acts like the permission for setting up of new industry. Machine Tool is a delicensed industry.

authorities have no legal backing, as they are not empowered to issue all clearances at a single point or direct respective authorities to take prompt decision. They act more as a post office or recommending body and therefore in practice they are ineffective.

The worst part of the system is requirement of multiple clearances for the same thing from various authorities in some cases. Narrating one such experience the chief executive of a firm stated, "*we had very sad experience about power connection. In spite of being in an industrial area, we have not received power connection as yet since we are not ready to pay bribe, which is commonly called as 'speed money'. When we wanted to install own power generating set we had to run from pillar to the post for obtaining permission for fuel storage. For one simple thing we had to get clearances from five different authorities e.g. local industrial area authority, State electricity board, controller of explosives, police and district collector. It delayed our project by at least six months. Although the power from generating set costs almost twice increasing our recurring cost, we have the consolation that we get uninterrupted power supply without incurring any expenditure on speed money to the State Electricity Board. One has to pay them for getting regular power supply."*

When it comes to operations stage, the firms have to face different set of difficulties, in terms of filling up of numerous forms under various acts/ rules and attending to various inspectors from different authorities. Commenting on such requirement one corporate executive of the firm F_D mentioned, *"We have to spend considerable amount of time on filling up various forms/ returns and satisfy the queries of inspectors from different department unnecessarily. There are plenty of duplication of information and requirement of unnecessary information, which none of the government department use. Quite a few acts/rules have lost relevance in the present context that needs to be repealed or amended accordingly. At least 25-30% of time of our personnel and accounts department is devoted on this. Moreover, as we do not give bribes, we have to suffer more."* The PMCTI study also observes on the similar line. It mentions that on an average a firm has to file about 40 reports annually and attend more than 25 inspectors (PMCTI, 2000). The firms were equivocal about the need for addressing the issues of 'inspector raj', streamlining of procedures, amending the outdated acts, inter-departmental coordination, accountability, infusing transparency, minimizing response time and implanting the system of self-regulation etc. by the Government as early as possible.

As regards to the winding up stage, it may be mentioned that winding up of a business entity comes in the form of either permanent closure or merger & acquisition (M&A) with another firm or restructuring of business. The latter occurs more frequently in the present dynamic business scenario. As regards to the closure, the CEO of the firm F_E quipped, "*there is lots of resilience in the Indian firms. They never shut down. More than 40 % firms of this industrial area are running in loss since so many years, but they are still pulling on."* We also did not come across any case of closure or M&A in our sample firms; therefore we choose to refrain discussing these two forms of winding up. But the case of restructuring particularly in terms of human resources was mentioned quite often. The firms equivocally mentioned that the existing labor laws are very conservative in respect of closure/ restructuring of an industrial entity. In this respect the remarks of the CEO of the firm F_O is worth mentioning, *"Manpower restructuring is rather one of the basic requirements in our business as Machine Tool industry is the first go in the red during the economic downturn and the last to come out after recovery.*

In order to survive, timely restructuring is a must, which is difficult in the present context due to strict regulations on hiring & firing. Overall it is easier to establish a business but very difficult to close down as one can easily hire a worker but cannot fire. Thus we desist from hiring new personnel at the time they are required most just due to the fear of not being able to get rid off them when they are not required and it certainly affects our performance. At present we have to do lots of liaison work with the State labor department to deal with such situations."

The above discussion suggests that adoption of this mechanism is considered to be a necessary evil. The firms have to incur a good deal of transaction cost and time in liaison job which otherwise could have been avoided. Although the business environment has changed considerably after the liberalization during the last decade, there has been limited change in legislations, rules, and procedures particularly those implemented at provincial level. Table 10.4 summarizes the level of bottlenecks encountered by the firms at the various stage of life cycle of the firms in qualitative terms after aggregating the responses. It may be observed that functioning at provincial level still requires considerable improvements. It seems to be more pinching for SSEs as they have to interact mainly at this level.

Table 10.4: Level of Bottlenecks at various stages of the Life cycle

Life Cycle Stage	Large & Medium firms		Small firms	
	Central level	State level	Central level	State level
Entry	Low	NA	Medium	High
Implementation	Low	High	Low	High
Operations	Medium	High	Medium	High
Exit	NA	High	NA	High

Note: NA- Not applicable.

The experiences of most of the firms suggest that lot more is required to facilitate speedy implementation and proper functioning of projects. Besides the changes in rules/procedures, another important change is required in the mind-set of the people. The chief executive the firm F_J summarized the situation as, "*Industrial governance has two aspects: the hardware i.e. legislations, rules, procedures & system in-force and the software i.e. mind-set of the people. No doubt, there has been some improvement in rules/ procedures particularly at the Central level but considerable changes are required at the State level. Moreover the overall mind-set of bureaucracy still believes in regulation & control rather than promotion & development. Unless and until we do not achieve transformation in the mind-set any amount of change in policy & procedure won't be successful. A sincere thrust on e-governance that infuses accountability, responsiveness and transparency might be helpful. There has been some beginning in this direction but a lot more is required. I think e-governance and change of mind set is complementary to each other. I agree that interactions with the government are essential but unwarranted interactions at each stage in order to run the business definitely twinge. This is a forced evil. Given the freedom, we won't like to spend time and effort on this type of interactions. It increases our cost and reduces profitability. Although no value could be* *indicated in quantitative terms it can be definitely told that it increases cost and therefore affects our competitiveness."*

It is seen that the scope/ degree of adoption of the mechanism varied from firm to firm, which is reflected from the data on thrust given on liasioning. There seems to be existence of some pattern. The PSEs (F_A, F_Q) gave less thrust on this mechanism. They can get the work done by virtue of being part of the Government. Some of the SMEs who stick to the principle to not indulge in such type of practices (F_C, F_D, F_J, F_O etc.) also ranked less to this mechanism. But they seem to have enough managerial and financial resources to deal with such situations. The small firms seem to be more vulnerable. In order to run their business smoothly, they give more thrust on this mechanism. There are certain medium sized firms who are also not much averse in adopting this. They make a trade off or cost-benefit analysis of each situation and act accordingly. Although we see clear relationship between the mechanism and indicator, but we do not get any conclusive evidence for its impact on performance of the firms. The plausible reasons are two fold. On the one hand the adoption of this mechanism increases the cost by way of direct expenditure on liasioning. On the other hand non-adoption of it enhances the cost due to delays as well as lost opportunities. So it is detrimental in both the situations. Moreover such types of expenses are not reflected in financial reports. Therefore testimonials by the firms are to be considered as evidences.

- *Creating linkages with supporting institutions (M2): G2F linkages*

In the liberalized scenario, creating linkages with various supporting institutions viz. R&D, finance, human resources and marketing has become essential for attaining international competitiveness. Table 10.5 portrays an overview of status of linkages of the firms with various supporting institutions in qualitative terms i.e. whether the firms had interaction with those institutions or not during the last three years. The symbol 'x' indicates affirmation regarding interaction with the institution and blank indicates the absence. The symbol '#' shows non-applicability of the case for the firm concerned. The linkages with CMTI have been disaggregated in terms of joint product development (T1a) and other services like testing & calibration, training, prototype development or precision machining etc. (T1b) to present a better picture.

Our data suggests that there has been sub-optimal linkage between the main R&D institutions for machine tools i.e. CMTI and the firms (T1a). Although the CMTI has been instrumental in technological development of this industry since its inception, we found diverse reactions about its present functioning. Only few large and medium firms particularly around Banglore such as F_A, F_D, and F_K etc. have taken advantage of this technological asset of the country for product & process development activities. It is also underlined by the fact that CMTI earns less than 10% of its revenue from machine tool firms these days. However, the firms do make use of its other services (T1b) occasionally. The firm F_A confirmed that it has been working in close cooperation of CMTI since long and there have been many cases of joint product development. The first machining center in the country was developed with the help of CMTI as back as in 1970s. Recently they jointly developed a state-of-the-art high speed Machining Center for aluminum auto components under the PATSER program of the Department of

Science & Technology, GoI.[129] Similarly the firm F_D also recently undertook joint development of PC based CNC Machining system. Although all the firms recognized the benefit of the CMTI particularly in terms of provision of technology infrastructure, they were skeptical about its lack of market orientation, high level of bureaucracy and high prices.

Table 10.5: An overview of Linkages with Supporting Institutions (M02)

	Technology Institutions					Financial Institutions						Marketing Institutions			
	T1a	T1b	T2	T3	T4	F1	F2	F3	F4	F5	F6	Mk1	Mk2	Mk3	Mk4
F_A	x	x	x		x		#	x	x	x		x	x	x	x
F_B		x	-	-		#	#	x	x					x	
F_C	x	x	x			#	#	x	x	x			x	x	
F_D	x	x	-	x	x	#	#	x	x	x			x	x	
F_E		x				#		x	x				x	x	
F_F		x				#		x	x						
F_G		x				#	#	x	x	x			x	x	
F_H		x				#		x	x	x			x	x	
F_I		x				#	#	x	x	x				x	x
F_J		x				#	#	x	x	x	x		x	x	
F_K	x	x	-	-		#	#	x	x	x			-	x	
F_L	x	x	-	-			#	x	x	x				x	
F_M		x	-	-		#	#	x	x	x			-	x	
F_N		x	-	-		#	#	x	x	x			-	x	
F_0		x				#	#	x	x	x				x	
F_P	x	x				#	#	x	x			x	x	x	
F_Q		x	x				#	x	x	x			x	x	

Abbreviation- x: Yes; Blank: No; #: Not Applicable; -: Data not available.
Technology Institutions T1a: CMTI for joint product development; T1b: CMTI for other services;
T2: CSIR; T3: TDB; T4: TIFAC.
Financial Institutions: F1: IDBI; F2: SIDBI; F3: SFC; F4: Commercial Banks;
F5: EXIM Bank; F6: VCFs.
Marketing Institutions: Mk1: DGS&D; Mk2: NSIC; Mk3: ITPO; Mk4: FIEO.

There appears to be minimal interaction with other technology development institutions such as CSIR labs (T2) and universities. They have been more useful in terms of supply of scientific manpower only. We found similar lack of linkages in respect of TDB (T3) and TIFAC (T4) as well. Some of the SMEs were not even aware of the existence of these institutions. Only the firms F_A and F_D reported the use of patent facilitating center of TIFAC. Commenting on the status of linkages and the national system of innovation the chief executive of one of the medium firms F_J remarked, *"we have all the institutions in place in our national system of innovation but what is missing in this innovation web is the proper linkage and the system for creating proper linkages. Everyone works in isolation. We are also equally responsible. It is due to lack of incentives as well as lack of initiative. On the other hand there is lack of drive among the institutions to reach to the users for their services. Nevertheless, things are changing now albeit in a slower pace."* The overall linkages of the firms with technology institutions seem to be low. Nevertheless the firms that have better linkages (e.g. F_A, F_C, F_D or F_L etc.) do show better performance as evident from number of products introduced

[129] PATSER: Program Aimed at Technological Self Reliance (PATSER) funds joint projects with industry.

in the market (I_5) as well as annual sales (P_1). The positive correlation of 0.67 significant at 1% level between the I_5 and indicator P_1 also substantiates the claim.

As regards to the *financial institutions* we found no evidence of interaction with the core financial institutions like IDBI (F1) and SIDBI (F2). However, there are valid reasons for the same. IDBI undertakes primarily refinancing through other intermediaries. It funds directly only for the mega projects i.e. projects with investment more than Rs 1000 million and none of these firms come in this category. SIDBI extends finance to small-scale industries only and the three firms in our sample did not avail financing or any other support service of SIDBI so far. The reasons being SIDBI came into existence only in 1990 and all these firms were established prior to that. For other services, the firms opined that the prevailing bureaucracy of SIDBI deter them to take adequate advantage of the institution.

It is seen that the firms have primarily relied on the SFCs (F3) for term loans as well as equity participation, if any; commercial banks (F4) for working capital loans and EXIM Bank (F5) for export finance. Therefore the interactions with these institutions are much more compared to the others. However, the firms were equivocal on the high level of bureaucracy, complicated procedures, and time taken in the finalization of the cases. Commenting on such aberrations a corporate manager of one medium sized firms told, "*The financial institutions operate in an atmosphere of disbelief and mistrust. The low level of computerization adds up the problem further. Just by replacing calculator with computer does not mean computerization. There is complete lack of system that integrates the documentation requirement of advances with the transaction recording of loans. There is hardly any computerization in respect of remittance instruments or discounting of Bills that make inter-bank transactions time consuming. All these lead to rent seeking attitude of employees of these institutions."* A few firms like F_D, F_J and F_O reported that they have in principle decided to not to give any bribe (commonly known as 'speed money') to any body in any circumstances and therefore they have to suffer sometimes a lot. Another common bottleneck reported was the higher rates of interest (14-18%) compared to international standards (2-5%) that severely affect their competitiveness. As regards to the Venture Capital (F6), we found only one firm F_J that has been floated based on equity participation by a public sector VCF.[130] To the best of our knowledge no other firm in this industry has availed this source of financing so far. The basic principal underlying Venture Capital is to invest in high-risk projects with the anticipation of high returns and in this industry under the present circumstances possibility of high returns is quite less, which eventually deters participation from VCFs.

The linkages in respect of *marketing activities* also do not seem to be optimal. Out of the four institutions, there is hardly any evidence of interactions of the firms with two institutions Mk1 and Mk4 (see Table 10.5). Since CNC Machine Tools are not common use items, the procurement channel of DGS&D (Mk1) does not have much of relevance. Only one firm F_A has interaction with this organization for supplying training CNC lathes to polytechnics and vocational training centers. The services of NSIC (Mk2) are limited to small-scale sector only for supplying machinery on hire purchase and lease finance basis. It does not cater to medium and large-scale firms. One small firm indicated that it had purchased CNC machine tool on

[130] As on date the VCF has offloaded the equity shares in favour of other shareholders of the firm.

hire-purchase basis through NSIC. Since the diffusion of CNC machine tools in small-scale sector is still limited, the interaction is less as yet. Nevertheless, quite a few firms reported to have supplied to SSEs through NSIC. It is gathering momentum albeit slowly. The small firms F_E and F_H had reservations regarding its bureaucratic attitude and high rate of interest. However, they appreciated NSIC efforts for providing common facility supports, technology centers and training programs etc. The ITPO (Mk3) is the only institution with which the firms have some interactions, as it organizes industrial fairs like IMTEX and Tool Tech fairs in India periodically in collaboration with the IMTMA. These fairs are the sole marketing platform for Machine tools. But for the other activities of ITPO, the reports were disappointing. We found very few evidence of linkages with FIEO (Mk4) as the total export activity of this industry is less. Moreover FIEO targets regular/ recognized exporting firms and number of such firms are very few. There seems to be lack of awareness among the firms regarding functioning of the FIEO. Only two firms F_A and F_I reported interactions with this institution.

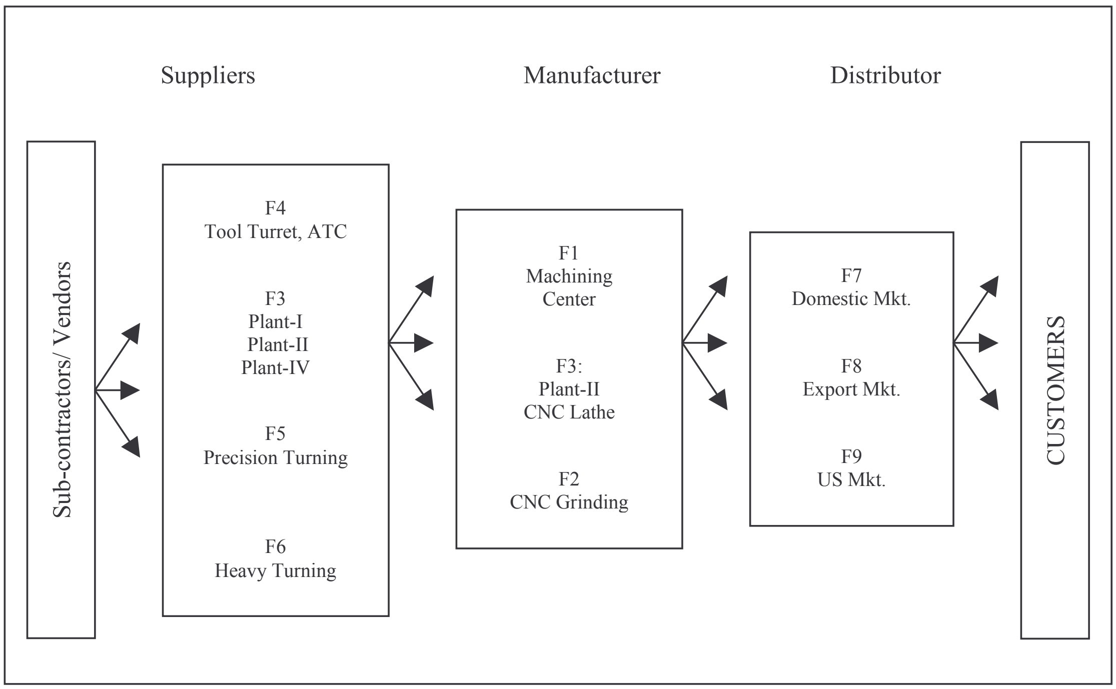
The overall linkages with the various supporting institutions do not seem to be encouraging. The data on level of adoption of this mechanism by the firms suggests only average level of interaction. The mean value for the three indicators level of adoption for technology-, finance- and marketing institutions i.e. I_2a, I_2b and I_2c respectively works out to be 3.18, 3.47 and 3.11 only. The firms seem to have more interactions with financial institutions compared to technology and marketing institutions. From the available data we can also infer another two distinct patterns. The level of interactions of SSEs is below average (I_2a, I_2b and I_2c being 2.9, 3 and 2.8 respectively), which in turn reflects in low performance level (P_1 and P_2). Some of the pro-active firms maintain better level of linkage (I_2a, I_2b and I_2c being 3.5, 4.0 and 3.25 respectively) that in turn reflects in their better overall performance as well.

- *Establishing linkages within supply chain (M3): F2F linkages*

In literature 'Network' has been referred as a stable set of relationships among independent firms- a way of organising economic behaviour that lies between market exchanges at one extreme and inter-firm transactions on the other (Finegold et al, 1994, Humphrey & Schimdtz, 1996). 'Network' has a broader connotation than subcontracting or consortium. For the purpose of our discussion we includes firms throughout the supply chain i.e. supplier, manufacturer, distributor and buyers as well as the Government and supporting institutions. Since we have already discussed firm - Government/ supporting institution linkages (G2F linkages) in the earlier section and manufacturer-user linkage in chapter IX, the following discussion will emphasize more on supplier-manufacturer linkage.

The issue of supplier-manufacturer linkages has been well recognized by the firms since long. In the pre-liberalization era it was given thrust due to policy constraints (local content requirement and barriers on imports etc.) as well as lack of proper suppliers. While in the post-liberalization period the resurgence of interest in it is driven by competition in a quest for survival and to achieve international competitiveness. The old firms like F_A, F_K or F_L had given thrust on development of supporting industries i.e. suppliers and sub-contractors (ancillary development program) from the beginning. Mascarehas (1982:38) notes, "*In 1957, it [the firm F_A] became the first public enterprise in India to encourage ancillary units. Under this scheme, [the firm] provided the entrepreneurs with assembly documents, list of equipment, jigs, fixtures . . .and training. It also provided the drawings and designs. In some cases, it has* *even negotiated with collaborators on behalf of its ancillaries."* Subsequently the firm developed ancillary units around all the five plants in the country. In majority of cases the firm encouraged its own employee to set up the ancillaries and became breeding pond of techno-entrepreneurs in the country. In the post-liberalization period the firm like F_J has been set up on the business model of networking (Figure 10.7). In fact the firm is an ideal example of how the mechanism of networking could be used to share common core competencies and leverages synergies.

Figure 10.7: Formation of Network: An illustration (F2F linkages)



The firm is a member of group of nine firms that work closely with one another. We name this firm as F1. It is now the largest manufacturer of vertical machining center (about 100 numbers per year) in the country. It undertakes design & development, some precision machining, final assembly, painting, testing and trial only in-house. Rest of the operations are either sub-contracted or taken from the other firms of the group. The firm has about 30 vendors out of which six are fully committed (supply 100% of their production) and 15 supply 25-50% of their production to the firm. Another firm F2 in the group manufactures CNC grinding machine. The firm F3 is the core of the group. It is the largest manufacturer of CNC lathes (about 300 numbers per year) in the country now. It has four plants. The Plant-I manufactures main components/ subassemblies and houses all necessary production machines like CNC Lathes, Machining Centers, and Precision Grinders etc. It feeds components to other firms in the group as well. The Plant-II is the hub of the company and houses the R&D, assembly, testing, tooling and trial activities. The Plant-III is the sheet metal plant that provides quality sheet metal components and the Plant-IV builds green CFC free cabinet coolers for the electronics of the machine to feed the whole group.

The firm F4 manufactures accessories and sub-systems for machine tool namely Tool Turrets for CNC lathes, Auto Tool Changers for machining centers, Power chucking cylinders, and Copy turning attachments etc. It is the largest manufacturer exporter of tool turrets in the country. F5 is a large volume precision CNC Turning job shop. Similarly F6 is the precision CNC job shop for heavy & large parts like bed column, saddle, etc. All these firms cater to the needs of their own group of companies as well as outside the group to attain economy of scale. Moreover for less precision jobs and other small components these firms are linked with series of second-tier suppliers. These second-tier suppliers are offered design & development supports, in-plant inspections; use of manufacturing facilities as required, and training on a regular basis. In the down stream of manufacturing, there are three firms (F7, F8 and F9) that undertake marketing and after-sales services for the group's products. One firm serves the domestic market and other two firms serves export market.

Commenting on the performance of the group, the chief executive of the firm F_J mentioned, "*We have been successful so far as our business model is based on networking. We do not function in isolation, as we understand that our destiny is tied up with success of group and not as an individual firm. However, it still needs much more strengthening to face the onslaught of competition and become successful in the international market. The present networking is more material flow based; it has to be made information flow based and that requires proper diffusion of ICT both within the firm and across the firms. We are encouraging our vendors to use more CNC machines in shop floor and computers in other business activities so that proper integration could be achieved. We are also taking appropriate steps accordingly at our end as well. So far it has been our own initiative but there is a need for the Government support to institutionalize the mechanism of networking for development of our industry on sustained basis.* " Three of our sample firms (F_D, F_G and F_J) are the members of this network. It is no coincidence that these firms are showing better performance on a sustained basis. During the last few years 1997-2001 when there has been overall decline in machine tool industry, these firms have grown both in domestic market as well as export market. There better performance is also reflected through the present data (see Table 10.3) on intermediate performance measures like importance given to networking (I_3), number of products introduced in the market (I_5) and higher asset-turnover ratio (I_6) as well as performance measures like annual sales (P_1) and export intensity (P_2).

- *Forming Consortium (M4): F2F linkages*

'*Consortium*' could be understood as a subset of 'Network'. For the purpose of our discussion, *we define Consortium as a group of independent CNC machine tool manufacturing firms*[131] *forming alliances to foster collective efficiency through coordinated collective initiatives.* The formation of consortium is one of the main forms of firm-to-firm (F2F) linkages. The consortium approach could be adopted for variety of activities such as marketing and after sales service activities in domestic market or abroad, procurement of critical inputs particularly from abroad, joint R&D, cooperation in production i.e. capacity sharing, and floating 'Lease financing" or 'Hire-purchase' agency etc. In India it has been adopted primarily for marketing activities and marginally for other activities. Consortium for marketing activities have already

[131] Firms within the same management or under the umbrella of a holding company are not included.

discussed in the previous chapter (Chapter IX) while discussing market development capability of the firms. Thus we will not repeat them here again. We will discuss other activities only.

Off late the firms in the industry have recognized the importance of formation of consortiums to remain competitive in the present liberalized scenario. In the pre-liberalization era firms could sustain without it due to protected domestic market and limited technology dynamism. Evidences suggest that now the firms are taking interest to form consortiums. It is seen that 10 out of 17 firms in our sample are active in some sort of consortium (see Table 10.3) for a variety of activities. As mentioned earlier four of our sample firms have formed a consortium in the name and style of '*Vishwaroop*'. They are also partnering for another consortium with few other firms as '*Indian Machine Tool Cluster* (IMTC)'. Another two sample firms are members of five firms consortium named '*Sahayog*'. Similarly one small firm belong to yet another consortium of eight SSEs known as '*Bangalore Machine Tools Manufactures Network* (BMTMN)' to leverages the strengths of its member firms to bring value-for-money to its customers. The firms opined that adoption of consortium approach has started giving positive results but it requires lots of understanding and trust among the partners for achieving a common cause and to sustain the endeavor in a meaningful way. It should not be treated just as a '*marriage of convenience'*.

Evidences suggest that adoption of consortium approach has not been in vogue so far in a meaningful way apart from marketing activities. However, we came across instances of joint procurement of CNC controls and inviting experts from abroad for common technical problems by the members of Vishwaroop consortium. Once the firms F_C and F_D (although members of different consortiums) joined hands to procure CNC controls from abroad. The IMTC consortium has initiated a common vendor development program. Instead of each firm having its own set of vendors, efforts are being taken to develop a set of common vendors for all members of the consortium. It will provide economy of scale to the vendors and supply of cost effective quality parts in time to the firms. The BMTMN consortium has also initiated common procurement. Besides, they are also embarking on inter firm procurement whereby members procure subsystems from among the group. However, we did not find any evidence for joint R&D, capacity sharing or lease-financing activities etc. so far. Nevertheless, it is interesting to note that all firms who have given emphasis on this mechanism have performed better (see Table 10.3) both in the domestic as well as in export market.

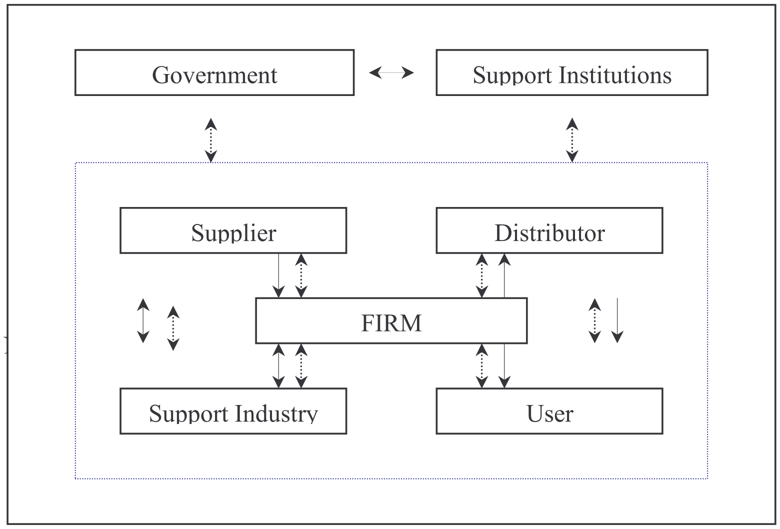
10.4 Synthesis and Conclusions

10.4.1 Synthesis

Our analysis prompts us certain significant issues that may be summated as follows. The *policy on industrial governance* draws attention primarily on three aspects: formulation & implementation of policies, building institutions and improved flow of information among various stakeholders. Eventually these require complex and dynamic *interactions* both within and between the various stakeholders: the Government, firms, supporting institutions and market. Such interactions lead to higher coordination and cooperation among the stakeholders that ultimately culminate in better performance of the firms. For the purpose of our discussion we have termed these interactions as *linkages*. Due to the abstract nature of policy on industrial governance and phenomena of linkages, we have examined the causal interactions in respect of building up of linkage capability in the firms through analysis of institutional framework in respect of industrial governance vis-à-vis linkages among various stakeholders. These are visualised in terms of government-to-government i.e. *G2G linkage,* government-to-firm i.e. *G2F linkage* and firm-to-firm i.e. *F2F linkage* (see Figure 10.2). Our analyses suggest that although there is an elaborate network of policy making & implementation as well as supporting institutions, there is lack of proper linkages. Moreover there are very few supporting institutions in the private sector or in private-public partnerships. In general, the present institutional framework does not stimulate proper linkages among the stakeholders and therefore there is a need for requisite actions from all the stakeholders.

The discussion in respect of causal interactions suggest that in response to the existing institutional framework firms adopted various mechanisms namely *liaison with the Government departments; creating linkages with support institutions; forming networks and forming consortiums* to build their linkage capability that ultimately translated into firms' performance. Firms have to *liaison with the government* departments at each stage of the life cycle in order to run the business. It is considered as *a necessary evil* that increases cost and reduces profitability. There has been some improvement in rules/ procedures particularly at the Central level but considerable changes are required at the State level. The linkages between the firms and various supporting institutions also appear to be sub-optimal. The reasons are wide-ranging: *lack of initiative* as well as awareness *among the firms*; high level of bureaucracy, cumbersome procedures, lack of accountability, rent seeking attitude and *lack of drive among the institutions* to reach to the users for their services etc. As regards to *forming networks*, it is seen that the issue of supplier-manufacturer-user linkages has been well recognized by the firms and the Government since long. In the pre-liberalization era the supplier-manufacturer linkage was driven by policy constraints (local content requirement and barriers on imports etc.) and lack of proper suppliers. But the manufacturer-user linkages used to be mostly at arms length due to protected market. Nevertheless, there was occasional close cooperation for development of cheaper import substitutes. In the post-liberalization period the supplier-manufacturer-user linkages are primarily driven by competition. Now some of the firms are trying to establish linkages throughout the supply chain i.e. supplier, manufacturer, distributor, and buyers. There have been some initiatives to adopt horizontal networking i.e. *consortium approach* as well in respect of marketing, joint procurement, inviting experts from abroad for common technical problems, vendor development and inter-firm procurement etc. But it is mostly limited to marketing activities so far. Our data suggests that the firms taking more pro-active approach in creating such networks seem to perform better. However, the present networking is more based on material flow rather than information flow both within and across the firms. Although the firms have recognized the importance of *networks* to attain international competitiveness, there is a need for proper sensitization of all stakeholders on this concept. It may be recognized that the essence of all these mechanisms in the first instance is adoption of concept of networks although the scope, span and degree of adoption may vary. A broad outline of networks indicating flow of information and material among various stakeholders may be depicted as in Figure 10.8.

Figure 10.8: Information and Material Flow across the Stakeholders

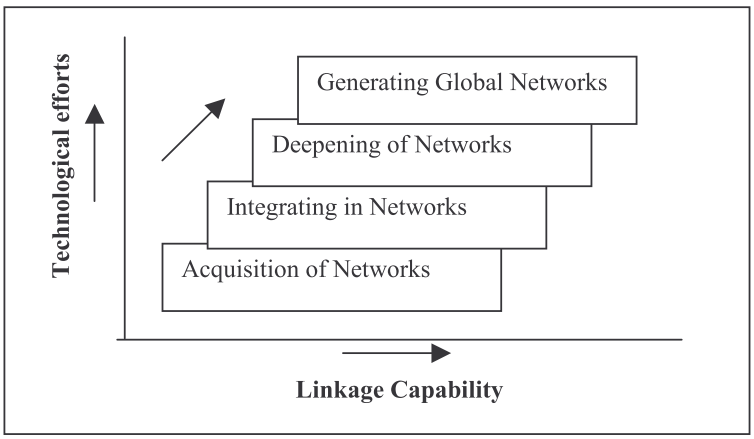


The first step in networking may be visualised as *acquisition of networks i.e. firms entering into* business relationships with other firms in the supply chain and supporting institutions, with recurrent transactions. It may include short-term arm's-length relationships as well. This is the state of affair as seen at present in the industry. We see sufficient evidence of initiation of linkage between firms to suppliers, firm to buyers, firms to supporting institutions etc. The firms that have better linkages (e.g. F_A, F_C, F_D or F_L etc.) do show better performance (see Table 10.3 and 10.5). Some of the firms have gone a step further. They are trying to establish long-term mutually *dependent relationships* with enhanced emphasis on information flow across the supply chain. Three of our sample firms (F_D, F_G and F_J) are the members of this network and it is no coincidence that these firms are showing better performance on a sustained basis. It is a step further of acquisition of networks advancing towards integration with external supply chain & other stakeholders. In the words Christopher (1998) and Stevens (1989) it implies initiation of transformation of '*baseline*' or '*stand alone*' organisations to '*externally integrated*' organisations. It may be termed as '*integration in networks'*.

The process of integration in networks is a complex process. It requires appropriate actions by all the stakeholders both within and across organisation's boundary. In order to achieve proper integration a firm has to adopt all the mechanisms mentioned earlier of with increased vigour. It also requires simultaneous emphasis on cross-functional integration and effective adoption of ICT applications across the functions within the firms. Such efforts open the scope for further deepening of integration process. It leads to *simultaneous integration of internal value chain* with *external supply chain* and other stakeholders *with a notion of shared decision making for achieving enhanced performance*. Although we do not get any evidence of such networking in the industry, the initiatives taken by the firms F_D, F_G and F_J are inching towards this goal. Such integration may be referred as '*deepening of networks'*.

A step further from '*deepening of networks'* could be visualised in terms of extension the horizon of networking beyond the national boundary as adopted by some of the multi national companies (MNCs). It implies integration in global supply chain and establishing linkages with foreign government and supporting institutions. It may be termed as *'generating global networks'*. In the present context, there has been no evidence of such networking as yet. Nevertheless for sustained development, particularly in this era of globalisation & liberalisation when the basis of competition has changed and arena of competition has extended, firms as well as the Government can no longer afford to be complacent. It is therefore imperative that firms take initiatives to adopt these processes and the Government should create enabling environment for the firms to do so. These four activities as described above could be considered as building blocks in the dynamics of building technological capability in respect of linkages. Further, all these activities although seem to be distinct but interrelated with each other and quite of few elements of each activity overlap. Therefore they may be seen in terms of continuum rather than in isolation. The requirement/ intensity of technological efforts increases as firms move up the ladder as well as move across translating into higher technological capability. At the risk of oversimplification the interrelationship between firms' technological effort, technological capability in respect of linkages and various activities may be depicted graphically as in Figure 10.9.

Figure 10.9: Dynamics of building Linkage Capability



10.4.2 Conclusions

- There is extensive institutional framework for policy making & implementation as well as supporting institutions in the country. But there seems to be acute lack of linkages among firms and these institutions.
- The firms primarily adopted the following mechanisms to leverage the existing institutional framework: *liaison with the Government departments*; *creating linkages with support institutions*; *forming networks* and *adopting consortium approach*.
- The firms that adopted these mechanisms in a pro-active manner have performed better both in domestic as well as export market.
- The dynamics of building linkage capability in firms could be visualized in terms of four distinct but interrelated processes namely: *acquisition of networks, integrating in networks, deepening of networks and generation of networks.* The intensity of technological efforts increases as firms move up the ladder as well as move across (i.e. move horizontally within each process) translating into higher technological capability.

SYNTHESIS[132]

This chapter synthesizes the findings of the last five analytical chapters in respect of policy-performance causations. Here our framework of analysis for causation gets transformed from policy-mechanism-performance (PMP) at the firm level to policy-mechanism-process-performance (PMPP) at the industry level. It also identifies the policy gaps and suggests some policy initiatives to strengthen the identified processes. At the end the findings are summarized and conclusions are drawn.

11.1 Introduction

During the operationalization of theoretical constructs we mentioned that for understanding the policy-performance causality, it was imperative to first ascertain the present status of various dimensions of industrial policy, their impacts on performance of the firms and where, when & why did policies succeed or fail? This has been achieved through the analysis of policy performance causation in the previous five analytical chapters. The discussions explored as to how the firms adopted various mechanisms individually or in different combinations to leverage the policies in force that finally culminated in firms' performance. We also found that in certain cases the mechanisms were adopted to compensate the absence of policy or lessen its adverse impact. The divergence in performance could be attributed to variations in scope and implementation of mechanisms by the firms. The variations occurred primarily on two counts. *First*, firms' strategy/ actions, i.e. a few firms acted in a more pro-active way than others. Such firms gave more emphasis on adoption of those mechanisms and consequently showed better performance. The firms took pro-active steps in two ways. On the one hand, they identified what policy provides as well as how best that could be used in their favour to enhance their performance and acted accordingly. On the other hand, they identified the policy gaps and dealt with them either through contributing themselves or taking other appropriate steps. *Second*, size of the firms i.e. small-scale firms appear to give less emphasis on adoption of mechanisms compared to medium and large-scale firms primarily due to lack of resources.

The analyses of policy–performance causation in the last five chapters led to identification of certain activities[133] that are found to be crucial for building various capabilities in the firms that ultimately culminate in performance. These activities could be better understood as '*processes*' as they are particular courses of action intended to achieve results or in other words they are purposeful activities to achieve a defined business outcome. By way of identification of these processes we have discovered another bead in the strand of policy-performance causation. As a matter of fact they may be considered *as the missing links* that *connect mechanisms* with *performance*. They replace the two-way arrows in our framework of analysis depicted in Figure 3.9 earlier.

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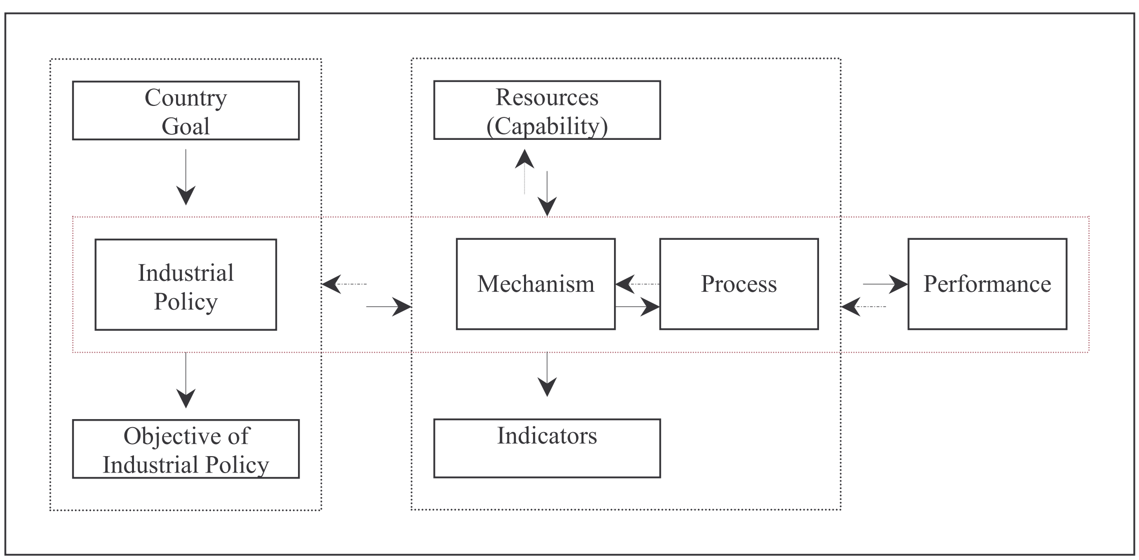
[132] This chapter is based on Kumar, A., 2003, Policy-Performance Causation: A Process Oriented View, paper presented in 7th Annual European Network of Industrial Policy (EUNIP) Conference 2003, Porto, Portugal, http://www.fep.up.pt/conferences/eunip2003/PROGRAM_PAPERS_EUNIP%202003.pdf.

[133] We referred them as key constituents in dynamics of building respective capabilities.

It may be mentioned that although the mechanisms and processes appear to be similar, there are fine distinctions between the two. *First*, a process has a broader connotation than mechanism. A process may encompass one or more mechanisms either in its essence or in totality. For example, the process of acquisition of technology encompasses the mechanisms such as transplanting product concept & design and continuous interaction with the technology suppliers etc. in their essence whereas the mechanism of assimilation of technology from various sources is subsumed in it in totality. *Second*, a process may be the underlying factor that triggers one or more mechanisms to work. The process of integration in networks triggers the mechanisms namely forming networks, creating linkage with support institutions or forming consortiums etc. *Third*, mechanisms may be common for one or more processes, although the scope and degree of adoption may vary. *Fourth*, the processes appear to be cumulative as well as mutually related with each other as evident from the names: *acquisition, integration, development and generation*. It implies that the adoption of higher level of process (say process of integration) requires adoption of certain level of earlier process (say process of acquisition). It will become more apparent as the discussion proceeds. In view of the above, it may be concluded that like mechanisms, the adoption of processes or variations on their use by firms may be influenced by various policies in vogue or firms' resources. Moreover influences on certain processes may be due to certain specific policy measures or a combination thereof. Thus there exists causality between policy, process and performance. The causation may be schematically depicted as in Figure 11.1.

Figure 11.1: Policy-Mechanism-Process-Performance (PMPP) Causation



In our original research design, it was proposed to reconfigure the analysis policy measure wise (i.e. row wise in Table 3.6) to consider the impact of a specific policy measure on other resources of the firms based on the earlier framework. But now we propose to introduce some extension in terms of consideration of '*processes*' in addition to '*mechanisms*' for the analysis of the causation. Such analysis will contribute in improving the understanding about the policy-performance causation and making inferences for each of the five dimensions of industrial policy based on the analyses done in previous chapters. Here we analyse the influence of each dimension of industrial policy on the identified processes that ultimately translates into performance. It will lead to identify the policy gaps and factors inhibiting adoption of these processes by the firms. Here again two points merit attention. First, since one of our objectives is to identify policy directions for development of the industry, all further analysis will be at a higher level of aggregation i.e. at the level of industry, nevertheless we will refer to firm level data as and when required to make the analysis more explicit. Second, we will also analyse the influence of other policy measures on respective processes if required as there exists considerable inter dependence among different policy measures i.e. analysis of cross-policy effects. Therefore, now onwards we transform our *framework of analysis* from policy-mechanism-performance (PMP) at the level of firm to *policy-mechanism-process-performance* (PMPP) *at the level of industry* keeping the structure of discussion the same as earlier. We will also keep on referring mechanisms as and when required as our entire discussion is built on analysis of mechanisms vis-à-vis policies in vogue.

Table 11.1 overleaf presents an overview of the individual elements of all the beads in the strand of policy-performance causation i.e. policy, mechanism, process and performance measure. The first column lists the five dimensions of industrial policy indicating the respective policy measures considered in our analysis as well as objective of the policy within the brackets. The individual mechanism, indicator, process and performance measure are listed vis-à-vis each dimension of industrial policy. The mechanisms that are similar in nature are clubbed together. The indicators are also listed accordingly for ready references. As regards to performance measures, both firm level and industry level performance measures have been indicated. Thus each row enumerates all the elements of policy-performance causation in respect of each dimension of industrial policy.

Table 11.1: Policy-Mechanism-Indicator-Process-Performance Matrix

Sl.	Policy	Mechanism	Indicator	Process	Performance Measure
1	**Technology Policy** i. FC Policy ii. In-house R&D Policy *(Building Technological Capability)*	▪ Transplanting Product concept and design ▪ Adaptation of product and process ▪ Improvement of product and process ▪ Continuous interaction with the Collaborator ▪ New Product Development ▪ Assimilation of Technology ▪ Continued up gradation of Technology	▪ No of products introduced based on last FC ▪ R&D intensity ▪ No of QSE ▪ Use of modern Technology (e.g. CAD) ▪ No of products introduced based on own R&D	▪ Acquisition of Technology ▪ Integration of Technology ▪ Development of product/ process ▪ Generation of Technology	Firm level ▪ Annual sales ▪ Export Intensity Industry level ▪ Domestic Market Share ▪ Av. Annual Growth rate ▪ Av. Price/ unit
2	**Investment Policy** i. Industrial Licensing Policy ii. FDI Policy iii. Import Policy *(Building Manufacturing Capability)*	▪ New investments/ modernization ▪ Outsourcing/ sub-contracting ▪ Importing material inputs	▪ Investment in plant & machinery ▪ CNC MT manufacturing capability ▪ Breadth of product-line ▪ Plant efficiency ▪ ISO-9000 certification ▪ No of products introduced in the market	▪ Acquisition of manufacturing capacity ▪ Assimilating mfg. capacity ▪ Integrating external mfg. Capacity ▪ Generating overseas mfg. capacity	Firm level ▪ Annual sales ▪ Export Intensity Industry level ▪ Investment ▪ Concentration ▪ Av. Price/ unit
3	**Education & Training Policy** i. Education Policy ii. Training Policy *(Building Human Capital)*	▪ Recruiting skilled personnel ▪ In-plant training ▪ Periodic training	▪ Skill intensity ▪ Turnover rate of employee ▪ Industrial relations	▪ Acquisition of skill, ▪ Integration of skill ▪ Development of skill ▪ Generation of skill	Firm level ▪ Labour Productivity Industry level ▪ Wage index ▪ Labour Productivity index
4	**Market Dev. Policy** i. Domestic Mkt. Development ii. Export Market Development *(Building Market Dev. Capability)*	▪ Interaction with users ▪ Creating awareness for use of CNC MT ▪ Participation in Industry/ Trade fairs ▪ Forming consortium ▪ Use of e-commerce	▪ No of products introduced ▪ Marketing intensity ▪ No of Sales & after-sales outfits ▪ Brand image in domestic market ▪ No of Sales & After-sales facility abroad	▪ Acquisition of Market ▪ Integrating with Market ▪ Development of Market ▪ Generation of Market	Firm level ▪ Annual sales ▪ Export Intensity Industry level ▪ Domestic market share ▪ Export Intensity
5	**Industrial Governance Policy** *(Building Linkage Capability)*	▪ Liaison with the Government depts./ institutions ▪ Creating linkage with support institutions ▪ Creating linkages within Supply chain ▪ Forming consortium	Quantum of: ▪ Liasioning with GI ▪ Linkages with GSI ▪ Linkages with suppliers ▪ Linkages with other firms	▪ Acquisition of Networks ▪ Integrating in Networks ▪ Deepening of Networks ▪ Generating global Networks	Firm level ▪ Annual sales ▪ Export Intensity Industry level ▪ Annual sales ▪ Export Intensity

11.2 Causal Interactions

11.2.1 Technology policy

As mentioned earlier, the Technology policy in context of the developing countries primarily concerns with access to new technology, its adaptation to local conditions, assimilation, absorption, product & process improvement and innovation of new products & processes etc. It mainly comprises of four policy measures: import of technology, promotion of in-house R&D, adequate supply of skilled personnel and provision of technology infrastructure. We have analysed the first two policy measures while discussing building technological capability for products (ch. 6); the third one: the supply of scientific & technology personnel was analyzed while discussing building human capital in the firms (ch. 8) and the last one: the provision of technology infrastructure was discussed while analyzing the linkage resources (ch. 10). In the present discussion, although we will concentrate on the first two policy measures, we will also refer to the others to get a holistic view.

Out of the four processes in respect of technology policy (see the first row Table 11.1), the process of *acquisition of technology* is the basic one in the quest for building technological capability in the firms. As mentioned earlier (ch. 6) it concerns with three main activities namely *identification*/ *selection, procurement* and *assimilation* of technology. The process starts with *identification* of relevant technology/ technology sources. Acquisition of an appropriate technology at reasonable price reflects positively on the performance of firms. It requires proper policy attention as none of the existing policies/ institutions: FC policy, in-house R&D policy or any technology support institutions offers specific attention to this aspect. There was a general consensus among the firms regarding this deficiency, particularly among the SMEs. Firms were of the view that in the absence of such support, they find it difficult to evaluate various technologies as well as to benchmark existing status of technology. There has been some initiative by the CMTI in this direction but there is no organized Technology Data Bank as yet to provide detailed information on various technology/ technology sources with proper evaluation.

The next step in the process of *acquisition* is *procurement* of technology, which we mean entering into agreement with technology suppliers that may be a firm or research institute from abroad or within the country. This process builds firms' capability in respect of evaluation of technology, negotiation for technological contents and mechanisms of transfer details, which have been rather limited in the firms as yet, particularly in the SMEs. In pre-liberalization period, the FC policy used to give ample directions through case-to-case evaluation of FC agreements, and impose host of restrictions through financial (e.g. payment of royalty and outright transfer fee) and non-financial conditionality (e.g. local content requirement, duration of agreement, and training of personnel etc.). Our interviews with the firms suggest that such conditionality had helped in negotiating with technology suppliers but inhibited proper transfer of know-how and proprietary technology, which created a substantial technology gap leading to technology laggardness. Under the protective regime such impacts were subdued but came into forefront the moment restrictions on imports were withdrawn in 1991. The domestic market share, which had reached its zenith in 1989 at 66% declined to 37% in 1998 gradually. The export intensity also showed the similar trend. Table 11.2 presents the average market share and export share for the three time periods: 1986-1990, 1992-96 and 1997-01.

Table 11.2: Domestic Market Share and Export Intensity (%)

Period	Av. Domestic Market Share (%)	Range Min.- Max.	Av. Export Intensity (%)	Range Min.- Max.
1986-90	65	49-66	16	12-20
1992-96	51	42-56	5	3-7
1997-01	52	37-61	6	4-9

Note: Figures rounded off for easier readability; Periods indicated are calendar years.
Source: Based on IMTMA data

In the post-liberalization period the non-financial conditionality has been withdrawn completely and due to commitments to the WTO, it could not be imposed any more. The financial conditionality has not been changed as such but relaxations are considered with open mind. Thus all codified aspects of FC agreements are left free for negotiations between the buyer and seller of technology. It is difficult to get conclusive evidence as to how far these relaxations have helped in enhancing the performance of the firms but it is plausible to suggest on the basis of views expressed by the firms that such removal of restrictions have been helpful. The firms that have signed FC agreements after 1991 have been able to get better bargain from technology suppliers in terms of technology contents and price without the policy-imposed conditionality. They claim that such relaxations have been instrumental in enhancing firms' performance. Nevertheless there seems to be a need for institutional support to guide the firms on various aspects of FC negotiations particularly for the SMEs. An initiative in public-private partnership with an active role of the IMTMA might be fruitful.

It may be relevant to mention that in spite of substantial relaxation in FC policy there has been marked decline in imports of technology in this industry since 1991. During 1985-90, altogether 50 FC agreements came into force for complete CNC machine tool, while after the liberalization just 20 agreements have been approved till the end of 2001. The situation is alarming since 1997 as only 4 cases have been approved and there has not been a single case of equity participation during this period. Now the question arises, why there has been decline in imports of technology? There are two plausible reasons. *First*, with virtually no barriers to import, foreign suppliers find it more profitable to export rather than adopting FC/ FDI as a mode of entry into the Indian market particularly in the situation when the growth of world machine tool is declining. The average annual growth rate of the world machine tool industry during 1991-95 was negative i.e. –3.0% and just 0.2% during 1996-00 (see Figure 5.2). *Second*, the small market size with low/ negative growth, and lack of quality component supplier in India are additional discouraging factors for the foreign investors to enter into the market. The firm F_B is an illustrative example of the situation how foreign firms enter into the market sensing its growth and leave judging the decline. During the last decade the domestic market growth rate has been negative (-2.9%). It has particularly worsened after 1996 from $650 million to just $230 million in 2000 (see Table 5.10) with an average annual growth rate of minus 20.8%. Therefore it is desirable that expansion of domestic market should be one of the prime concerns for the policy.

A further step in the *process of acquisition* is *assimilation of technology*. It is one of the main mechanisms adopted by the firms. It concerns with acquisition of new knowledge from different sources and integrating them with what is already known by the firms. A successful adoption of this process helps the firms in creating technological capability to understand the 'know-how' and 'know-why' of technology. Our data suggest that the basic factor for assimilation is the firms' own technological effort. The other factors identified were: interaction with domestic buyers; imported products; domestic products; visit to industry fairs; technical literature/ trade Journals; workers' suggestion; foreign collaboration; interaction with foreign buyers; suppliers of parts & components; R&D institutions; and industrial consultants etc. (see Table 6.5). Our analyses suggest that there is definite role of various policy measures in strengthening these aspects and the firms that adopted this process sincerely have performed better. The abolition of all non-financial conditionality of FC policy with simultaneous liberty to import industrial inputs and low tariffs has positively contributed to adoption of this process. On the other hand, the ineffectiveness of in-house R&D policy has forced firms to give more thrust on own technological efforts to face the competition. All these have resulted in achieving relatively better performance as evident from increasing share of CNC machine tool in overall output both in terms of quantity as well as share in overall production compared to pre-liberalization phase. The output of CNC machine tool has increased from 550 numbers and 33% of value in 1990 to 1382 numbers and 51% of value in 2000 respectively. There has been increase in share in exports from 20% to 38% also as evident from Table 11.3.

Table 11.3: Share of CNC Machine Tool in overall machine tool Production and Exports

Year	Quantity (Nos.)	Share in Production	Share in Exports
1990	550	33%	20%
1995	956	38%	8%
2000	1382	51%	38%

Note: Figures rounded off for easier readability.
Source: Based on IMTMA data.

With the *process of integration of technology* we mean *adaptation and absorption of technology.* This process encompasses *mechanisms* such as transplanting product concept & design, adaptation/ improvement of product & process, continuous interactions with collaborator and continued up gradation of technology etc. On the one hand the process is aptly influenced by various policy framework in vogue and on the other hand its successful adoption culminates in better performance of the firms. The causation could be perceived clearly by presenting illustrations through comparison of two periods i.e. the decade before vis-à-vis the decade after the liberalization. First of all, even during the protective regime, the relative openness of FC policy in respect of CNC machine tool facilitated the imports of technology and India entered into production of these machines in a sustained way. Among the non-financial conditionality, particularly the conditions regarding progressive import substitution of components, firm's right to sub-license the imported technology, and project execution by domestic engineering consultancy firms had major implications. The conditionality of time bound indigenisation with simultaneous restriction on imports on raw material & components, in the scenario when supporting & related industries were not developed in the country, induced firms to give proper thrust on product & process engineering to manufacture critical parts in-house as well as to develop ancillary firms for non-critical items (i.e. subcontracting). Firm's right to sell or sub-license technology also contributed to the latter. These efforts also helped in incorporating incremental improvement and innovative use of technology in related products to some extent. The policy for promoting in-house R&D through various fiscal and non-fiscal incentives given to recognized in-house R&D outfits of firms also acted synergistically for adaptation and absorption of technology and to promote development of indigenous technology. Thus within a span of five years 1985-90 about 40 firms were producing CNC machine tool worth $79 million amounting to 33% of the total output (see Table 5.8).

However, these policy measures had negative impacts on these processes as well. Such measures induced the firms and the CMTI/ other supporting institutions for technology development to pursue R&D primarily for adaptation/ absorption crowding out the efforts for new product development. It forced the firms to channel efforts for substituting imported components with local sub-quality components and raw materials irrespective of cost and quality. The lack of reliable suppliers and restrictions on imports impelled the firms to create economically unviable facilities in-house particularly for critical components (e.g. spindle, CNC controls etc.) and activities (e.g. steel foundry). Moreover, the fleet of financial/ non-financial conditionality accompanied with procedural hassles inhibited proper transfer of know-how and proprietary technology that perpetuated substantial technology gap. All these put the firms in a disadvantageous position particularly in the international perspective primarily due to higher cost and lower quality. A comparison of unit prices in US dollars of CNC machine tool reveals that in 1990, a machining center produced in India, Korea and Taiwan used to cost 226.7, 116.3 and 59.5, where as CNC lathe was valued at 122.8, 61.5 and 50 thousand US dollars respectively (see Table 11.4). It means Indian CNC machine tools were approximately twice expensive than Korea and three times costlier than Taiwan. It was one of the reasons for negligible exports of CNC machine tool (just 11.6% i.e. $9 million of total production of about $79 million in 1990). There were only 12 CNC lathes and three machining centers out of the total exports of 68 CNC machines in that year (EXIM Bank, 1996). The RSCA in 1990 was negative at -0.4 (see Table 5.11).

Table11.4: Av. Unit price of CNC Machine Tool in International perspective (, 000 $)

	CNC Lathe			Machining Center		
	India	**Korea**	**Taiwan**	**India**	**Korea**	**Taiwan**
1990	122.8	61.5	50.0	226.7	116.3	59.5
2000	41.5	53.2	27.3	77.8	86.3	34.5

Source: Based on Alcorta (2001: Table 7) for 1990 values and CECIMO (2003) for 2000 values.

Unlike the pre-liberalization era, the policy framework in the post-liberalization period is moving away from direct intervention. The non-financial conditionality for FC and restrictions imposed through import policy have been relaxed considerably so the firms are free to take their own decisions as per the market conditions. The procedural hassles have also been mitigated to a large extent. Now the main driving force for adoption of these processes is the need for survival to face competition from imported products rather than the FC policy per se. Our data suggest that these changes have been well recognized and appreciated by the industry in general and some of the firms in particular. It is seen that the firms giving ample thrust on adoption of these processes are accordingly able to improve their performance that in turn has improved industry performance to some extent as well. It is evident from higher share of production and exports in 2000 (see Table 11.3) as well as improvement in price competitiveness compared to 1990 vis-à-vis Korea and Taiwan (see Table 11.4).

The *process of development of new product & process* is the next step in building technological capability and achieving better performance. As stated earlier, in the context of developing countries, development of new products does not mean development of new-to-world products or products at the frontier of technology. It simply means development of products new to the firm. In the present context it means development of machine tool of a specific product-family, incorporation of additional features in existing products, developing new models, repositioning product for new market segment, innovative use of technology in related product, diversification in different product-family, or diversifying into different industry segment etc. It may be mentioned that the degree of technological efforts varies in increasing order for these activities. Minor incremental improvement requires less effort compared to developing new models or entering into different product-family or industry segment. Like the previous process, adoption of this process is also influenced by various policy measures and simultaneously contributes to achieve better level of performance.

Our data suggest that unlike the pre-liberalisation period, the present non-interfering nature of FC policy has facilitated the adoption of this process, as it is not crowding out efforts for new product development in preference to developing import substitutes. This in turn is facilitating the introduction of more numbers of new products/ new models in the market. However, we did not get any conclusive evidence of influence of promotion of in-house R&D policy on adoption of this process. It is seen that 11 of our sample firms introduced 58 new models during the span of three years 1995-97 i.e. 19 models per year on an average, where as in the year 2000 only, these firms introduced 50 new models in the market. This has led to an increase in production of CNC machine tools as well as share in exports (see Table 11.3). During our analysis in chapter 6, we have seen that the firms introducing more new products in the market have performed better than others (see Table 6.4). However, the overall performance of the industry both in national and international perspective could not be rated as satisfactory. It could be seen from the comparison of performance in terms of negative average annual growth rate of production and retarded change in share of CNC machine tool in total production of machine tool during the two periods 1986–1990 and 1997-2001 (see Table 11.2) irrespective of the cautions expressed earlier for interpreting the data. It suggests the presence of other inhibiting factors for lower adoption of aforesaid processes such as lack of creation of enabling environment through provision of better technology infrastructure, industry-institution linkages and necessary fiscal incentives etc.

The *process of generation of technology* includes innovation of new product/ process and innovation of new technology. These require much higher level of technological effort, technological capability and framework conditions. As mentioned earlier, firms in the developing countries in general and India in particular in CNC machine tool industry are yet to attain such level. The progress of Korea, Taiwan and China could be at best attributed to attaining capability to produce cost-competitive products at lower end of technology rather than products at the frontier of technology. Such products are still in the domain of developed countries like USA, Germany, Switzerland and Japan etc. Nevertheless, for sustained industrial development in the environment of continuous technological changes it is pertinent that appropriate steps should be initiated to acquire such technological capability progressively (Lall, 2001; Kim, 1998). It is therefore imperative that the firms should accelerate the process of learning by way of rapid acquisition, integration and development of technology to become capable of generation of technology to achieve sustained development. For supporting such development, it is pertinent that the technology infrastructure should be developed accordingly. It entails simultaneous and balanced development of R&D activities in general and for CNC machine tool in particular among research institutes, universities and firms with proper networking as well as requisite human skills.

11.2.2 Investment Policy

Investment policy concerns with mobilization of both domestic- as well as foreign investment in the country. It primarily hovers around regulations on entry & expansion, and regulations on imports. The main policy measures for the former are industrial licensing and FDI policy, and for the latter import licensing policy and tariff policy. We discussed these policies in chapter 7 while analyzing policy-performance causation for building manufacturing capability in the firms. The discussion led to identification of four processes: acquisition of in-house manufacturing capacity, assimilation of manufacturing capacity, integrating external manufacturing capacity, and generating overseas manufacturing capacity.

The *process of acquisition of in-house manufacturing capacity* is the basic process for building manufacturing capability in the firms. It concerns with establishment of manufacturing facilities and related systems in-house. It may relate to green-field investment, modernization for increasing capacity or enhancing overall quality of manufacturing system, manufacturing new product or diversification. The process encompasses the *mechanism* of investments in plant & machinery; and imports of material inputs etc. On the one hand, the process is influenced by various policies in vogue, particularly the regulations on entry & expansion and regulations on imports and on the other hand its proper adoption culminates in better performance of the firms. The exemption from industrial licensing, scrapping of MRTP Act and requirement of filing Industrial Entrepreneur Memoranda (IEM), which is a post-scrutiny measure have virtually abolished all restrictions on entry and expansion. Our interviews with the firms suggest that such dismantling of barriers have facilitated the adoption of this process and helped firms to take decisions based on their evaluation of market conditions. The establishment of F_I is an illustrative example for green field investment and floating of outfits for manufacturing new products by the firms F_C and F_O demonstrate the case for ease of diversification in the post-liberalisation period. The adoption of this process has also been facilitated by removal of restrictions on imports of capital goods. It influenced the process primarily in two ways. First, it induced a sense of fear for competition from imports due to abolition of quantitative restrictions and progressive reduction in tariffs that brought down the prices. Secondly, the firms themselves found it relatively easier and cheaper to import machine tools to build manufacturing capability.

The positive impact of these policy changes could be gauged through a comparative analysis of the two time periods 1985-90 and 1992-97 in respect of factory sector for overall machine tool industry (NIC_357) regarding annual average growth rate of firms, employees and investment in terms of real Gross Fixed Capital Formation (GFCF) and Net Fixed Capital Formation

(NFCF) at 1993-94 prices.[134] The average annual growth rate of number of firms and number of employees has increased from 0.4% to 5.2% and 1.7% to 3.8% respectively. Similarly the average annual value of GFCF and NFCF has increased from Rs 706 to 1299 and Rs 163 to 684 million at 1993-94 prices respectively (Table 11.5).

Table11.5: Firms, Employees and Investment: A comparative overview

Period	Average annual growth rate (%)		Average Annual Value (Rs million at 1993-94 prices)	
	Nos. of Firm	Nos. of Employee	GFCF	NFCF
1985-90	0.4	1.7	706	163
1992-97	5.2	3.8	1299	684

GFCF: Gross Fixed Capital Formation; NFCF: Net Fixed capital Formation
Source: Based on ASI data

Another positive impact is seen in terms of reduction in level of concentration (although marginal) and simultaneous rise of medium sized firms in the industry. The share of top 5 firms and top 10 firms have come down from 61% and 70% in 1989 to 52% and 66% respectively in 1999 indicating reduction in level of concentration (Table 11.6). The number of medium sized firms in top 5 and top 10 firms has doubled up during these periods.

Table 11.6: Level of concentration in the industry (%)

Year	Top 5 firms	Top 10 firms	Top 15 firms
1989	61	70	NA
1994	47	58	66
1999	52	66	72

Note: Figures rounded off for easier readability.
Source: For the year 1989 Wogart et al. (1993) and the rest based on IMTMA data.

The process is also influenced by the policy regarding procurement of material inputs from abroad or agents of foreign suppliers in the country. The latter has been possible due to removal of so called actual user (AU) condition for imports. Now the decision to use imported inputs is taken primarily based on availability of material inputs from domestic sources in required quality, quantity, time, and price. Our interviews reveal that the firms import certain critical components as either they are not manufactured in country at all or do not conform to required quality standards. Industry data suggest that imported inputs constitute almost 40-50% of cost of CNC machine tools. CNC controls alone cost around 20-25%. The effect of hassle free imports is felt right from the design stage. With the confirmed availability of required components now it has been easier to design & develop new products or to incorporate additional features in existing models compared to pre-liberalization period. In manufacturing stage, the deregulation has increased the availability of inputs and reduced the lead-time to imports. Similar impact is seen in after-sales stage as well. In general, the overall inventory carrying cost, risk of stock-outs and requirement of working capital have reduced culminating in reduction in price of machine tools. Moreover, the progressive reduction of tariffs has also contributed to reduction in prices of imported inputs considerably. The deregulation has rather

[134] Such industry level data are available till the financial year1997-98 only.

influenced throughout the supply chain and therefore domestic inputs are also available at lower price and with better quality. All these developments are enabling the firms to offer products at a relatively lower price. For example, the average unit price of the two major CNC machine tools namely CNC lathe and Vertical Machining Center for the three periods 1990, 1995 and 2000 (see Table 11.7 below) illustrates the same.

Table11.7: Av. Unit price of CNC Machine Tool (, 000 $)

	CNC Lathe				Vertical Machining Center			
Year	Production		Export		Production		Export	
	Qty.	Price	Qty.	Price	Qty.	Price	Qty.	Price
1990	281	123.0	12	80.7	70	157.5	3	120.0
1995	497	66.7	14	44.2	88	98.1	1	46.9
2000	747	41.5	21	27.8	178	57.2	4	35.1

Source: Based on IMTMA data

As regards to the progressive reduction in tariffs, two points merit attention. First, the overall rates are still at the higher side compared to other countries. Secondly, anomalies in tariff structure i.e. inverted duty structure do persist. Ideally tariff should increase based on value addition in the products i.e. the lowest for raw material, and progressively increasing for component, sub-assemblies, and finished goods. But a glance at Table 11.8 illustrates the anomalies in respect of this industry.

Table 11.8: Material inputs and Tariffs

Material inputs	% of End-product Value	Basic Duty Rate (%) FY2000-01
Steel castings/forgings/coils/ plates	10-15	35-40%
CNC control & drives	35-40	25%
Electrical/Electronics Items	10-15	25%
Precision bearings	5-10	35%
Hydraulic/Pneumatic elements	5-10	25%
Mechanical sub-assemblies	15-20	25%
Consumable & stores	5-10	25%
Cutting Tools	2-10	35%
Components of CNC controls	-	35%

Source: Duty rates based on CBEC (2001); Rest: Industry data.

It may be seen that the duty on the finished goods i.e. CNC Machine tool is 25%, where as the main raw materials (e.g. steel castings/ forgings etc.) attract higher duty of 35-40%, or components like precision bearing/ cutting tools attract 35% duty. The sub-assemblies like CNC controls & drives; electrical/ electronics items; and hydraulic/ pneumatic items etc. have the same 25% duty. The value wise break-up (column 2) indicates that 20-30% items attract duty at a higher rate i.e. 35-40% and rest 70-80% items are at par with the finished product rate of 25%. Similarly CNC controls attract 25% duty whereas components of CNC controls attract 35%. It is therefore pertinent that such anomalies in tariff structure need to be addressed.

Another issue, which is worth mentioning at this juncture, is the issue of foreign direct investment (FDI). It is observed that regardless of favorable policy environment the level of FDI is very low in this industry. None of the firms in our sample has been able to attract any foreign investment in the post-liberalization period. Out of 207 FC/FDI agreements approved for overall machine tool industry in the post-liberalization period, only 20 pertain to complete CNC Machine Tools and interestingly enough none of them involve FDI. Most of the investments are in the area of cutting tools and accessories or setting up of after-sales facilities by the foreign manufacturers. The actual inflow of machine tool industry during the last decade amounts to just 0.23% of total FDI in industry sector only (see Table 4.7). Our interviews with the firms suggest two panoptic reasons for lack of FDI in this industry. The first one relates to industry structure i.e. small domestic market, lack of sophisticated demand, low growth, low profitability, and lack of quality component suppliers etc. The second one concerns with the open policy environment i.e. with no barriers to import, foreign manufacturers find it more profitable & easier to export rather than investing in manufacturing locally considering the low domestic demand and higher specialization of the products. In the pre-liberalization period the FDI/ FC were used as mode of entry into the domestic market by the foreign investors. The case of F_B is an illustrative example for the above (see 6.3.1.3). However, the recent trend in FDI in cutting tools, R&D set ups and after-sales service outfits are encouraging signals for the possible FDI in future if the market grows. In view of the above it is pertinent that effective steps should be taken to encourage FDI in the industry.

The *process* of *assimilating manufacturing capacity* concerns with complementing the firms' in-house manufacturing capability with outside sources through subcontracting or capacity sharing.[135] It enables the firms to complement their own production process, achieve cost effectiveness, and increase flexibility etc. It triggers the mechanisms of subcontracting and formation of consortiums. As mentioned earlier, with the mechanism *subcontracting* we mean procuring components/ subassemblies and certain services/ operations from other domestic manufacturers/ service providers. The decision to subcontract is taken primarily based on 'make or buy' criteria and level of development of supporting & related industries etc. It is seen that the *process* is aptly influenced by policy framework in vogue. In the pre-liberalization era firms used to give thrust on this process due to policy constraints (local content requirement and barriers on imports etc.) as well as lack of proper suppliers. While in the present scenario the resurgence of interest in the process is driven by the quest for survival and achieving international competitiveness. The reduction in barriers on entry & expansion as well as ease of imports of machinery have facilitated the establishment of subcontracting firms, which was otherwise hindered in pre-liberalization period. Similarly removal of QR, abolition of AU condition and reduction in tariffs have also facilitated the adoption of this process.

The case of the firm F_J is one of the few illustrative examples of that explain how the process of *assimilating manufacturing capacity* primarily through the mechanism of subcontracting has helped the firms to achieve better performance leveraging the liberalised policies in vogue. Within a span of seven years of inception, the firm has become the largest manufacturer of

[135] Although we came across of adoption of mechanism of formation of consortium for capacity sharing, we did not get any conclusive evidence of its impact on performance of the firms. Nevertheless, the firms have started to recognize the importance of this mechanism.

vertical machining center in India. At the industry level, the adoption of this process is evident from the higher growth rate of number of firms, employees and average investments in machine tool sector in the post-liberalization period (see Table 11.5). The improved performance of the industry in terms of higher production, better exports (see Table 11.3), reduction in average unit price (see Table 11.8) and reduced level of concentration (see Table 11.6) could be attributed to adoption of this process as well.

The process of *integrating external manufacturing capacity* signifies deepening of both the preceding processes i.e. assimilation of manufacturing capability and acquisition of in-house manufacturing capacity. It is seen that the present relationships in respect of subcontracting and capacity sharing are more on arms-length basis rather than the notion of interdependence and mutuality. Although, there has been some initiatives in this direction by some of the pro-active firms like F_D and F_J etc. (see section 10.3.2 Figure 10.7) we hardly found any concrete evidence for adoption of this process. It may be recognized that with the progress of industrialization more capital/ skill intensive activities are undertaken in technologically matured industrial sector, which results in increased specialization and higher use of intermediate products. These dynamic shifts reflect changes in both technologies of products/ processes that demand more division of labour. Moreover, the ongoing changes in technology in machine tool industry is changing the dynamics of manufacturing system and call for adoption of new forms of organizations, and work process in the firms and therefore require a more information flow based integrated supplier networks. From the policy point of view, it requires enhanced institutional supports. It calls for overall development of SMEs and culture of networking for which more promotional nature of policy supports are essential.

The process of *generating overseas manufacturing capacity* is a step forward that signifies further deepening of the preceding processes of acquisition, assimilation and integration of manufacturing capacity *beyond the national boundary* that culminates in building reasonably high manufacturing capability. In fact it has to be seen in international context due to integration of global market and increased potential for global subcontracting. It may be mentioned that this also requires simultaneous adoption of process of development of product/ process and generation of technology. At this stage technology intensive and knowledge intensive activities are undertaken that require substantially higher level of investments, technology, management skills and coordination. As mentioned earlier, the firms are yet to attain such level. Nevertheless, for attaining sustained development requisite efforts are required by the firms along with necessary policy supports from the government.

11.2.3 Education and Training Policy

In the policy framework, Education and Training in India are considered as a social policy that primarily acts at the macro level. However, our discussion is limited to micro level impact of education and training policy. Education policy concerns with generating skilled work force as per the specific requirement of the industry (skill creation) and training policy deals with pre-employment and post-employment training for upgrading skills (skill development) to build various capabilities in the firms. The analysis of policy-performance causation in respect of E&T policy (see ch. 8) led to identification of four distinct but interrelated processes that are adopted to build human resource capability in the firms namely *acquisition of skill, integration of skill, development of skill and generation of skill.*

The *process* of *acquisition of skill* concerns with acquirement of educated/ skilled personnel in the firms.[136] It is seen that the process is aptly influenced by various policies in vogue, and its proper adoption culminates in better performance of the firms. Our interviews with the firms brought out certain elucidating issues that are worth mentioning in the present context. The extensive E&T system generates adequate scientists, engineers; diploma holders and ITI trained workers. But the exam ridden E&T system throttles creativity and analytical skill. Moreover, they lack industrial exposure and practical knowledge. Therefore there exists a gap between education and employability in general. It is well recognised that as the process of industrialization proceeds and structural shifts occur, progressively higher level of technology, investment and human skills are required. The ongoing changes in technology is changing the dynamics of manufacturing system and requires adoption of new forms of organizations, work process and workforce system in the firms and therefore necessitate new and higher level of human skills (Lall, 2001; Tan & Batra, 1995). This is quite relevant for Machine Tool industry in particular. But the existing E&T system does not provide the required human skill for this industry. Although there are arrays of universities, research institutes, engineering colleges and polytechnics in the country but none of them is exclusively devoted to machine tool thus creating a lack of specific focus on R&D in machine tool. Moreover, there are not enough machine tool related disciplines in these institutes. Therefore, the supply of educated persons suitable for this industry is inadequate.

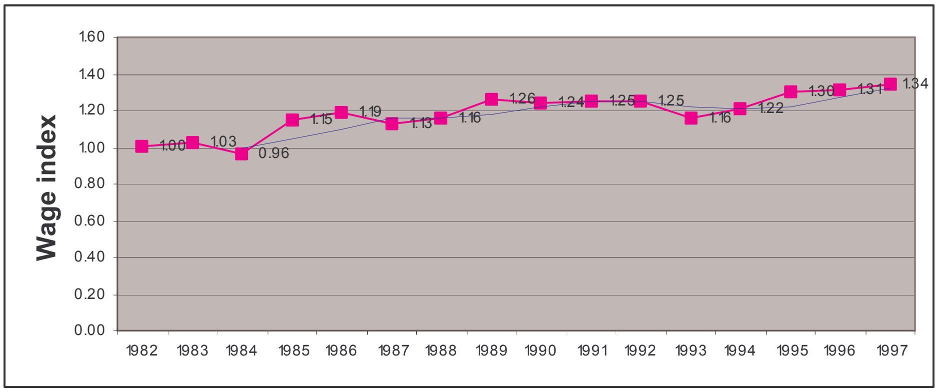
In view of the above and considering the fact that educated/ skilled persons are better learners and training them lead to larger gain in productivity (Deolalikar et al., 1997; Lall, 2001), the firms are consequently giving due emphasis on this process through adoption of the *mechanism* of recruitment of *educated/skilled personnel* in the first instance. The overall higher level of skill intensity in the firms (average being 79%) is an evidence for the same. Some of the firms (e.g. F_D, F_J and F_C etc.) that manufacture mainly CNC machine tool have still higher skill intensity (95%, 93% and 90% respectively) than the industry average and they have performed better (see Table 8.3).

The increasing level of skill intensity at the level of industry could be gauged from the level of wage index per employee (see Figure 11.2). The wage index is constructed based on the latest available Annual Survey of Industries (ASI) time series data for annual emoluments paid to employees of machine tool industry for the period 1982-83 to 1997-98 (ASI, 2001). The changes in average wage per employee over time could be attributed to two main factors, first, price rise and secondly, increase in employee skills. In order to isolate the effect of wage increase due to skill, we first nullify the changes due to price hike by deflating the total wage paid by consumer price index for industrial workers (base 1982-83 prices). Then we construct wage index per employee over time. Now the changes in wage index constructed thereof could be considered as a proxy for changes in skill level of employees. The data suggest that the wage index is showing a rising trend, particularly in the post-liberalisation period. A trend line fitted based on three years moving average also substantiates the claim. The increase could be

[136] For the purpose of our discussion an e*ducated person* means person with formal education (technical or non-technical) of secondary level and above. *A skilled person* means educated person with specialized training or work experience or both.

attributed to rising share of CNC machine tool, which requires higher skill, in total output. It may be seen that the average wage index for the period 1992-97 is higher (1.25) than 1985-90 (1.18) and gradually increasing since 1993, reaching as high as 1.34 in the year 1997-98.

Figure 11.2: Wage-index of Machine Tool industry: 1982-1997

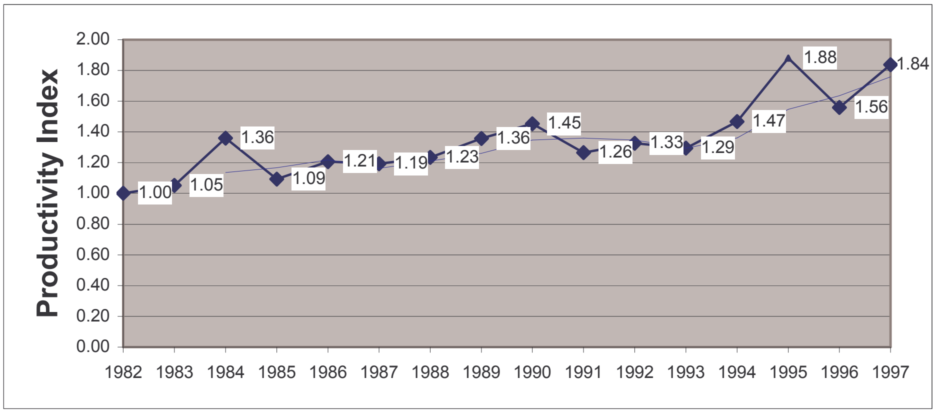


Source: Based on ASI data

The process of integration of skills means converting the acquired human skills into the human resource capability of the firms. It is achieved through adopting the *mechanism* of imparting in-plant training to the new incumbents. Our data suggest that the firms have to emphasize specifically on this process to prepare new incumbents, as the existing E&T system does not generate the required skills necessary for undertaking the assigned jobs in the firms directly. This process becomes mandatory in bridging the gap between education and employment. But unfortunately, none of the policy measures provides any support for adoption of this process. It is gathered that all firms recognize the importance of adoption of this process irrespective of size or ownership. The medium and large firms adopt this process in a more structured manner compared to the smaller firms. Its proper adoption culminates in better performance of the firms. Even a comparison of productivity index of the three small firms suggests that the higher is the thrust on in-plant training; the better is the level of productivity (see Table 8.3). There is a need for proper policy supports reckoning the externality generated and increase in internal economies by adoption of this process.

At the industry level the impact of adoption of the process could be seen in progressively increased level of labour productivity (output per employee) as depicted in Figure 11.3. We have constructed a time series for labour productivity index for machine tool industry for the period 1982-83 to 1997-98 based on available ASI data (ASI, 2001). The impact of price rise is neutralized by deflating the value of output (Rs million) by wholesale price index (WPI) for non-electrical machinery at 1993-94 prices. The trend line based on three years moving average shows an increasing trend of productivity index over time. It is relatively more pronounced in the post liberalisation period. In comparison to the period 1985-90, the average productivity index has increased from 1.2 to 1.5 during 1992-97 indicating higher thrust on adoption of this process in the post-liberalisation period. This finding is also in concurrence with our earlier observation of increasing level of skill intensity and wage index.

Figure 11.3: Productivity-index of Machine Tool industry: 1982-1997



Source: Based on ASI data

The *process of development of skill* is a step further in building human resource capability in firms. It concerns with upgrading knowledge and skills of the employees as per the firms' needs to keep pace with new developments in technology and market demand. The steady progression towards manufacture of CNC machine tool is increasing the need for higher skills and knowledge of contemporary technology as well as increased specialization. Thus enhanced thrust on adoption of this process is mandatory. Like the earlier process, the firms recognize the importance of adoption of this process. This process triggers the *mechanism of periodic training* to employees. The medium and large firms adopt this mechanism in a more structured manner compared to the smaller firms. It is seen that the firms emphasizing more on this process perform better. It is substantiated through the significant positive correlation between level of adoption of the mechanism and labour productivity (see Table 8.3). At the level of industry, the result of adoption of this process could be gauged through rising wage index and productivity index (Figure 11.2 and 11.3 respectively).

Our data reveal that the firms give less emphasis on this process compared to the previous ones in the absence of proper policy supports. We found two plausible reasons. First, majority of the firms reported that employees become more vulnerable to poaching by other firms or likely to leave on their own for better prospects after receiving advanced training. It is more prevalent in small firms as well as in executive level, particularly in R&D, manufacturing and marketing departments in medium and large firms. Such scenario indicates the presence of pervasive market failure in labour market. It is therefore imperative that proper system of incentives should be developed to induce both employee and employers to opt for requisite training. Secondly, there is a lack of institutional supports for training. There have been some efforts on the part of the government to provide training specifically for CNC machine tool in a few existing institutes but the basic orientation of such institutions towards non-CNC machine tool acts as bottlenecks. There is a need to design appropriate courses for development of CNC machine tool in consultation with the industry. There is also lack of participation of private sector or public-private partnership both in education as well as in training system. The IMTMA and Development Council for Machine Tool may play a central coordinating role in this endeavor.

The *process of generation of skill* refers to the development and generation of new skills. It may be possible when firms reach the stage of innovation of new product/ process at the frontier of technology, which we referred as *generation of technology* earlier in section 11.2.1. It requires deepening of the earlier three processes as well as other processes mentioned in our discussions. As mentioned before, firms in the developing countries in general and India in particular have yet to attain such level. These require much higher level of technological effort, technological capability and framework conditions. Nevertheless, it is essential that both firms and the Government should take appropriate steps to move in this direction.

11.2.4 Market Development Policy

As the name suggests, the Market development policy addresses demand side issues and concerns with the development of market. We have discussed this earlier in terms of *domestic market-* and *export market development.* The former hovers around purchase/ price preferences in the public procurements; lease financing/ hire-purchase schemes; and scheme for technology upgradation by the firms etc. The latter includes cost-neutralisation measures *and* developmental measures for exports. The cost-neutralisation measures provide monetary benefits primarily to compensate the cost disadvantage suffered by the firms vis-à-vis imports where as the developmental measures have more promotional connotation. Our analyses of policy-performance causation in respect to these two policy measures suggest that the existing policy frameworks do not provide adequate support in this regard. It further led to identification of four distinct but interrelated processes namely *acquisition of market, integration with market, development of market and generation of market.*

The process of *acquisition of market* is the basic process in the quest for building market development capability in the firms. This concerns with identification of buyers, creating awareness about firm's products & capabilities, developing business contacts, and finally supplying/ exporting as well as maintaining links with buyers for feedbacks/ further purchases. This process could also be further segmented into two based on national boundary: *domestic market* and *foreign market*. It is seen that on the one hand the process *acquisition of domestic market* is liable to be influenced by various policy measures in vogue and on the other hand its proper adoption culminate in better performance. In the pre-liberalization era the protection imposed through quantitative restrictions (criterion of indigenous availability & essentiality of imports) as well as high tariffs (see section 7.2.3) were acting as inbuilt market development measures for creating demand from the domestic users. But in the post-liberalisation period due to complete abolition of QR and considerable reduction in tariffs there is no such implicit policy support is available. The views of the firms suggest that the existing policy measures are either ineffective or marred with cumbersome procedures. Hence they do not provide adequate support for domestic market development and do not stimulate demand for CNC machine tools in the country.

In the absence of requisite policy supports, the firms started giving more emphasis on mechanisms like direct interactions with the users, creating awareness among prospective users, participation in trade fairs in India/ abroad, formation of consortiums and use of e-commerce etc. In other words we may say that the process of acquisition of domestic market triggered the above mechanisms. It is seen that the firms that adopted these mechanisms more vigorously and in a more novel way have performed better (see section 9.2.3). At the industry level, the adoption of these mechanisms is showing positive results in terms of gradual increase in domestic market share. We illustrate this through data on market share of six main CNC machine tool produced in India (Lathe, Machining Center, Milling machine, Boring & Milling machine, Drilling machine and Wire cut EDM) that constitute 86% of production in value terms (Table 11.9).[137] The market share that had reached 72% in 1990 before the liberalization gradually slipped to 43% in 1998. It is again showing an increasing trend since then. It has reached to 73% in the year 2001. However, these figures should be interpreted with caution. The high market share does not mean that the industry is performing well. The quantum of production and exports both in values as well as quantity is very less. The market share of 73% in 2001, amounts to just $49.5 million (1057 Nos.) and export equals to $2.6 million (90 Nos.) only.[138] It is therefore pertinent that relevant policy supports should be provided for the development of domestic market.

Table 11.9 Domestic Market Share & Export Ratio of CNC Machine Tool: 1990-2001

Year	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**
Market share	72	56	43	62	66	73
Export intensity	8	2	12[#]	3	2	5

Note: Figures rounded off for easier readability;
#: The higher export intensity was due to OEM supplies by two firms, which has stopped since then.
Source: Based on IMTMA data.

A step further to building market development capability is the process of *acquisition of overseas buyers*. This consists of identification of overseas buyers, creating awareness about firm's products & capabilities abroad, developing business contacts, exporting and maintaining links with buyers for feedbacks/ further purchases etc. Like the earlier case, this process is also aptly influenced by various policy measures in vogue and its successful adoption culminates in better performance of the firms. Although India followed protectionist policy after the independence, the export market development policy has always been given due importance. However, they have been ineffective due to variety of reasons. In the post-liberalization period this policy is attracting more attention in terms of cost-neutralisation and promotional measures. The views of the firms suggest that the former provide monetary benefits primarily to compensate the cost disadvantages suffered by the domestic firms vis-à-vis the imports. They are the barest necessity for doing the business. They need fine-tuning and streamlining of procedural hassles. But, the promotional measures have been more or less ineffective due to various reasons so far. For example, most of the firms cannot avail of the Market Development Assistance (MDA) scheme due to minimum requirement of aggregate export of Rs 20 million over the last three financial years (viz. F_D and F_I etc.) in spite of taking effective steps for exports. Similarly the scheme of export processing zone (EPZ) although good for promoting exports, are not effective as neither the firms are able to set up 100% exports oriented plants nor there has been any FDI in EPZs.

[137] Non-availability of data, particularly for imports, for other types of CNC machine tool has led us to limit our analysis to six main types of CNC machine Tool.

[138] Exchange rate used: $1 = Rs 47.391 for the year 2001 (RBI, 2002).

In order to give more thrust on acquisition of market abroad, the firms are adopting mechanisms like participation in Trade fairs abroad; forming consortium for export marketing and use of e-commerce etc. with a renewed vigour. However, it is mentioned that such initiatives are still limited to a small number of firms. The initiatives of some of the pro-active SMEs like F_C, F_D, F_I and F_H etc. are worth mentioning (see section 9.3.3). Nevertheless, firms in the industry have recognised the importance of this process and have initiated action to this effect with varying degrees of success. At the industry level, we see an increasing trend in exports of CNC machine Tools, particularly since 1997 (see Table 11.9). Although the absolute value of export intensity is still quite low (about 5% only), efforts are underway to increase the exports. It is expected that exports will increase gradually.

The *process* of *integration with market* means establishment of sustained producer-buyer interactions with recurrent transactions. Like the earlier process, this one also can be seen in terms of *domestic market* and *foreign market.* This process is considered to be crucial in building market development capability of the firms due to various endogenous as well as exogenous reasons. In the pre-liberalization period it used to be sufficient to produce machine tools having normal business contacts with the users as the market used to be virtually sellers market well protected from imports. But after 1991, due to removal of restrictions on imports & streamlining of procedures, the business environment has changed a lot. Now the firms are required to take pro-active approach and preempt the needs of users through establishing proper linkages in order to compete with foreign manufacturer or other domestic competitors. Moreover such removal of restrictions has induced significant structural changes in the major user industries. Now users require better quality, more flexibility, higher tolerances, faster processing and reduction in lead-time, timely delivery etc. to enhance their own competitiveness. Thus the users are also interested in enhanced interactions.

Like the earlier process, this process also triggers the mechanisms of direct interactions with users, participation in trade fairs, formation of consortiums and use of e-commerce etc. However, it requires more thrust and reorientation to attain the objective of integration. This requires more interaction and proper exchange of information between manufacturer and buyers. The initiatives by the firms like F_O and F_G are good examples of proper integration with domestic buyers. As regards to the *process* of *integration with foreign market,* we found it to be embedded in various channels namely subcontractor of parts/ components, and supplying machine tool in semi-finished/ finished form to OEM to be marketed under OEM's brand. Some of the firms F_A, F_J and F_N etc. are worth mentioning in this regard. Although adoption of this process is still in the emergent stage and rather isolated, firms are convinced about the potentials of the process and possible pitfalls of ignoring this to stay competitive in the market. Although it is difficult to set apart the impact of adoption of this process on the overall performance of the industry, the positive trend in terms of increased output, market share, lower per unit price of CNC machine tool and to some extent export intensity (see Table 11.3 and 11.4) could be attributed to the same as well. From the policy point of view, it is seen that there is no direct support for this process as such. So far it has been primarily firms' own initiative but there is a need for proper support to institutionalize this process with provision of suitable incentives. It calls for development of culture of networking and supports for adequate diffusion of ICT both within the firms and across the firms and enhanced interactions with foreign buyers etc.

With the *process* of *development of market* we mean creation of market abroad by way of licensing, joint venture, or FDI for the products new to the firm but not new to the world. The new market may be other less industrialised countries or in some cases industrialised countries as well. Such efforts allow firm to generate market for firm's finished product as well as components and other technological inputs. It may also help to establish export platform to take advantage of low labour cost/ other factor endowments as well as to gain entry into the regional blocks namely EU, NAFTA etc. It differs from the earlier process of integration with foreign buyers in respect of direction of flow of technology. In the former, material/ technology flows from buyer to firm, while in the current case the direction of flow is from the firm to buyer. Unfortunately, we did not get any evidence of adoption of this process as none of the firms have achieved such level of capability so far in respect of CNC machine tool. However, in past there have been instances for non-CNC machine tool (for e.g. F_A). Nevertheless, for attaining sustained development requisite efforts are required by the firms along with necessary policy supports from the government.

The *process* of *generation of market* is a step further. It concerns with creation of market abroad by way of exporting, licensing, joint venture, or FDI for new products at the frontier of technology. This requires simultaneous adoption of process of generation of technology, generating overseas manufacturing capacity, and generations of skills as well as deepening of all earlier processes are necessary. In order to achieve these, much higher level of technological effort, technological capability and policy supports are required.

11.2.5 Industrial Governance

The *policy on industrial governance* concerns with mitigating the various sources of the government failure i.e. information deficiency, lack of flexibility, problems of incentive & efficiency and rent seeking. It draws attention primarily to three aspects: formulation & implementation of policies, building institutions and improved flow of information among various stakeholders. Eventually these require complex and dynamic *interactions* both within and between the various stakeholders: the Government, firms, supporting institutions and market. Such interactions lead to higher coordination and cooperation among the stakeholders that ultimately culminate in better performance of the firms. For the purpose of our discussion we have termed these interactions as *linkages*. Due to the abstract nature of policy on industrial governance and phenomena of linkages, we have examined the causal interactions in respect of building up of linkage capability in the firms through analysis of institutional framework in respect of industrial governance vis-à-vis linkages among various stakeholders. These are visualised in terms of government-to-government i.e. *G2G linkage,* government-to-firm i.e. *G2F linkage* and firm-to-firm i.e. *F2F linkage* (see Figure 10.2). Although there is extensive institutional network for policy making & implementation as well as supporting institutions in the country, there seems to be acute lack of linkages among the firms and these institutions. Our analyses suggest that the present institutional framework does not stimulate proper linkages among the stakeholders. It further led to identification of four distinct but mutually related processes, which we named as *acquisition of networks, integration in networks and deepening of networks and generating global networks.*

With the processes of *acquisition of networks* we mean *entering into* business relationships with other entities that include firms throughout the supply chain and supporting institutions, with recurrent transactions. It may include short-term arm's-length relationships as well. It may be recognised that a number of features of CNC machine tool industry in India suit the formation of networks. *First,* it is composed predominantly of SMEs that are mainly located in geographic clusters (e.g. Banglore-Coimbtore, Mumbai-Pune and Delhi etc.) in proximity of the main end users. *Second,* the investments and resources required to attain international competitiveness are beyond the scope of most of the firms individually due to firms' small size. *Third*, it has been well recognised that for rapid product development, achieving economy of scale/ scope, increased flexibility, responding to new opportunities close links among suppliers, manufacturer, buyers and supporting institutions become essential that can be well nurtured through networks. It is evident from the success of Japan, Italy and Taiwan machine-tool firms. *Fourth*, networking offers flexibility to tide off the problem of overcapacity due to cyclic nature of demand. In spite of these, we found only sporadic evidences of networking. The process encompasses the mechanisms of forming networks, forming consortium, liaison with the Government departments and support institutions.

Like other processes, this process is also influenced by various policies in vogue, and its proper adoption culminates in better performance of the firms. In the pre-liberalization era it was induced through policy measures of local content requirement and barriers on imports etc. as well as establishment of various institutions, although with little success. Our interviews suggest that most of the relationships were essentially on arm's-length basis with little regards to the essence of networking. In the post-liberalization period the revival of interest in this process is propelled by infusion of competition. But there are very few commensurate policy supports available worth mentioning. There is a need to institutionalize this process with provision of appropriate incentives and requisite institutional supports. Recognising the importance of the process, the firms on their own are increasingly moving toward adoption of this process. There are quite a few evidences of supplier-manufacturer or manufacturer-buyer or manufacturer-supporting institution relationships. But it is still in its infancy, partial and isolated. Nevertheless, it may be worth mentioning that the firms giving adequate emphasis on this process have performed well (see Table 10.3) both in the domestic as well as in export market. The firms like F_D and F_J etc. have demonstrated that how networking improves performance (see the illustration of F2F linkages is section 10.3.2). It confirms the applicability and recognition of this process. At the industry level it is difficult to pin point the impact of networking. However, the positive trend in terms of increased output, market share, lower per unit price of CNC machine tool and to some extent export intensity (see Table 11.3 and 11.4) could be attributed to impact of adoption of this process.

The *process of integration in networks* implies entering into business deals with other entities on the concept of *long-term mutually dependent relationships* with enhanced emphasis on information flow. It is a step further to acquisition of networks advancing towards integration of internal value chain of firm to external supply chain & other stakeholders. The process is crucial because of endogenous as well as exogenous reasons. The inherent characteristics of machine tool industry demand integration in networks. The users provide the 'demand pull' that induces the machine tool firms to innovate initial solutions to technological problems by developing new skills and techniques to fulfill the requirements of buyers. On the other hand the firms on their own innovate based on feedback from the market and provide 'technological push'. There are ample empirical evidences in literature regarding the significant role played by the producer-user interactions in inducing technical changes around the world (Egan & Mody, 1992; Fransman, 1986; Hobday, 1995; Lee, 1996; Rosenberg, 1963, 1976). In our discussions also, while analysing product development capability in chapter six we found evidence that the firms consider interaction with domestic buyers and foreign buyers as the second and ninth most important source for assimilation of technology (see Table 6.5) respectively. The interaction with foreign buyers has been ranked low as most of the firms do not export and therefore have less interaction with foreign buyers. The exogenous factors are increased competition from imports and structural changes in the user industry. Now users require better quality, more flexibility, higher tolerance, faster processing and reduction in lead-time, timely delivery etc. to enhance their own competitiveness. Thus the users are also interested in integrating into the networks.

The process of integration in networks is a complex process. In order to achieve proper integration a firm has to adopt all the mechanisms mentioned earlier particularly establishing linkages across supply chain, forming consortium, and establishing linkages with support institutions with increased vigour. It also requires simultaneous emphasis on cross-functional integration and effective adoption of ICT applications within the firms. We found only sporadic evidence of use of ICT. It is highly fragmented e.g. CAD in R&D or CNC machine tool in manufacturing and use of email/ website for market development etc. Our interviews suggest that main bottlenecks are lack of adequate incentives for investment in ICT. The firms are unwilling to invest due to uncertainty about returns on such investments, inability to specify proper IT applications, unable to retain talented IT personnel and reluctance of employees to get retrained etc. In general, the adoption of the process is yet to pick up in a meaningful way. Nevertheless firms are increasingly recognizing the importance of this process and taking initiatives to adopt it. The firms who have taken more interest have achieved better performance than others (e.g. F_D and F_J etc.).

As regards to establishing linkages with support institutions and various government agencies, it may be said that the linkages appear to be sub-optimal. The reasons are wide-ranging: *lack of initiative* as well as awareness *among the firms*; high level of bureaucracy, cumbersome procedures, lack of accountability, rent seeking attitude and lack of drive among the institutions to reach to the users for their services etc. There is a need for change in the overall mind-set of the bureaucracy that still believes in regulation & control rather than promotion & development. A sincere thrust on simplification of rules & procedures as well as adoption of ICT *(e-governance*) will spontaneously redress above problems and infuse more accountability, responsiveness and transparency.[139] Such initiatives will create enabling environment for adoption of the process. It may also be imperative to provide some legal backing similar to SME Co-operative Association Law of Japan and Korea (Yokoo, 2001).

[139] A survey by EIU (2003) indicates that India ranks 43 in respect of '*E*-readiness' ranking out of 60 countries in 2002. 'E-readiness' signifies the extent to which a country's business environment is conducive to Internet-based opportunities. The countries, where Governments have drawn up clear plans for IT investment and computer literacy, enhanced competition among infrastructure providers and enacted laws to deal with the gray areas created by the Internet are better placed (EIU, 2003).

The process of *deepening of networks* implies enhanced emphasis on the earlier process of integration in networks. It requires simultaneous integration of internal value chain with external supply chain and other stakeholders *with a notion of shared decision making for achieving enhanced performance*. The earlier process was only a step towards achieving the goal of proper integration into networks, while this process is meant to achieve proper integration. A further step next to *deepening of networks* is the process of *generating global networks.* It implies extending the boundary of networking beyond the country *i.e. integration in global supply chain* as adopted by some of the MNCs. However, in the present context, there has been no evidence of adoption of these two processes so far. Nevertheless for sustained development, particularly in this era of globalisation & liberalisation when the basis of competition has changed and arena of competition has extended, firms as well as the Government can no longer afford to remain complacent. It is therefore imperative that firms take initiatives to adopt these processes and the Government should create enabling environment for the firms to take appropriate initiatives.

11.2.6 Interdependencies

Our analysis has brought out certain elucidating facts about the interrelations both within and among the three main constituents of the causality chain i.e. policy, process and performance. I will elaborate this keeping process at the center of analysis. The processes pertaining to individual dimension of industrial policy are although distinct, but seem to be interelated and cumulative. For example, every subsequent process in respect of E&T policy namely acquisition of skill, integration of skill, development of skill and generation of skill are interelated with each other and require a certain amount of adopotion of previous process or processes. They also become increasingly complex and intricate in nature. However, it is difficult to quantify the reqiured amount adoption per se for moving forward to the next process. It could be one of the agenda for future research. Further, these processes more or less seem to follow similar pattern for each dimension of indusrtial policy in the form of acqisition (A), integration (I), development (D) and generation (G) as shown in Table 11.10.

The interdependence also extends across the rows i.e. the processes for technology dimension are complementary and mutually related to processes for investment dimension and so on. For example, the process of acquisition of technology goes concurrently with acquisition of manufacturing capability. Similarly the process of development of technology, development of market or deepening of networks demand simultaneous adoption of each other. In other words one can say that better performance can not be achieved by adopting the processes in isolation. Further, the processes in respect of one dimension of industrial policy are also influenced by policy measures of other dimension of industrial policy i.e. presence of cross-policy effect. For example, the process of acquisition of manufacturing capacity is also influenced by Technology policy (e.g. FC policy) or Market development (stimulating demand) or policy on Industrial Governance (hassle free procedure of getting license) in addition to Investment policy.

Table 11.10: Policy-Process matrix: Summary of Interdependencies

Policy⇓	Process ⇒	Acquisition (A)	Integration (I)	Development (D)	Generation (G)
Dimensions of Industrial Policy	Technology	Acquisition of Technology	Integration of Technology	Development of product/ process	Generation of Technology
	Investment	Acquisition of mfg. capacity	Assimilating mfg. capacity	Integrating external mfg. capacity	Generating overseas mfg. capacity
	Education & Training	Acquisition of skill	Integration of skill	Development of skill	Generation of skill
	Market development	Acquisition of market	Integrating with market	Development of market	Generation of market
	Governance	Acquisition of Networks	Integrating in Networks	Deepening of Networks	Generating global Networks
Product on PLC		Decline/Matured	Matured	Growth	Introduction
Structural Shift at Industry level		Labour Intensive	Capital Intensive	Technology Intensive	Knowledge intensive

We also see a relationship between these processes and product life cycle as well as the level of industrialisation. However, it is cautioned that it is some sort of oversimplification. The *product life cycle* (PLC) *theory* emanates from the dynamic perspective of the international comparative advantage. On the basis of this theory it may be said that the adoption of various processes follow the natural evolution of product and production process. Usually a product at the frontier of technology or new technology initially appears in an industrially developed country that requires higher level of technological capabilities and adoption of processes pertaining to generation stage. As the product and process technologies are widely understood/ simplified and the product passes through growth (*sunrise industry*) stage and then attains its maturity (*matured industry*), these require adoption of processes pertaining to development and integration respectively. On the above analogy, the firms adopting the processes of acquisitions take up manufacturing of products at matured or declining stage in the product life cycle and move forward. For example, initially the firms started manufacturing simple stand alone CNC machine tool (say simple 2-axis CNC lathe) based on imported technology and then moved towards complex CNC machine tool (e.g. turning center or flexible machining cells).

Similar relationship could be visualised in terms of level of industrialization. In the beginning at low level of industrialisation firms take up more labour intensive products. During this time most of the processes adopted correspond to processes of acquisition stage. With the progress of industrialization more capital & skill intensive activities are undertaken. In the advanced stage of industrialization technology intensive and knowledge intensive activities are undertaken that require substantially higher level of investments, technology, management skills and coordination. Accordingly, firms need to adopt correspondingly higher level of processes i.e. integration, development and generation respectively.

11.3 Policy justifications

Our analyses of causal interactions suggest that the government needs to give proper emphasis on strengthening these processes through various policy measures to achieve sustained development of the industry. But the question arises whether such conclusion conforms to theoretical justifications for the interventions? We will verify this with reference to our arguments for the government intervention enumerated in chapter 2 while presenting our theoretical perspective. It encompassed three paramount but interrelated issues: *why* should the government intervene; *how* should the government intervene and the rationale for intervention for CNC Machine Tool industry.

While examining the rationale for the government intervention we saw that prevailing socio-economic conditions in the developing countries do not fulfill the basic conditions for the success of market: *perfect competition, perfect information*, and *full employment*. Thus market is unable to equate private and social costs & benefits leading to pervasive *market failure*. In such circumstances it is therefore desirable for the government to intervene to redress such market failures. The main sources of market failures are identified as *externality, increasing returns to scale i.e. internal economy, imperfect or nonexistent factor markets, non-competitive market, lack of industry coordination* and *information deficiency*. Our analyses suggest that strengthening these processes through various policy measures are instrumental in redressing one or more sources of market failures mentioned above.

For example, strengthening the *process of acquisition of technology* redresses *market failure* primarily in respect of *information deficiency* and *externality*. The process of *acquisition of technology* begins with *identification and* evaluation of relevant technology/ technology sources. An appropriate technology from a reliable source at reasonable price culminates in better performance of firms. As most of the firms in this sector are SMEs, they do not foresee sufficient incentives for investing in the process nor have sufficient capacity for doing so. Even larger firms perceive an element of risk. When successful, they are quickly imitated by other firms through various means or through poaching the key technical staff. Thus the firms do not get adequate return on investment and when they fail there is always a loss. Such problems of *non-appropriability* deter firms to pursue the process. On the other hand, firms face considerable difficulty in gathering requisite vital information on international technology market, as there are lots of tacit elements involved in it particularly in the case of Machine Tools industry, which is quite fragmented and technology intensive. These inherent imperfections call for concerted efforts in the part of the government regarding gathering and disseminating requisite information for the domestic firms as well as promotion of country's image abroad as a viable destination for technology transfer. The snap shot of various processes vis-à-vis sources of market failure is presented in Table 11.11.

Table 11.11: Process – Sources of Market Failure Matrix

Market Failures → **Process↓**	Externalities	Internal Economy	Imperfect Factor Markets	Non-competitive Market	Industry Coordination	Information Deficiency
1. Acquisition of Technology	x			x		**x**
2. Integration of Technology	x	**x**	**x**	x		**x**
3. Development of product/ process	**x**	**x**	**x**	**x**		**x**
4. Generation of Technology	**x**		**x**	**x**		**x**
5. Acquisition of in-house manufacturing capacity	**x**	**x**	**x**	**x**	**x**	**x**
6. Assimilating manufacturing capacity	**x**	**x**	**x**	**x**	**x**	**x**
7. Integrating external manufacturing capacity	**x**	**x**		**x**	**x**	**x**
8. Generating overseas manufacturing capacity	**x**	**x**	**x**	**x**	**x**	**x**
9. Acquisition of Skill	**x**	**x**		**x**		**x**
10. Integration of Skill	**x**	**x**		**x**		**x**
11. Development of Skill	**x**	**x**	**x**	**x**	**x**	**x**
12. Generation of Skill	**x**	**x**		**x**	**x**	**x**
13. Acquisition of Market	**x**	**x**	**x**	**x**		**x**
14. Integrating with Market	**x**	**x**	**x**	**x**	**x**	**x**
15. Development of Market	**x**	**x**	**x**	**x**	**x**	**x**
16. Generation of Market	**x**			**x**		**x**
17. Acquisition of Networks	**x**			**x**	**x**	**X**
18. Integrating in Networks	**x**			**x**	**x**	**x**
19. Deepening of Networks	**x**			**x**		**x**
20. Generation of Networks	**x**			**x**		**x**

Similarly, the process of *integrating external capacity* contributes to redressing almost all sources of market failure in general and internal economy as well as industry coordination in particular. It allows firms to achieve cost effectiveness, increased flexibility, and complementing own production process that culminate in attainment of internal economy. Industry co-ordination is attained due to alleviation of strategic uncertainty that reduces the chances of under investment or over investment in upstream industries (i.e. component industry and other related industries). Such efforts also generate positive externalities in terms of continuous diffusion of technology, generation of forward & backward linkages, higher division of labour and specialization as well as others get encouragement by the perpetuation of successes achieved i.e. 'demonstration effect' etc.

As regards to the question of *'how'* of the government intervention, it may be stated that interventions for strengthening processes are also in agreement with our cerebration of *Structuro-classical* perspective that advocates activism albeit with selected intervention to complement the market with outward-orientation (see Figure 2.6). The argument runs as follows. The strengthening of processes through various policy supports connotes *activism*. These policy supports have to be specific to the industry (but not specific to any firm), thus these measures fall in the category of *selected* interventions. Further, majority of the measures would have connotation of *horizontal* interventions (see section 2.3.2) as they are directed towards selected activity that could span across the industry (e.g. use of ICT, venture capital fund, introduction of e-governance etc.). These measures will lead to as well as implemented by private sector or public-private partnerships, therefore the process-oriented support measures contribute in *complementing* the market rather than replacing it. Such approach also leads to new product development, adoption of new techniques and modern management practices, and creation of linkages with foreign buyers etc. that provide stimuli for exports i.e. *outward orientation* rather than creating dependence on domestic market. Over and above, these actions also contribute in reducing sources of the government failure as well. The measures for strengthening the process of networking such as introduction of e-governance, simplification of procedures, infusion of accountability to functioning of the bureaucracy/ supporting institutions etc. will be instrumental in reducing information deficiency, increasing transparency, perpetuating flexibility in overall functioning of the government. In this way the process oriented policy supports help in creating belief in market mechanism and advancing towards neo-classical extreme on the Structuralist-neoclassical continuum.

From the perspective of the process of policy-making, it may be recognized that due to sheer complexity of social problems, lack of time, and resources most of the policy decisions are made without thorough analysis. There is a need for bringing more information and systematic analysis into the policy-making process (Lindblom & Woodhouse, 1993; Meier, 1991). Our way of analysing the policy-performance causation that lead to identifying the policy directions for development of an industry through strengthening of the processes proposes *a new perspective for policymaking.* It is an attempt to provide more systematic analysis. Although we considered CNC machine tool industry for empirical evidence, such process-based analysis could be equally applied to other industries as well. It may be recognised that reality is dynamic and by addressing these processes, which incorporates the time dimension of process of industrialization one can do real time analysis by relating things in a more practical and pragmatic way. In view of the above it may be concluded that our approach is simple, provides comprehensive solution and improves policy-making process.

11.4 Conclusions

The analyses of policy – performance causation through exploring as to how firms adopt various mechanisms to leverage various policy measures in vogue in the previous five analytical chapters, led to identification of certain processes that are found to be crucial for building various capabilities in the firms and eventually culminate in firms' performance. The identification of these processes in fact has established another bead in the strand of policy-performance causation. These *processes* may be considered *as the missing links* that *connect mechanisms and performance* in our analytical framework depicted in Figure 3.9. A further analysis of influence of each dimension of industrial policy on these processes lead to recognition of policy gaps. Such analyses of the causal interactions suggest that the government needs to give proper emphasis on strengthening these processes through various measures to achieve sustained development of the industry.

It is seen that such policy supports are in conformance with theoretical justifications for the government interventions for the process of industrialization as they redress various sources of market failures as well as government failures. These policy supports are also in agreement with our cerebration of Structuro-classical perspective that advocates activism albeit with selected intervention to complement the market with outward-orientation. In this way the process oriented policy supports help in creating belief in market mechanism and advancing towards neo-classical extreme on the Structuralist-neoclassical continuum. In view of the above it may be concluded that our way of arriving at the policy directions for development of an industry through diagnosis of mechanisms and processes proposes *a new perspective for policymaking*. It is an attempt to provide more systematic analysis. The approach is simple that provides comprehensive solution and improves policy-making process.

Chapter Twelve

SUMMARY AND CONCLUSIONS

This chapter presents the final summary and conclusions. To begin with, the chapter describes the objective of the thesis i.e. what I wanted to do? Then it presents the road map of the thesis i.e. how did I proceed? It is followed with the presentation of what did I discover i.e. the findings and policy recommendations. The limitations and agenda for further research come next. The last section expatiates the concluding remarks.

12.1 What did I plan?

This study is all about understanding how the micro level government policy works at the firm level in the process of industrialization in the context of the developing countries. It attempts to analyse issues such as: how policy measures influence performance of the firms; how to bring more information and systematic analysis into the policy-making process; how do the firms leverage policies to build technological capability that ultimately culminate in firms' performance; why do some firms in an industry perform better than others under the same policy environment. It also identifies policy directions for sustained development of a strategically important industry like CNC Machine Tool in India. In the process, a host of other issues emerge which are relevant to the stylized facts regarding policy-making and government intervention in the era of liberalisation.

The study specifically endeavours to find answers to the following research questions:

- How Industrial policy affects performance of the firms? or in other words, how the firms behave in response of the policy in vogue that culminates in the firms' performance?
- Why should it be essential for the Government to intervene for sustained industrialization of the country?
- What should be the constituents of the Industrial policy?
- What should be the new policy directions for sustained development of CNC Machine Tools industry in India?

12.2 How did I proceed?

To start with, we built the theoretical foundation of the study in the chapter 2. Since the study concerns with role of the government in the process of industrialization, we did start with the discussion on the process of industrialization and the underlying motivation for a developing country to industrialize. It led to three overriding questions that dominated our discussions: *why should the government intervene*, *how should the government intervene*; and *how policy affects performance of the firms?* We identified the answer of the '*why*' based on the rationale of '*market failure'*. Due to the prevailing situation of vicious cycle of poverty in the developing countries, the pre-conditions for the market success i.e. *perfect competition,* perfect *information*, and *full employment* do not exist. Therefore, the conventional rationale for the government intervention, *market failure* still holds. The main sources of market failures identified are *externality, increasing returns to scale, imperfect factor market, lack of industry coordination and information deficiency.* However, it may be recognized that the same situation also leads to the gov*ernment failure i.e. imperfect information, lack of flexibility, problems of incentive & efficiency* and *rent seeking.* The puzzle of choice between market (market failure) and the government (government failure) was solved through analysis of the two school of thoughts: Neoclassical and Structuralism. We argued that the two schools should be viewed as the two extremes on the same continuum rather than as 'either-or' dichotomous construct. The gov*ernment failure* is not necessarily an argument for eschewing government intervention. On the other hand, for redressing market failure there is always a need for the government intervention. Thus, *what matters is "how", "where", "when" and "to what extent" of the government intervention.*

As regards to the '*how*' of intervention, we proposed *a harmonious synthesis of the government and market, which we termed as the Structuro-classical perspective.* It sets forth the premise that *rational government intervention is fundamentally important for the process of industrialization although the belief in market mechanism is indispensable*. The government should participate actively (*activism*) for redressing market failure with more emphasis on *complementing* the *market*, *selective intervention* and *outward orientation*. However, the policy prescriptions should be designed *with utmost caution* based on actual economic, social, technological and political situation prevailing in a country and its national goal. In order to establish the further 'how' of the government intervention, we established its taxonomy. In a broader sense all government interventions that affect industrial development may be considered as Industrial Policy (IP). The statement is true but for a meaningful discussion it ought to be narrowed down. Thus, Industrial policy is segmented in three levels as '*tertiary*', '*secondary*' and '*primary*' on the basis of nature of impact of various policies (macro and micro) that affect industrial development (see Table 2.2). The micro level policies that directly influences the process of industrialization is covered under '*primary industrial policy'* i.e. '*PIP'* We define PIP as '*microeconomic measures designed to influence the structure, resources, conduct and performance of the industry both from the supply-side and the demand-side perspective in order to achieve sustained industrialization and international competitiveness*.' It includes an optimal mix of functional, horizontal and selective policies. We have considered the PIP as *industrial policy per* se and referred throughout in our discussions as *industrial policy*. For a better understanding we further segment the PIP in terms of mutually reinforcing elements namely *Technology, Investment, Education & Training, Market development, and Industrial Governance.* The first three address supply side issues, the fourth one market development deals with demand side issues and the last one concern with mitigating the sources of government failures.

For empirical evidence, we have chosen CNC Machine Tools Industry in India. The strategic importance of the industry in the process of industrialization in this era of technological progress and the researcher's familiarity with the industry are the two main reasons for its choice. The strategic importance of an industry is reflected through the amount of externalities it generates for the process of industrialization in terms of its impact on manufacturing, possibility of dynamic increasing returns to scale, influence on product characteristics and production process of other industries, backward and forward linkages, and the negative consequences for the economy if the industry is not developed properly. We therefore examine the impact of various elements of the industrial policy as mentioned above on the performance of this industry. It is seen that although each element of industrial policy mitigates various sources of market as well as government failures, in the context of CNC machine tool industry, they are more effective for certain specified sources of market failure viz. Technology policy *for capturing externalities*; Investment policy for *coordinating industries*; Education & Training policy for *raising internal economies*; Market development policy for s*preading Information* and *policy on industrial gov*ernance for s*timulating linkages and information flow.*

The operationalisation of the theoretical constructs in chapter 3 led us to answer *how policy affects performance of the firms*. This was achieved through the analysis of policy performance causation. In order to do that, first we ascertain the present status of various elements of industrial policy, their impacts on performance of the firms and where, when and why did policies succeed or fail? In the literature, the discussions on impact of government policy on performance have figured prominently, particularly, in the context of East Asian remarkable success. It is mostly viewed at an aggregate level in the following way. The government formulates policies keeping into mind the national goals. The national goals (say *integration with global economy*) are reflected in the broad objectives of Industrial policy (*export promotion*) and vice versa. The objective is achieved through implementation of the combination of policy measures (*liberalised import policy*), which in turn influence the performance of the industries (*international competitiveness*). A well-articulated policy when implemented in a proper way enhances performance and inappropriate policy or poor implementation of good policy may even work in reverse direction. Although the studies are quite meaningful, there has been overwhelming stress on macroeconomic aspects of industrial behavior and broad measures of industrial performance vis-à-vis the role of government policy in the market setting. They offer inadequate understanding of the mechanisms of influence of policies on firms' performance in the setting of firms.

The S-C-P paradigm of IO economics provides some insights as to how the firms operate under a policy regime in place or in other words how policy influences the strategies and performance of the firms. However, it does not extend adequate understanding of the mechanism of the influence of policies on firms' performance. There is a need for more elaborate micro-level analysis. It may be recognised that firms' performance predominantly depends on the *resources* owned or controlled by the firms rather than market structure only. Resources are essential for attaining static efficiency that requires a current set of resources as well as for dynamic efficiency (technological progress), which necessitates continuous development of resources. It is the interplay of external environment, internal environment and the government policies that affect building of various capabilities in firms that finally culminates in firms' performance. Therefore it is imperative that *resources* of the firms should be given adequate importance in assessing the policy-performance causation. There are a few studies in technology capability literature where resources have been given some credence in analysis of the causality. But these studies primarily focus on the phenomena of technological change rather than firms' performance vis-à-vis policy. This study *attempts to fill in this void*.

In this study we have attempted to explain the policy-performance causation placing *resources* at the *center of analysis* in a simple but comprehensive way as per the framework presented in Figure 3.9. The three elements of the causality chain: *policy*, *resource* and *performance,* are the *building blocks of our analysis*. The *first building block* pertaining to policy consists of three elements: national goal, industrial policy and objective of the specific policy measures. The *central building block*, the *resources* of a firm could be understood as stocks of available factors both tangible and intangible that are owned or controlled by a firm and which enable the firm to conceive of and implement strategies in order to improve its performance. Since our analysis concerns at the level of firms, we refrain from using the traditional macro level definition of resources i.e. land, labour and capital. For the sake of simplicity and easier understanding, we have segmented resources on the basis of functional areas in firms such as *R&D&E*, *manufacturing*, *human*, *marketing*, *and linkage*. *Linkage* refers to coordination and cooperation of firms with the industry specific institutions, infrastructures and various stakeholders. The *third block* i.e. *performance* has been elaborated in literature in various ways. They vary enormously in scope, context, and level of analysis give varying signals. It is seen that no single measure captures all the notions of performance. In the *selection* of performance criteria, the *availability of reliable data* has *prevailed over the logic.* We consider it as one of the limitations of the study as it limits the comprehensiveness of assessment. For a better understanding we have segmented performance measures in terms of level of analysis i.e. *firm level* and *industry level*. At the firm level we have considered *annual sales, export intensity* and *labour productivity*. At the industry level measures such as annual sales, export ratio, domestic market share, average price per unit, RSCA, labour productivity index, and wage index have been used.

The *resources* of firms have been further elaborated in terms of three more constructs: *capability, mechanism* and *indicator*. In this context it is mentioned that resources are inputs into the production process but on its own, few resources are productive. They become productive in cooperation and coordination with other resources using human capital. For example, a firm is able to create capability of *developing new product* on the basis of its R&D&E resources in cooperation with marketing research (marketing resource), availability of finance for R&D activities (financial resource), technical personnel (human resource) and coordination with research institutes and other supporting agencies (linkage resources). Thus *capability* connotes as what a firm can do as a result of combination of resources working together to achieve performance. The second construct, *mechanisms,* may be understood as actions undertaken by the firms for achieving the capabilities. It is more or less similar to conduct of the S-C-P paradigm. The difference being, *conduct* is seen in the *market setting*, whereas *mechanism* is to be seen in the *internal setting* of the firms. Policy measures influence the choice and thrust on the use of various mechanisms by the firms. In other words it may be said that the firms adopt different mechanisms in various combinations to leverage the policies in force. Some mechanisms may be specific to certain policy measures and some may be common to various policy measures. *Indicators* are basically *intermediate performance measures.* Indicators have been considered as the measure for judging the outcome of adoption of a mechanism or combination of mechanisms to achieve various capabilities.

In order to ascertain the influence of various elements of industrial policy on the performance of the firms we structured these parameters in the form of a 5 x 5 matrix in terms of the five *elements of industrial policy* and the five r*esources of the firms* (see Table 3.3). It may be recognised that although, each element of policy influences all the resources, but certain policy exerts more influence on some specific resources than others. For example, Technology policy influences directly on R&D&E resources rather than human resource or marketing resource of the firms. In other words, Technology policy is not an appropriate measure for building marketing capability of the firms and so on. We termed such impacts as *direct impact*. In our analysis, we have *concentrated* on *direct impact* cells only. The other four direct impact cells identified are investment policy/ manufacturing resources; education & training policy/ human resources; market development policy/ market resources; and policy on industrial governance/ linkage resources. In order to gain deeper insights, the technology-, investment- and the market development policies have been further disaggregated in terms of relevant policy measures (two each) namely FC policy and policy for promotion of in-house R&D; regulations on entry/expansion and regulations on imports; domestic market development and export market development policy respectively. In this way our policy-resource matrix increased to 8 x 5 matrix having eight direct impact cells. Then we identified mechanisms and indicators for each of the eight direct impact cells. These mechanisms and indicators become the medium for analyzing the impact of various policy measures on different resources of the firm. It is mentioned that the mechanisms and indicators however had to be modified accordingly to meet the situation and the practical considerations met in course of field investigations. Table 3.6 presents the final list of mechanisms and indicators.

The general framework of operationalisation has been presented in the Figure 3.10. It consists of four elements: *policy & industrial development*, *Machine Tools industry*, *analyses of policy-performance causation* and summary & *conclusions*. In order to understand the functioning of industrial policy in India, one needs to understand how the industries in India performed under the policy regime till date in the first place. We achieved this through analysing the evolution of policy framework and its impact on the overall industrial performance in India in *chapter four*. Then we narrowed down our analysis in *chapter five* to Machine Tool industry. We analysed both the World Machine Tool industry as well as the Indian Machine Tool industry in respect of evolution, structure, technological status and position vis-à-vis other countries etc. Then we moved to *the core of our analyses efforts i.e.* analysis of policy-performance causation. It has been undertaken in distinct but interrelated steps. *First*, in chapters six to ten, we analysed how the firms adopted various *mechanisms* to leverage the policies in force to build different capabilities that finally culminate in firms' performance. For example, the promotional nature of Technology- and Investment policy as well as increased transparency in industrial governance since 1991, led the firms to emphasize more on mechanisms of assimilation of technology, new product development and subcontracting to build product development- and manufacturing capability that culminated in increased sales and exports. In the absence of suitable Education and Training policy the firms recruited educated persons, imparted in-plant training and periodic training to build human resource capability that increased firms' labour productivity.

In the *second step* (chapter 11), we reconfigured our analysis row-wise i.e. policy measure wise (see Table 3.6) in order to consider the impacts of a specific policy measure on other resources of the firms. Our analyses in the five analytical chapters led to identification of certain activities that are found to be crucial for building various capabilities in the firms. These activities we termed as '*processes*' since they are particular course of action intended to achieve a defined business outcome. We visualized these processes as the missing links that connect mechanisms to performance. Thus, we introduced some extension in our existing framework of analysis and considered the '*processes*' supplementary to '*mechanisms*' in the analysis of causation. Here our framework of analysis for causation transformed from policy-mechanism-performance (PMP) at the firm level (Figure 3.9) to policy-mechanism-process-performance (PMPP) at the industry level (Figure 11.1). Such analysis helped in better understanding of the policy-performance causation, identification of policy gaps, and factors inhibiting adoption of these processes by the firms.

12.3 What did I discover?

The answer to the question 'what did I discover?' could be presented in two distinct but interrelated parts. The first part: *general findings,* concerns with what did I discover in each of the chapters through four to eleven. The second part describes the policy directions i.e. *policy recommendations*.

12.3.1 General findings

The analysis of policy environment suggests that the process of industrial development in India empirically corroborates the notion of linkage of policy and performance. The policy of self-reliance/ import substitution after the independence was the outcome of prevailing situation at that time and the contemporary intellectual climate. It is seen that the initial performance was somewhat positive. But the failure to change with the emerging realities pushed the performance to decline. During the seventies and eighties, when most of the developing countries attuned their policies as per the emerging realities of openness towards trade and investment, India continued to hang around policy of import substitution and the misplaced notion of self-reliance. It was only in 1991 that a sweeping reform was undertaken at the behest of international development agencies to bale out India from acute balance of payment (BOP) crisis. The new policy framework switched from the notion of '*self-reliance'* to *'integration with the global economy'*. It is gradually moving towards the neoclassical end on the Structuralist-Neoclassical continuum. The initial response of liberalization had been reasonably well. But the overall results are *mixed and fluctuating*.

The Machine Tools industry in India has also more or less chartered the same path as the overall industrial sector. It has largely grown under a protected environment to achieve the objective of self-reliance. As a result a well diversified but fragmented and technologically less advanced industry has evolved. The industry has acquired technological capability in relatively less complex non-CNC and low-end of CNC machine tools only. The liberalization since 1991 has highlighted the weaknesses of this industry particularly in respect of lack of technological capability, international competitiveness and capability to satisfy the needs of domestic engineering industry. A comparison with the main machine tool producing countries in the developed as well as developing world in terms of two performance measures: domestic market share and revealed comparative symmetric advantage (RSCA) reveals that, India's position has moved from bad to worse after the liberalisation. On the one hand the industry has not able to defend the domestic market and on the other it has lost export competitiveness. The industry is operating under both the supply side and the demand side constraints. However, the consolatory development is the steady rise of CNC segment of the industry in terms of production, domestic market share and to some extent exports. The structure of this industry segment is almost same as overall industry i.e. few large firms coexist with large number of

SMEs. The level of concentration is still high. The progressive abolition of barriers to entry and other liberalisation measures has led to emergence of quite a few techno-entrepreneurs setting up SMEs with proactive approach adopting modern business practices. They have been comparatively more successful and gaining market shares primarily at the cost of large firms. These firms are trying to build capability in the standardized CNC machine tools. Another notable feature, which is evolving is the efforts of the firms towards building networks and consortiums, particularly in the marketing activities.

The firm level analysis of policy-performance causation was undertaken first in respect of Technology policy vis-à-vis R&D&E resources of the firms. We found that the firms adopted various mechanisms to leverage the policies in force in order to build up technological capability for product development that finally reflected in firms' performance. However, the adoption of mechanisms varied in scope and implementation culminating in differential performance. The firms that took more pro-active approach have performed better. Smaller firms found it difficult to adopt the mechanisms properly primarily due to resource constraints. On the overall, firms' own technological effort is seen to be the basis of creation of technological capability irrespective of the source of technology. Still, it might be necessary to supplement with imports of technology for better performance. We found that the firms undertook technological efforts in respect of various activities like identification of technology, acquisition of technology, assimilation of technology, adaptation of technology, absorption of technology, incremental improvement of products, innovative use of the technology in related products, and development of new products based on known technology to build technological capability for product development. In addition to the above, there could be certain additional activities (e.g. innovation of new technology and innovation of new products based on new technology). All these activities although seem to be distinct but interrelated with each other and quite of few elements of each activity overlap. We aggregate these activities in four broad groups namely *acquisition-*, *integration-*, *development-* and *generation of technology.* The requirement/ intensity of technological efforts increases as firms move up the ladder as well as move across (i.e. move horizontally within each activity) translating into higher technological capability of product development. As regards to the general observation regarding the FC policy and in-house R&D policy, the views of the firms indicate that these policies have worked, albeit with a difference. The FC policy has been quite supportive throughout. It has also worked with a lag in terms of spillover effect that helped the industry to grow over time. The response in respect of in-house R&D policy has not been encouraging. There seems to be a need of more attractive tax incentives and removal of bureaucratic hurdles for promotion of R&D&E activities in the firms.

Then we proceeded to analyse the causal interactions in respect of Investment policy vis-à-vis Manufacturing resources of firms. The investment policy includes mainly *regulations on entry/ expansion*, *and restrictions on imports.* The abolition of restrictions on entry/ expansion and FDI have created conducive environment for the firms to take decision freely for new investments, expansion, location, production capacity, or product specification based on their business acumen. Similar impact is seen in respect of removal of restrictions on imports as well. It has provided incentives for the firms for *new investments* in two ways. First, it induced a sense of fear from competition from imports due to abolition of QR as well as progressive reduction in tariffs. Second, imports of machine tools have become relatively easier and cheaper for further investments for the firms themselves. Our findings reveal that the firms adopted primarily two mechanisms namely investments for in-house manufacturing, and outsourcing to leverage the liberalization in investment policies. We found that investment in-house manufacturing facilities is the necessary but not the sufficient condition for building technological capability for manufacturing in the firms. It ought to be complemented with outsourcing. Firms usually undertook high value added and critical operations *in-house* and *subcontract* non-critical operations. They resorted to imports due to lack of availability of material inputs from domestic sources in required quantity, quality, time, and price. Subcontracting and importing from abroad are the two subsets of outsourcing. In general, the entire process of building technological capability for manufacturing could be disaggregated in four distinct but interrelated activities namely: acquisition of in-house manufacturing capacity, assimilation of manufacturing capacity, integrating external manufacturing capacity, and generating overseas manufacturing capacity. The requirement of TE increases as firms move up the ladder as well as move across translating into higher technological capability.

The analysis of the causation in respect of Education & Training (E&T) policy vis-à-vis Human resources in the firms, suggests that the extensive E&T system in India generates scientists, engineers, and technicians without adequate industrial exposure/ practical knowledge creating acute gap between education and employability. Moreover, there seems to be less emphasis on skill development after the employment. There is virtually no system of incentive for employee or the employers to emphasize on skill development. In response to such policy gaps the firms primarily adopted three mechanisms namely recruiting skilled personnel; in-plant training; and imparting training for continuous up gradation of skill. The first two mechanisms become instrumental in bridging the gap between education and employability. The third one enables the firms to keep pace with new development in technology and market demand. In this case also we found that the mechanisms adopted by the firms although seem to be similar in nature, varies in its content, scope and implementation culminating to difference in performance of the firms. The firms that took more pro-active approach have performed better. The dynamics of building human capital in firms could be visualized in terms of four distinct but interrelated activities namely: *acquisition of skill, integration of skill, development of skill and generation of skill.* The intensity of technological efforts increases as firms move up the ladder as well as move across translating into better human resource capability. These require adequate policy support for the reasons of externality to enable firms for rational decision-making.

So far the analysis of causation hovered around the supply side issues but the demand side issues remained untouched. We addressed the same through the analysis of causation in respect of policy on market development vis-à-vis firms' marketing resources. The Market development policy concerns with development of market, both within and across the national boundary i.e. domestic market and export market. Our findings suggest that the existing policy frameworks fall short in supporting the market development efforts of the firms and unable to stimulate sufficient demand of the CNC machine tools in the domestic market. They are also vexed with the problems of the procedural hassles. The firms adopted the following mechanisms namely *interaction with the users*, *participation in trade fairs*, *consortium approach* and *use of e-commerce* to buildup market development capability. Like the earlier cases, the mechanisms adopted by the firms varied in scope and implementation resulting in divergence in performance. Some of the pro-active firms that adopted the mechanisms in a more planned manner reaped the dividends accordingly. The firms that performed better in the export market also showed better performance in the domestic market. But the reverse does not seem to be true. It suggests that better export orientation contributes in achieving better performance. On the overall, the analysis indicated that the process of building technological capability in respect of market development constitutes of four distinct but interrelated activities namely *acquisition of market*, *integration with market*, *development* of market and *generation of market.*

In the last four chapters we discussed how policies on technology, investment, education & training and market development influence building of respective capabilities in the firms and in turn determine firms' performance. The discussions also suggested that deficiencies like poor implementation of policies, lack of necessary institutional support and coordination/ cooperation among various stakeholders hinder in achieving desired performance by the firms. The analysis of policy-performance causation in respect of policy on Industrial governance vis-à-vis Linkage resources of firms is an attempt to address all these issues. Due to the abstract nature of policy on industrial governance and phenomena of linkages, we examined the causal interactions through analysis of the institutional framework in respect of the industrial governance vis-à-vis the linkages among the various stakeholders. The linkages are visualised in terms of government-to-government i.e. *G2G linkage, gov*ernment-to-firm i.e. *G2F linkage* and firm-to-firm i.e. *F2F linkage* (see Figure 10.2). Our analyses suggested that there were extensive institutional network in the country. But there seems to be acute lack of linkages among the firms and these institutions. The present institutional framework does not stimulate proper coordination and cooperation among the stakeholders. It is desirable that both the government as well as the firms takes appropriate actions to address these problems. It was found that the firms primarily adopted the mechanisms of *liaison with the government departments*; *creating linkages with support institutions*; *forming networks* and *adopting consortium approach* to leverage the existing institutional framework. The firms that adopted these mechanisms in a pro-active manner have performed better. The analysis further led to identification of four distinct but mutually related activities for building the linkage capability in the firms. We referred these activities as *acquisition of networks, integration in networks and deepening of networks and generating global networks.* Like in the earlier cases the requirement of technological efforts increases as firms move up the ladder as well as move across translating into higher technological capability and better performance.

Our analyses in the five analytical chapters led to the identification of certain activities that are found to be crucial for building various capabilities in the firms. These activities we term as '*processes*' as they are particular course of action intended to achieve a defined business outcome. Although the mechanisms and the processes appear to be similar, a process has a broader connotation than mechanism. *First*, A process may encompass one or more mechanisms either in its essence or in totality. *Second*, a process may be the underlying factor that triggers one or more mechanisms to work. *Third*, mechanisms may be common for one or more processes, although the scope and the degree of adoption may vary. *Fourth*, these processes seem to follow similar pattern for every dimension of indusrtial policy in terms of acqisition, integration, development and generation. Although distinct, they appear to be cumulative and interelated as well. As a matter of fact the identification of these processes has added another bead in the strand of policy-performance causation. They may be considered *as the missing links* that *connect mechanisms with performance*. They replace the two-way arrows in our framework of analysis depicted in Figure 3.9 earlier.

The row-wise analysis of policy-performance causation considering the 'processes' supplementary to the 'mechanisms' suggests that like mechanisms, the adoption of processes by firms are also influenced by various policies in vogue and their proper adoption culminate in better firms' performance. Thus the government needs to give proper emphasis on strengthening these processes through various policy measures to achieve sustained development of the industry. It is seen that the processes in respect of one dimension of the industrial policy are also influenced by the policy measures of other dimension of the industrial policy i.e. the presence of the cross-policy effect. For example, in addition to the Investment policy, the process of acquisition of manufacturing capability is also influenced by the Technology policy or the policy on the industrial governance and so on. The interdependence is also visible among the processes across the rows i.e. the processes for technology dimension is complementary and mutually related to the processes for investment dimension and so on. For example, the process of acquisition of technology goes concurrently with the acquisition of manufacturing capability. Further, the processes appear to be more cumulative as well as mutually related with each other. It suggests that strengthening the lower level processes through proper policy supports is essential for adoption as well as imparting policy supports for the higher level of processes.

We also found that the strengthening of these processes through various policy measures are in conformity of our theoretical justifications for the government interventions. It is instrumental in redressing one or more sources of market failures. Strengthening the processes in respect of linkage resources mainly through infusion of use of ICT and e-governance etc. mitigates the sources of government failures as well. It is also in agreement with our cerebration of *Structuro-classical* perspective for the process of industrialization that advocates activism albeit with selected intervention to complement the market with outward-orientation. The strengthening of processes through various policy supports connotes *activism*. Since quite a few of these are to be specific to the industry (but not specific to any firm) thus these measures fall in the category of *selected* interventions. However, majority of measures would have connotation of *horizontal* interventions as they are directed towards selected activity that spans across the industry (e.g. use of ICT, venture capital etc.). As most of the measures lead to promotion of private sector or public-private partnerships, therefore the support measures contributes in *complementing* the market rather than replacing it. Such measures also provide stimuli for exports i.e. *outward orientation* rather than creating dependence on domestic market only. In this way the process oriented policy supports help in creating belief in market mechanism and advancing towards neo-classical extreme on the Structuralist-neoclassical continuum.

From the perspective of the process of policy-making, it is well recognized that due to sheer complexity of social problems, lack of time, and resources most of the policy decisions are made without thorough analysis. There is a need for bringing more information and systematic analysis into the policy-making process. Our way of analysing the policy-performance causation that lead to identifying the policy directions for development of an industry through strengthening of the processes proposes *a new perspective: a process-oriented perspective for policymaking.* It is an attempt to provide such systematic analysis. Although we applied this approach to CNC machine tool industry in India, such process-based analysis could be equally applied to other industries and other developing countries as well, with proper modifications. It may be recognised that reality is dynamic and by addressing these processes, which incorporates the time dimension of process of industrialization one can do real time analysis by relating things in a more practical and pragmatic way. In view of the above it may be concluded that our approach is although simple, but provides comprehensive solution that improves policy-making.

12.3.2 Policy Recommendations

It is proposed to present the policy recommendations in respect of each dimension of Industrial policy vis-à-vis the processes. Here a few points merit attention. *First*, due to cumulative nature of the processes and interdependencies among the processes vis-à-vis each dimension of Industrial policy the policy recommendations for the lower order processes (say acquisition) should be considered as stepping stone for policy recommendations for the higher order of processes (say integration). Similarly the policy recommendations for the higher order processes should also be initiated for strengthening the lower order processes as well. It may also be possible that a policy recommendation is applicable to more than one process. *Second*, the institutional supports should be preferably in public-private partnerships. Establishment of service providers in private sector individually or in consortiums should also be encouraged. *Third*, considering the fact that the processes pertaining to the '*generation'* stage concerns with operating at the frontier of technology and the firms in the developing countries in general and India in particular in CNC machine tool industry are yet to attain such level, we would like to concentrate on policy recommendations for strengthening the first three levels of processes i.e. *acquisition, integration and development* only. *Fourth*, attention has been given to the fact that the recommendations do not violate commitments to the WTO.

12.3.2.1 Technology policy

Technology policy concerns with access to new technology, its adaptation to local conditions, assimilation, improving upon them and innovating new products & processes. Its overall objective is to move forward on the technological ladder from the stage of *acquisition to innovation*. It mainly constitutes of four policy measures: import of technology, promotion of in-house R&D, supply of skilled personnel and provision of technology infrastructure. Accordingly the recommendations hover around these policy measures.

i. Acquisition of Technology

- Establishment of Technology Data Bank to provide detailed information on various technology/ technology sources,
- Managerial consultancy/ training for evaluation of technology and negotiations with technology suppliers in respect of technological contents, mechanism of transfer etc. particularly for the SMEs,

ii. Integration of Technology

- Strengthening/ restructuring of the CMTI

- Establishment of research institutes/ metrological centers/ quality control centers focused on CNC Machine Tool in different regions of the country,
- Requisite fiscal and non-fiscal incentives for promotion of in-house R&D in the firms,
- Matching grant/ soft loan for R&D projects
- Financial supports to intermediary R&D institutions (e.g. testing, consulting)
- 125% Tax deduction of Capital expenditure for R&D activities as allowed to drugs & pharmaceutical industry etc.,

iii. Development of Technology
- Technology Financing Institutes in line with Venture Capital Funds
- More thrust on patents and IPR regulations
- Providing funds for applied research
- Supports for joint/ contract research projects

12.3.2.2 Investment policy

Investment policy primarily thrusts on mobilization of domestic and foreign investments to induce competition in the domestic market. It hovers around regulations on entry and expansion, and regulations on imports. The main policy measures for the former are industrial licensing and FDI policy, and for the latter import licensing policy and tariff policy.

i. Acquisition of manufacturing capacity
- Ease of financing for establishment of SMEs,
- Soft loan to SMEs for buying CNC Machine Tools,
- Creation of enabling environment for FDI,
- Automatic approval for 100% foreign equity participation from the existing 51%,
- Removal of inconsistencies in the tariff structure
- Lowering of duty on CNC controls

ii. Assimilating Manufacturing capacity
- Establishment of subcontracting & partnership exchange (SPX)
- Preferential financing for establishment of subcontracting firms
- Establishment of Machine Tool Technology Parks with special incentives for FDI

iii. Integrating external Manufacturing capacity
- Supports for proper diffusion of ICT both within and across the firms,
- Supports for joint up gradation of manufacturing technology by the firms and subcontractors/ suppliers

12.3.2.3 Education and Training policy

For the purpose of our discussion we have focused on the micro level impacts of Education and training policy for building human capital in the firms. Education policy concerns with generating skilled work force as per the specific requirement of the industry *(skill creation)* and training policy deals with pre-employment and post-employment training for upgrading skills *(skill development)* to build various capabilities in firms.

i. Acquisition of Skills

- Establishment of more CNC Machine Tool related disciplines in existing universities engineering colleges, polytechnics and industrial training institutes,
- Establishment/ conversion of a few existing universities, engineering colleges, polytechnics focused on CNC Machine Tool and related technologies
- Inculcating interest among students from the secondary level in manufacturing/ Machine Tool through sponsoring visits to local firms and other measures,
- Restructuring Small Industry Service Institute (SISI) in line with Singapore Vocational and Industrial Training Board (VITB),

ii. Integration of Skills

- Sensitizing firms on importance of requisite in-plant training,
- Matching grants/ soft loans / Tax incentives for expenditure on in-plant training activities and creation of training infrastructure in the firms,
- Encouraging firms, distributors, suppliers and education and training providers participate in common training centers,

iii. Development of Skills

- Establishment of training institutes with major focus on CNC Machine Tool in public-private partnerships or in private sector,
- Establishment of Skill Development Funds (SDF) as done in Singapore or Malaysia. Development Council for Machine Tool/ IMTMA may act as nodal agency,
- Financial incentives for intermediary training institutions/ consultants,
- Formation of local training consortiums involving the firms, research institutes, and training institutes etc.

12.3.2.4 Market Development policy

The Market development policy addresses demand side issues and concerns with development of market. Its main objective is to create demand in the domestic market and promote domestic products in the export market. We have discussed this earlier in terms of *domestic market-* and *export market development.*

i. Acquisition of Market

- Support for creating awareness through 'BUY CNC', 'BUY INDIAN' campaign
- Fiscal and non-fiscal incentives to SMEs to buy CNC Machine Tool e.g. reduction/ exemption of excise duty, investment tax credit, accelerated depreciation and subsidized finance etc. The provision of 50% first-year cost write-off in line with the Jobs & Growth Tax Relief Reconciliation Act 2003 of the USA may be a good option,
- Supports for establishing Lease Financing/ Hire purchase agency for Machine Tool,
- Sensitization of firms for export opportunities and export procedures,
- Removing procedural hassles for cost-neutralisation measures for exports,
- Provision of export finance at international rates of interest,
- Removal of minimum export requirement of Rs. 20 million for availing MDA
- Financial supports for participating in Trade fairs, use of e-commerce, and export consortiums etc.

ii. Integrating with Market

- Sensitization of firms for integration with market,
- Increased government procurement for sophisticated machine tools,
- Fiscal/ non-fiscal incentive for joint product development and repeat purchase,
- Establishment of Export promotion Funds on matching grant basis,

iii. Development of Market

- Matching grant to IMTMA or other agencies for identification of market/ investment opportunities abroad,
- Soft loans/ Line of Credit to less developing countries to import CNC Machine Tool from India and to establish joint ventures with Indian firms.

12.3.2.5 Policy on Industrial Governance

The *policy on industrial governance* concerns with mitigating the various sources of the government failure. It draws attention primarily on three aspects: formulation & implementation of policies, building institutions and improved flow of information among various stakeholders. Eventually these require complex and dynamic *interactions* both within and between the various stakeholders: the government, firms, supporting institutions and market.

i. Acquisition of Networks

- Creating awareness among all stakeholders about networking,
- Provision of technical advisory services and incentives for adoption of networking practices,
- Empowerment of the Development Council for Machine Tool with adequate fund for promotional activities,
- More thrust on coordinating role of the IMTMA and ICAMT_UNIDO for networking.

ii. Integrating in Networks

- Strengthen Cluster Development Program,
- Supports for use of ICT/ other modern management techniques for SMEs e.g. certain percentage of such expenditure (say 40%) may be considered as expense,
- A sincere thrust on simplification of rules and procedures as well as adoption of ICT in the government *(e-governance)*,
- Change in the mindset of the bureaucracy in the government/ supporting institutions from regulation to promotion and development.

iii. Development of Networks

- Sensitization of all stakeholders for shared decision making for achieving better performance,
- Incentives for networks for access and use of capital; providing common facilities and infrastructure; extending education and training; and export promotion initiatives etc.

12.4 Where to go next?

In this real world nothing is perfect. Our research is no exception. Thus it is important to direct attention to the limitations of the present research and directions for future research. The initial limitations appear in respect of measurement of variables and subjective bias of the data. Although every attempt has been made to identify the appropriate mechanisms, indicators and performance measures, we do not claim exhaustiveness. The mechanism and indicators had to be further modified accordingly to meet the situation and practical considerations met in course of field investigations. As regards to the criterion of selection of performance measures, the availability of reliable data has prevailed over theoretical appropriateness. In respect of quantification of mechanisms, it is stated that due to complex and abstract nature of majority of mechanisms, it has been difficult to adjudge the status of adoption of such mechanisms that could be compared across the board. Thus, we have taken recourse to qualitative comparison of the facts on a five-point scale, ranging from 1 (not important) to 5 (crucial) at the risk of over simplification due to fuzziness of such rankings and perceptual differences of the firms. We all applied this in case of some of the indicators as well. Further, for some of the indicators and performance measures due to lack of availability of reliable data across the firms we had to use proxy measures in place of the appropriate measures. Such limitations although limit the comprehensiveness of the assessment, offer scope for further elaboration depending on time, scope and situation of the study.

As regards to the overall findings of the research, we would like to draw attention on the following. The analyses only suggest the impact of policy. It is not able to illustrate what would have happen had there been no policy? Nor we do know what would have been the intensity of impact of policy: either more or less or how much? The analyses of causal interactions although give good insight of impact of various policy measures in building different capabilities in the firms that culminates in firms' performance, it is difficult to single out the impact of any specific policy on firms' performance since all the policy measures are interrelated. The same observation applies in respect of the mechanisms, processes and performance measures as well. It has not been possible to identify or establish one to one relationships among them. Nevertheless, these may be considered as the pointers for future research.

Further, there are limitations in respect of generalization. For a policy research based on case study method like ours, generalizations of results may not be possible. We claim very limited external validity. The prevailing economic, socio-political environment, institutional setup, technological capability, and national objective of countries are so diverse that recommendations for one country cannot be applied for other countries. However, efforts have been undertaken to describe the situations/ context/ methods so vividly that other researchers who would like to transplant the methodology or findings, may do it with less hassles by incorporating necessary modifications. In this way, the present research of single industry/ single country settings may be replicated in multiple industry/ single country or a comparative analysis in single industry/ multiple country settings as well.

12.5 Final Remarks

This study is a novel attempt to understand the causal relationships between industrial policy and performance at the firm level in the context of developing countries. The study explored how the firms adopted various mechanisms individually or in different combinations to leverage the policies in force to build different capabilities that finally culminated in firms' performance. It is seen that in certain cases the mechanisms were adopted to compensate the absence of policy or lessen its adverse impact. The divergence in performance could be attributed to variation in scope and implementation of mechanisms by the firms. Some of the pro-active firms gave more emphasis on adoption of the mechanisms and consequently showed better performance. The firms identified what policy provides and how best that could be used in their favour and acted accordingly. Moreover, they also recognised the policy gaps and dealt with the problem by contributing themselves. Further, the small-scale firms appear to give less emphasis on adoption of the mechanisms compared to others primarily due to lack of resources. Such findings suggest that policy supports should be designed in such a way that it should help the firms making better use of the policies as well as create conducive environment for development of the industry in general and SMEs in particular.

The identification of certain activities, which we term as '*processes*', has both theoretical and practical implications. As a matter of fact it has added another bead in the strand of policy-performance causation. The processes may be considered as the missing links that connect mechanisms with performance. Our analysis suggests that like mechanisms, the adoption of processes by the firms is also influenced by various policies in vogue that finally culminates in firms' performance and hence the performance of the industry. Thus the government needs to give proper emphasis on strengthening these processes through various policy measures to achieve sustained development of the industry. Such policy supports conform to the theoretical justifications for the government interventions, as they are instrumental in redressing various sources of market failures as well as the government failures. Further, they are also in agreement with our cerebration of *Structuro-classical* perspective for the process of industrialization. Although quite a few measures would be industry-specific, majority of measures would have connotation of *horizontal* interventions, since they are to be directed towards selected activity that spans across the industry. In this way the process based policy supports help in creating belief in market mechanism and advancing towards neo-classical extreme on the Structuralist-neoclassical continuum.

The practical implications emanate from its relevance for all the stakeholders in the process of industrialisation in general and the firms in particular apart from the policy-making institutions. The visualization of cumulative nature of processes (acquisition, integration, development and generation) vis-à-vis different elements of industrial policy and their interdependencies open up new vistas for future planning. Such comprehension of the scenarios will help the firms as well as other stakeholders to formulate/ implement strategies and actions in a more systematic way. The employees of the firms can also derive the benefit of hindsight from the research findings. Further, efforts have been undertaken to present the research in such a way that readers find it easy to read and simple to comprehend without compromising with the theoretical rigor. It may be claimed that the research is an attempt to provide a systematic analysis for arriving at the policy directions for development of an industry. Our approach is although simple but provides comprehensive solution that improves policy-making.

At the end, it is important to draw attention to the limitations of the present research, particularly on three counts. *First*, although every attempt has been made to identify the appropriate mechanisms, indicators and performance measures, we do not claim exhaustiveness. *Second*, the analyses of causal interactions although give good insight of policy-performance causation, we have not been able to establish discreet relationships between various variables i.e. policy measures, mechanisms, processes, indicators, performance measures. *Third*, the present research is in single industry/ single country settings only. It does not analyse multiple industry/ single country and single industry/ multiple country settings etc. Thus there is need for further elaborations on these aspects. These limitations offer scope for further theoretical study as well as empirical research.

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Appendix A.1

Survey Questionnaire

Part I - General

1.1 Name of the Firm

1.2 MAILING Address

1.3 YEAR of commencement of commercial production
Year of commencement of commercial production of CNC Machine Tool

1.4 Ownership : Proprietary/ Pvt. limited/ Public limited/ Foreign Joint venture/Foreign subsidiary/ Government of India Enterprise/ 100% EOU

In the case of foreign equity participation please give name of the foreign equity participant and percentage thereof:

1.5 Total Number of Employees: 0-50/ 51-100/ 101-200/ 201-500/ 501-1000/1001- 2000/ 2001 & above

1.6 Items Of Manufacture & Annual Capacity

SL. No.	Product Description	Qty. (Nos)

1.7 Annual production And Exports for the last five years **(Financial year wise)**

Qty (Q) in Nos. Value (V) in Rs lakh

	PRODUCTION				EXPORT			
YEAR	**TOTAL**		**CNC MACHINE TOOL**		**TOTAL**		**CNC MACHINE TOOL**	
	Q	V	Q	V	Q	V	Q	V
Average of 1989-92								
1992-93								
1993-94								
1994-95								
1995-96								
1996-97								

1.8 Investments (Gross block less investment in land & buildings) - **in Rs lakh**

Investment		**Investment in last five years year wise** (i.e addition to gross block in plant and machinery) in Rs Lakh					
PLANT & Machinery	**Present**	**Av. of 1989-92**	**1992-93**	**1993-94**	**1994-95**	**1995-96**	**1996-97**
Indigenous							
Imported (CIF)							
NC/CNC Machine Tools							
Indigenous							
Imported (CIF)							

1.9 Future Production & Investment Plan (In Rs lakh)- Financial year wise

(Rs lakh)

	1998-1999	1999-2000	2000-2001	2001-2003 (2 yrs.)	2003-2008 (5 yrs.)
Production					
Fixed investment (Land, Bldg. & m/c)					
Machine Tools					
CNC Machine Tool					
Conventional Machine Tool					

1.10 FINANCIAL PERFORMANCE

KINDLY ATTACH BALANCE SHEET AND PROFIT & LOSS ACCOUNT FOR THE LAST THREE YEARS

1.11 WHO ARE YOUR MAIN BUYERS- (IN TERMS OF % OF SALES)

SL.NO.	BUYER	% OF SALES
1	AUTOMOBILE INDUSTRY	
2	AUTO ANCILLARY INDUSTRY	
3	AGRICULTURAL IMPLEMENTS (TRACTORS ETC)	
4	MACHINE TOOL & ITS ACCESSORIES	
5	GENERAL ENGINEERING	
6	GOVERNMENT ORGANISATION DEFENSE /RAILWAYS/ OTHER PSES	

1.12 WHO ARE YOUR MAIN COMPETITORS (DOMESTIC MFGRS. AS WELL AS FOREIGN MFGRS.) IN INDIA.

SL. NO.	TYPE OF MACHINE	NAME OF COMPETITORS	
		INDIAN MANUFACTURER	FOREIGN MANUFACTURER

1.13 IN YOUR PERCEPTION WHAT ARE THE STRENGTHS OF YOUR COMPANY. (KINDLY INDICATE THE THREE MOST IMPORTANT ONE- PL. RANK AS 1 = MOST IMPORTANT AND SO ON)

SL.NO.	STRENGTHS	RANK
1	OVERALL TECHNOLOGICAL SKILL	
2	DESIGN STRENGTH	
3	SKILLED MANPOWER	
4	LOW COST	
5	QUALITY PRODUCT	
6	ABLITY TO ATTRACT GOOD FOREIGN COLLABORATOR	
7	BRAND IMAGE	
8	BREADTH OF PRODUCT LINE	
9	GOOD DISTRIBUTION (MARKETING NETWORK)	
10	GOOD AFTER SALES SERVICE FACILITIES	
11	GOOD SUPPLIERS (BROAD VENDOR BASE)	
12	GOOD USE OF INFORMATION TECHNOLOGY	
13	OTHERS (PLEASE SPECIFY)	

1.14 IN YOUR PERCEPTION WHAT ARE THE WEAKNESS OF YOUR COMPANY (KINDLY INDICATE THE THREE MOST IMPORTANT ONE- PL. RANK AS 1 = MOST IMPORTANT AND SO ON)

SL.NO.	WEAKNESSES	RANK
1	OVER STAFFED	
2	LACK OF BRAND IMAGE	
3	LOW BREADTH OF PRODUCT LINE	

4	INABILITY TO GET FC WITH INTERNATIONAL MARKET LEADER	
5	LACK OF MARKETING CAPABILITIES	
6	POOR AFTER SALES-SERVICE	
7	POOR VENDOR BASE	
8	LACK OF TECHNOLOGICAL SKILL	
9	LACK OF MODERN MANUFACTURING FACILITIES	
10	AGING WORK FORCE	
11.	OTHERS (PLEASE SPECIFY)	

1.15 WHAT IS YOUR CORE COMPETENCY?
Core competency is the collective learning/skill in the organization that would see through the competition in future. if such competence are product specific please specify.

PART II- TECHNOLOGY

2.1 SOURCE OF TECHNOLOGY

A. FOREIGN COLLABORATION

PRODUCT	**NAME AND COUNTRY OF FOREIGN COLLABORATOR**	**NATURE OF COLLABORATION TECHNICAL/ FINANCIAL OR BOTH**	YEAR OF COLLABORATIO N

B. IN-HOUSE R&D

PRODUCT	**NEW INNOVATION**	**INCREMENTALINNOV ATION**	**GESTATION PERIOD IN YRS.**

2.2 FUTURE PRODUCTION PLAN

PRODUCT DESCRIPTION	**PROJECTED PRODUCTION AFTER THREE YEARS (IN NOS.)**	TECHNOLOGICAL SOURCES*
EXISTING PRODUCT		
NEW PRODUCT TO BE INTRODUCED, IF ANY		

***** TECHNOLOGICAL SOURCE : FOREIGN COLLABORATION (FC), IN-HOUSE &D (IN-R&D); OR OTHERS (VIZ. CMTI ETC.:- PLEASE SPECIFY)

2.3 DETAILS CONCERNING RESEARCH & DEVELOPMENT AND ENGINEERING (R&D&E) DEPARTMENT

SL. NO.	**DESCRIPTION**	**DETAILS**
1.	Total number of employees in R & D & Engineering deptt.	
2.	No of employees having Ph.D. degree	
3.	No of patents held	
4.	No of patents applied for	
5.	Annual expenditure on R&D & E as % of turnover	
6.	Gross Investment in R&D & E dept. (Rs Lakh)	
7.	Gross Investment in CAD/ CAE facilities (Rs Lakh)	
8	Year of installation of first CAD/CAE station	

For question number 2.4 to 2.7 please indicate the relative importance of each as per the following scale: *1- Not important; 2-slightly important; 3-important; 4-very important; 5-crucial; 0-don't know.*

2.4 How important were the ideas and other inputs from the following source for the development and introduction of new or improved products and processes? Pl rank them as per the above scale.

SL. NO.	SOURCE	RANK
1	Workers suggestion	
2	Suppliers of components/parts	
3	Foreign buyers	
4	Domestic buyers	
5	Foreign collaborator	
6	In-house R&D	
7	Consultants	
8	Professional and trade journals	
9	Overseas travel by staff	
10	Product of competing firms - domestic	
11	Product of competing firms - foreign	
12	Government R&D institution	
13	Others- pl. specify	

2.5 The following table lists a series of potential obstacles arising from environment of enterprise that may hinder the realization of innovation in your enterprise. Indicate the relative importance of each of the obstacles mentioned with respect to the innovative activities of your enterprise over the past two to five years.

SL. NO.	OBSTACLES	RANK
1	Market too small	
2	Lack of technical standards	
3	Customers not sophisticated	
4	Shortage of skills	
5	Not enough credit facility	
6	Interest rate too high	
7	Lack of distribution channel	
8	Lack of Govt. support	
9	Lack of Govt. - Business - Institution linkage	
10	Lack of critical component suppliers	
11	Lack of coordination among marketing, design and production wing of your firm	
12	Others- pl specify	

2.6 Pl. indicate the relative importance of the following technology-related activities in your enterprise as per the above scale.

SL. NO.	TECHNOLOGY-RELATED ACTIVITIES	RANK
1	Basic Research	
2	Applied Research	
3	New Product Development	
4	New Process Development	
5	Product Design	
6	Product Engineering	
7	Monitoring new development	
8	Foreign collaboration	
9	Training in the use/application of new technologies	
10	Others- pl. specify	

2.7 Please indicate the relative importance of following objectives for the technological changes that have been introduced in your enterprise during past few years?

SL. NO.	OBJECTIVES FOR TECHNOLOGICAL CHANGES	RANK
1	Replace obsolete product	
2	Extend product range	
3	Increasing or maintaining market share	
4	Creating new markets	
5	Improve production facilities	
6	Lower production cost	
7	Improving working condition/safety	
8	Other objectives - pl. specify	

2.8 Are you a ISO 9000 certified company ? **Yes/No.**

If the answers is yes- Type - ISO 9001/ 9002/ 9003/ 9004.
Year of award (first time) -
Name of the certification agency -

2.9 Pl. indicate whether you manufacture these items/ components in-house or out source (domestic or imported) – in terms of percentage (%) of volume.

Sl.No.	Items/Components	Mfgr. in-house	Out source	
			Domestic	Imported
1	Heavy castings & forgings			
2	CNC controls & drives			
3	Ball Screws			
4	Precision bearings			
5	Hydraulic/Pneumatic elements			
6	Work holding fixtures			
7	Mechanical assemblies			

PART III- MANAGEMENT

3.1 What is the mission of your Organisation? Are they clearly stated or are they merely implied from performance?
The corporate mission is the purpose or reason for the corporation's existence. A mission statement specifies what activities the Organisation is to pursue and what course management has chartered for Organisation to follow. It answers the questions: what business is the Organisation in? and why?

3.2 What are the objectives of your firm? Are they clearly stated or are they merely implied from performance?
Objectives are the end results of the planned activity. They state what is to be accomplished by when and are often quantified (e.g. profitability, efficiency, growth, or market leadership etc.).

3.3 What strategy or mix of strategies is the corporation following? Are they consistent with each other, with the mission and objectives?
A strategy of a corporation forms a comprehensive master plan stating how the corporation will achieve its mission and objectives (e.g. stability, growth, retrenchment, cost leadership, differentiation, technological leadership or technological followership etc.).

Pl. Put a tick mark in the appropriate column for your answer for question 3.4 to 3.6:

3.4 Who takes the strategic decision for (i) Enquiry responses for your products (ii) Final quotation for the product and (iii) New recruitment of technical manpower?

Sl.No.	Action by	Enquiry response	Final quotation	New recruitment
1	The chief Executive			
2	The Board of Directors/ Partners			
3	The Senior management team			
4	Combination of the above			

3.5 What is the effect on productivity of employees in your firm due to following steps taken (if any)? Please indicate if you have adopted these measures.

Sl.No.	Productivity enhancement measures	Adopted	Improved	Marginally improved	Declined
1	Effective use of computers	Yes/No.			
2	Automation of routine task	Yes/No.			
3	Better supervision	Yes/No.			
4	Enhanced training and development	Yes/No.			
5	Buying expertise and experience	Yes/No.			

3.6 Please indicate the ability to attract and retain the workforce needed. The workforce have been categorised in 4 groups. Please indicate their numbers as well.

Sl .No.	Type of workforce	Total Nos.	**Turnover rate** (% of people left) average of last 3 yrs.	Ability to attract and retain	
				High	**Poor**
1	Technical (Engineers etc.)				
2	Skilled labour (ITI & above)				
3	Unskilled				
4	Adm. & others				
5	Total				

3.7 Is there any evidence that the Organisation faces a skill shortage or surplus in view of changing business needs? **Yes/No.**

3.8 Do the senior management recognise the impact of new information technology on management control procedures? **Yes/No.**

PART IV- MARKETING

Marketing function includes market research, distribution, sales promotion/analyse & after sale-service activities.

4.1 DETAILS CONCERNING MARKETING DEPARTMENT

Who looks after the marketing function? CEO/Partners/Board/Sr. Management Team/Separate agency (Sister concern/others- Please specify). In case the marketing activities are looked after by any sister/other organisation kindly mention and give details of that organisation as far as possible. If it is in-house function please indicate -

SL. NO.	DETAILS	REMARKS
1.	Total No of employees in the Marketing dept.	
2.	No of employees with degree/diploma & above, in engg. or marketing discipline	
3.	Annual budget for marketing function as % of annual turnover	
4.	Share of Marketing research functions in the marketing budget (%)	
5.	Share of Distribution functions in the marketing budget (%)	
6.	Share of Sales promotion/ advt. functions in the marketing budget(%)	
7.	Share of after sales service functions in the marketing budget(%)	
8.	Nature of distribution channel used: Direct marketing (DM), authorised distributors (AD) or both **(give % share as well)** - Domestic market - Export market	 DM/AD/BOTH DM/AD/BOTH

For question number 4.2 to 4.4 and 4.6 to 4.8 pl. indicate the relative importance of each as per the following scale: ***1- Not important; 2-slightly important; 3-important; 4-very important; 5-crucial; 0-don't know.***

4.2 In your opinion what are the existing capabilities of your company, which could give you an edge over your **foreign competitors** in the **domestic market?**

SL. NO.	CAPABILITIES	RANK
1	Low cost	
2	Better quality	
3	Better reliability & performance	
4	Breadth of the product line	
5	Sustained relationship with the users and knowledge of user's needs	
6	Low and timely delivery schedule	
7	Simple design & adaptive to local condition	
8	Proximity to users	
9	Brand name, image and goodwill	
10	Protection in domestic market	
11	Good after sales facilities	
12	Faster response on breakdown	
13	Professional approach towards machine tool marketing	
14	Total solution for problems	
15	Greater customer interaction at the time of ordering machine	
16	Capability to supply tooled up Machine Tool	
17	Others - pl. specify	

4.3 In your opinion what are the existing capabilities of your company, which could give you **an edge** over your competitors **in the export market.**

SL. NO.	CAPABILITIES	RANK
1	Low cost	
2	Low cost and high quality	
3	Simple design & adaptive to local condition	
4	Access to cheaper locally supplied parts /components	
5	Capability to supply tooled up machine tool	
6	Breadth of product line	
7	Good distribution channel abroad (own) and after sales facilities	
8	Good tie-up for marketing and after sales service abroad	
9	Others - pl. specify	

4.4 Pl rank as per the above scale the relative importance of the reasons which create hurdles in the export marketing success for your company:

SL. NO.	HURDLES	RANK
1	A relatively large domestic market	
2	Lack of production capacity	
3	Low breadth of product line	
4	Lack of quality	
5	Lack of exposure to foreign markets	
6	Lack of resources (Capital)	
7	Problems in maintaining delivery schedule	
8	Lack of distribution channel and after sales service facilities in foreign land	
9	Lack of direct communication with foreign buyers	
10	Comparative disadvantage due to non-tariff barriers	
11	Lack of government support	
12	Others - pl. specify	

4.5 Please indicate your target market for exports.
At present - USA/ EC/ Africa/ Latin America/ CIS/ East Asia/ Japan/ China/SAARC
In future (in 5 years) - USA/ EC/ Africa/ Latin America/ CIS/ East Asia/ Japan/ China/SAARC

4.6 How do target export market? Please rank as per the above scale.

Sl.No.	Reasons	Rank
1	Geographical proximity	
2	Geographical location	
3	High consumption of machine tools	
4	Growing consumption of machine tools	
5	Strength of economy to pay	
6	EXIM Bank program	
7	Personal contact	
8	Ease in bidding	
9	Possibility of re-export from that country	
10	Others (Please specify)	

4.7 In what ways would you like to widen the access in foreign market? Please rank as per the above scale.

Sl.No.	Ways	Rank
1	Contract manufacturing (buy back arrangement)	
2	Tie-up with distributors overseas	
3	Supply on lease (tie-up with CG Leasing company)	
4	Supply credit through exim bank	
5	Wholly owned subsidiary (WOS)	
6	Tie-up with another Indian WOS abroad	
7	Jointly floating a company with other Indian manufacturers	
8	Through IDBI discounting sale	
9	Others (please specify)	

4.8 In what ways would you like to widen the access in domestic market? Please rank as per the above scale.

Sl.No.	Ways	Rank
1	Contract manufacturing (buy back arrangement with major domestic mfgrs.)	
2	Tie-up with major distributors in India	
3	Supply on lease (tie-up with CG Leasing company)	
4	Arranging supply credit through IDBI/SIDBI	
5	Jointly floating a marketing company with other Indian manufacturers	
6	Training & retraining of users/prospective users on use of CNC machine tools	
7	Taking steps for rapid diffusion of CNC machine tools in SMEs	
8	Others (please specify)	

4.9 In your perception what could be the government initiative to develop machine tool industry in India and to promote exports of machine tools from India? Please comment on these. You may like to attach separate sheet if necessary.

- Promotional activities in India
- Promotional activities abroad
- Net protection to domestic industry
- Fiscal incentive
- Infrastructure availability
- Others (please specify)

Appendix A.2

LIST OF FIRMS USED AS CASE STUDIES

Firm	Details
F_A	Large-scale government owned firm with FC
F_B	Medium sized private owned firm with FC and foreign equity participation
F_C	Medium sized private owned firm with FC
F_D	Medium sized private owned firm without any FC
F_E	Small-scale private owned firm with FC
F_F	Small-scale private owned firm without any FC
F_G	Medium sized private owned firm with FC
F_H	Medium sized private owned firm with FC
F_I	Medium sized private owned firm with FC
F_J	Medium sized private owned firm without any FC
F_K	Medium sized private owned firm with FC
F_L	Large-scale private owned firm with FC
F_M	Medium sized private owned firm with FC
F_N	Medium sized private owned firm with FC
F_0	Medium sized private owned firm without any FC
F_P	Medium sized private owned firm without any FC
F_Q	Large-scale government owned firm with FC

Appendix A.3

INTERVIEW SCHEDULE

General

- How does your firm's performance get affected by various government policies (industrial policy)?
- What should be the role of the government for the sustained development of CNC Machine Tool industry in the present liberalised environment?

Technology Policy

- What are the mechanisms adopted by your firm in response to the policy on imports of technology (FC policy) to develop firm's technological capability of product development?
- What are the various forms of the product development activity adopted by the firm and level of emphasis given on those activities?
- What is your assessment about the FC policy? Has the FC policy been favourable?
- How the inflow of technology through FC has contributed in the development of the industry indirectly through technology spillovers?
- What are the mechanisms adopted by your firm in response to the policy for promotion of in-house R&D to develop firm's technological capability of product development?
- How much is the level of importance given to tax incentives for undertaking R&D activities on a four-point scale 1 (not important) to 4 (crucial)?
- What would have been the impact on the level of R&D activity had there been no tax incentives or if the tax incentives are withdrawn in future? Whether it would be at reduced level or same level or no influence at all?
- What needs to be done?

Investment Policy

- How the policy on regulation on entry and expansion is influencing firm's performance?
- What are the mechanisms adopted by your firm in response to the policy on regulation on entry and expansion to develop firm's manufacturing capability?
- What are the possibilities of FDI in the industry?
- How the policy on regulation on imports is influencing firm's performance?

- What are the mechanisms adopted in response to the policy on regulation of imports to develop firm's manufacturing capability?

- What needs to be done?

Education and Training policy

- How the Education and Training policy is influencing firm's performance?

- What are the mechanisms adopted by your firm in response to the policy to develop firm's human resource capability?

- What needs to be done?

Market development policy

- How the policy on domestic market development is influencing firm's performance?

- What are the mechanisms adopted by your firm in response to the policy to develop firm's domestic market development capability?

- How the policy on export market development is influencing firm's performance?

- What are the mechanisms adopted in response to the policy to develop firm's export market development capability?

- What needs to be done?

Policy on Industrial Governance

- How the policy on industrial governance is influencing firm's performance?

- What are the mechanisms adopted by your firm in response to the policy to develop firm's linkage capability?

- How much is the quantum of liasioning with the government institutions, supporting institutions, linkages with the suppliers and linkages with fellow manufacturers for formation of consortiums?

- What needs to be done?

NEDERLANDS SAMENVATTING

Het onderzoek dat in deze dissertatie is beschreven is gericht op het verwerven van meer inzicht in de effecten van industriebeleid op de resultaten van individuele ondernemingen. De context waarin het onderzoek is gesitueerd wordt in algemene zin gevormd door industrialiserende ontwikkelingslanden, in het bijzonder echter door India. Op deze wijze vormt het onderzoek een aanvulling op reeds eerdere publicaties over de effecten van overheidsindustriebeleid, waarin vooral macro-economische aspecten aan bod komen en het functioneren van een industrie in meer algemene termen aan de orde is. De vraag die bij het onderzoek centraal stond is "hoe beïnvloedt industriepolitiek de prestaties van ondernemingen". Als veld van onderzoek is gekozen voor de CNC-machine-industrie in India. Het onderzoek is te karakteriseren als exploratief en kwalitatief en gebaseerd op casestudies.

In het onderzoek is gezocht naar verklaringen voor de (causale) relatie tussen industriebeleid en ondernemingsresultaten. Drie elementen staan centraal in de zoektocht naar causale relaties: beleid, resources en ondernemingsresultaten. Beleid is beschouwd in ruime zin, met als relevante onderdelen: technologie, investeringen, opleiding en training, marktontwikkeling en corporate governance. Als resources zijn onderscheiden: research, development & engineering, productie, personeel, marketing en netwerkrelaties. Voor ieder van de resources is nog een onderscheid gemaakt naar bekwaamheden (competenties), mechanismen (als link tussen beleid en ondernemingsresultaat) en indicatoren (van de mechanismen). De analyse is vooral toegespitst geweest op de wijze waarop ondernemingen zich mechanismen eigen maken en activeren met de bedoeling daardoor bekwaamheden op te bouwen, die ervoor zorgen dat industriebeleid wordt benut ten gunste van het ondernemingsresultaat. In sommige gevallen is geconstateerd dat mechanismen werden eigen gemaakt, die de afwezigheid van beleid compenseren, dan wel negatieve effecten van actueel beleid beperken. Voorbeeld is o.m. het Technologie- en Investeringsbeleid dat, in combinatie met de toenemende transparantie in corporate governance, sinds 1991 ondernemingen ertoe gebracht heeft meer aandacht te besteden aan mechanismen zoals adoptie van nieuwe technologieën, productontwikkeling en uitbesteding, ten behoeve van betere product ontwikkelings- en productiecompetenties. Uiteindelijk leidde dit tot meer verkopen en export. Een ander voorbeeld is het ontbreken van een adequaat opleidings- en trainingsbeleid, dat ondernemingen ertoe bracht om goed opgeleide werknemers aan te trekken, in-company training in te voeren en periodieke training te introduceren ter wille van een betere arbeidsproductiviteit. Waarnemingen hebben inzicht gegeven in de verschillen tussen ondernemingen met betrekking tot verschillen in het eigen maken van mechanismen. Een beperkt aantal pro-actieve ondernemingen bleek in staat adequaat om te gaan met vraagstukken betreffende het evalueren van beleid en het ontwikkelen van passende mechanismen. Kleinere ondernemingen bleken hierbij in het nadeel.

In het verdere verloop van het onderzoek bleek het concept "proces" een belangrijk hulpmiddel om de relatie tussen beleid, mechanisme en ondernemingsresultaat te verhelderen. Een, in de onderneming aanwezig, proces maakt het mogelijk dat mechanismen "resultaat boeken". Een proces is van toepassing voor één of meer mechanismen, en kan bevorderen dat een mechanisme individueel werkzaam is, dan wel in samenhang met andere. Processen worden beschreven aan de hand van de volgende vier processtappen: acquisitie, integratie, ontwikkeling/verbetering en voortbrenging. Net zoals geconstateerd bij de mechanismen, worden processen en hun adoptie beïnvloed door actueel beleid en beïnvloeden op hun beurt het ondernemingsresultaat. Uit één en ander kan geconcludeerd worden dat de overheid bij het concipiëren en tot uitvoering brengen van (industrie)beleid er verstandig aan doet rekening te houden met het al of niet aanwezig zijn, c.q. mobiliseerbaar maken van zulke processen in ondernemingen. De geldigheid van deze concluderende opmerking wordt evenwel ingeperkt vanwege het beperkte veldonderzoek, dat al te genereuze generalisaties in de weg staat.

CURRICULUM VITAE

Ashish Kumar was born 30 August 1960 in Ranchi, India. After completing secondary school and intermediate education, he graduated in Mechanical Engineering with distinction in 1981 from Ranchi University, India. Further, in 1988 he obtained bachelors of law (LLB) from the same university. In 1994, he was awarded MBA (Industrial policy and Corporate Strategy) with distinction from Maastricht School of Management (MsM), Maastricht, the Netherlands. He also attended short-term professional training programs in Sector technology and Management at erstwhile RVB (now MsM), Maastricht in 1992 and in Total Quality Management (TQM) at Stockholm, Sweden in 1997. During the course of PhD studies, he has contributed several papers to conference proceedings. His main research interests are industrial policy formulation and implementation, technological capability, industrial governance, cluster development and industry structure analysis.

Kumar has extensive work experience in manufacturing industries as well as in the government. During the first four years of his professional career since 1981 he worked in the shop floor environment in manufacturing firms in the private as well as public sector. Since 1985, he is working in the field of industrial policy formulation and implementation at regional and national level in the Department of Industrial Policy and Promotion (DIPP), Ministry of Industry, Government of India. In 1997-98, he also undertook industry specific research projects including Machine Tool industry under the aegis of the National Council of Applied Economic Research (NCAER), New Delhi concurrently. In 1999, he went to Zanzibar as an Industrial Expert (Manufacturing) for advising the Government of Zanzibar on the process of industrialization under the Indian Technical Economic Cooperation (ITEC) program of the Government of India.

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