

# A Research and Management Agenda for Chain and Network Science

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EDITORIAL

## Abstract

In the present editorial we address key issues and research questions in the field of chain and network science. Theoretical approaches discussed in this editorial include Network Theory, Supply Chain Management and Industrial Organisation Theory. Major research themes derived from these approaches are formulated in the conclusions. The editorial ends with the management implications of the different articles in this issue.

## 1. Introduction

Globalisation and technology development (e.g. ICT) drive companies towards new forms of co-operation in chains and networks. A society of well-informed, wealthy consumers looks critically at the attributes of products and processes (environmental impact, social accountability, etc.). This implies that companies have to develop and operate in responsive, effective and efficient chains and networks to bring their goods to the market. As a consequence, companies are faced with the challenge of developing new ways of interacting with suppliers, clients, consumers and other stakeholders, such as governments and NGOs.

Operating in chains and networks is not new, of course. Since the 1980s, companies have been improving their logistics and quality systems by developing new forms of organisation for facilitating chain co-operation, supported by scientific insights from disciplines such as organisational behaviour and institutional economics. In the years to come, more and more disciplines will be needed to develop knowledge and insights into chain and network competition. It is the mission of chain and network science (CNS) to bring together these scientific insights into useable concepts for the management of companies working together in chains and networks.

In this paper we will elaborate on a number of theories that provide insight into the structure and activities of actors in chains and networks. We will discuss the key issues and research questions that are raised by these theories and present an agenda of research themes and management challenges for the years to come.

## 2. Network theory

In CNS, networks are looked upon as the total of actors within one industry and/or between related industries, which can potentially work together to add value to customers (Omta et al., 2001). Actors can be distinguished either at the micro-level, where the actor is a person, for

instance the individual producer, entrepreneur etc., or at the meso-level, where actors are aggregations of individuals working together for a common goal, e.g. firms, research institutes, and government agencies. Network approaches look at dynamics in relationships within a social-economic and business network environment. Less tangible and visible concepts like trust, power, core competencies and the social-economic environment are vital in these approaches. An important aspect is the reciprocal character of the relationships between the actors (Lazzarini et al., 2001). As Powell (1990) states: *'The basic assumption of network relationships is that one party is dependent on the resources controlled by another, and that there are gains to be had by the pooling of resources.'*

To apply these approaches to management issues and research questions we use a framework from Moller and Halinen (1999). They recognise four levels of issues in the complexity of managing business networks and relationships. Below we will discuss the relevant research questions and management issues for each level of network management.

- *Level 1: Industries as networks - network visioning*
  - *Key issues:* networks, as configurations of actors carrying out value activities, from the 'environment' the firms are embedded in. They are not transparent but must be learned through enactment. Understanding networks, their structures, processes, and evolution is crucial for network management.
  - *Key managerial challenges:* How to develop valid views of relevant networks and the opportunities they contain. How to develop views of network evolution for identifying strategic development opportunities. How to analyse strategic groups of firms, forming focal nets, for understanding network competition.
- *Level 2: Firms in networks - network management*
  - *Key issues:* Firms' strategic behaviour in networks can be analysed through the focal nets they belong to and through the positions and roles they play in these nets.

Positions are created through business relationships. Capability to identify, evaluate, construct and maintain positions and relationships is essential in a network environment

- *Key managerial challenges*: How to develop and manage strategic nets (supplier nets, development nets, customer nets). How to enter new networks (market area entry, new product/service filed). How to manage network positions.
- *Level 3: Relationship portfolios - portfolio management*
  - *Key issues*: The firm is a nexus of resources and activities. A core strategic issue is to determine which of these activities are carried out internally and which through different types of exchange relationships. The capability to manage a portfolio of exchange relationships in an integrated manner is required.
  - *Key managerial challenges*: How to develop an optimal customer/supplier portfolio. How to manage customer/supplier portfolios from organisational and analytical perspectives.
- *Level 4: Exchange relationships - relationship management*
  - *Key issues*: Individual customer/supplier relationships form the basic unit of analysis in a network approach to business marketing. The capability to create, manage and conclude important relationships is a core resource for a firm.
  - *Key managerial challenges*: How to evaluate the future value and customer- lifetime value of a relationship. How to create, manage and conclude relationships from organisational and analytical perspectives. How to manage relational episodes efficiently.

### 3. Supply chain management

Within the realm of CNS, supply chains are considered to be composed of the actors in a business network which vertically work together to add value to customers. Supply Chain Management research focuses on value creation and the product flow throughout the chain from primary producer up to the consumer. Key attention is paid to integration or attuning of operational processes, such as logistics and quality management, and supporting processes, such as information technology and costing. Lambert and Cooper (2000) define generic research questions for SCM, the most important of which are listed below:

- What are the operational definitions of the key business processes and what are the relationships among these processes? How can firms achieve a thorough cross-functional approach in Supply Chain Management?
- What is the process in taking the map of an existing supply chain and modifying it to obtain the best supply chain given the desired outputs?

- What is the value proposition at the consumer level or end point of the supply chain? How should the various firms in the supply chain share the costs and the benefits?
- What metrics should be used to evaluate the performance of the entire supply chain, individual members or subsets of members?
- What determines with whom to link business processes? What are the critical factors to the firm's success and that enable the firm to link with specific companies?
- What determines the type/level of integration that should be applied to each process link?

An important feature of SCM, which differentiates it from the other approaches described in this paper, is its focus on the design and redesign of supply chains. SCM approaches thereby have a strong applied science perspective. This translates into typical analysis and (re)design opportunities, such as presented by Ellram and Cooper, 1993; Lambert and Cooper, 2000; Lalonde and Pohlen, 1996; and Ziggers and Trienekens, 1999:

- the design of supply chain information sharing and monitoring systems,
- the design of co-ordination systems of multiple levels for inventory reduction,
- the design of joint planning systems on different management levels,
- the reduction of supplier bases for better co-ordination,
- the design of logistics systems to increase the speed of information and inventory flows,
- the design of supply chain costing methods,
- the evaluation of supply chain performance and design of performance systems,
- the design of integrated supply chain quality systems.

Of major importance in SCM research is the use of ICT, enabling companies to shift activities to third party providers and allowing firms to co-operate across markets and across industries. In this regard a key research issue in SCM is whether information technology opportunities might offer exchanges of information between companies, which resembles an (organisationally) integrated enterprise. In this respect information technology might offer an alternative to closer organisational relationships, meaning that the advantages of a market-like organisation can be linked with the advantages of process integration (Clemons and Row, 1992; Lancioni et al., 2000).

### 4. Industrial organisation theory

Industrial organisation theories, such as transaction cost economics (TCE), agency and game theory, are concerned with the governance relationships of organisational co-

operation, integrating views from business economics and organisational theory. TCE (e.g. Williamson, 1985) and agency theory (Eisenhardt, 1989) provide the rationale for the make-or-buy decisions that determine which chain activities will be vertically integrated and which will be produced through transactions with other firms. In TCE, transactions are characterised by their frequency, uncertainty, and asset specificity. TCE offers interesting starting points for the analyses and design of vertical governance relationships (e.g. Zylbersztajn and Farina, 1999), although there is still limited empirical evidence of the performance effects of following 'TCE guidelines' (Rindfleisch and Heide, 1997). One of the reasons for this might be that neither buyers nor suppliers are completely free to select and change counterparts. Exchange relationships within chains and networks imply certain features, e.g. a certain degree of flexibility, durability, information exchange, and trust, which are delivered against a certain price (the transaction costs or management costs). Key research questions in the realm of governing these exchange relationships are:

- *What are the features determining exchange relationships?*
  - What determines the stability and durability of an exchange relationship, the knowledge exchange in such a relationship, and the level of trust that is being developed?
  - Specific institutional arrangements within chains and networks are challenged by turbulence in the external socio-economic environment and by internal disputes and conflicts of interests among agents. Which arrangements are able to deal with these tensions and are able to survive and which tend to disintegrate?
  - What is the role of investments in relation-specific assets and co-specialisation, or of the development of competencies that are non-transferable and unique to the network?
- *How to analyse and improve the performance of various institutional arrangements under different conditions?*
  - Specific intermediate forms of markets, networks and hierarchies are used in different circumstances: what works best, and why?
  - What are the benefits and the costs, and how are they shared among the actors involved?
  - How can performance be evaluated, in what terms and by measuring which variables?
- *What is the relationship between the functioning of a chain or network and the functioning of the organisations that make up this collaborative structure?*
  - What are the consequences of specific chain and network relationships on the nature of the organisations involved?

- What is the relationship between the organisational features of a network and the internal organisation of the actors in this network?
- If co-operation in a chain or network implies a distribution of authority and responsibilities that transgress traditional organisational boundaries, how does this affect the internal organisation and functioning of firms?
- *What are the possibilities to change modes of exchange and interaction?*
  - To what extent is the development of the institutions that govern transactions between actors an autonomous process?
  - To what extent can it be guided and directed?
  - What is the role of time; how fast can changes come about?

## **5. Conclusions**

In our view, chain and network research should focus on the construction of a toolbox, comprising theories that balance the approaches discussed in this paper, analyse the dynamics of co-operative arrangements, and combine methods, techniques and working applications to analyse and improve the management of supply chains and networks. More specifically, integrated chain and network research should focus on:

- Current institutional arrangements, including the ownership and distribution of assets (both production facilities and intangibles such as knowledge and goodwill), and the possibility that the arrangements lead to lock-in.
- Degrees of interdependence between actors (power relationships): the way typical characteristics of dependence of one actor upon another influences the evolution of institutional arrangements at the micro-level (the firm), the meso-level (the network), or the macro-level (the socio-economic environment).
- The characteristics of the technologies that are available to manage interaction (transaction technologies), for instance, the impact of ICT on collaborative arrangements.
- The characteristics of the technologies that are used in production (transformation technologies) and their dynamics.
- Market dynamics: the way differentiation of demand affects collaborative arrangements.
- Institutional and policy change at the aggregate level, differences in institutional arrangements among industries and across countries.

In conclusion, the description of a research agenda for CNS is a starting point, a first attempt to define and delineate

this new multidisciplinary field of research, a first step in structuring current thought on chains and networks and in identifying future development paths.

### **This issue: management implications**

JCNS intends to be a virtual platform in which scientists meet with business managers to exchange the latest ideas and concepts on chains and networks. Therefore an overview of the managerial implications of the different contributions in the third issue is given.

In the first article of this issue, *Food supply chains: are efficiency and responsiveness mutually exclusive?*, Koops et al. analyse core resource constellations, relating to marketing capabilities and technology capabilities, and their impact on both product-mix and process changes. Their findings point out that managers need to be aware that their resource bases do not exist or operate in isolation of each other. Initiatives to improve either efficiency or responsiveness processes must consider the interrelated nature of the resource base. For example, a strategic initiative to improve operational efficiencies should not ignore customer requirements and should incorporate marketing capabilities into the strategic change process due to the inter-relatedness of these two core capability bases. Furthermore, cultivation and development of marketing and technology capabilities can support companies in breaking through the path dependencies created by assets related to current activities.

In the second article of this issue, *Co-operating to compete in high velocity global markets: the strategic role of flexible supply chain architectures*, Gow et al. investigate how firms can create and capture value in highly volatile markets, by exploiting both performance gaps and opportunity gaps through the development and use of flexible supply chain architectures. The theoretical framework they develop depicts a process whereby growth begins with a streamlining of the current business to provide funds to exploit the opportunity gap. To do so the firm must identify, cultivate and exploit its core competencies. However, one must be aware that core competencies can be task specific and may not provide a perfect match to the new product/market. Cultivating new competencies from 'scratch' can take many years, therefore, the optimal way to build the required new competencies may be to acquire them from other firms. Firms can find new strategic directions by shifting their strategic intent and leveraging their resources against the competencies of others by forming mutually beneficial business relationships.

In the third article of this issue, *Retailer's branding strategies: contract design, organisational change and learning*, Mazé discusses contractual innovations in supply chains as a consequence of new branding strategies of retailers, based on high quality and guaranteed food products. Tripartite contracts between retailers, agri-food firms and farmers' associations introduce more transparency in the chain regarding quality and rent sharing and lead to more balanced (negotiation-) power relationships in the chain. In contrast to analyses focusing on contract formalisation as a support for court enforcement and *ex post* conflict resolution, Mazé concludes that contract adaptations also reflect mutual learning processes between contractors leading to a reduction in misunderstandings. In the (meat) chain explicit contracts with farmers' associations may then decrease the cost of private enforcement sanctions by defining a stronger commitment of these organisations, while at the same time preserving contractual freedom of individual breeders.

In the fourth article of this issue, *Environmental factors, supply chain capabilities and business performance in horticultural marketing channels*, Matanda and Schröder investigate the relationship between environmental uncertainty, supply chain capabilities and business performance in the context of the Zimbabwean horticultural sector. They show the importance of innovation in markets with changing customer demands and preferences. On the other hand, they find that market turbulence had a negative impact on performance, indicating the need for improved market intelligence. In their case study they show that, although channel participants recognised the need to innovate in terms of product development, packaging and storage, these participants also believed that the costs involved in doing this exceed the benefits. Policy implications for both government and major export buyers are that farmers, in particular smallholders (in developing countries at least), require technical support and the availability of credit.

In the fifth article of this issue, *Improving co-operation to make the South African fresh apple export value chain more competitive*, Hardman et al. investigate aspects of co-operation between players in the South African apple chain. They conclude that value chain players must broaden their view on the environment in which their chain operates, on the businesses of the other chain partners and on the key sources of risk associated with their investments. In this respect key attention should be paid to co-operation in production planning, delivery scheduling and quality control. Their findings suggest that higher levels of trust lead to increased joint problem-solving and to more communication in the chain, also positively impacting the commitment of human resources to strengthening the relationships in the chain.

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