Wageningen University – Department of Social Sciences

Msc. Thesis

Reliability and Robustness of the Wageningen Innovation Assessment Tool (WIAT)

Business Administration/ Management Studies Group

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Management Summary

Nowadays innovation has become one of the vital means of survival for companies in almost every sector of industry. Due to the importance of innovation, various tools have been designed to measure the success of innovation projects within companies. The Wageningen Innovation Assessment Tool (WIAT) is one of the benchmarking tools that have been designed by the Management Studies department to investigate the potential of innovation projects. WIAT measures the potential of an innovation project by extracting the tacit knowledge of the innovation project team using a questionnaire.

The tool is based upon insights from past studies by Cooper & Kleinschmidt (1987) and Hollander (2002). It centers on the critical success factors that influence innovation. Currently the WIAT database comprises of some 100 diverse project-assessments of successful, failed and running projects of companies mostly in the agri food industry. The database has become heterogeneous; henceforth as the dataset increases it becomes needful to systematically evaluate the tool.

Therefore, this MSc-Thesis project analyzed the database of WIAT by considering various categories in the dataset, and analyzing individual questions and factors in the WIAT. The aim of the thesis project was to study and improve the robustness of WIAT in assessing innovation projects by analyzing the WIAT database and assessing the influence of personal competencies in innovation.

To meet the objective of the research, a framework was designed in order to answer the research questions formulated below:

Question 1: What are the principles upon which WIAT is built on?

Question 2: How reliable and robust is WIAT in innovation assessment?

Question 3: How can the reliability and robustness of WIAT be improved?

The answers provided in Question 1 form the theoretical framework which led to the qualitative analysis and question 2 provides the results of the analysis. Question 3 aimed at translating results and theoretical review into recommendations for improving on the reliability and robustness of WIAT. Reliability and robustness are the main issues the study focused on. The WIAT database was analyzed to improve on its reliability and robustness and thereby result in enhanced external validity and construct validity since the tool is useful in innovation assessments.

An in depth theoretical study was done on innovation management, innovation assessments and factors influencing innovation to provide the background and assumptions upon which the tool is built on. The review focuses on past research findings on product development which lead to a detailed background on innovation assessment tools and key success factors of innovation. The tool is based upon the Genesis tool which was designed as a follow up to the Newprod tool. WIAT is built upon four constructs; company, team, market and product. It has been used specifically in Dutch agri-food companies.

Individual competencies which fall under internal factors are also identified in literature. It has been shown that a lot of studies have not dealt with the issue of individual competencies but have focused more on firm-specific competencies. Recognizing the need for different kinds of individual creative styles is an important aspect of developing successful innovations given that the team factor was found to be one of the critical success factors in the analysis.

Exploratory factor analysis was the main method used to analyze the dataset, to determine how many factors are present and gather some indications of their nature and relationships. Reliability tests were also carried out to show the stability and strength of the factors using the Cronbach's alpha. Finally comparison tests were carried out using Independent samples t-test, ANOVA and MANOVA to check the differences among sub groups and the status of the projects.

An optimal factor structure was arrived at comprising of eight factors with 38 variables as compared to the 46 variables of the conceptual structure. The factors are named basing on existing literature on innovation management and are; Innovation team, Market potential, Innovativeness, Market competition, Company-market fit, Marketing resources, Product superiority and Other resources. Differences were found significantly in the factors; 'innovation team, market potential, company-market fit and other resources', and they are considered critical success factors.

Overally, the analysis managed to define the underlying structure for WIAT factors using empirical data. Generally the results tell that the tool is reliable and robust as indicated by the strength of the factors and by that it can detect differences among different groups or subjects. Finally, further analyses such as confirmatory factor analysis and regression analysis are recommended in order to refine the factor structure.

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1 Introduction & Background

Innovation is one of the most critical means that a company needs in order to survive and grow in an ever changing economic environment. It ensures that a company remains dynamic. Innovation does make a huge difference to organizations of all shapes and sizes. For enterprises to survive nowadays they have to be capable of regular and focused change. They have to manage the whole process of generating new ideas, selecting the good ones and implementing those ideas which constitute the innovation process (Tidd and Bessant 2007). As a result of the importance and the sheer amount of resources going into innovation, various tools have been designed to support innovation managers by measuring the success of innovation projects within companies.

One of the innovation assessment tools is the Wageningen Innovation Assessment Tool (WIAT) which has been designed to investigate the potential of innovation projects by extracting the tacit knowledge of the innovation project team through the use of a questionnaire. WIAT focuses on the critical success factors of innovation. The tool is based on a combination of insights from previous studies by Cooper & Kleinschmidt (1987) and Hollander (2002). The tool is based on the previous Genesis tool (Hollander, 2002) and was developed over the last two years. Currently it comprises some 100 diverse project-assessments, i.e. successful, failed and running projects of companies mostly in the agri food industry. The critical success factors incorporated in the questionnaire include the project company fit, level of team cooperation, level of competition and cooperation with external partners. Currently project information in the WIAT database is heterogeneous, derived from small enterprises (SMEs) to large enterprises (LEs), information that has been derived from internally and externally carried out projects and radical versus incremental innovations. As the dataset increases it becomes needful to systematically evaluate the tool.

After two years of data collection it is important and possible to check whether the structure of the WIAT is still suitable for the analysis of projects of the agri-food industry and other industries it is being used to assess. These checks are necessary in order to improve on the robustness of the WIAT tool. This MSc-Thesis project analyzes the database of WIAT by considering the various tests in the dataset, and analyzing individual questions and factors in the WIAT. Therefore it is crucial to

study the reliability and robustness of the WIAT considering these issues with the aim to improve on the tool.

WIAT is oriented at the project, company and contextual level of the innovation process but it does not incorporate the individual level in its assessment (figure 1). Incorporating the individual level could make the WIAT richer and stronger than the previous tools such as Genesis (Hollander 2002) and Project Newprod which were solely focused on project level. WIAT incorporate the contextual level to a certain extent as it is focuses on agri- food sector. Also the market construct is integrated in its constructs which represents the contextual level. The individual level analysis can be reached by incorporating the individual competencies within innovation teams. Developing any successful innovation requires the creativity and combined effort of the individuals in the innovation teams hence it is necessary to incorporate individual competencies into WIAT.

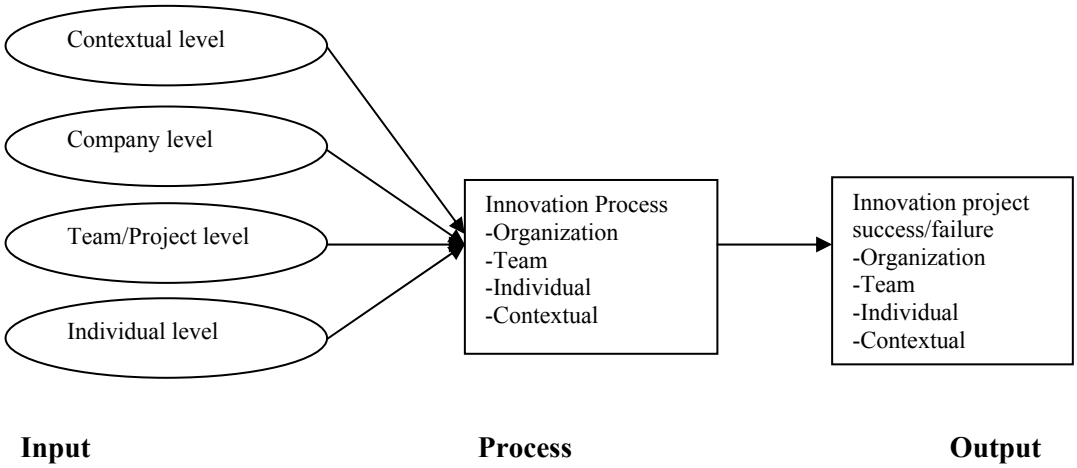


Figure 1 Framework of the innovation process and influencing factors

Tidd and Bessant (2007) state that success in innovation depends upon two key ingredients; resources and the personal capabilities in the organization to manage them. These personal capabilities also relate to the competencies within innovation teams which also have a large influence on innovation projects. Managing innovation is about building dynamic capability and these capabilities are mostly the hardest to handle on (Tidd and Bessant 2007). The impact of experience or dynamic capabilities is also another important factor that influences success in innovation. Therefore innovation assessment using WIAT can be improved by adding the terms on

individual competencies onto the WIAT questionnaire which are a crucial element since they extend to the individual level of the innovation process.

Conclusively, the research project comprises of two items, firstly studying the WIAT with the aim of improving on it by analyzing the database considering the various subsets in the dataset, and analyzing individual questions and factors in the WIAT. It is important to improve on the robustness of WIAT by distinguishing between the ex-ante and ex-post performance. Secondly this project aims to determine whether competencies play a role in influencing innovation projects and how they can be incorporated into WIAT to improve on its robustness.

1.1 Conceptual Design

The conceptual design establishes what, why and how much is studied. It comprises of the research objective, the research issue, the research framework and the definitions of concepts in this research. We will now subsequently detail each of them for this project.

1.1.1 Research Objective

In this section the research objective is outlined. The objective provides an overall idea of the knowledge the research project will generate in order to contribute towards a solution (Verschuren & Dooreward 2005).

The objective of this research is to study the reliability and robustness of WIAT in assessing innovation projects by:

1 analyzing the WIAT database and

2 assessing the influence of personal competencies in innovation projects in order to improve on innovation assessment.

The project involves analysis of the WIAT database through statistical analysis of the results in the datasets. The findings are useful in improving the WIAT tool which is highly significant since this innovation assessment tool is based on more recent and earlier publications as compared to other tools. It is worthwhile to build on it and thereby improve innovation assessment. Competency assessments on ten projects that are already available and a database of competency tests are to be done to meet the second part of the objective.

1.1.2 Research Issue

This constitutes the research questions that must be answered in order to accomplish the research objective (Verschuren & Dooreward 2005).

To ensure that the research objective is realized the following questions are formulated.

Research question 1: What are the principles upon which WIAT is built on?

1a. What are the background and assumptions behind the WIAT instrument?

1b. What are the constructs that form WIAT?

1c. Are there any external and internal factors that could influence innovation assessment of WIAT?

1d. Which competencies within organizations and individuals support the success of innovation?

Research question 2: How reliable and robust is WIAT in innovation assessment?

2a. What are the measures necessary to study reliability and robustness of WIAT?

2b. How adequate is WIAT in assessing innovation projects?

2c. Should individual competencies be incorporated in the WIAT?

Research question 3: How can the reliability and robustness of WIAT be improved?

1.1.3 Research Framework

The research framework follows which gives a schematic representation of the research objective and includes the approximate steps that need to be taken in order to realize the objective. It is crucial for building up the key concepts and theoretical framework of the research project (Verschuren & Dooreward 2005).

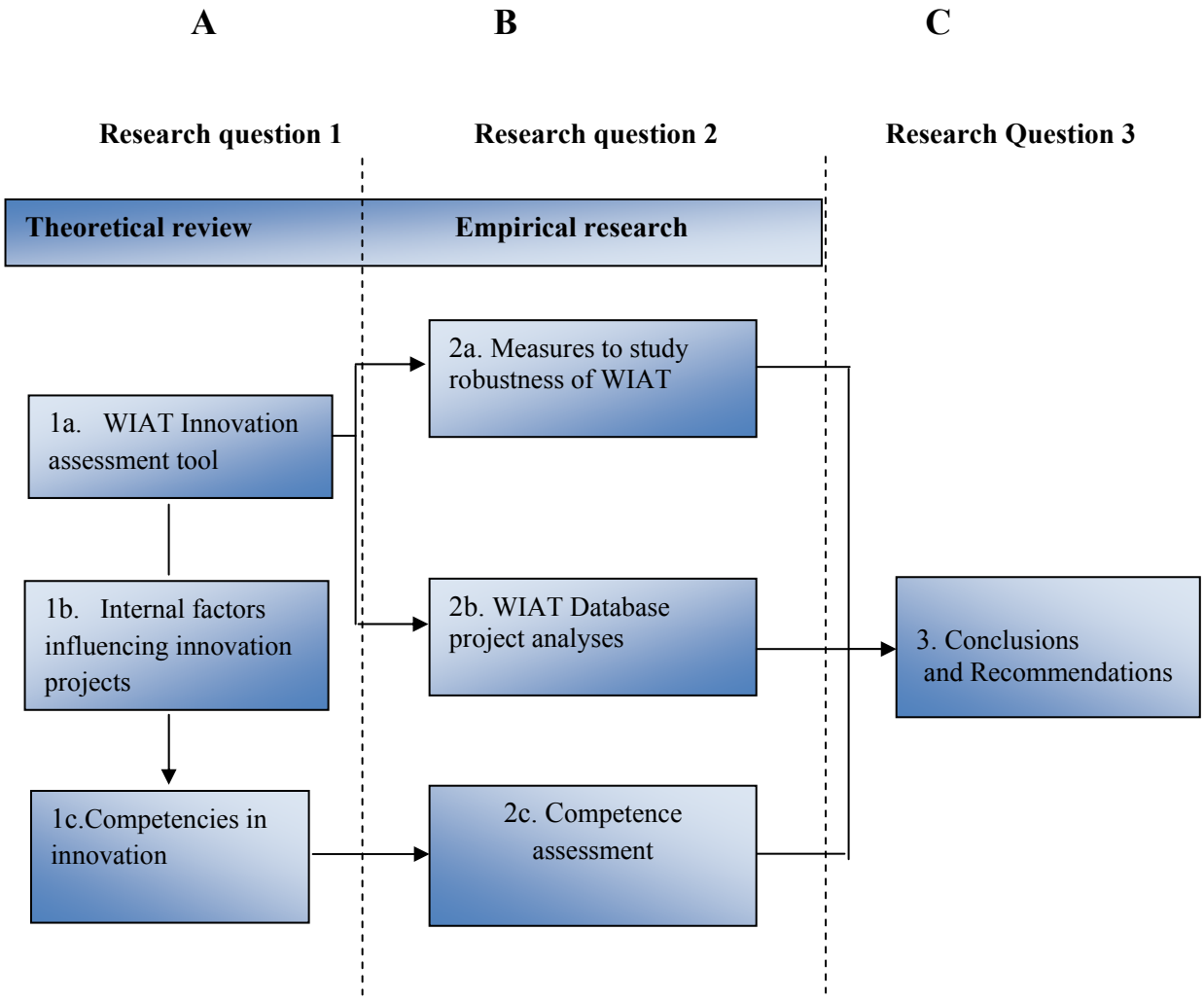


Figure 2 Research Framework

As presented in figure 2, the first stage (section A) of this research project involves an in depth theoretical review of WIAT and internal factors that influence innovation projects with particular attention to competencies. This helps to answer research question 1 and the sub questions corresponding to the subsections (1A & 1B) in the research framework (fig 2). The theoretical review is important for giving a basis on how the WIAT tool was developed and the fundamental principles that determine the outcome in assessing innovation projects. In view of differing competencies in organizations it is important to know how competencies influence the innovation process and to determine if they are an important element to incorporate in the WIAT tool.

The second stage (section B) of this research project is an in depth analysis of the WIAT database, focusing on the dataset and making statistical analysis of the results, evaluating the factors and questions in order to improve on the tool thereafter. Analysis of ten available innovation projects and on line competency assessment for the innovation teams involved in the projects is meant to be carried out. This part is meant to answer research question 2 and the sub questions corresponding to the sub sections 2A and 2b of the framework (fig 2).

Lastly conclusions and recommendations (section C) are given basing on the theoretical study and the empirical analysis on how the robustness of WIAT can be improved. This answers research question 3.

1.1.4 Definition of concepts

The list of definitions is according to the discussion in Bryman & Bell 2003 (business research methods, Oxford University press)

Reliability, replication and **validity** are presented as criteria for assessing business research (Bryman & Bell 2003). The terms are defined below since the study purposes to measure robustness of a tool.

Validity is concerned with the integrity of the conclusions that are generated from a piece of research (Bryman & Bell 2003). The main types of validity are construct/measurement validity, internal validity, external validity and ecological validity.

Construct validity is the degree to which a measure of a concept truly reflects that concept (Bryman & Bell 2003).

Ecological validity is a concern with the question of whether social scientific findings are applicable to people's everyday natural settings (Bryman & Bell 2003).

Internal validity is concerned with the question of whether a finding that incorporates a causal relationship between two or more variables is sound (Bryman & Bell 2003).

External validity is concerned with the question of whether the results of a study can be generalized beyond the specific research context in which it was conducted (Bryman & Bell 2003).

Robustness refers to the effectiveness of a measure across subgroups (Glasgow 2007). It is categorized as one of the three forms of **external validity**. The other forms are realism and statistical generalizability (Simonson & Winner 1992).

Reliability refers to the degree to which a measure of a concept is stable. (Bryman & Bell 2003). It is necessary for validity, which implies that a study's conclusions are valid if the results are reliable. There are three prominent factors involved when considering whether a measure is reliable which are stability, internal reliability and inter-observer consistency (Bryman & Bell 2003). In this project the focus is on internal reliability which concerns whether the indicators that make up a scale or index are consistent.

For the purpose of this project, there is an analysis of the WIAT database to improve on its robustness and reliability and thereby result in enhanced external validity and construct validity since the tool is useful in innovation assessments. Focus is mainly on enhancing **external** and **construct validity**.

A **competence** is the integrated set of knowledge, attitudes and skills of a person (Mulder 2007). This research project is also concerned with individual competencies and how they can influence innovation projects.

1.2 Technical research design

The third part of this proposal is the technical research design which consists of the research material, research strategy and plan. It gives an overview on how to carry out the research and how to gather the data.

1.2.1 Research material

The research material is mainly from the field of innovation management and human resources management with particular focus on innovation assessment and competency development for innovation teams. There are different kinds of data sources and methods of data generation:

Scientific literature is used mainly on human resources management and innovation management from the ISI Web of Science. The project proposal is based on the book of Verschuren and Doorewaard (2005). With regards to the theoretical review, a brief review of the theoretical knowledge behind the WIAT tool is

necessary: the main sources are the texts written by Cooper (1987) and Hollander (2002). The work of Fortuin 2007 also represents WIAT and for that reason it is of great use to the thesis. With regards to statistical analysis the book of Andy Field (2005) is used. To gain insight into the individual competencies essential for innovation teams, two papers by the co-reader of this project Elise du Chatenier (2007) on human resources management are used.

For empirical research, triangulations of data sources and methods should lead to an analysis of a deeper and more complex level and thereby enhancing the robustness of innovation assessment using WIAT tool.

Database: The WIAT database is the source of material for the statistical analysis and the competency tests results is useful in the project.

Documents such as the WIAT questionnaires are used in this research project in analysing the questions and factors involved in WIAT assessment.

People are used as data sources, particularly Maarten Batterink (PhD) who designed the WIAT and Elise du Chatenier (PhD) who is currently carrying out PhD research on the individual competencies for innovation teams.

1.2.2 Research strategy

The research strategy, which is the coherent body of decisions about the way in which the research project is carried out, is described below (Verschuren and Doorewaard, 2005).

The research is a **case study** since we want to gain profound insights into several objects and processes (Verschuren and Doorewaard, 2005). It is considered as a **data base analysis** since it involves an analysis of the WIAT database.

Prior to the data base analysis, **desk research** is conducted to gather information on the background and assumptions behind WIAT and on factors influencing innovation as shown in Figure 2 (sub sections 1A, 1B & 1C). This is crucial in order to lay a foundation for the empirical section. It is carried out through gathering information from literature in libraries and archives.

Statistical analysis (quantitative content analysis) is carried out for evaluating and interpreting the findings of the WIAT database. SPSS is the statistical package that is used to analyze the dataset.

Conclusions and recommendations are drawn out of the statistical analyses.

1.2.3 Research Planning

This gives the main phases of the activities that are carried out to achieve the research goal.

Designing the research project

This involves exploring the project context and finding exactly what is needed. It also includes a rough screening of the literature on innovation management, innovation and assessment competencies for innovation.

Preparatory research

Preparatory research involves familiarizing with the theoretical material and gathering information on the background of WIAT. It also involves writing the research proposal and having meetings with supervisors to discuss and come up with the proposal.

Literature research

This phase is focused on gathering information on the research topic. Wageningen university library is the principal source of information. Journals on the ISI Web of Science are used. An overview of the literature is made taking into account the important facts.

Empirical research

Following after that is the exploratory analysis of the WIAT database Comparison is made on the cases in the WIAT database. Results from the statistical analysis are outlined relating them to the literature review.

Writing of the report

The final stage involves recording and writing the report on the analyzed data, making conclusions and recommendations. A draft is done first and the final report is made after comments have been received from the supervisors. The final report should answer the research questions and state to which degree the objective has been realized (Verschuren and Doorewaard, 2005).

This thesis project started in September 2007 and ended in March 2008.

2 Literature Study

The first research question of this study is formulated as "*what are the principles upon which WIAT is built on*''. To answer the question a set of sub-questions are defined according to the part of the research framework they belong to. The first section (A) initiates the research with theory development. Therefore this chapter presents the main concepts on innovation management and innovation assessment tools in detail which provides an answer to the sub questions of part A.

The chapter centers on the background and assumptions behind the WIAT instrument and on the internal factors affecting innovation which brings out the issue of individual competencies. Because WIAT deals with innovation, an overview of what innovation is and the innovation process is given. The last section of this chapter will present an outline of the individual competencies influencing innovation. The theoretical review will set a base to start the empirical study and to use in drawing conclusions and recommendations.

Section 2.1 introduces the main concepts on innovation. The definition of innovation is given, the types of innovation described and the innovation process is outlined to give the background of the subject behind which is innovation. In addition to this, the subject of innovation assessment is described touching on past research findings and the existing innovation assessment tools. This should answer sub-question 1a which is stated as "*what are the background and assumptions behind WIAT."*

Following that is section 2.2 which aims to answer the sub-question 1b: "*are there any external and internal factors that could influence innovation assessment of WIAT."* The factors that influence innovation are studied, starting with factors external to the firm and then the internal factors. Out of the internal factors emanates, the issue of competencies which leads to section 2.3. This sections aims to answer sub-question 1c which is stated as "*which competencies within organizations and individuals support the success of innovation"*. Finally a summary is given which describes the underlying essential ideas from the theoretical study that form the principles upon which WIAT is built upon to set a base for the empirical analysis.

2.1 Innovation management

2.1. 1 Definition of Innovation

Innovation is the process of translating ideas into useful- and used- new products, processes or services (Tidd & Bessant 2007). It is not only invention but making ideas work technically and commercially. There are various definitions of innovation which may vary in the wording, but they all stress the need to complete the development and exploitation aspects of new knowledge not just its invention. The roots of innovation concepts are based on the Schumpeterian economics, emphasizing innovation and entrepreneurship.

Innovation is an important capability for organizations because the environment is constantly changing. Hence, innovation gives organizations strategic advantage as they can offer something no one else can and in ways that others cannot match (Tidd et al 2005).

Innovation is an offspring of knowledge (Freeman 1982). There are 2 types of knowledge which are codified knowledge and tacit knowledge.

- Codified Knowledge: in the form of publications, patents, blueprints

- Tacit Knowledge: embedded in the "know-how" and dexterity of individuals, in and organizational routines (Freeman 1982).

Innovation involves organizing different pieces of knowledge with intention to balance creativity with the discipline of making something happen. It thus involves creating new possibilities through combining differing knowledge sets. Utilization of knowledge is crucial to boost up innovation as knowledge becomes more tacit.

Innovation management focuses on the regular processes that organizations use to develop new and improved products, services and processes. It deals with harnessing the creative ideas of an organization's employees and utilizing it to bring a steady flow of profitable new innovations to the marketplace, quickly and efficiently.

Innovation is a process and hence it needs to be actively managed. Innovation management is about learning to find the most appropriate solution to the problem of consistently managing this process and doing so in the ways best suited to the context of the organization (Tidd & Bessant 2007).

The ever changing environment poses a great challenge to manage innovation. Brown & Eisenhardt 1995 state that product development is among the essential processes for success, survival and renewal of organizations, particularly for firms in either fast-

paced or competitive markets. Tidd and Bessant (2007) have also mentioned that innovation has become a generic activity associated with survival and growth. Companies need to innovate in order to survive. Those companies that do survive are the ones capable of systematic change.

2.1.2 Types of Innovation

According to Tidd and Bessant (2007), innovation can take many forms but it can be reduced to four dimensions of change (the 4ps of innovation):

- product innovation: involves changes in products or services offered by an organization
- process innovation: implies changes in the ways in which products or services are created and delivered.
- position innovation: refers to changes in the context in which products or services are introduced.
- paradigm innovation: deals with changes in the underlying mental models which constitute what the organization does.

Degree of novelty is also another dimension to innovations. There are degrees of novelty starting from minor, incremental improvements right through to radical changes. Each of the 4Ps can take place within these degrees of novelty running from incremental through to radical change. As far as innovation management is concerned, the approach to change will differ, depending on whether it is incremental or radical change in product or process (Tidd et al 2005).

Incremental innovations are found to be the most common. Tidd & Bessant (2007) refer incremental innovations as "doing what we do but better" They involve minor improvements or limited number of changes to current products or processes. Whilst radical innovations are fundamental changes that represent revolutionary changes in technology (Dewar & Dutton 1986). They refer to completely a new concept, idea, design, and product.

According to Garcia and Calantone (2002), although the majority of research takes a firm's perspective toward the degree of newness, others look at new to the world, new to adopting unit, new to the industry, new to the market and new to the consumer (Song & Montoya-Weiss 1998; Rubenstein 1987; O'Connor 1998; Cooper

& Kleinschimdt 1991; Atuahene-Gima 1995). This forms another level of the measure of the degree of newness of innovation.

2.1.3 Innovation process

The underlying challenge for any organization is to obtain a competitive edge through innovation, and consequentially through this to survive and grow. Tidd and others (2005) have identified the innovation process which is outlined as common to all firms. It involves the following (Tidd et al 2005):

- Searching and scanning the environment for opportunities and threats for change
- Selecting: deciding which of the opportunities for change to respond to.
- Implementing: involves translating the trigger idea into something new and launching it in a market
- Acquiring the knowledge resources to enable the innovation
- Executing the project under conditions of uncertainty which require extensive problem – solving.
- Launching the innovation and managing the process of initial adoption
- Sustaining adoption and use in the long run and revisiting the original idea and modifying it.
- Learning form progressing through the cycle and improving the ways in which the process is managed.

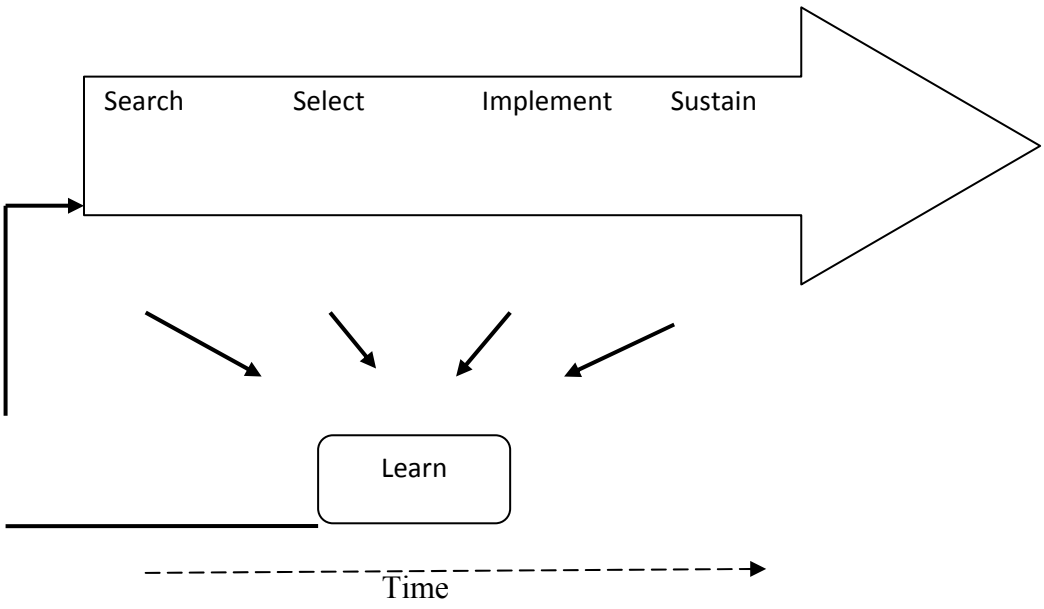
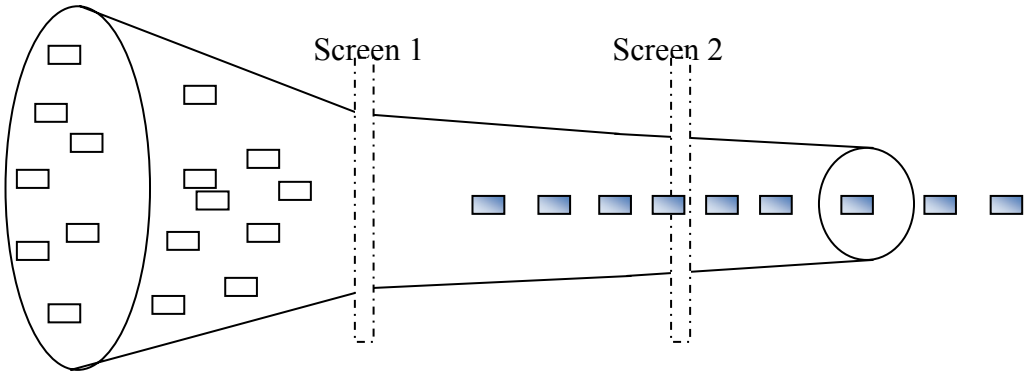


Figure 3 Simple representation of the innovation process (adapted from Tidd 2005)

Innovation funnel

Successful innovation has also been attributed to a series of sequential steps termed as the development funnel (Wheelwright & Clark 1992). Figure 4 represents "the innovation funnel" which illustrates the process that firms ideally go through to identify many ideas, select the few most promising for development and focus resources into getting them into the market. The overall innovation process starts with a wide range of inputs and gradually refines and selects from among them. This funnel provides a graphic structure for thinking about the generation and screening of alternative development options and combining a subset of these into a product concept (Wheelwright & Clark 1992). A handful formal development projects are created that are then pushed to rapid completion and introduction.

Phase one of the funnel represents the initial concept and idea generation for potential product or process development. The aim at this stage is to widen the mouth of the funnel, which can be done through gathering of ideas from various sources rather than just research and development (R&D). A narrowing of the channel occurs at screen 1 which comes at the end of the product/process concept development stage. This involves the initial review by middle level managers (peers) drawn from the individual functions to determine what additional information is needed before a go/no-go decision (screen 2) can be made. If an idea is found to be complete in phase one, it can be moved into phase two where project bounds are outlined in detail and required knowledge specified. If the idea is still inadequate, the specific tasks needed to complete it are revised and the time at which it can be reviewed. At screen 2, senior management reviews the product or process development options and selects those that should become innovation projects. This stage constitutes the go/no- go decision point and any project passing through it is funded and staffed with the expectation that it is carried through to market introduction (Wheelwright & Clark 1992). Phase three involves execution of the projects by the development team.



Phase one	Phase two	Phase three
Product/process idea generation and concept development (also advanced development, identification and review)	Detailing of proposed project bounds and required knowledge	Rapid, focused development projects of multiple types

Figure 4 Representation of the development funnel (adapted from Wheelright & Clark 1992)

2.1.4 Innovation Assessment

This part describes past research findings on product development by giving an outline of three research streams (Brown and Eisenhardt, 1995) derived from past studies which summed up most of the previous studies on innovation assessment. A summary of relevant and recent studies on new product development is given as an extension to the three streams of research. This gives a background of the constructs that form WIAT looking back at past empirical research on innovation assessment.

In the next part innovation assessment tools are described with focus on the Newprod and Genesis tools upon which WIAT is based. A classification of past tools is also made from other studies. WIAT is also described in detail focusing on the background and the assumptions it is based on. This is useful in bringing out the theories and assumptions upon which the tool is built on which is necessary for supporting the statistical analysis results.

Past research and findings on product development

The high incidence of industry new product development failure has been acknowledged over a decade ago (Booz-Allen & Hamilton 1968, Cooper 1979, Crawford 1987, Urban & Hauser 1993, Ernst 2002). Because of the high levels of uncertainty associated with innovation, assessment of innovations has become a priority for many organizations. The main reason for innovation assessment is to investigate success versus failure potential in order to form prescriptive guides for the innovation process. The way the firm develops and launches a new product is improved by awareness of the variables that are of relative importance leading to corrective action (Cooper 1979).

A variety of tools and techniques have been designed to assist in screening new product ideas, including rating scales, checklist models to judge the overall sustainability of the product idea to the company and concept test models to screen for market acceptability. One of the problems with these rating scales was that neither the screening variables included nor their relative weightings were empirically derived. They were simply based upon estimates (Cooper 1979). Thence, there arose the need to come up with methods that are empirically derived.

These past researches (such as Booz, Allen and Hamilton 1968) highlighted most of the problems faced by innovators. Another research direction was the investigation of new product failures (Cooper 1975, Davidson 1976, Hopkins and Bailey 1976; Lazon 1965). The reason for these researches was that an understanding of past failures would be the beginning step to prescriptive solutions. Further researches were done to study successful product developments in order to uncover the key to successful innovations (Cooper 1976, Globe, Levy and Schwartz 1973,). Recent research has concentrated on comparing product successes and failures. It has been based on the notions that only through a direct comparison of successes with failures will the variables that differentiate the two be established.

Brown and Eisenhardt (1995) performed an intriguing study on past research and findings on product development. Firstly, they categorized empirical literature into three steams: problem development as rational plan, communication web and disciplined problem solving. Secondly they went on to synthesize the research findings into a model of factors affecting the success of product development.

According to Brown & Eisenhardt (1995), the rational stream builds on the Myers and Marquis (1969) and SAPPHO studies (Rothwell 1972, Rothwell et al 1974); the communication stream on the early work of Allen (1971, 1977) and the problem – solving stream on Imai and colleagues (1985). Each stream focused on the constructs highlighted in the pioneering works.

- Rational plan research; focuses on a broad range of financial performance of the product
- Communication web: deals with the narrow effects of communication on project performance
- Disciplined problem solving: concerns the effects of product - development team, its suppliers and leaders of the project.

The rational plan has emphasis on that success of an innovation is achieved if the product is well planned, implemented and appropriately supported Focus is on discovering the independent variables which are correlated to the financial success of a product – development project. The studies are often exploratory with a broad perspective. The setback with these studies is that the theoretical understanding of relationships is quite limited and non significant findings are not reported.

With regards to the communication web the underlying proposition is that communication within the project team members and outsiders stimulates performance of the development teams. These studies emphasized on size depth not breadth as in the rational plan thereby making the results valuable as they give a theoretical understanding of a narrow segment of the phenomenon. However, the main shortcoming of this perspective is that it is so focused on communication by project team members whilst other factors such as product attributes and market attractiveness are neglected.

Regarding the disciplined problem-solving perspective; successful product development is seen as a balancing act between relatively autonomous problem solving by the project team and the discipline of strong project management and an overarching product vision. As a result, a fast productive process and a high quality product concept are developed. This stream of research deals specifically with the organization of work, development process and product concept. However the stream suffers in that it lacks political and psychological realism, also some of the constructs are challenging to grasp. It also relies too extensively on a Japanese viewpoint.

Brown and Eisenhardt (1995) conclude their work by coming up with an integrative model of product development by bringing the three streams together as they offer complementary and overlapping insights into product development. They give a summary of key findings within the literature and comparison of the research streams (table 1). They state that some concepts in the researches are less sharply defined and some theoretical links are not well tested hence they recommended further research to test the validity of these tenuous links. Checking the relative importance of the factors is also considered necessary to examine the robustness of the claims.

The three streams summarize past research findings and bring up factors that were drawn out of these studies in assessing innovation. This is necessary for this research in order to gain insight into the evolution of the factors which came out of several studies and their implication on the current tool under this study. The three streams research outlines the methods and theories behind past findings in the area of product development which is important to this study to be aware of the strengths and weaknesses of these methods and how WIAT can be implicated considering this. It appears WIAT falls under the communication web stream when considering the three perspectives of research which implies that it relies heavily on the objectivity of the project team. This is so because it deals mainly with team communication this is detailed out in a later section where it is outlined in detail.

Table 1 Comparison of three research streams

Concepts	Rational plan	Communication web	Disciplined Problem solving
Key idea	Success via superior product, attractive market, rational organization	Success via international & external communication	Success via problem solving with discipline
Theory	Mainly at heoretical	Information and resource dependence	Information including problem solving
Methods	Bivariate analysis; single informant, many independent variables	Deductive and inductive; multivariate multiple informants	Progression from inductive to deductive; multiple informants, single industry, global studies
Product	Product advantage (uniqueness, quality, fit with core competence)	-	Product integrity (product vision which fits customers and firm)
Market	Size, growth, competition	-	-
Senior management	Support	-	Subtle control
Project team	X-functional	-	X-functional
Communication	High cross-functional	High internal, high external – various types and means	High internal
Organization of work	Planning and effective execution	-	Overlapped phases, testing, iterations and planning
Project leaders	-	Politician and small group manager	Heavyweight leader
Customers	Early involvement	-	-
Suppliers	Early involvement	-	
Performance (dependant variable)	Financial success (profits, sales, market share)	Perceptual success (team and management ratings)	Operational success (speed, productivity)

Source: Brown and Eisenhardt (1995)

Overview of past research and findings on new product development

In this section we give a review of past empirical studies as an extension to the three streams of research which is outlined in the previous section. This is critical to understand the background factors and constructs into new product development (NPD), thereby providing an understanding of the background of innovation assessments. This section aims to answer the sub question on what are the constructs that form WIAT.

Ernst (2002 worked on a review of past empirical literature on new product development. His review is an extension of the streams of research within Brown & Eisenhardt (1995). The review tries to summarize the most important findings in a compact and structured way (Table 4). Ernst's study centers more on the success factors of new product development which is crucial as it gives the background of the factors or principles upon which the tool under study is based. Table 4 is used as the theoretical framework in this study, which is based on the work of Ernst 2002. Important information concerning the NPD studies especially concerning the sample and the measurement of NP success and the essential findings are summarized in the table (table 4). Recent NPD studies have been added to the table and an extra column showing the underlying construct.

In the table the name of the author and the success measure used in the study are identified and the main results or findings are also summarized. Most of the authors rely on Cooper and Kleinschmidt's preliminary conceptual work; hence their findings barely differ from their work (Ernst 2002). Five broad categories (Ernst 2002) are used to structure the presentation; (1) NPD process, (2) organization (3) culture (4) role and commitment of senior management and (5) strategy. The factors considered here are those which have positive impact on the NPD process.

Table 2 Empirical results on New Product Development (NPD)

Publication	Level of analyses, n	Success measure	Underlying constructs	Main results
Atuahene –Gima 1995	Programme, n=275	Building of 2 success variables: 1. Market performance 2. Project performance	Market orientation considering the following aspects: 1.Environmental conditions – hostility of the industry environment 2.Product characteristics - stage of product life cycle -degree of product newness to customers and the firm	1.Market orientation, esp. regarding the following aspects: -collection and use of market information -development of market-oriented strategy -implementation of market –oriented strategy *Influence of market orientation varies depending whether it's radical or incremental innovation.
Balbontin et al., 1999	Project, n=208 American and British firms	Selection of successful and unsuccessful projects by respondents	Analysis of critical success factors in USA and UK basing on the following: -Market, customer and product characteristics -Organizational climate, culture and structure -Influence of government -Company learning ability	1.Good proficiency of marketing and design activities 2.Accurate market forecast and predictions about customer requirements 3.High level of information flow contact between technical and commercial entities 4.Project manager with necessary (management, marketing, technical) skills
Barczak, 1995	Programme, n=140	Reduction of 6 success variables into one success dimension: performance index	Telecommunications industry – considers the shortcoming of NPD studies cutting across industry lines. Effect of the interrelatedness of strategy, structure and process on NPD performance	1. A professional NPD process, esp. regarding the following aspect -screening ideas
Blindenbach and Ende 2006	Project based firms 4 companies, 6projects	Multiple criteria scale with the following indicators: 1. Project performance 2. Market performance 3. Learning effects for future innovation.	Derived set of 5 factors to use as reference: 1.Planning of work 2.Senior management involvement 3.Team 4.Involvement of outside parties 5.Activities undertaken	Significant differences between project-based firms and literature on functionally organized firms. 1.Planning of work 2.Team 3.Involvement of outside parties- customer involvement 4.Activities undertaken
Calantone and di	Project, n=189	Selection of successful	Determine the extent and nature of	1. Marketing activities esp. regarding the

Benedetto, 1988	Model used data on industrial products only	projects (from a profitability standpoint) by respondents	interrelationships between factors basing on these underlying factors: 1.Technical resources, skills and activities 2.Market resources, skills and activities 3.Market intelligence activities 4.Lauch activities 5.Relative product quality	following aspects: - marketing resources and skills - competitive and market intelligence 2. Technical activities esp regarding the following aspects: - technical resources and skills - competitive and market intelligence Adequate performance on all of these activities considered critical to product success.
Calantone et al, 1997	Project, n=142 Industrial products	Selection of successful projects (from a profitability standpoint) by respondents	Factors to consider in attempting to accelerate cycle time in a hostile competitive environment basing on the following aspects: 1.Proficiency of new product activities 2.Environmental hostility	1. Predevelopment marketing activities 2. Predevelopment technical activities 3. Marketing activities 4. Technical activities
Cooper 2007	Business-unit level 161 companies	Reduction of 10 success variables into 2 success dimension 1. Profitability 2. Impact on the business	Updating previous work on NPD using 5 major blocks which are: 1.New product development process 2.Organisation 3.New product strategy 4.Firm's internal culture and climate 5.Senior management's commitment and involvement	Factors that drive new product performance: 1. A high-quality new product process. 2. A clearly defined new product strategy for the business unit. 3. Adequate new product resources—people and money 4. High-quality new product teams 5. Senior management commitment 6. Innovative climate and culture 7. Cross-functional teams 8. Senior management accountability
Cooper and Kleinschmidt,(1979, 1985, 1990,2002) NEW PROD	Project level Phase 1: Project, n =195 Phase 2: Project n=203 Phase 3:Project, n=200	Financial performance Phase 1: a. Analysis of variance between successful and unsuccessful projects b. Reduction of independent variables to 18 factors,	Developed in Ontario and Quebec (Canada) in 3 phases. Based on six blocks or of variables that impact on new product outcomes which are as follows: 1.Commercial Entity 2.Information Acquired	Phase 1 1.Proficiency of NPD process 2.Information acquired 3.Extensive use of market research 4.Strong market orientation Phase 2 Positive impact on profitability

		discriminant analysis between successful and unsuccessful projects. Phase2: 10 success measures 1.Profitability level 2.Payback period 3.Domestic market share 4.Foreighn market share 5.Relative sales 6.Relative profits 7.Sales objectives 8.Profit objectives 9.Opportunity window on new categories 10.Opportunity window on new markets Phase 3:2 success dimensions: 1. Programme impact(sales) 2.Programme profitability	3.Proficiency of Process Activities 4.Nature of the market place 5.Resource Base of the firm 6.Nature of the project	1.Proficiency of pre-development activities 2.Protocol or project definition 3.Proficiency of market related activities 4.Proficiency of technological activities Phase 3 1.Product superiority and uniqueness 2.Project company resource capability 3.Market need, Growth and size 4.Economic advantage of product 5.Newness to the firm 6.Technological resource compatibility 7.Market competitiveness 8.Product customization or specialization
De Brentani, 1989	Project, n=276	Reduction of 16 success variables into 4 success dimension: 1. Sales and market share performance 2. Competitive performance 3. 'Other booster' 4. Cost performance	Focus on services in comparison to physical goods innovation. Analysis basing on "product" and new service variables: A. "Product" variables 1.Product characteristics 2.Market related attributes 3.Company-related attributes 4.New service development process B. Service-related variables 1.Intangibility 2.Simultaneity 3.Heterogeneity 4.Perishability 5.Types of service	1.Strong market/customer orientation 2. Existence of a NPD process 3.Service quality 4.Corporate synergy/ project company fit

Fortuin et al, 2007 (Assessment tool development)	Project, n=46 Agrifood industry	Multiple criteria with the following indicators: 1.Project performance 2.Product performance 3.Future performance	Based on Cooper's pivotal work (e.g. 2002) and Hollander (2002). Uses the following constructs: 1.Project company fit 2.Project resources 3.Team communication 4.Product superiority 5.Product aspects 6.Market competition 7.Market volume 8.Environment	Key success factors: 1.Team communication 2.Product superiority 3.Market potential 4.Cross functional team 5.Heavyweight leader Tool under development for assessing innovation projects
Griffin, 1997	Programme, n=383	4 success dimensions out of 7 single economic success variables 1. Overall success 2. Relative success 3. Market success 4. Financial success Classification of firms in 'Best' and 'Rest' based on the 4 success dimensions	Strategy, process and organizational factors: Multi-functional teams Top management support Portfolio and pipeline management Multiple organizational structures Customer needs	Significant differences between best and rest 1. Existence of a formal NPD process where the best include any particular step in the NPD process.
Hollander 2002	Genesis assessment tool Project , n=44	Multiple criteria with the following indicators: 1.Project performance 2.Product performance 3.Future performance	Based on the study by Cooper (NEWPROD) incorporating the NEWPROD factors. 1.Product superiority and uniqueness 2.Project company resource capability 3.Market need, Growth and size 4.Economic advantage of product 5.Newness to the firm 6.Technological resource compatibility 7.Market competitiveness 8.Product customization or specialization	Determine probability of success using the following identified factors 1.Project-company fit 2.Project resources 3.Communication 4.Project team 5.Product superiority 6.Product aspects 7.Market competition 8.Market volume 9.Environment Factors fall under company, team, product

				and market construct
Mishra, Kim and Lee, 1999	Project, n=288	Selection of successful and unsuccessful projects by marketing managers	Cross country study of South Korean firms comparing with Canada and China, basing on the following variables: 1.Environmental variable -market competitiveness -market attractiveness 2.Controllable variables -proficiency of new product activities considering 13 NPD activities -product offering and launch effort -information acquired during new product process	1.Impact of proficiency of the formal NPD activities esp. regarding the following aspects: -initial screening -detailed market study or market research -prototype testing in-house 2.Intelligence acquired about the market esp. regarding the following aspects: -knew customers needs, wants and specifications for the product -knew customer price sensitivity -knew competitor product strategies
Parry and Song, 1994	Project, n=258	Selection of successful and unsuccessful projects by NPD managers	Extension of Cooper's model to China using the 77 variables developed by Cooper	1.Proficiency of process activities esp. regarding following aspects: -product development -market research -preliminary market assessment -initial screening -financial analysis 2.Information acquired during the new product process esp. regarding the following aspects: -knew customers needs, wants and specifications -knew the market size
Rothwell et al 1974	Project, n=86	Selection of successful and unsuccessful projects by respondents Commercial standpoint-market share, profit and alignment with company strategy.	5 underling factors from SAPPHO 1 which are: 1.Strength and characteristics of management 2.Understanding user needs 3.Marketing performance 4.Efficiency of development 5.Communications	1.Strong customer orientation esp. regarding the following aspects: -better understanding of customer needs -early identification of customer dissatisfaction -intensive customer training -update of customer information during the NPD process 2.Careful project selection

Song and Noh 2006	Korean high-tech firms 124projects(62 successes/62 failures)	Dealing with "best practices" A seven criteria to define success and failure relating to projects: 1.Return on investment 2.Profit 3.Market share 4.Sales 5.Opportunities for technical leadership 6.Market dominance 7.Customer satisfaction	1.Project environment 2.Skills and resources 3.Project leadership 4.Strategic fit 5.Process 6.Product positioning strategy	Factors that contribute to NPD success in the three following categories: 1. Project environments 2.Skills and resources 3. Strategy
Song and Parry 1997	Project, n=1.400	3 success dimensions: 1.Relative profitability 2.Rekative sales 3.Relative market share	Similarities and differences in NPD processes of Japanese & US firms considering these factors: 1.Marketing resources and skills 2.Technical resources and skills 3.Internal commitment 4.Cross-functional integration 5.Competitive intensity 6.Market potential 7.Product differentiation	1.Proficiency of activities in business/market opportunity stage 2.Project fit 3.Cross functional integration 4.Resources and motivation 5.Internal commitment Involving customers and manufacturers will improve NPD processes
Souder et al 1997	Product, n=150	Consensus of multiple respondents on the success or failure (commercial standpoint) of the project	Similarities and differences between small-technology based firms in New Zealand and US.	1.Proficiency of marketing activities during the NPD process 2.Proficiency of technical activities during the NPD process 3.Marketing skills (knowledge about the market)
Sun and Wing 2003	Hong Kong toy industry; 8 companies Company and project level	Delphi method and Biblical model	Critical success factors from previous studies: 1.Structured new product development process 2.Senior management commitment and support	Classification of factors within the NPD phases High importance factors: Phase1: Clearly defined target market Phase 2: Implementation of quality standards

			3.Clear product definition 4.	Phase 3: Internal communication within project team Phase 4: Delivery of new product to customers in time
Tidd and Bodley, 2002	Project, n=50 (25 firms from the UK)	1.Sales growth 2.Market share 3.Payback 4.Return on Investment 5.Net Present Value	Basing on the following factors: 1.Product advantage 2.Market knowledge 3.Clear product definition 4.Risk assessment 5.Project organization 6.Project resources 7.Proficiency of execution 8.Top management support	NPD process in relation to novelty of the new product/technology regarding the following factors: 1.Cross functional teams 2.Heavyweight project manager 3.Project coordinator
Von Hippel 1986	Exploratory study	Analysis of lead users' importance	Good customer knowledge and application area	Utilizing lead users in marketing research by: 1.Identifying an important market or technical trend 2.Identifying lead users who lead that trend 3.Analyzing lead user need data 4.Project leading user data onto the general market of interest

Based upon Ernst 2002

On the basis of the table and in line with Ernst (2002), we find that within the new product development process (NPD) the following four activities and/or contents are of specific importance (table 2.3); (1) The quality of planning before starting the development phase (Barczak 1995, Calantone et al 1997, Mishra et al 1996, Song and Parry 1996), (2) The regular commercial assessment of the NPD project during all phases (Parry and Song, 1994, Song and Parry 1996) which can be the basis of the decision to terminate or intensify a project, (3) The orientation of the NPD to the market (Atuahene-Gima 1995, Souder et al 1997) and (4) distinguishing between market and customer integration into NPD (de Brentani 1989, Von Hippel 1986).

Table 5 below gives a summary of the overview of the main activities found in the studies.

Table 3 Summary overview of the empirical studies on New Product Development

	Activities	Sources
1.The quality of planning before starting the development phase	Essential preparations for the project involve: - first broad evaluation of ideas - execution of technical and market-directed feasibility studies - commercial evaluation of the NPD project - description of the product concept, target market, customer gain from using the product in comparison to competitor' products	Barczak 1995, Calantone et al 1997, Mishra et al 1996, Song and Parry 1996, Ernst 2002
2.The regular commercial assessment of the NPD project	Process-oriented controlling approach as a basis for continuing or terminating a project at certain milestones - timely and consequent termination of unprofitable NPD projects as a key success factor -Initial selection before development phase considered as crucial	Barczak 1995, Calantone et al 1997, Mishra et al 1996, Song and Parry 1996, Ernst 2002
3.The orientation of the NPD to the market	Quality of market research - understanding and evaluation of customer needs - accurate prediction of market potential -observing competition	Atuahene-Gima 1995, Souder et al 1997, Ernst 2002
4.Distinguishing between market and customer integration into NPD	-Importance of market orientation for NPD success. -Integration of customers into the NPD process as active figures in the sense of 'lead users'.	de Brentani 1989, Von Hippel 1986, Ernst 2002

1. With regards to the quality of planning before the development phase (table 2.3); the necessary preparations for the project include; the first broad evaluation of ideas, execution of technical and market-directed feasibility studies and a commercial evaluation of the NPD project (Barczak 1995, Calantone et al 1997, Mishra et al 1996, Song and Parry 1996).

2. Regular assessment of the NPD process is crucial as it serves as the basis for the decision whether to redefine or terminate a project at certain milestones. Mostly poor projects run too long as early intervention is considered too sensitive thus regular assessment could assist reduce this problem. Timely and consequent termination of unprofitable NPD projects was earlier identified as an important success factor by Cooper and Kleinschimdt (1995a).

3. The orientation of the NPD process to the needs of the market refers to the quality of market research regarding the understanding and evaluation of customer needs (e.g Mishra et al 1995; Parry & Song 1994), the accurate prediction of market potential (Balbontini et al 1999), the competition observation (Calantone & Benedetto 1988, Mishra et al 1996) and this information should be updated during the entire NPD process (Ernst 2002).

4. Ability to distinguish between market and customer integration into NPD is another essential element that comes out of the findings. The guide lines of measuring customer orientation lead one to assume that, as the work of Cooper and Kleinschimdt, it is in principle intended to capture whether the NPD process is aligned with the needs of the customer and /or market. The constantly positive findings reflect the importance of market orientation (de Brentani 1989, Rothwell et al 1974). In the work of Von Hippel (1986) customers are explicitly integrated in the NPD process as active figures in the sense of 'Lead Users'.

In addition to past research findings, research is still going on concerning new product development assessment and especially critical success factors that leads to success in new product development. However, whereas past studies have referred mostly to a broad range of aspects, recent studies have become more context specific (Song & Noh 2006, Blindenbach-Driessen & Ende 2006, Fortuin 2007). These recent studies have relied on past studies as a base to explore the contextual areas of study. Blindenbach-Driessen & Ende (2006) who have done some recent work on innovation have concentrated only on project-based firms basing their work on past studies (Brown & Eisenhardt 1995, Ernst 2002, Montoya-Weiss & Calantone 1994). They identified key success factors of innovation in project-based firms (Table 2.2) having explored previous factors from other studies in order to meet the contextual set up of project - based firms. Song and Noh (2006) also made a study considering the context of Korean firms. The tool under scrutiny (WIAT) has been designed with focus on the Dutch agri-food industry context (Fortuin, 2007). Several others studies have also been conducted with particular attention on certain contexts such as supplier orientation, novelty of products, high technology industry and low technology industry and many others.

One may derive that there is a shift of focus from the past studies as compared with the recent studies. It is important to note this and this shift could be for the better as the studies are more specific and concentrate on a specific sector.

From these studies we find that each study integrates one or two aspects of the three streams of research mentioned previously with some even integrating all aspects of the three streams. All the three streams have strengths and weaknesses as well as overlapping and complementary interests (Brown and Eisenhradt, 1995). Hence most of the studies integrated a certain stream or even all thereby completing the interests and increasing the depth and breadth of the research. For instance Hollander (2002) covers both the rational plan and communication web, whereas Cooper falls under the rational plan.

From the studies looked we find the underlying constructs in assessing innovation projects. There is some vagueness in this area of study because there has been no real consensus on the factors. Each study has emphasis on certain areas which makes it difficult to come up with a uniform set of factors or constructs. The review is crucial for this research in order to assist in the analysis of the tool under scrutiny. The next section deals with the tools for innovation assessment.

Classification of tools

Hollander (2002) identifies and lists some previous product development tools and techniques. These include brainstorming, morphological analysis, synetics, the Delphi method, focus groups, product life cycle, concept test, conjoint analysis, in-home use test, quality function deployment, limited roll-out, test marketing, marketing forecast models and computer forecasting (Hollander 2002, Nijssen & Frambach 2000). Hollander also mentioned four groups of tools which are scoring models, economic benefit models, mathematical programming and cognitive simulations. According to Hollander these overviews are not comprehensive however they contributed ideas to developing business development assessment tools.

The EIRMA (1995) reported 100 methods of project evaluation in its report as stated in the work of Hollander (2002). They were divided into fourteen groups according to similarity of their features. Three meta-groups came out of the fourteen groups and are identified as (1) financial methods (2) human judgement and (3) learning. The first group could be linked to the rational plan perspective, the second to the communication web and the

third to the disciplined problem solving perspective in the three research streams findings (table 1).

It is important to note the limitations of these methods. The judgemental methods such as scoring models rely on subjective managerial inputs on multiple criteria (Hollander 2002, Saaty 1980). Learning models introduce an empirical component by comparing proposed projects with past experience (Hollander 2002). However, they are also considered weak because of reliance on a single person as the interviewee.

Existing tools

To gain the theoretical background of WIAT, it is crucial to study the Newprod model by (Cooper 1979a) which is based on the SAPPHO study by Rothwell 1972 as a starting point. This tool which belongs to the rational plan stream utilizes an empirical modeling methodology, and theoretical and practical experience has been gained with the tool which has been in use since 1987 (Hollander 2002).

i. Newprod

The NewProd is empirically derived from a study of a random sample of 177 Canadian industrial companies. It is based on the premise that the profile of a new product project, in terms of a number of qualitative characteristics, is a reasonable predictor of success (Cooper 1992). The model is based on six blocks or groups of variables that impact on new product outcomes (Cooper 1979. These include:

1) The Commercial Entity
2) Information Acquired
3) Proficiency of Process Activities
4) Nature of the market place
5) Resource Base of the firm
6) Nature of the project

These blocks were delineated to permit the formation of 77variables that were expected to be related to new product outcomes. Managers were tasked to identify two of typical new products that had been introduced into the market, one a commercial and the other a failure. The manager responsible for the project had to respond to the 77 statements (Cooper 1979). They were asked to respond to the questionnaire as if they were at the beginning of the project. They had to indicate their level of agreement or disagreement and their level of certainty for each answer. Responses were based upon a 10point Likert

scale, which means 0 points mean total disagreement and 10points for total agreement. As for certainty, a score below 5 shows uncertainty and a score above 5 shows certainty.

The original Newprod questionnaire measured the development factors related to the company, product and market (Hollander 2002, Cooper 1979). 48 new variables were deducted as a screening tool (Cooper 1981; 1985). The 48 variables were combined into thirteen factors of which eight were used in the final prediction model (Hollander 2002). The eight Newprod factors are listed as follows:

1. Product superiority and uniqueness
2. Project company resource capability
3. Market need, Growth and size
4. Economic advantage of product
5. Newness to the firm
6. Technological resource compatibility
7. Market competitiveness
8. Product customization or specialization

These factors were used to predict probability of success that the new product earn money for the company.

Newprod was able to predict 84% of the expost cases correctly, using a dichotomous scale. In the second version of the tool the number of statements was reduced from 48 to 30 with 9 factors because of respondents' complaints that the questionnaires were too long and this would in turn reduce reliability of answers (Cooper 1992). Newprod resulted in an increased understanding of project strengths and weaknesses and more insight of risks, uncertainties and critical areas of ignorance. It also provides valuable inputs to GO/KILL decisions which results in improved resource allocation. The tool also encourages team building as the members of the project team learn to develop a shared vision and direction for the project.

Conclusively, although the tool is useful in new product development, it has also suffered some limitations. According to Calantone et al (1999) and Hollander (2002) it has the following limitations:

1. Reliance on historical data which may not be applicable to the future.
2. The data was collected in organizations from a variety of industries which could influence the model if used within another organization.

3. Newprod compares the new product ideas with the knowledge base and predicts the probability of success; if the product ideas have similar scores, the tool is of limited use as a selection tool.
4. Financial success is the only dependent performance measure.

The next section describes the Genesis tool which was developed as a follow up to Newprod.

ii. Genesis tool

Hollander developed the Genesis tool in 2002 as a follow up to the Newprod with the aim to increase product performance by providing relevant, reliable and valid management information (Hollander 2002). This information will enhance the controlling power of business development teams which is the overall function of the tool.

The questionnaire is the central element of Genesis tool. Its overall function is described in a black box design, an input and output figure (fig 5). Data is collected and entered into the black box containing the business development assessment tool. Output of the box is information concerning the possible future performance of the project.

Figure 5 The overall function of the design (Hollander 2002)

Genesis is based on four relevant business development constructs: company, team, product and market. For each construct three of the most relevant factors for analyzing development project factors were defined. The tool consists of twelve factors which were then reviewed and reduced to nine factors (fig 6). The questionnaire is a central element to the tool and was developed from the original Newprod questionnaire (Cooper 1981; 1982). Hollander focused on the innovation team while Cooper developed the Newprod questionnaire around the company. However, the intended meaning of the factors remained the same. Since the focus was on the team, only those variables controllable by the project team were used in the assessment tool. The 12 factors are listed below:

1. Strategy
2. Project-company fit

3. Project resources
4. Communication
5. Project leader
6. Project team
7. Product superiority
8. Product scope
9. Product aspects
10. Market competition
11. Market volume
12. Market environment

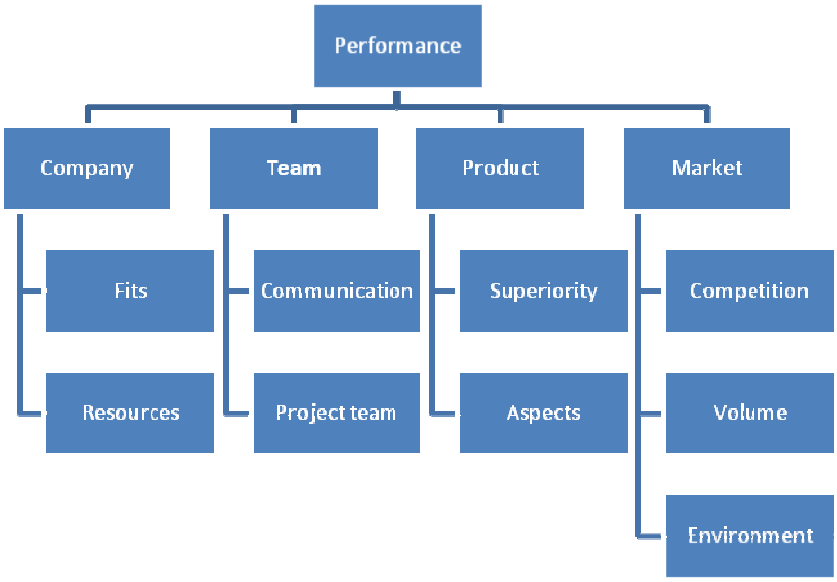


Figure 6 Genesis questionnaire model (Hollander, 2002)

Three different time-dependent project performance measures were used in this tool: project performance, product performance and future performance (Hollander 2002).

The questionnaire consists of a response scale and a certainty scale to give respondents the possibility to indicate their degree of certainty in their response. It comprised of 73 statements and it also used a 10point scale as in Newprod. Three persons per project had to complete the questionnaire to improve on the reliability of the survey. Statements can be customized to fit a specific project. The final questionnaire was reduced to nine factors (Fig 6) and 48 statements. The nine factors are listed below:

1. Project-company fit

2. Project resources
3. Communication
4. Project team
5. Product superiority
6. Product aspects
7. Market competition
8. Market volume
9. Environment

Genesis' tool constructs are used to measure the controllable factors for business development teams. In addition to these controllable factors, the tool also measures the co-operation between the team members using the response and certainty scores at the team level. At least five persons fill the questionnaire for the sake of reliability. Four team aspects are determined which are: optimism, consensus, confidence and integration.

The assessment procedure can be executed within a few days. Genesis tool enables the storing of the collected project data in a knowledge database consisting of success and failure projects previously assessed making it possible to make effective comparisons.

Therefore in concluding this part, the Genesis has additional elements that compared to the Newprod. The focus shifted from company level to the team level and the assessment involves multiple respondents. The questionnaire can be adjusted to a specific company and project. More factors than the controllable ones can be assessed and performance is measured by multiple indicators.

iii. Wageningen Innovation Assessment Tool (WIAT)

This section gives an outline of WIAT which is the main subject of this thesis project.

Objectives and functions

WIAT was developed two years ago by the Department of Management Studies of Wageningen University. It is primarily based on the Genesis tool (Hollander, 2002), and it also includes insights from other studies in the field of innovation (Booz-Allen & Hamilton, 1968, Cooper, 1985, Jamrog, 2006).

The aim of WIAT is to diagnose strengths and weaknesses in the innovation project, to predict the success potential at an early stage of its development. It is crucial to assess the project in its early stage in order to select possible paths and to reduce or eliminate the probability of failure (Fortuin et al., 2007).

The subjects of analysis have mainly been Dutch companies of the agrifood business. Almost 100 projects have been assessed so far, involving successful, running and failed projects

The high effectiveness of the WIAT is determined by the fact that it is able to extract the tacit knowledge of the innovation team concerned. This is because it takes into consideration the real feelings of all the team members, which are sometimes unexpressed (Batterink, 2006). Once the analysis has pointed out early warning signals, then it is possible to actively discuss them. As a result, the chance of success of the project can be improved.

WIAT can be alternatively applied to one innovation project using many respondents or to many projects using one respondent. The following section outlines on the application on the case companies.

WIAT Methodology

WIAT starts with structured interviews with a number of top innovation executives about innovation management in general, drivers and barriers to innovation. In these interviews the following topics are scored using a 5 points scale (Batterink 2006):

- Importance of innovation for the company.
- Reasons to pursue innovation.
- Ability to identify creative people.
- Drivers and barriers to develop an innovative culture.
- External driver to innovation.
- Creativity and action taken to support innovation.

The scores are then compared with the recent AMA (American Management Association) findings. This is a study which was conducted on a large number of multinational companies to investigate drivers and barriers to innovation (Jamrog, 2006).

Following that a meeting is organised with the project leader, to adapt the WIAT questionnaire to the specific situation of the innovation project at hand.

Figure 7 depicts the constructs used to assess the chance of success and failure.

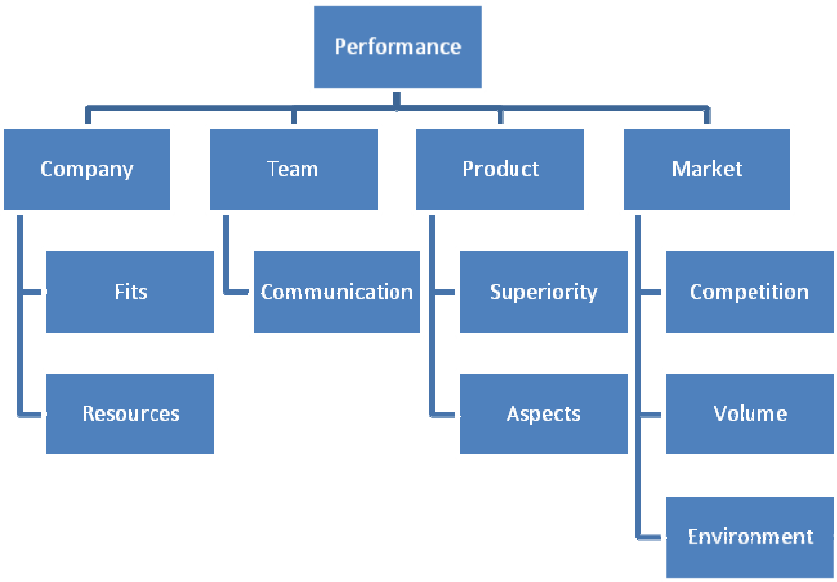


Figure 7 WIAT questionnaire model (based on Fortuin et al., 2005)

The structure of WIAT is quite similar to the one in Genesis. The four constructs are the same as in the Genesis tool. However, only the factors have been reduced to eight according to a new scale of importance. The main difference lies with the team construct which has only one factor, 'communication' in WIAT; whereas with Genesis there are two factors, 'project team' and 'communication'. The indicators measuring the performance of the assessed project are the same (project, product and future).

It also has the questionnaire as a central element in its assessment. The questionnaire is composed of 53 statements, to be answered by a flexible number of project entrepreneurs, experts or R&D team members.

WIAT specifically treats internal dimensions: company (materials, resources), team (top management involvement, team communication), process (project structure) and product (product specifications). Also incorporated are the contextual dimensions such as market (size, degree of competition and customer needs) and environment (economic, social and political).

The procedure of answering the questionnaire is the same as in the original NewProd. Agreement/disagreement and certainty/uncertainty are maintained and the scale is based on 10 points: 1 means strong disagreement and uncertainty, 10 stands for strong agreement and certainty. Each personal response is kept anonymous with operational time being approximately 20 minutes.

A more general questionnaire about the company profile, the cooperation and sources of information relevant for the assessed project has to be filled out by the project leader.

After the questionnaire has been answered, the following team scores can be calculated per statement (Batterink 2006):

- Average answers score
- Standard deviation on the answer score
- Average certainty score
- Standard deviation on the certainty score

Analysis of these scores gives a first impression concerning team communication.
Generally it is possible to affirm that the statements with a positive answer score and a relatively high certainty score are identified as strengths of the innovation project. This combination can be repeated and can result in a list of strengths, weaknesses, questions and unknown risks (Table 2.2).

Table 4 Statement assessment (Batterink, 2006)

Statement	Certainty	Uncertainty
Agreement	Strength	Question
Disagreement	Weakness	Unknown risk

The results are used as a starting point for the team discussion and results are further on compared with a database containing data about the projects already assessed. Final discussion with the team members leads to defining specific actions to be taken and provide practical suggestions on improvements. WIAT's level of sophistication is comparable to the Newprod and the Genesis tool has a predictive validity similar to it.

Therefore, WIAT is a tool under development which implies that the project database still relies on historical data. As soon as the running projects are finished and assessed, WIAT is increasingly based on the ex-ante evaluation of innovation projects. It comprises of eight conceptual factors as indicated in Fig 7 and is based primarily on the previous Genesis tool (Hollander 2002).

2.1.5 Conclusion

In concluding the first part of the theoretical review, the definition of innovation has been given and the innovation process outlined. Innovation is described as the process of translating ideas into useful- and used- new products, processes or services not just invention. The innovation process is outlined in the current version by Tidd et al (2007) and also the past version of the innovation funnel concept. Types of innovation are also outlined. This helps to

understand the concept of innovation which is the area of study in this research as WIAT is involved in innovation management.

Past findings on research about new product development are summarized to give insight into the background of innovation assessment. This helps to understand the factors that are used to build innovation assessment tools and the measures that were previously used and are now used. Three research streams were identified from past studies and outlined. They give insight into the theory building up of innovation assessment and that helps in giving an understanding of the formation of these tools and measures.

Innovation assessment tools that have been in use before WIAT are also described in the last section, with focus on the background, assumptions and how they have been implemented. The Genesis (Hollander 2002) and Newprod (Cooper 1992) tools were detailed out as they also form the background of WIAT. This is essential since WIAT is built on some previous insights in these studies and this forms its background as well. The WIAT which is based on insights from others studies and the Genesis tool has been described detailing the factors used in the assessment and mentioning its aim which it to extract tacit knowledge from the project team and thereby use it to predict the success of an innovation. Genesis tool was developed based on insights from the Newprod and it tried to improve on weakness encountered with the previous tool. The WIAT is also based upon concepts from the Genesis tool. It is necessary to detail the background and assumptions in order to be able to analyze its robustness which is the aim of this research.

Therefore this section partly answers the question on the principles upon which WIAT is built on. It has been realised that WIAT is a tool for monitoring innovation projects within firms. It is built upon success factors which were originally identified by Cooper who is actively involved in new product development studies. Hollander (2002) in his work on the Genesis tool incorporated these factors and WIAT was built based on the Genesis tool constructs. The critical success factors identified in WIAT are Project Resources, Team Communication, Product Superiority, Performance and Market Volume. The notion behind WIAT is to extract the tacit knowledge concerning an innovation project from the innovation team. It takes into consideration the real feelings of all the team members, which are sometimes unexpressed in order to diagnose the success or failure probability of an innovation project. Hence assessment using WIAT provides an overview of what needs to be present for an optimal innovation process.

2.2 Factors influencing innovation

Section A of the research framework is divided into the study of the background and assumptions behind WIAT, of internal factors which influence innovation and focus on individual competencies particularly. This part will thus provide insights to answer the sub questions; "Are there any internal and external factors that could influence innovation assessment of WIAT?" and "which competencies within individuals support the success of innovation?" First a study to check if there are factors which influence innovation is done, both internal and external. Secondly the individual competencies and their influence on innovation success are described in detail. Lastly a summary of the section is given and the importance of individual competencies drawn out.

The external and internal factors

There are various drivers to innovation which can be external or internal to the firm. These factors derive from a wide range of company functions and are often referred to as "the determinants of innovation" (Souitaris 2002). External factors deal with doing the *right projects* whilst internal factors deal with doing *projects right* (Cooper 1999).

2.2.1 External factors

External factors also termed environmental factors are usually beyond control of the firm. They include characteristics of the new product's market, technologies and competitive situation. Although they are beyond control of the project team, external factors are useful to consider when selecting and making a priority of projects. As stated by Batterink et al (2006), the innovation process is embedded in the firm's environment. Hence external factors play a role in influencing the innovation process of any organisation. Depending on the controllability, the environment can be divided into the general (remote) and task (operational) environment (Batterink et al 2006). The general environment comprises of the economic, political, social and technological factors which affect all organisations. The task environment is characterised by those factors which interact directly with the firm and have direct impact on its activities, for instance supply chain partners or competitors.

For innovation to become feasible certain technological prerequisites must be met. Innovation is stimulated by the presence of a need and its necessity which determines the time and speed to innovation. Thus the intensity of the need determines the speed of a new product to market. Once the technological prerequisite is in place, need is created and the new product is designed.

However there are also socio cultural challenges to innovation. New products and technologies bring about change to the society which implies that the society will have to adjust to the new product or technology. There is need for willingness to change and take risks from the society which all depends upon the culture of a society. Some cultures are more conservative, risk averse and change resistant than others. Cultures that are resistant to change inhibit ideas and hence postpone or disturb innovation advancement. The cultural climate must be responsive and willing to adjust to change and risk. It is easier to carry out innovations in organizations where the environment is perceived as non- threatening. Cultures define the limits of change beyond which the innovator is at risk (Dunphy et al 1996).

Innovation is also dependent upon the structure and product dispersion of the particular industry. Industrial sectors vary in terms of sources, paces and rates of technological change (De Jong & Vermeulen 2006). Degree of regulation within a particular industry will impact the industry's capacity for innovation. Regulations that protect a particular industry from external forces, especially such as foreign competition, reduce the incentive to innovate which eventually leads to technological obsolescence. For instance the case of the American past experience with the steel and automobile industries. It seems that the higher the degree of regulation within an industry the lower the level of resulting innovation for that industry (Dunphy et al 1996). Therefore industrial policy and legislation have an impact on innovativeness of organizations.

Ability to innovate is also inversely proportional to the degree of competitiveness of the industry. The more competitive the industry is the higher the tendency to innovate by the firms in that industry. Competition gives pressure to innovate and thus organizations are forced to innovate in order to survive the competition.

Innovation is also influenced by national level factors. The infrastructure of a country affects the innovativeness of firms. Availability of venture capital and subsidies results in an increase in innovations. For example innovation subsidies in the Dutch agri-food industry assist in getting innovation projects started. In addition, local, national and European authorities have implemented policies on innovation which influence innovation in organizations (Niosi, 1995). On the other hand, massive government regulation is also generally believed to have a negative impact on innovation. Government bureaucracy acts as an inhibitor to innovation because regulatory agencies tend to be risk averse by nature (Dunphy et al 1996). The higher the central government's bureaucracy and regulatory powers, the lesser the tendency there is for innovation within a country. Also the type and power of a government determines the innovativeness of organizations within that country.

Therefore the institutional, technological and political environment plays a part in determining the innovativeness of firms. (Avermaete et al 2003).

To summarize external factors are those environmental factors that are of little control to the firm. Most research has focused on the internal factors which are predominantly controllable to the firm and therefore influence the success of innovation. This leads to the internal factors.

2.2.2 Internal factors

They focus on process factors or action items which are things that the project team does or does not do very often (Cooper 1999). Nonetheless, these actions are controllable and discretionary hence they are seen from time to time. Empirical research on new product performance has identified four categories of factors that affect success of innovation: market-related, product-related, new product development process-related and organization-related factors (Calantone et al, 1994, Cooper 1979, Cooper and Kleinschmidt 1987). Organization-related factors are normally under managerial control over the long run while market-related are not controllable by managers and are more external to the firm.

Calantone and Weiss (1994) further on identified eighteen factors in four major categories that capture the essence of research on the determinants of new product performance. Results in all other empirical studies included in their review could be classified according to the list of these factors. The four major factors identified in their study are (1) strategic factors, (2) development process factors, (3) market environment factors and (4) organizational factors (Calantone & Weiss 1994).

(1) Strategic factors constitute five factors which are product advantage, marketing synergy, technological synergy, and strategy and company resources.

Product advantage refers to the customers' perception of product superiority with respect to quality relative to competitors.

Marketing synergy represents the fit between needs of the project and the firm's resources and skills with respect to distribution, advertising, promotion, market research and customer service.

With regards to *strategy* this indicates the strategic drive for the development of a project for instance, defensive, reactive, proactive, and imitative. The measures of fit between new product and corporate strategy and measure of product positioning are included as part of the strategy factor. Firms need strategy in order to obtain technical, marketing and production

synergies between different projects. A coherent strategy enables firms to build on past successes and to capitalize on emerging strengths (Rothwell 1992).

Company resources factor signify the compatibility of the resource base of the firm with requirements of the project. It involves capital, manufacturing facilities and manpower requirements. Company resources which include the skills that a firm possesses are very important to this research.

(2) Market environment factors are more external to the firm and have been discussed under external factors. However, in the Calantone &Weiss(1994) study they are classified as internal factors.

(3) Development process factors comprise of protocol, proficiency of predevelopment activities, proficiency of market related activities, proficiency of technological activities, top management support, speed to market and financial/business analysis.

Protocol factor stands for the firm's knowledge and understanding of specific, marketing and technical aspects prior to product development for example the target market, customer needs, wants and preferences, the product concept and product specifications. "Origin of idea" measures are included in this factor as well.

Proficiency of predevelopment factor relates to the proficiency of initial screening, preliminary market and technical assessment detailed market study and market research. Preliminary business or financial analysis is also included in this factor.

Proficiency of market-related factor deals with proficiency of marketing research, customer tests of prototypes, test markets, selling, advertising, distribution and market launch.

Proficiency of technological activities factor is associated with the firm's ability to be proficient in product development, in house testing of the product or prototype, trial or pilot production, production start up and acquiring necessary technology.

Top management support, control and skills factor refers to top management's commitment to projects, their daily involvement and control over project development. The idea of key individuals is also included. Rothwell (1992) also states that top management visibility is crucial especially in the case of major innovations and in overcoming the barriers and resistance to innovation that usually exist in companies.

Speed to market factor refers to the speed of the development process or launch effort. It involves launch timing, development cycle time and first or second to market effects.

Cost factor refers to the speed of the development cost including measures of production, R&D, or marketing cost overruns or expenditures.

Financial or business analysis factor is related to the proficiency of ongoing business analysis during development prior to commercialization and full-scale launch (Calantone & Weiss 1994).

(4) Organizational factors comprise of internal/external communication and *organizational factors*. With regards to *internal or external communication factor* reference is made to coordination and communication within the firm and between firms. It involves information exchange between departments and external firms; cross functional participation on projects and degree of interaction. Nowadays communication with external firms is very important for successful innovation. More and more companies are now engaging in open innovation to enhance their innovation. By open innovation it refers to the process of combining internal and external sources for both the development and implementation of new technologies or products (Chesbrough, 2003). In practice this means that experts from different organizations share and create new knowledge collaboratively.

Organizational factors refer to the organizational structure of the firm especially with respect to new product project (teams, new venture matrix). It also includes issues concerning organizational climate, size, centralization, and reward structure and job design.

This factor incorporates the human resources and skills that firms possess which is an important phenomenon to this research. Other studies (Rothwell 1992, Rubenstein 1976) have outlined that organizations do not make innovation projects successful but individuals do. Organizational structure and control mechanisms are not sufficient conditions for successful technological innovation. Roles of certain individuals involved in innovation projects play an important part in contributing to the success of an innovation. This now leads us to a deeper look into the issue of competencies that individuals possess which are critical for innovation.

To summarize, this part described the internal and external factors which influence innovation. External factors are related to the environment and the firm has little control over them. Internal factors deal with the process factors that the firm can control in order to improve the success of innovation projects. Generally the factors are common to all industries although their rank order of importance can vary from sector to sector (Rothwell 1992). It is important to look into these factors since WIAT; the tool under study incorporates these factors in innovation assessment. Internal factors influence innovation and will thus consequently influence the assessment of innovation using WIAT. The next section then describes the issue of individual competencies and their influence on innovations.

2.3 Competencies influencing innovation

This section will give an outline of company-wide and individual competencies that influence innovation.

During the 1990s, the concept of competence dominated management strategy literature putting emphasis on 'core competence' as a key organizational resource (Delamare & Winterton 2005, Mitrani et al 1992, Campbell & Sommers Luchs 1997). Prahalad and Hamel (1990) introduced the notion of 'core competencies' which influenced management theory in the 1990s (Souitaris 2002). They defined core competence as 'the collective learning in the organization especially how to co-ordinate diverse production skills and integrate multiple streams of technologies' (Prahalad &Hamel 1990, Delamare & Winterton 2005).

In accordance to the resource-based theory, sustained competitive advantage is viewed as originating from a firm's internal resources if they can add value, are unique, rare, are difficulty for competitors to imitate and are not substitutable (Delamare & Winterton 2005). The importance of the core competence approach lies in the fact that it recognizes the complex interaction of people, skills and technologies that drives performance. In addition to this it addresses the importance of learning and path dependency in its evolution (Scarborough, 1998, Delamare & Winterton 2005). With reference to the firm, competencies are the technical and organizational skills behind each firm's end products that a company need to identify and develop in order to be competitive (Souitaris 2002). Pavitt (1991) expressed that firms gain profitable innovative leads through building up 'firm specific competencies' that take time or are difficult to imitate.

2.3.1 Individual competencies

With regards to individual competencies, competence is the integrated set of knowledge, attitudes and skills of a person (Mulder 2007). They are assumed to be recognizable, assessable and relevant for practice. They can be developed, learned, and described on different levels. It is presumed that there is a powerful relationship between competencies and organizational effectiveness (Caird 1992). Individual competencies have been described as a characteristic of an individual that has been shown to drive superior job performance and include both visible 'competencies' of knowledge and skills and underlying elements of competencies like traits and motives (Delamare & Winterton 2005). In this research the focus is on individual competencies because WIAT already incorporates company-wide competencies in its assessment of Innovation. The individual competencies are absent and thus there is more focus on them.

Nowadays with the high involvement of companies in open innovation, collaborative knowledge sharing becomes crucial. There are challenges that innovation teams face in the process which can be due to diversity of professional backgrounds in the teams which can lead to conflicts (Tidd et al 2001). In order to deal with these challenges there is need for strong communication and relationship skills of the team members.

However, it is peculiar that management theory has emphasized more on competencies that are unique and firm specific with little attention on the issue of individual competencies and their impact on organizational performance (Du Chatenier 2007, Delamare & Winterton 2005).

In the innovation process, which consists of scanning the environment, defining the project, developing the product and implementing, there is knowledge creation and sharing to create common goals, prototypes, plans and strategies. It also involves combining different knowledge sets and integrating ideas so as to come up with a new idea. Factors which challenge this process if dealt with, successful innovation projects will be on the rise.

There are various individual competencies that are required to deal with the challenges encountered by innovation project teams in order to achieve success in innovations. They include strong negotiation, creativity and interpersonal influencing skills, good planning and task coordination skills, networking abilities and self-directed learning skills (Du Chatenier et al 2007). Table 3 gives a preliminary competency profile based on theory which addresses the challenge and relevant competency framework and the competency components. The competency profile consists of four categories self, interpersonal, project and content management (Du Chatenier et al 2007).

Table 5 Relevant competency frameworks

Challenge	Relevant competency framework	Competency components
Complex goals Low proximity Team decomposition	Team work competence	Conflict resolution; Collaborative problem solving; Communication; Goal setting and performance; Planning and task coordination
Low levels of trust	Key components of trust	Being benevolent; reliable; competent; honest; open
High diversity	Negotiating	Openness; Active awareness of own perceptions; Ability to engage with others to explore assumptions
High diversity	Novelty generation or creativity model	Novelty seeking; novelty finding; novelty producing; Innovative performance
Power differences Unequal reciprocal commitment No learning history but future Insufficient resources	Political skill	Social astuteness; Interpersonal influence; Networking ability; Apparent sincerity
No single centre of overview	Skills of self-directed learning	Engaging in divergent thinking; accepting feedback; diagnosing learning needs; formulating objectives; identifying resources for accomplishing objectives; designing strategy plan; carrying out the plan; collecting evidence of accomplishments
Team instability High level of creative turmoil	Copying with chaos tools	Managing butterfly effects; managing boundaries; transforming feedback; using fractals; using attractors; self organization; coupling
Overall learning process	Learning competence	Learning knowledge; learning skills; learning attitude; learning motivation, self confidence
Overall innovation process	Entrepreneurial competence	Opportunity competence, relationship competence, conceptual competence, organizing competence, strategic competence, commitment competence
Overall collaboration process	Competencies for Boundary Spanners	Building sustainable relationships; managing through influencing and negotiation; networking; managing complexity and interdependencies; managing roles, accountabilities and motivations

(Source: Du Chatenier et al 2007 unpublished data)

According to Rothwell (1992), success in innovation is people centered. Therefore, since innovation is a 'people process'; it is essential to consider the competencies that individuals possess which influence the innovation process. An overwhelming number of projects studied have shown that certain individuals had played (often informal) roles in their initiation, progress and outcome (Rothwell 1992). The role of product champion, technological gatekeepers and other team members are sufficient conditions for project success. The quality of staff is recognized as being an important factor in innovation processes (Bessant et al 2003). However the role and what types of quality are needed have

not yet been investigated (Du Chatenier 2007). Therefore it becomes necessary to consider the influence of individual competencies in innovation assessments.

The second section of the theoretical review, answers the question on factors which influence innovation. These have been divided into external and internal factors to the firm. The internal factors are detailed which are divided into four major categories namely market-related, product-related, new product development process-related and organization-related factors.

With reference to Table 4 on past researches on new product development and rregarding the factors influencing innovation, most authors have concentrated on factors that increase success of innovation or new product development (NPD) as used in most studies. These are usually termed key success factors or critical success factors. Most of these factors are internal and they are similar to the factors outlined in this section from the study by Calantone and Weiss (1994). What differs from the studies is the weight or relative importance thrust upon each factor. We also find that most or all of the studies incorporate market-related factors which are external to the firm. This supports the point raised before that these external factors are useful to consider when selecting and making a priority of new product development projects.

Individual competencies are drawn out of the internal factors as falling under organizational related factors and are detailed out with emphasis on their importance in project teams and the firm as a whole. It has been shown that a lot of studies have not dealt with the issue of individual competencies but have focused more on firm-specific competencies. The need to pay attention to individual competencies has been outlined as people or individuals are the ones who contribute to success in innovations. According to Tidd & Bessant (2007) recognizing the need for different kinds of individual creative styles is an important aspect of developing successful innovations. The creativity styles are shaped by background factors, knowledge and skills acquired by the individual which form the competencies that they possess.

2.4 Summary on literature study

This chapter has been designed to gain answers to part A's research question, "*what are the principles upon which WIAT is built*". Firstly the main concepts that address innovation management have been outlined. Since the tool under study deals with innovation it is

important to grasp the concept of innovation management. These concepts have assisted in building a theoretical framework from literature.

Section 2.1 outlines the definition of innovation, types of innovation and the process. Secondly the area of innovation assessment is developed, a crucial subject in this research as it focuses on an innovation assessment tool.

It begins with a scan through past research and findings on product development which leads to an outline of three streams of research on this subject. A table of past researches on new product development is given with several studies showing the underlying constructs used and the main results. It is important to have these studies and understand the constructs since the research is focusing on studying and analyzing the construct of WIAT.

WIAT falls much more under the communication web as it deals to a larger extent with team communication and agreement levels of the team members. This implies that it relies on the objectivity of the project team. However, it is based on success factors which originated from Cooper who developed his work under the rational stream and came up with key success factors that determine product development success. Cooper developed the Newprod tool for assessing innovation projects which is based upon these key success factors which were related to the company, product and market.

The Genesis tool was designed as a follow up to the Newprod tool basing on four constructs; company, team, market and product. It has more focus on the innovation team while the Newprod had more focus on the company. Additional elements that were left out in Newprod were added to Genesis and it involves multiple respondents with more attention on team cooperation. The tool uses three different time-dependent performance measures: project performance, product performance and future performance unlike the Newprod which used only one.

Following after this is a detailed description of WIAT. The tool is based on the constructs of the Genesis tool with some slight alterations. It is based on the same four constructs as Genesis; company, product, team, product and market. WIAT also incorporates an external dimension, that is, the environment and has eight success factors. The prime concept with WIAT is to extract the tacit knowledge concerning an innovation project from the innovation team taking into consideration the real feelings of all the team members, which are sometimes unexpressed in order to diagnose the success or failure potential of an innovation project. It has also been used specifically in Dutch agri-food companies.

Section 2.2 describes the external and internal factors which influence innovation. This part is studied in order to answer sub-question 1b; "*are there any external and internal factors that could influence innovation assessment of WIAT*". Factors which influence innovation subsequently affect innovation assessment using WIAT as it assesses innovation projects. External factors are the factors which have to do with the environment; and are usually beyond control of the project team, but are worth considering when selecting and prioritizing projects.

Internal factors are studied with more detail as they are important to this research. They are mainly focused on process factors which are controllable to the project team. Four major categories of internal factors are identified which are: market-related, product-related, new product development process-related and organization-related. Competencies are picked as part of the organisation-related factors emanating from the resources that a firm owns.

Individual competencies are defined as the skills, attitudes, and knowledge that individuals have. Most managerial theory has focused on company wide competencies without adequate attention on individual competencies. Hence it also comes up that the issue of individual competencies is absent in the assessment tool. Therefore it is important in this study to describe the importance of individual competencies and their influence in innovation. This was studied in order to answer sub-question 1.d; "*which competencies within organizations and individuals support the success of innovation*". Some individual competencies are realized to be influential in innovation processes. They are framed as; team work competence, trust competence, negotiating competence, novelty generation competence, political skill, self-directed learning competence, copying with chaos tools, learning competence, entrepreneurial competence, and competence for boundary spanners.

Having outlined the theory behind the WIAT, what follows is the detailed plan of the methodology applied in studying its robustness. Certain tools and methods are involved in analyzing the tool to improve on it and these are outlined in the forthcoming chapter.

3 Methodology

Introduction

This chapter details how the analysis of the innovation assessment tool under study is carried out. This intends to answer research question 3 which reads; *what are the measures necessary to study reliability and robustness of WIAT?* An outline of business research terms focusing on the measures necessary for the purpose of this study is given. Meanings of important terms the statistical analysis procedures are depicted to provide the steps to be taken in the analysis.

Since this thesis research work aims to study the robustness of an innovation assessment tool, it becomes essential to outline how the analysis is done in order to show the extent to which the analysis is carried out within the limited time. In studying the robustness of WIAT, some basic research concepts are defined mainly according to the discussion by Bryman and Bell (2003) and Hair et al (1998).

3.1 Reliability and Robustness of WIAT

There are three perspectives (Bryman and Bell 2003) that form criteria for assessing business research; which are validity, reliability and replication. Validity is concerned with the integrity of the conclusions that are generated from a piece of research (Bryman & Bell 2003). Reliability refers to the degree to which a measure of a concept is stable while replication is the degree to which the results of a study are consistent.

There are two main forms of validity which are internal and external validity. External validity stands for the power of a study to show generality of its findings (Krathwohl 1993). The aspect of robustness is one of the three forms of external validity. By robustness as mentioned before in the early chapter we refer to the effectiveness of a measure across sub-groups (Glasgow 2007). Hence the study will focus on this aspect of validity in order to show how widely the tool can be applied and thereby enhance its effectiveness as it is important for a study or tool in this case to have generality power (Krathwohl 1993). In the past years many studies have concentrated largely on internal validity with less focus on external validity (Krathwohl 1993, Winer 1992). Internal validity refers to whether the evidence of a study supports the existence of a relationship between or among its variables (Krathwohl 1993). However the importance of external validity has been raised and the need to analyze the generality power of studies is crucial.

Robustness as one form of external validity is concerned with whether the general effect holds up in the face of wide variations in subject populations and settings. Thus the study analyses the effectiveness of WIAT across sub-groups since it is being used in real life situations. WIAT has been applied mostly in the Dutch agri-food companies and it can be more effective by incorporating other industries thus studying its robustness could make it more valuable to other settings. It is critical to study the robustness of WIAT as an innovation assessment tool in order to improve upon the tool and make it more reliable and robust

The other two forms of external validity are realism and statistical generalizability. Realism is concerned with whether the research study (tasks, stimuli, settings) was realistic and, therefore, the results likely to be generalizable to a more natural environment (Winer 1992). Statistical generalizability has to do with whether the results from a study using a particular sampling approach can be generalized to the larger population of interest. For the purposes of this study one form of external validity is addressed, which is robustness because the aim of this study is to make the WIAT more effective by analyzing its robustness and give recommendations for improvements.

Reliability of the tool will also be analyzed to show whether conclusions drawn out of WIAT assessments are reliable. It reveals the extent to which a variable or set of variables is consistent in what it is intended to measure (Hair et al, 1998). Hence, the analysis focuses on checking whether the constructs that make up WIAT are consistent. This involves checking the factors that make up WIAT to see whether there are any background factors that call for attention. This is done by transforming background factors into variables of theoretical interest. In doing this the analysis also involves checking if there are any factors that compromise the theoretical explanation of the tool. Basically thus reliability has to do with how dependable WIAT is as a tool for assessing innovation. This is critical as it makes the tool more robust and reliable to the real world in which it is being applied. The tool deals with a crucial issue of innovation which determines the survival of most companies nowadays, therefore it is important to check on its reliability and robustness and thereby improve on it. To check on WIAT's reliability, statistical tests are carried out mainly the Cronbach's alpha.

The next aspect which is considered crucial in this research is; construct validity. This type of validity is important also as one cannot measure external validity without having valid constructs. Checking the construct validity will give us a true picture of how well the constructs and factors were translated into actual measures in the assessment of innovation. The questions or variables that make up the WIAT questionnaire which is the measurement tool in assessing innovation projects is analyzed as part of construct validity aspects. In

accordance to Krathwohl (1993), evidence of construct validity is shown when the test in question correlates highly with other target measures of the construct. On the contrary it is evidenced by low or zero correlations with measures that ought not to relate with it. Regarding related cases, the test will have intermediate correlations with measures that are almost but not quite the same (Krathwohl 1993). In the case of WIAT, comparison is made with the Genesis tool which stands as its model example. If the tests correlate highly with those of Genesis this is evidence of construct validity. Construct validity is deemed valuable in the case of the tool under scrutiny as this will determine how valid the constructs are regarding content and the theories behind it. Thus it is important to check the construct validity of WIAT as we are studying the robustness which in turn enhances its external validity.

3.2 The database

Currently the WIAT database (table 6) consists of 70 projects with about 226 respondents which is named the WIAT subset in the analysis. It also consists of projects analyzed with the Genesis tool together with the WIAT projects and in total there are 551 respondents; this is termed the overall dataset. Genesis cases make up about 330 respondents and this is named; the Genesis subset in the analysis. The categories in the dataset include the sub sector, market, respondents, inter organizational cooperation, stage during measurement, technological innovation, product/process innovation and questionnaire variables. The database is quite large which is important in order to enhance the stability of the results.

Table 6 Data set structure

Name of data set	No. of respondents	No. of projects
Overall set	551	127
Genesis sub set	330	57
WIAT sub set	226	70

3.2.1 Operationalization

To study the robustness of WIAT, factor analysis is the main approach in this research. The field of factor analysis involves the study of order and structure in multivariate data (Tucker and MacCallum 1997). Factor analysis reduces a data set from a group of interrelated variables into a smaller set of uncorrelated variables (Field 2000). The general aim of factor

analysis is determine the nature of underlying factors and to develop an understanding of their relationships to the surface attributes and to each other. Hair et al, (1998) defines factors analysis as an interdependence technique whose primary purpose is to define the underlying structure among the variables in the analysis. In this case we want to enhance the effectiveness of WIAT across sub groups hence factor analysis is more appropriate as we establish the underlying structure of the variables in WIAT. The analysis will also be suitable as we want to understand the relationships across sub groups involved in WIAT innovation assessment. It is useful in determining what constructs lie behind a set of relationships (Krathwohl 1993). This is critical as it enhances the generality strength of the tool.

Factor analysis is valid and stable with more than a single study and in this case it is possible to be applied because we have at least 70cases.

For the factor analysis procedure certain attributes need to be selected with an effort to achieve wide representation of the tool. According to Hair et al, (1998) for factor analysis to be done there must be a set of variables upon which to form relationships; for examples what variable best predict the team, and in this case the questions in the WIAT questionnaire form the set of variables for building blocks of relationships.

Apparently, the following potential attributes are identified from the dataset:

- Size of the firm (small, medium or large)
- Product/ Process/ Incremental innovation
- Radical /Incremental innovations
- Ex ante/ Ex post projects
- Open / Internal innovation
- Industry sub sector

A wide coverage of the domain is obtained so as not to miss any important common factors hence the decision to include many attributes.

Factor analysis is conducted in an exploratory manner to explore the data so as to determine how many factors might be present and to gather some rough indications of their nature and relationships. The goal of this is to summarize the data by defining a small number of factors that adequately represent the original set of variables (Hair et al, 1998). This process involves deleting variables with inadequate representation which should lead to a better understanding of the factors observed in early studies. In this case factor analysis begins with the overall data set then Genesis subset and finally the WIAT subset. Factor analysis is carried out on the respondent and project level.

Principal component analysis (PCA) is the method used mainly in performing the factor analysis with varimax rotational method. Common factor analysis (CFA) is applied in cases where there is need to verify the pattern of the factors. PCA decomposes the original data into a set of linear variates where as CFA only estimates the underlying factors (Field 2000).

Thus, exploratory factor analysis provides an initial indication of common factors along with factor weights, factor intercorrelations and unique variances of the attributes which is achieved as explained by Field (2000, chapter 6).

Another goal of this exploratory procedure is to achieve data reduction through identifying representative variables from the larger set of variables for use in subsequent analyses and creating an entirely new set of variables much smaller in number to simplify the subsequent analysis (Hair et al, 1998). This goal is met as explained in chapter 6.

After the process of refining of the factors through exploratory analysis, the next procedure is checking reliability levels of the factors. Cronbach's alpha is used as mentioned earlier.

Furthermore, comparison tests are run to check differences on the sub groups pertaining to the status of the projects that is failed, running or successful projects. The comparison tests enable us to check if the tool can detect differences among projects that are failed, running or successful. Differences are also checked between ex ante and ex post projects; and LEs and SMEs. The independent samples t-test and advanced test such as ANOVA and MANOVA are used to test for comparisons.

Independent samples t-test is used to do comparisons on different subjects assigned to each experimental condition. In this case different subjects are subjected to the WIAT measurement tool such as ex ante, ex post, failed and successful projects. It is used in situations where there are two levels of the independent variable.

Analysis of variance (ANOVA) is used to compare several means in which there are more than two levels of the independent variable. Multivariate analysis of variance (MANOVA) goes a step further in carrying comparison tests in situations where there are several dependent variables (Field, 2000).

Factor analysis and reliability levels test for the construct validity of the tool. Additionally, comparison tests and reliability levels, test for the robustness of the tool.

Prior to checking the validity of the tool descriptive statistics is carried out to give a summary of the data. This is done to perceive important aspects of the data and in organizing and presenting the perception. This is important in order to have some idea of the patterns within the data and identify the extent of missing values. The missing values are large, hence imputation is done on the appropriate missing gaps in the dataset.

3.3 Statistical Protocol

This gives a list of the statistical procedures that are carried out in the analysis.

1. Checking the data on descriptive statistics

Four basic assumptions must be met for the tests to be accurate. These include normality of distribution, homogeneity of variance, independence and interval measurement (Field 2000). Thus the data are tested to check the distribution by obtaining summary statistics of the data that relate to the distribution of scores. The distribution is defined by running frequency analysis. To describe the characteristics of the data the mean, mode, standard deviation, variance and range are selected (Field 2000). In order to check normality of the distribution, the values of kurtosis and skeweness are used (Field 2000).

In this case there are some departures from normality and homoscedasticity on the data. 80% of the variables are positively skewed and have a flat distribution as indicated by negative values of kurtosis. However, factor analysis can still be done considering the other assumptions and requirements for factor analysis which are detailed in the next part.

2. Checking on missing data

Missing data are checked for in order to improve the accuracy of the results.

The extent of missing data is quite large and cannot be ignored, especially in the WIAT sub set. Missing data are largely caused by one set of respondents who did not respond to some questions thereby ending up with substantive missing values. Variables, 12, 30, 31and 42(appendix 2) are affected mostly with missing values. Imputation is done on the missing values. Replacement values are calculated using valid data filled in by the respondents for each factor in the conceptual structure. For the total set there are 1010 responses missing before imputation; and after imputation we are left with 576 responses missing (shown in appendix 2). Therefore an average of the valid responses is calculated. This is based on the assumption that a value derived from all other observations in the sample is the most representative replacement value (Hair et al, 1998).

3. Exploratory factor analysis (EFA)

EFA is the main method used in determining the interrelationships and the underlying structure among the variables in the WIAT dataset as defined in the previous section. EFA is done to analyze the structure of the correlations among the various variables in the dataset, by defining sets of variables that are highly interrelated which formed the factors. These factors were assumed to represent various dimensions from the data. It provides a clear understanding of which variables may act in concert and how many variables may actually be expected to have an impact in the analysis. Factor analysis provides the basis for creating a new set of variables in a smaller number of new variables which is important in making the WIAT questionnaire more usable as it will have fewer questions for the respondents to handle and for further data analysis such as regression analysis.

Firstly the data is checked in order to make sure that it meets the critical assumptions underlying factor analysis. According to Hair et al, (1998) the following rules of thumb must be met before factor analysis is run (Hair et al 1998):

- Factor analysis is performed on metric variables
- If a study is being designed to reveal factor structure, strive to have at least five variables for each proposed factor
- Sample size must have more observations than variables and the minimum absolute sample size should be 50 observations
- Maximization of the number of observations per variable, with a minimum of 5 and at least 10 observations per variable

Regarding the WIAT dataset, the assumptions above are met. There is already an underlying structure that exists among the variables in the dataset as explained in the literature review. The variables are almost five for each proposed factor and the sample is equal to 554 cases which is large enough to conduct factor analysis. Also there are more than 50 observations and the number of observations per variable is more than ten. To cater for the heterogeneity of the data, separate factor analysis is performed on each group and the results compared to identify differences not reflected in the results of the overall sample.

From a statistical standpoint, there are some departures from normality and homoscedasticity on the data. However with reference to Hair et al (1998) these apply only to the extent that they diminish the observed correlations, only normality is necessary though it is rarely used. Therefore it is of minor importance so factor analysis can be performed on the dataset. In fact some degree of multicollinearity is desirable so as to identify the interrelated sets of variables. In this case there are some variables which did not present a normal

distribution. 80% of the variables are positively skewed and have a flat distribution as indicated by negative values of kurtosis. However, Hair et al, (1998) states that if there is some degree of multicollinearity it is possible to continue with factor analysis.

The data is also checked for three measures of intercorrelation which are the Bartlett test of sphericity, measure of sampling adequacy (MSA) and the correlation matrix (Hair et al, 1998).

Firstly, for factor analysis to be conducted the number of correlations above 0.3 should be substantial. Secondly, the Bartlett test of sphericity ($p<.005$), which is a statistical test for the presence of correlations among variables; is another test used to determine the appropriateness of factor analysis. It provides the statistical significance that the correlation matrix has significant correlations among the variables (Hair et al, 1998).

A final measure to quantify the appropriateness of factor analysis is the measure of sampling adequacy (MSA) with an index ranging from 0 to 1, reaching 1 when each variable is predicted accurately without error by other variables (Hair et al, 1998). The MSA should be above 0.5 for factor analysis to be conducted.

The measures are explained in the following section considering the WIAT dataset.

By visually inspecting the correlation matrix, the results showed quite a substantial number of correlations above 0.3 which is appropriate for factor analysis.

Regarding the Bartlett test of sphericity ($p<.005$); in this case it is significant ($p<.001$) which means that sufficient correlations exist among the variables. Therefore factor analysis is appropriate for these data.

For the dataset under study the MSA is ranging around 07. to 0.8 which is considered as adequate and meritorious respectively (Hair et al, 1998). We conclude that the three measures of intercorrelation are satisfactory, so factor analysis can be conducted on this dataset.

EFA is performed in the following levels:

- Overall set consisting of 551 respondents from Genesis and WIAT cases
- Genesis subset consisting of 330 respondents
- WIAT subset consisting of 226 respondents

Initially factor analysis is run using the latent root or eigenvalues criterion to extract the factors as a guide line for the first attempt at interpretation with 1.0 as the cut off value.

4. Reliability tests

Cronbach's alpha tests are run on the factors derived after the factor analysis to determine the reliability levels and also with the conceptual factors. The conceptual factors are the ones incorporated in the WIAT questionnaire which is under use currently. They are outlined in the theoretical review (chapter 2) and the questionnaire is found in appendix 5.

Reliability tests are useful in order to assess the degree to which the data meet the expected structure, after having performed the exploratory approach as mentioned earlier. The reliability alpha is also important as it measures the 'unidimensionality' or extent to which a scale measures one underlying construct. It shows the strength of the factors. According to Hair et al (1998) for this type of explorative analysis a good alpha should be above 0.7 and an alpha of 0.6 is satisfactory. This is what is followed in this research when we mention that an alpha is good or optimal.

5. Comparison Tests

Lastly, comparison tests are performed using independent sample t-test, ANOVA or MANOVA to check for the differences among the subgroups and categories as mentioned earlier. They are applied with strong emphasis on project level because success or failure is measured at project level.

Therefore, this section described the terms of reference in analyzing the robustness of WIAT, with robustness being the study of the effectiveness of a measure across sub groups. It is one form of external validity as mentioned earlier and it is important to study in the case of WIAT since the tool is being used in the industrial world to improve on its generality power. Reliability is also an important aspect in this case as it is a prerequisite for validity. This is critical in order to check the internal consistency of the tool under study. Comparison tests are also performed across the sub groups.

The section ends with the statistical protocol which consists of the steps that is undertaken in performing the analyses with exploratory factor analysis being the main procedure that is used to analyze the data. A description of the data set has been given and the subsets in it. The database is quite large enough to perform factor analysis and run the statistical procedures.

The next chapter presents the results of the statistical analyses performed on the data set.

4 Results

In this section a description of the results is given on the analyses that were run on the data sets. Following up on question 3 of this research project; *what are the measures necessary to study reliability and robustness of WIAT?,* statistical analysis is carried out to establish how reliable and robust WIAT is. In the previous section it is concluded that exploratory factor analysis should be used to study the reliability and robustness of the tool under study. In order for the research project to meet its objective, which is to study the robustness of WIAT in innovation assessments, it is crucial to run some statistical analysis on the WIAT database. In this section, the first part; section 4.1 to 4.3 gives an outline on the results of the analyses on the overall data set, then the Genesis subset and lastly the WIAT subset. The last sections comprise of the comparison tests; and the concluding section on the results.

4.1 EFA using the overall data set

The overall data set consists of both cases from Genesis and WIAT and the cases are analyzed at respondent level. It consists of 554cases.

The results indicated that 12factors (figure 8) are being extracted using the eigenvalues criterion as mentioned in chapter 3.

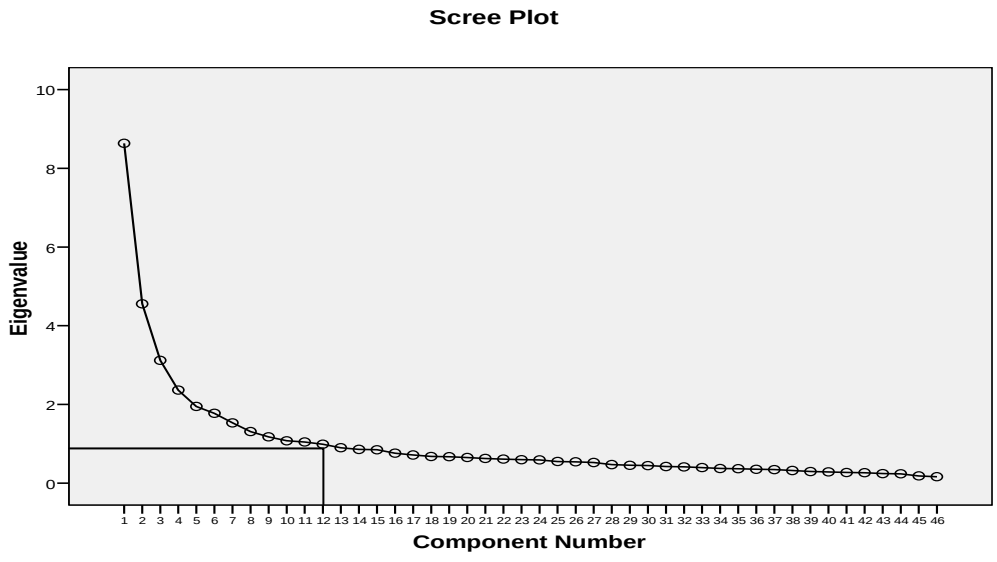


Figure 8 Scree plot with overall data set

However some variables are loading on more than one factor and some factors are meaningless. Thus, we decided to run the factor analysis making a choice to extract 9 factors considering the conceptual model of Genesis, which has 9 factors.. Having run the factor analysis and trying to extract 9 factors, the structure turned out sub-optimal because one of the factors is meaningless and some variables are loading on more than one factor. Also for the variables with loadings which are too low (<0.4) we chose to leave them out of the structure. Hence two questions on the environment construct are truncated already in the initial analysis. Missing values are treated by imputation for each respondent, the average of their response on each conceptual factor. Factor analysis is then performed using the pairwise method considering the distribution of missing data which is random. By excluding cases pairwise it means that a respondent's data are excluded only from calculations for which a datum is missing (Field 2000).

Factor analysis is repeated iteratively testing several alternative structures. For instance individual factors are deleted from, and extra factors added to the initial structure, until a final structure is concluded on. Two rotational methods are used to cross check for any differences in the factor structures; that is varimax and orthogonal, and the results are basically similar. Consideration is also made to the WIAT conceptual factors (fig. 2.3). The optimal structure is thus used against the WIAT conceptual factors. The optimal structure is reached at a point when the factors are both conceptually and statistically meaningful; that is meaningful in explanation and each variable significantly loading on one factor only. The variables with loadings above 0.4 are considered. The first factor came out with eight variables just as in the conceptual factor structure. Regarding the structure of the total set of variables, clearly eight distinct and meaningful dimensions are derived to make up the optimal structure.

Given the sample size above 500, factor loadings of .40 and higher, are considered significant for interpretative purposes (Hair et al 1998). For all the variables in the structure the loadings are above .50 which is good (table 4.1a). Table 4.1b shows the labels of the factors, the variables, and the corresponding Cronbach alpha. The optimal structure is obtained with all the variables having high loadings on a single factor. Variables that are loading on more than one factor are deleted and they make up eight variables, hence 38 variables are retained in the optimal structure.

The following table (table 7) shows the factor structure that is arrived at after engaging in several iterations to obtain the optimal structure.

Table 7 Overall data set factor structure

Factors and variables	Factor loading	Alpha if item deleted
1.Innovation team (α = 0.82)		
1. Gteam7- team focused on collecting knowledge	.705	0.80
2. Gteam1- enough team-communication	.681	0.79
3. Gteam8- members completely satisfied with process	.677	0.80
4.Gteam3- perfomance requirements clear	.675	0.80
5.Gteam4- participation in the same team again	.629	0.80
6. Gteam5- members understand potential problems of project	.603	0.81
7. Gteam2- management explicit commitment to project	.561	0.82
8. Gteam6- members can confront member if in doubt of opinions	.543	0.82
2.Market potential α = 0.84		
9. Gmavol3- potential customers great need for product	.762	0.79
10.Gmavol5- product's high potential creates additional products	.728	0.81
11. Gmavol4- product will definitely be used by customers	.726	0.81
12. Gmavol2- market for product growing quickly	.676	0.82
13.Genvir1- project contributes to company's competitive advantage	.671	0.81
14. Gmavol1- large monetary value of the market for product	.580	0.83
3. Innovativeness α =0.83		
15. Gprasp2- high tech innovation	.746	0.79
16. Gprasp1- product new to the market	.726	0.79
17. Gfit1- new product type	.721	0.80
18. Gprasp3- product's mechanical and or technical complexity	.713	0.81
19. Gfit2- company satisfies new type of customer needs	.672	0.81
20. Gfit4- company new technology required for development	.609	0.81
4.Market competition α =0.74		
21. Gmacom1- market highly competitive	.782	0.66
22. Gmacom2- market with many competitors	.781	0.66
23.Gmacom5- market characterized by frequent product introductions	.673	0.70
24. Gmacom6- market characterized by intense price competition	.633	0.73
25. Gmacom3- market with one strong dominant competitor	.582	0.74
5. Company- market fit α =0.70		
26. Gfit6- distribution system for product totally new to company	.785	0.59
27. Gfit7- type of advertising required totally new to company	.752	0.61
28. Gfit8- competitors for this product completely new to company	.658	0.64
29.Gfit3- potential customers for product totally new to company	.575	0.69
6.Marketing resources α =0.82		
30. Gresou6- project advertising resources are adequate for project	.860	0.73
31. Gresou5- project marketing resources are adequate for project	.769	0.75
32. Gresou7- project sales resources are adequate for project	.693	0.75
7. Product superiority α =0.80		
33. Gprsup3- product's unique features	.709	0.66
34. Gprsup4- product's unique use	.698	0.81
35.Gprsup1- product's superiority to competing products	.662	0.72
8. Other resources α =0.67		
36. Gresou3- project production resources adequate for project	.688	0.55
37. Gresou4- project financial resources adequate for project	.688	0.47
38.Gresou1- project management resources adequate for product	.550	0.70

The factors names conform to existing literature on innovation management (see chapter 2) and the Genesis model. Most of the names of the factors are based on the names of the factors in the conceptual model. 'Market competition' factor has the same name as in the conceptual model the only difference being that the variables have changed. This also applies to the factor 'product superiority'. In contrast the factor 'innovativeness' has a different name as in the conceptual model, though it has been named before in previous studies by Hollander

(2002). It is named as such because of the technological aspect and newness of the product or service which has to do with innovativeness.

The 'innovation team' factor has been named differently from the conceptual factor which is 'team communication'. The variables in it relate to a number of issues about the project team not only communication hence the change of name.

The factor, 'company- market fit' is named differently from the conceptual factor, 'Project Company fit'. This is so because all the variables loading onto this factor relate company fit to the market.

Resources are now divided into two; one with variables relating to marketing resources and the others referred to as other resources. This last factor has the lowest alpha (α=0.67) of all, and the variable with the lowest loading, i.e. project management.

The alphas of the factors are also presented in table 6. The results show that all the factors have a good Cronbach alpha (α >0.70) except for other resources (α=0.67) which is just below 0.7. However an alpha of 0.6 is deemed acceptable as mentioned in the previous section. The alphas also show that when some variables would be removed, the alpha of the construct improves however in this analysis they are left in because they are considered important theoretically. In future these variables could be removed to reduce the number of questions whilst making the tool more efficient and effective.

The following tables show the individual variables and factors that are removed and retained in the analysis.

Table 8 Re assessed factor**, Innovation team**

Team communication	**Renamed: Innovation team**
Conceptual factor	Re assessed factor
Member – enough communication with team to do my work efficiently and effective	**Member – enough communication with team to do my work efficiently and effective**
Management – explicit expressed commitment to the project team	**Management – explicit expressed commitment to the project team**
Member – performance requirements are clear	**Member – performance requirements are clear**
Member – wants to participate in a new project with the same team again	**Member – wants to participate in a new project with the same team again**
Member - completely understands the potential problems of the project	**Member - completely understands the potential problems of the project**
Member – if doubt opinion team member I will surely confront member	**Member – if doubt opinion team member I will surely confront member**
Team – focused on collecting knowledge for our project	**Team – focused on collecting knowledge for our project**
Member – completely satisfied with the product development process used	**Member – completely satisfied with the product development process used**
No. of variables=8	No. of variables=8
Cronbach alpha= 0.82	Cronbach alpha= 0.82

The team communication factor did not change with relation to the number of variables and also the reliability level remained at 0.82. However, it is renamed as the innovation team factor. This came out as the first factor in the analysis.

Market volume factor is renamed to ‘market potential’ and now comprises of six variables instead of five variables. One item from the environment factor fits more appropriately under this factor. The alpha improved slightly from 0.81 to 0.84.

Table 9 Reassessed factor**, Market potential**

Market volume	**Renamed: Market potential**
Conceptual factor	Re assessed factor
Market – monetary value of the market for product is large	**Market – monetary value of the market for product is large**
Market – growing very quickly for product 38A	**Market – growing very quickly for product**
Market – potential customers great need for product	**Market – potential customers great need for product**
Product – will definitely be used by the customer 50A	**Product – will definitely be used by the customer**
Product – high potential, can create additional products	**Product – high potential, can create additional products**
	Project – contribute to the competitive advantage of the company
No. of variables: 5	No. of variables: 6
Cronbach alpha= 0.81	Cronbach alpha= 0.84

Table 10 Re assessed factor**, Innovativeness**

Product aspects	**Renamed: Innovativeness**
Conceptual factor	Re assessed factor
Product – innovative and new to the market	**Product – innovative and new to the market**
Product – high technology one	**Product – high technology one**
Product – mechanically and/or technically complex	**Product – mechanically and/or technically complex**
Product – first on the market	**REMOVED**
	Company – new product type
	Company – satisfy new type of customer needs
	Company – new technology required (R&D) for development
No. of variables=4	No. of variables=6
Cronbach alpha= 0.79	Cronbach alpha= 0.83

With regards to the product aspects factor there is a renaming of the factor to 'Innovativeness'. This is concerned with the newness of the product or project, which is an important aspect of innovation. Three variables from the company construct now load onto this factor, as they all relate to newness and technological complexity. One item is removed

from the factor and this factor now remains with six variables in place of four variables. Also the alpha is improved from 0.79 in the conceptual factor to 0.83.

Table 11 Re assessed factor**, Market Competition**

Conceptual factor	Re assessed factor
Market- a highly competitive one	**Market- a highly competitive one**
Market – with many competitors	**Market – with many competitors**
Market – with one strong dominant competitor	**Market – with one strong dominant competitor**
Market – high degree of loyalty to existing products	**REMOVED**
Market – frequent new product introductions by competitors	**Market – frequent new product introductions by competitors**
Market – characterized by intense price competition	**Market – characterized by intense price competition**
No. of variables: 6	No. of variables: 5
Cronbach alpha= 0.74	Cronbach alpha= 0.74

For the factor market competition one item is deleted leaving the factor with five variables because of loading on two factors. The alpha for this factor is also good (>0.7) and the deletion of one factor did not change the alpha compared to the conceptual factor.

Table 12 Re assessed factor**, Company-market fit**

Project-company fit factor	**Renamed: Company- market fit**
Conceptual factor	Re assessed factor
Company – new product type	**MOVED**
Company – satisfy new type of customer needs	**MOVED**
Company – new potential customers	**Company – new potential customers**
Company – new technology required (R&D) for development	**MOVED**
Company – new production process	**REMOVED**
Company – new distribution system and/or type of sales-force	**Company- new distribution system and or type of sales force**
Company – new type of advertising and promotion required	**Company – new type of advertising and promotion required**
Company – new competitors in the market	**Company – new competitors in the market**
No. of variables=8	No. of variables=4
Cronbach alpha= 0.77	Cronbach alpha= 0.70

MOVED means that the item has moved to another factor.
REMOVED means that the item has been deleted.

The project – company fit factor had eight variables in the conceptual structure and is refined ending up with four variables whilst the other three variables moved to form another factor named 'Innovativeness' as we shall see later. One item had the problem of loading on more than one factor hence it is removed as shown in table 4.2. The reliability level (alpha) of the re-assessed factor decreased from 0.77 in the conceptual model to 0.70 in the final model. Nevertheless the alpha level remains at the optimal the level.

Table 13 Re assessed factor**, Resources**

Conceptual factor	Re assessed factor
	1. Marketing resources factor
Project – marketing research skills and people	**Project – marketing research skills and people**
Project – advertising and promotion resources and skills	**Project – advertising and promotion resources and skills**
Project – sales force and/or distribution resources & skills	**Project – sales force and/or distribution resources & skills**
	No. of variables=3
	Cronbach alpha= 0.82
	2. Other resources factor
Project – management skills	REMOVED
Project – engineering skills and people	**Project – engineering skills and people Project – production resources or skills**
Project – production resources or skills	
Project – financial resources	**Project – financial resources**
No. of variables=7	No. of variables=3
Cronbach alpha= 0.82	Cronbach alpha= 0.67

The resources factor became two factors; one standing for marketing resources and another standing for other resources. However the question of management skills had to be removed from the variables as it had the problem of loading on two factors which meant it did not fit well with the structure. The alpha for marketing resources remained the same as the resources-factor in the conceptual factor (=0.82). However the alpha for the factor other resources is below 0.7 (=0.67) which is still acceptable.

Table 14 Re assessed factor, **Product superiority**

Conceptual factor	Re assessed factor
Product – superior to competing products in meeting customers needs	**Product – superior to competing products in meeting customers needs**
Product – higher quality than competing products 31A	**REMOVED**
Product – unique features or attributes	**Product – unique features or attributes**
Product – do a job customer cannot presently do with what is available	**Product – do a job customer cannot presently do**
Product – reduce customers costs compared to present time	**REMOVED**
No. of variables=5	No. of variables=3
Cronbach alpha= 0.78	Cronbach alpha= 0.80

Two variables are removed from the product superiority factor because of loading on more than one factor and also the alphas are too low (below 0.70) when incorporating these variables. This means there is no goodness of fit with these variables. Therefore, they are consequently deleted. Another reason is that statement 'Product – higher quality than competing products' is very similar to the statement 'Product – superior to competing products in meeting customers needs' which is also part of the factor, hence there is repetition. This could explain why it did not fit well in the end. Truncating the two variables did raise the alpha slightly from 0.78 to 0.80.

Table 15 Re assessed factor, **Environment** (truncated)

Conceptual factor	Re assessed factor
Project – contribute to the competitive advantage of the company	MOVED
Product – will meet the applicable laws	REMOVED
Product – will have positive effect on environment	REMOVED
No. of variables: 3	No. of variables: 0
Cronbach alpha= 0.53	

The factor, environment is taken out completely as all the item loadings of the variables are too low. As shown the alpha of the conceptual factor is also too low (0.53). The

item which is indicated ‘MOVED’ has been shifted onto another factor, i.e. to factor; market potential.

Conclusively, an eight- factor structure is arrived at using principal component analysis on the overall dataset. First, the factors from the conceptual model are re-assessed to reduce the number of variables whilst keeping the same level of reliability, or perhaps improving it. The Cronbach alphas of the 8 factors have been calculated (table 6) and variables that reduced the alpha are deleted. Factor analysis performed again on the dataset. This results in the concluded 8-factor structure. Seven out of the eight newly established factors had a good alpha which is above .70. One factor is very close to .70 with an alpha of 0.67 which can be considered satisfactory for this type of analysis. In tables 7 to 14 the eight conceptual factors are shown against the re-assessed factors. For most of the factors the reliability level increased except for company fit where the level decreased slightly from 0.77 to 0.70 though it is still optimal. The overall dataset is then used as the model for the subsets as the results are satisfactory. The final eight factors with their variables are used to analyze also the two subsets, i.e. Genesis and WIAT subsets.

4.3 EFA using Genesis data set

In order to improve the stability of the results factor analysis is also performed on subsets of the data, that is, the Genesis dataset and WIAT dataset. This is done to estimate the factor model for each set and thereby make comparisons of the resulting factor matrices. This would thus provide an assessment of the robustness of the structure across the sample. The next section gives a description of the results on the Genesis dataset. The number of cases in this dataset is 311. Factor analysis is performed on the Genesis set using the latent root or eigenvalues criterion and 12factors emerged (figure 9). However some of the factors are not as optimal as with the overall dataset.

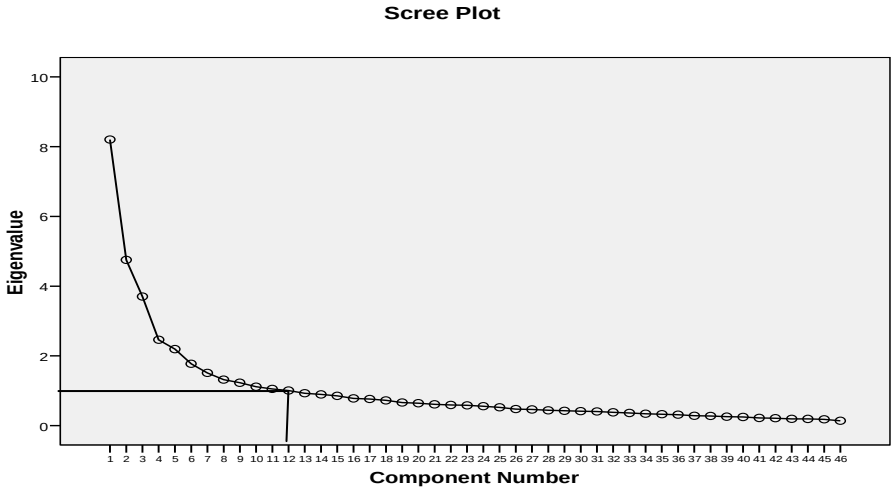


Figure 9 Scree plot with Genesis data set

The analysis is then run to come up with an eight-factor structure as in the overall dataset. The table (table 16) below shows the eight-factor structure that is produced.

Table 16 Genesis compared to the overall set structure

Overall set	Factor loadings & alpha	**Genesis**	Factor loadings & alpha
1. Innovation team	**alpha= 0.82**		**alpha=0.83**
1. Gteam7	.705	1. Gteam7	.708
2. Gteam1	.681	2. Gteam1	.701
3. Gteam8	.677	3. Gteam4	.697
4. Gteam3	.675	4. Gteam5	.669
5. Gteam4	.629	5. Gteam8	.660
6. Gteam5	.603	6. Gteam3	.653
7. Gteam2	.561	7. Gteam6	.592
8. Gteam6	.543	8. Gteam2	.498
2. Market potential	**alpha= 0.84**		**alpha=0.71**
9.Gmavol3	.762	9. Gmavol2	.805
10.Gmavol5	.728	10.Gmavol3	.699
11.Gmavol4	.726	11.Gmavol1	.673
12.Gmavol2	.676		
13.Genvir1	.671		
14.Gmavol1	.580		
3. Innovativeness	**alpha= 0.83**		**alpha=0.84**
15.Gprasp2	.746	12.Gprasp2	.826
16.Gprasp1	.726	13. Gprasp1	.802
17.Gfit1	.721	14. Gprasp3	.720
18.Gprasp3	.713	15.Gfit1	.716
19.Gfit2	.672	16.Gfit4	.680
4. Market competition	**alpha= 0.74**		**alpha=0.78**
20.Gfit4	.609	17.Gfit2	.674
21.Gmacom1	.782	18.Gmacom1	.838
22.Gmacom2	.781	19.Gmacom2	.823
23.Gmacom5	.673	20.Gmacom6	.784
24.Gmacom6	.633		
25.Gmacom3	.582		
5. Company-market fit	**alpha= 0.70**		**alpha=0.78**
26. Gfit6	.785	21.Gfit7	.857
27. Gfit7	.752	22.Gfit6	.857
28. Gfit8	.658		
29. Gfit3	.575		
6. Marketing resources	**alpha= 0.82**		**alpha=0.85**
30. Gresou6	.860	23.Gresou5	.845
31. Gresou5	.769	24.Gresou6	.836
32. Gresou7	.693	25.Gresou7	.785
7. Product superiority	**alpha= 0.80**		**alpha=0.83**
33. Gprsup3	.709	26.Gprsup1	.819
34. Gprsup4	.698	27.Gprsup2	.756
35.Gprsup1	.662	28.Gprsup3	.753
		29.Gprsup5	.601
8. Other resources	**alpha= 0.67**		**alpha=0.70**
36. Gresou3	.688	30.Gresou1	.715
37. Gresou4	.688	31.Gresou4	.634
38. Gresou1	.550	32.Gresou3	.552
		33.Ggresou2	.511

(See appendix 1 for complete names of the variables)

Table 17 Genesis alphas before and after adjusting to overall set factor structure

Factor	***Alpha of the Genesis factors*** Before	***No. of variables***	***Alpha of the Genesis factors using model*** After	***No. of variables***
1. Innovation team	0.83	8	0.83	8
2. Innovativeness	0.84	6	0.84	6
3. Product superiority	0.83	4	0.79	3
4. Marketing resources	0.85	3	0.85	3
5. Market competition	0.78	3	0.77	5
6. Other resources	0.70	4	0.65	3
7. Market potential	0.71	3	0.82	6
8. Company-market fit	0.78	2	0.69	4

The Genesis structure is almost similar to the overall set structure. The order of the structure is different except for the team factor which remained the same as with the overall data set and it is also the largest factor. More variables are removed in this structure retaining with 33variables as compared to the overall set which has 38variables. There are more cross loadings which could be due to the sample size being smaller. The Cronbach's alpha is good; for all the factors had alphas which are above 0.70. The results are close to the overall data set except for the different number of variables that are retained in total. The company fit factor has two variables which are considered too low. .According to Hair et al (1998) the variables should be at least three in each factor for an optimal solution.

Further on, factor analysis is done using the Genesis data set with the 38 variables retained in the overall data set. The structure obtained is almost similar to the overall data set structure except for small differences. In order to deal with these small differences the alpha is calculated using the 38 variables in the overall set on the Genesis cases (Table 17)

Generally the alphas are good except for the factor; other resources; which has a lower alpha (0.65). Thus regarding the factor analysis results using the Genesis data set, we find more similarities with the results of the overall dataset. The high number of similarities is good for stability of the results.

The table below shows the alphas of the Genesis model by Jan Hollander (2002) against the ones which are calculated with the WIAT conceptual model.

Table 18 Comparison of factors in the Genesis model (Hollander's book 2002) with the alpha calculated using WIAT conceptual model (46variables)

Genesis factors (reported by Hollander 2002)	*Cronbach's alpha*	*Genesis factors from the conceptual model(recalculated)*	*Cronbach's alpha*
1.Company fit	0.85	1.Company fit	0.78
2.Project resources	0.79	2.Project resources	0.80
3.Communication	0.87	3.Team communication	0.83
4.Product superiority	0.87	4.Product superiority	0.82
5.Product aspects	0.84	5.Product aspects	0.77
6.Market competition	0.85	6.Market competition	0.77
7.Market volume	0.81	7.Market volume	0.77
8.Environment	0.71	8.Environment	0.58
9.Project team	0.87		

There are some differences in the alphas from the Genesis model (Jan Hollander 2002) and the alphas calculated in this project using the Genesis data set. The main difference is found with regards to the 'environment' factor which has a lower alpha (0.58) using the WIAT conceptual factors whereas in the Genesis model (Jan Hollander 2002) the alpha is high (0.71). This could be due to the reason that Hollander used part of the dataset in his study.

To conclude, factor analysis is performed on the Genesis subset and the structure derived is similar to the overall set structure except for small differences. The overall set structure is then imposed on the Genesis set and the reliability levels are optimal and this improved the Genesis factor structure.

4.4 EFA using the WIAT database

Exploratory factor analysis is conducted on the WIAT subset as well which is crucial as the project focuses on WIAT. Thus it is important to determine the underlying structure of this dataset.

WIAT dataset consists of 226 cases. This data set has a set of missing values for a group of respondents who did not attend to all the questions in the questionnaire. However as mentioned earlier some missing values had to be imputated although for this set some had to be left out because there are substantive missing values. Imputation could not be done is such cases, hence the analysis is run pairwise in order to maintain the accuracy of the results.

Analysis is run in the same way as the previous data sets with eigenvalues criterion first resulting in 12 factors (figure 10).

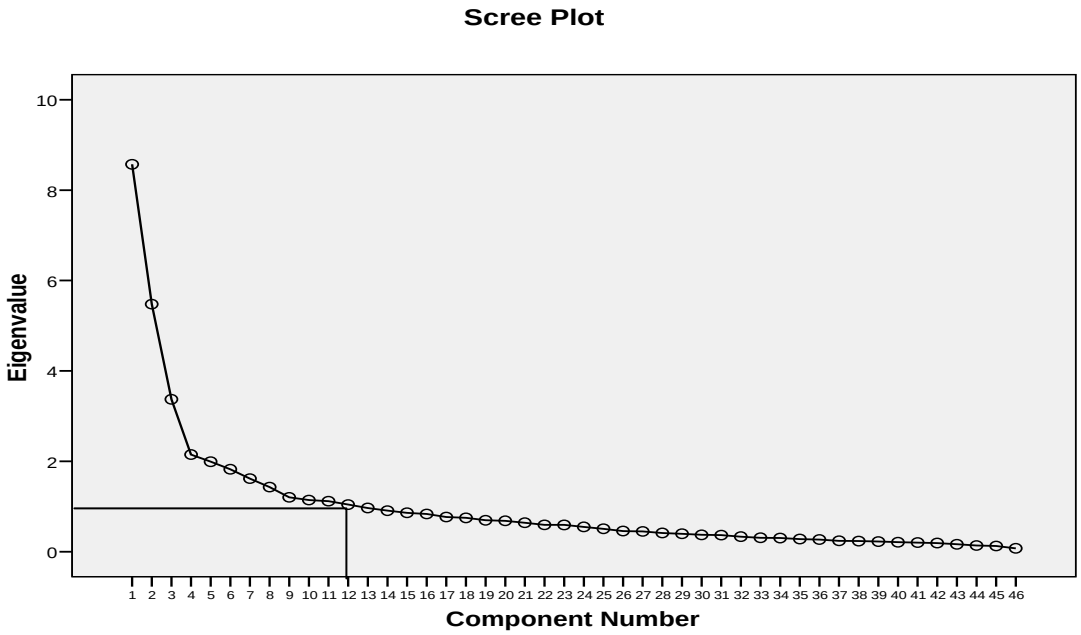


Figure 10 Screeplot with WIAT dataset

Further analysis is done to come up with eight factors as in the overall data set. There are some differences on the factor structure hence the analysis for WIAT data is then performed using the 38variables from the overall dataset. The differences are most likely due to the sample size being smaller.

More variables are deleted in this structure also ending up with 30 variables as compared to 33 with Genesis data set and 38 variables in the overall data set.

For the WIAT dataset there are considerable differences on one factor; resources. This factor differs with other sets in that all the resources load onto one factor unlike in the Genesis and overall sets where resources are divided into marketing and other resources. However it is interesting to also note that with the WIAT set, the team factor is split into two that is 'team communication' and a factor labeled 'team commitment'. This supports the point mentioned earlier in chapter 2 that WIAT falls under the communication web stream of research as deduced with the emphasis on the team factor. The following table shows the factor structure using WIAT dataset.

Table 19 WIAT compared to the overall set structure

Overall set & factor label	Factor loading & alpha	WIAT set	Factor loading & alpha
1. Innovation team	**alpha=0.82**	**1.Team commitment**	**alpha=0.67**
1.Gteam7	.705	1. Gteam7	.789
2.Gteam1	.681	2. Gteam4	.669
3.Gteam8	.677	3. Gteam8	.621
4.Gteam3	.675	**2. Team communication**	**alpha=0.85**
5.Gteam4	.629	4.Gteam6	.715
6.Gteam5	.603	5.Gteam3	.703
7.Gteam2	.561	6.Gteam5	.566
8.Gteam6	.543	7.Gteam2	.422
2. Market potential	**alpha=0.84**	**3. Market potential**	**alpha=0.85**
9.Gmavol3	.762	8.Gmavol4	.818
10.Gmavol5	.728	9.Gmavol3	.798
11.Gmavol4	.726	10.Gmavol5	.789
12.Gmavol2	.676	11.Gmavol2	.734
13. Genvir1	.671	12.Gmavol1	.653
14.Gmavol1	.580	13.Genvir1	.582
3. Innovativeness	**alpha=0.83**	**4. Innovativeness**	**alpha=0.64**
15.Gprasp2	.746	14.Gfit4	.775
16.Gprasp1	.726	15. Gprasp3	.720
17. Gfit1	.721		
18.Gprasp3	.713		
19.Gfit2	.672		
20.Gfit4	.609		
4. Market competition	**alpha=0.74**	**5. Market competition**	**alpha=0.64**
21.Gmacom1	.782	16.Gmacom1	.806
22.Gmacom2	.781	17.Gmacom2	.702
23.Gmacom5	.673	18.Gmacom6	.700
24 Gmacom6	.633		
25 Gmacom3	.582		
5. Company-market fit	**alpha=0.70**	**6. Company fit**	**alpha=0.85**
26. Gfit6	.785	19.Gfit6	.811
27. Gfit7	.752	20.Gfit7	.745
28. Gfit8	.658	21.Gfit8	.607
29. Gfit3	.575		
6.Marketing resources	**alpha=0.82**	**7.Resources**	**alpha=0.82**
30. Gresou6	.860	22.Gresou6	.832
31. Gresou5	.769	23.Gresou7	.822
32. Gresou7	.693	24.Gresou4	
		25.Gresou5	
		26.Gresou1	
7. Product superiority	**alpha=0.80**	**8. Product superiority**	**alpha=0.82**
33. Gprsup3	.709	27.Gprsup3	
34. Gprsup4	.698	28.Gprsup4	
35.Gprsup1	.662	29.Gprsup1	
		30.Gprasp1	
8. Other resources	**alpha=0.67**		
36. Gresou3	.688		
37. Gresou4	.688		
38. Gresou1	.550		

(see appendix 1 for complete names of the variables)

Table 20 WIAT alphas before and after adjusting to overall set factor structure

Factor	*Alpha of the WIAT factors- before*	*No. of variables*	*Alpha of the WIAT factors using overall set structure- after*	*No. of variables*
1. Innovation team	0.67	3	0.82	8
Team communication	0.85	4		
2. Innovativeness	0.64	6	0.83	6
3. Product superiority	0.82	4	0.80	3
4.Marketing resources/			0.82	3
Resources	0.82	5		
5. Market competition	0.64	3	0.74	5
6. Other resources			0.67	3
7. Market potential	0.85	6	0.84	6
8. Company-market fit	0.74	4	0.70	4
Total variables		30		38

Table 20 shows the alphas of the WIAT dataset after performing factor analysis with the 38variables of the overall set. This resulted in 30variables remaining due to some variables loading on more than one factor which shows there are not fitting well in the structure, hence they are deleted . Six factors have good alphas >.70 while two are not that optimal being slightly <.70. This could be due to the smaller sample size hence the overall data set is now used as the model. 'Innovativeness' factor which also has lower alpha has two variables only which is not considered optimal, at least three or four variables are considered appropriate (Hair et al 1998). Hence there is an improvement in the WIAT structure after adjusting to the overall set model as the alphas have improved significantly unlike before where there are three alphas which are below 0.70.

Therefore, the Cronbach alphas for the WIAT dataset are then re-calculated using the 38 variables of the model and they are shown in Table 20.

The alphas are generally good with four being above .80 which is also very good. Market competition looks a bit lower just below 0.7 (= 0.68) because of one item "market - characterized by intense price competition' which lowers the alpha of this factor when using this dataset. This could be due to different opinions of the respondents who fall under WIAT database. When using the overall set and Genesis set the alpha is good. Hence the item is not deleted from the structure.

Reliability tests are also performed on the WIAT conceptual factors so that a comparison can be made with the concluded structure of the overall set (table 21).

Table 21 WIAT conceptual factors compared to the overall set structure (Cronbach alpha)

Conceptual factor	*alpha*	*No. of variables*	*Overall set factors*	*alpha*	*No. of variables*
1.Company-market fit	0.77	8	1.Company fit	0.70	4
2.Project resources	0.85	7	2.Marketing resources	0.82	3
			3.Other resources	0.67	3
3.Team communication	0.81	8	4.Innovation Team	0.82	8
4.Product superiority	0.75	5	5.Product superiority	0.80	3
5.Product aspects	0.78	4	6.Innovativeness	0.83	6
6.Market competition	0.69	6	7.Market competition	0.74	5
7.Market volume	0.85	5	8.Market potential	0.84	6
8.Environment	0.45	3			
Total variables		46			38

The alpha for the 'environment' factor is quite low which also explains why the factor is completely deleted. Most of the alphas of the factors improved when we compare the new factor analysis with the conceptual factors. The 46 variables in the conceptual factors are also reduced to 38 variables. However there is an improvement on the new structure as compared to the original structure where some alphas are too low and the variables are now reduced which makes the questionnaire more effective.

As explained previously there seems to be a lot of improvement on the factors after the analysis between the conceptual structure to the new overall set structure which is the aim of the analysis. For instance the environment factor is not significant hence it is truncated in the analysis. The variables remaining have more meaning and fit well in the different factors they are now belong too as shown by the reliability tests results.

4.5 Reliability with other subsets

Reliability test are also performed using the ex ante and ex post; and the small and large companies data sets. Table 22 shows the alphas for the four subsets.

Table 22 Cronbach alpha for subsets

Factor	Overall set n=551	Ex ante set n=476	Ex post set n=58	LEs n=490	SMEs n=63
1. Innovation team	0.82	0.81	0.84	0.82	0.86
2. Market potential	0.84	0.84	0.87	0.84	0.78
3. Innovativeness	0.83	0.85	0.69	0.83	0.75
4. Market competition	0.74	0.76	0.71	0.73	0.71
5.Company-market fit	0.70	0.68	0.78	0.70	0.77
6. Marketing resources	0.82	0.82	0.85	0.83	0.53
7.Product superiority	0.80	0.80	0.76	0.79	0.81
8. Other resources	0.67	0.64	0.78	0.67	0.68

The reliability results (table 22) are generally good and are almost the same except for a few cases where they differ among the sub sets.

For the innovation team factor, the alphas range around 0.80 with the highest being for small medium enterprises (SMEs).

With regards to the market potential factor the alphas are ranging over 0.80 except for SMEs which is just below 0.80.

Ex post dataset has a lower alpha on innovativeness as compared to other subsets. This could be because it might be difficult to predict the innovativeness of a project after it has been completed.

Market competition factor also has alphas between 0.71 and 0.76 which is almost the same for all the sets.

Company-market fit factor has a higher alpha with the ex post and SMEs data sets as compared to overall and ex ante which could be for some reasons connected to the characteristics of the respondents.

With regards to SMEs, the factor marketing resources has a lower alpha (0.53). This could be explained by the fact that, SMEs do not usually have defined marketing departments because of their size.

This might be attributed also to the small size of the sample in contrast to larger samples which produce more accurate results.

With regards to the factor; other resources, the alpha for ex post data set is very good (0.78) while other sub sets have their alphas ranging around 0.68.

4.6 Constructs averages

The next section presents the constructs averages and significance test of the differences. This important in order to check the robustness of the tool in detecting differences among different subjects as mentioned earlier. These tests enables us to check if the differences among different groups of subjects can be depicted using the WIAT. The independent t-test measure is used to calculate the averages and standard deviations for the data sub sets and subsequently the t-statistic which shows if there are significant differences among the groups that have been selected. This is more appropriate as it allows us to note individual differences between subjects.

The construct averages are calculated using the factor loadings (see Table 14) for each variable and calculating the mean for each respondent. They are calculated in order to check for differences among the sub sets since different conditions applied to the subjects; for instance the fact that some subjects fall under ex ante and ex post, WIAT and Genesis, and LEs and SMEs. Therefore the constructs averages are derived from the overall factor analysis results.

The sample formula for calculating each factor average is presented below:

*Team = (Gteam7*0.705+Gteam1*0.681+Gteam8*0.677+Gteam3*0.675+Gteam4 *0.629+Gteam5*0.603+Gteam2*0.561+Gteam6*0.543)/0.705+0.681+0.677+0.675 +0.629+0.603+0.561+0.543).*

Comparison tests are done firstly at project level then at respondent level as well.

4.6.1 Comparisons at project level

The following section describes comparison done using the projects data set. An attempt was made to perform a multivariate analysis of variance (MANOVA) test which enables us to check for similarities and differences using several dependent variables. This would have been good for conducting comparison test to check how the sub sets differ from each other looking at the interactions between independent variables; in this case such as interactions between WIAT projects and the status of the project which could be failed, running or successful. The result of the Box test is significant ($p<0.05$) which implies that the correlations between any two dependent variables are not the same in the groups. The assumption of homogeneity of covariance would have been violated although this can be dealt with by looking into more detail of this procedure. ANOVA is not adequate since it allows for a single dependent variable, Furthermore, for ANOVA-contrasts three levels of the

independent variable are required while most of the groups in this project have only two levels except for status of the project. The independent t-test which is easier to interpret is then used in the comparison tests.
Another data set is designed at project level to enable contrasts to be carried out using variables that relate to the project performance such as project status and inter-organizational cooperation.

The dataset consist of a total of 127 projects. Constructs means are then calculated using the projects data set for the different subsets. Table 23 shows the results of the constructs means for the WIAT and Genesis sub sets. The WIAT averages are higher than Genesis averages same as with the respondent level averages. Two factors have insignificant differences which are 'market potential' and 'product superiority'. This differs with the respondent level averages (see Appendix 3) where 'company-market fit' and 'other resources' showed insignificant differences whereas the other six factors have significant differences. The significant difference with the factor 'company-market fit' could signal that agri-food companies go for more radical innovations. The other factors which have significant differences might lead to the interpretation that the level of market competition and size are high in agri-food companies.

Table 23 Constructs scores; WIAT & Genesis with total set

	WIAT n=61		*Genesis* n=41		n=102
Factor	Mean	Std.dev.	Mean	Std.dev.	p-value
Innovation team	7.53	0.98	7.02	0.69	*
Market potential	6.88	1.33	6.58	0.81	
Innovativeness	5.87	1.77	4.74	1.83	*
Market competition	5.84	1.36	4.96	1.16	*
Company-market fit	6.38	1.74	5.52	1.36	*
Marketing resources	6.56	1.18	6.00	1.14	*
Product superiority	7.31	1.50	6.86	1.27	
Other resources	6.93	1.17	6.58	0.76	*

* presents significant differences $p<0.05$

Regarding ex ante and ex post subsets (Table 24); the averages for ex post projects are generally higher than ex ante projects. All the construct averages have non significant

differences except for innovation team. This shows that the 'innovation team' plays an important role between the ex ante and ex post projects

Table 24 Constructs scores; Ex ante & Ex post with total set

	Ex ante n=83		*Ex post* n=20		n=103
Factor	Mean	Std.dev.	Mean	Std.dev	p-value
Innovation team	7.18	0.78	7.78	1.04	*
Market potential	6.68	1.09	7.00	1.53	
Innovativeness	5.07	1.95	5.40	1.58	
Market competition	5.56	1.39	5.57	1.61	
Company-market fit	6.01	1.36	6.76	2.06	
Marketing resources	6.27	1.18	6.63	1.49	
Product superiority	7.02	1.37	7.17	1.50	
Other resources	6.72	0.97	6.99	1.34	

* presents significant differences $p<0.05$

With reference to inter-organizational projects (Table 25), projects where there is inter-organizational cooperation are more positive than those with no cooperation as shown by the higher averages. Significant differences are found on two factors; innovation team and innovativeness while other factors had insignificant differences. This shows that when there is inter-organizational cooperation, performance of the team differs significantly as to when there is no cooperation. Additionally it affects the level of newness of the product as indicated by significant differences in the factor, innovativeness.

Table 25 Constructs scores; Inter-organizational cooperation with total set

	Cooperation n=17		*No cooperation* n=65		n=103
Factor	Mean	Std.dev	Mean	Std.dev	p-value
Innovation team	7.76	0.87	7.07	0.77	*
Market potential	6.91	1.04	6.82	1.13	
Innovativeness	5.71	1.76	4.64	1.84	*
Market competition	5.49	1.64	5.55	1.36	
Company-market fit	6.28	1.39	5.74	1.34	
Marketing resources	6.56	1.16	6.17	1.15	
Product superiority	7.56	1.41	6.93	1.27	
Other resources	7.35	1.29	6.67	0.93	

* presents significant differences p<0.05

Table 26 shows the construct averages with failed and successful projects. The means for the successful projects are higher than the failed projects. Four factors exhibited significant differences while the other four had insignificant differences. The four factors with significant differences include innovation team, market potential, company-market fit and other resources.

Table 26 Constructs scores; Status of the project with total set

	Failed projects n=16		*Successful projects n=21*		n=37
Factor	Mean	Std.deviation	Mean	Std.deviation	p-value
Innovation team	7.06	0.87	7.71	1.00	*
Market potential	6.10	1.31	7.09	1.17	*
Innovativeness	5.27	1.67	5.02	1.86	
Market competition	5.18	1.22	5.19	1.68	
Company-market fit	5.87	2.04	6.32	1.94	*
Marketing resources	5.99	1.67	6.58	1.16	
Product superiority	6.42	1.32	7.30	1.45	
Other resources	6.37	1.03	7.10	1.11	*

* presents significant differences p<0.05

In addition to the above comparisons, the WIAT dataset is also selected and the t-tests performed to check the contrasts among the status of the project and moment of measurement. With regards to failed and successful projects in the WIAT dataset (Table 27); the factor averages of the successful projects are higher than in failed projects. Significant differences are found with the market competition, market potential and product superiority factors.

Table 28 exhibits, the running and successful factor averages with the successful results being more positive than running projects. Innovation team and market potential factors show significant differences in the two subsets.

As for running and failed averages (table 29), failed projects have higher averages than running in some factors with factor ‘market competition’ having significant difference.

Table 27 Constructs scores; Status of the project with WIAT set

	Failed projects n=9		*Successful projects n=13*		n=22
Factor	Mean	Std.deviation	Mean	Std.deviation	p-value
Innovation team	7.38	0.98	8.03	1.05	
Market potential	5.98	1.67	7.59	0.85	*
Innovativeness	5.50	1.65	5.53	1.69	
Market competition	5.17	1.41	5.57	1.61	*
Company-market fit	6.40	2.31	6.43	2.25	
Marketing resources	6.37	1.70	6.71	1.32	
Product superiority	6.49	1.32	7.67	1.35	*
Other resources	6.44	1.11	7.42	1.21	

* presents significant differences $p<0.05$

Table 28 Constructs scores; Status of the project with WIAT set

	Running projects n=35		*Successful projects n=13*		n=48
Factor	Mean	Std.deviation	Mean	Std.deviation	p-value
Innovation team	7.32	0.89	8.03	1.05	*
Market potential	6.81	1.27	7.59	0.85	*
Innovativeness	5.95	1.92	5.53	1.69	
Market competition	6.21	1.17	5.57	1.61	
Company-market fit	6.46	1.18	6.43	2.25	
Marketing resources	6.58	1.04	6.71	1.32	
Product superiority	7.17	1.51	7.67	1.35	
Other resources	6.78	1.12	7.42	1.21	

* presents significant differences $p<0.05$

Table 29 Constructs scores; Status of the project with WIAT set

	Running projects n=35		*Failed projects n=9*		n=44
Factor	Mean	Std.deviation	Mean	Std.deviation	p-value
Innovation team	7.32	0.89	7.38	0.98	
Market potential	6.81	1.27	5.98	1.67	
Innovativeness	5.95	1.92	5.50	1.65	
Market competition	6.21	1.17	5.17	1.41	*
Company-market fit	6.46	1.18	6.40	2.31	
Marketing resources	6.58	1.04	6.37	1.70	
Product superiority	7.17	1.51	6.49	1.32	
Other resources	6.78	1.12	6.44	1.11	

* presents significant differences $p<0.05$

Regarding, ex post and ex ante averages for the WIAT data set; there are no significant differences amongst the factors. Nevertheless, in line with the overall set the means for ex post are higher than ex ante projects (Table 30). At respondent level most of the factors have non significant differences except for 'innovation team' and 'company-market fit' (Appendix 3: Table 37). This could attributed to the fact that for ex post cases the subjects are more positive about the innovation project as compared to ex ante where they could be still having some doubts, hence the significant differences on company-market fit and the innovation team factors. Actually the fact that only 2 factors are significantly more positive confirms the view that ex post questionnaires may reflect the ex ante information rather well in general.

Table 30 Constructs scores; Ex ante & Ex post with WIAT set

	Ex ante n=38		*Ex post n=19*		n=57
Factor	Mean	Std.deviation	Mean	Std.deviation	p-value
Innovation team	7.32	0.89	7.83	1.05	
Market potential	6.81	1.22	6.95	1.57	
Innovativeness	5.98	1.85	5.36	1.65	
Market competition	6.12	1.19	5.47	1.58	
Company-market fit	6.28	1.35	6.78	2.11	
Marketing resources	6.51	1.06	6.71	1.48	
Product superiority	7.19	1.45	7.15	1.54	
Other resources	6.74	1.10	7.10	1.29	

*presents significant differences $p<0.05$

Averages are also calculated for the Genesis projects on the project status (Table 31; 32). Generally the averages of successful projects are higher than the failed and running projects. However there are no significant differences among the factors.

Table 31 Constructs scores; Status of the project with Genesis set

	Failed projects n=8		*Successful projects n=8*		n=16
Factor	Mean	Std.deviation	Mean	Std.deviation	p-value
Innovation team	6.67	0.62	7.36	0.76	
Market potential	6.32	0.66	6.28	1.20	
Innovativeness	5.48	1.79	4.32	1.92	
Market competition	5.15	1.06	4.24	1.23	
Company-market fit	4.76	1.59	6.07	1.44	
Marketing resources	5.49	1.49	6.51	0.71	
Product superiority	6.61	1.36	6.63	1.46	
Other resources	6.32	0.98	6.77	0.22	

* presents significant differences $p<0.05$

Table 32 Constructs scores; Status of the project with Genesis set

	Running projects n=14		*Successful projects n=8*		n=22
Factor	Mean	Std.deviation	Mean	Std.deviation	p-value
Innovation team	7.05	0.71	7.36	0.76	
Market potential	6.48	0.62	6.28	1.20	
Innovativeness	4.76	1.81	4.32	1.92	
Market competition	5.05	1.26	4.24	1.23	
Company-market fit	5.99	1.24	6.07	1.44	
Marketing resources	6.57	0.88	6.51	0.71	
Product superiority	6.74	1.00	6.63	1.46	
Other resources	6.66	0.73	6.77	0.22	

* presents significant differences $p<0.05$

Further more, at respondent level (Appendix 3:Table 37), LEs and SMEs have four factors with significant mean differences while the other four are non significant; 'company-market fit, marketing resources, market potential and market competition'. With regards to marketing factors the differences in these cases could be significant because SMEs usually do

not have marketing departments that are well defined; hence the weight on marketing issues is considered with little significance. Surprisingly the construct scores for LEs are lower than SMEs' scores which might be due to the size of the data sets.

Conclusively thus the independent samples t-test is used to do comparisons and contrasts with the data subsets and there are quite some differences noted which could be useful to explain using the theoretical background.

The next section gives the conclusions of the results found in the statistical analyses.

4.7 Conclusion

In this section the main conclusions from the results are summarized.

Firstly the data set is analyzed in order to check if the critical assumptions critical for running factor analysis are met. Consequently, the assumptions are met; however there is quite a number of missing values which could not be ignored. Missing values are then dealt with by replacing them with an average that is calculated using the other responses by the subject. Where the average could not be properly calculated the missing values are left as they are.

Secondly, factor analysis is run on the three main data sets; WIAT, Genesis and overall set resulting in three different solutions. This is done to determine the interrelationships and the underlying structure among the variables in the datasets. The three solutions had eight-factor solutions. Table 33 below shows the overall set factor solution and the corresponding reliability level.

Table 33 Overall set factor structure

	Factor	Cronbach alpha	No. of variables
1.	Innovation team	0.82	8
2.	Market potential	0.84	6
3.	Innovativeness	0.83	3
4.	Market competition	0.74	3
5.	Company-market fit	0.70	5
6.	Marketing resources	0.82	3
7.	Product superiority	0.80	6
8.	Other resources	0.67	4

The Genesis structure is more similar to the overall set structure whilst the WIAT structure is a little bit different from the overall set. The factors in Genesis had similar labels

with the overall set with only a few differences on the variables within each factor. Whereas in the case of WIAT the team factor which emerged as the first and bigger factor in the other two solutions is divided into two factors. For the other sets it is the resources factor which is divided into two instead; marketing and other resources. The overall set structure produced the optimal structure with 38 variables in eight factors. The alphas for these factors are also good/satisfactory (>0.7). Hence the optimal solution has fewer variables (38) as compared to the conceptual which has 46 variables.

The new factors are named basing on the existing literature on innovation management and the conceptual model as outlined in chapter 2 of this study. Regardless of the environment factor which is truncated, some factors such as market competition, product superiority and company-market fit retained the conceptual labels. Some factors are renamed such as innovation team which is previously team communication. . Variables also changed as some are moved onto another factors and some are totally removed.

With regards to all the three sets' structures, the environment factor is truncated as the variables could not fit in the structure. Also when the alphas for the conceptual factors are calculated it is found to be low and thus unsatisfactory (<0.7).

The optimal solution is then imposed upon the WIAT dataset and Cronbach alphas are calculated which are good and satisfactory. Also the overall set structure is imposed upon Genesis set and alphas are calculated which came out as satisfactory as well. This enabled comparisons to be made on the three sets and to ensure stability of the results.

Furthermore reliability tests are run on other subsets which include ex ante, ex post, LEs and SMEs sets. Some differences could be noted on the reliability levels between the subsets (see Table 22) which implies that the tool can detect differences among groups. For ex ante and LEs data sets the results are very similar to the overall set; they are also larger data sets which could be the reason for this. The ex post and SMEs datasets are smaller but the level of reliability is generally good except for a few factors. Regarding ex post datasets the level of reliability for factor, innovativeness, is low which could be due to the fact that it becomes difficult to determine how innovative a project is after its completion. With regards to SMEs, the reliability level of the factor, other resources is low which could be due to lack of defined skills and resources for innovation.

Following that the constructs averages are computed and the differences in data subsets means exhibited. There are various differences which could be explained with the support of literature amongst the ex ante and ex post, LEs and SMEs, failed, running and successful projects and projects with or without inter-organizational cooperation. The main

differences are found in the factors; innovation team, market potential, company-market fit, innovativeness and other resources. This could imply that they are key success factors for innovation projects. Although multivariate analysis could not be run the independent samples t-test managed to exhibit some contrasts in the data subsets.

Conclusively, one can say the whole analysis is successful to a large extent as we managed to perform exploratory factorial analysis to define the underlying structure for WIAT using empirical dataset. The data met the conditions necessary for factor analysis; hence the analysis is carried out resulting in eight factors. Reliability tests are also run on the conceptual and the new factors and on the data subsets. Lastly comparison tests are done using the independent t-tests. Generally the results tell that the tool can detect differences among different groups or subjects.

The next chapter will discuss the conclusions of the whole thesis project, relating the results of the analyses to the theoretical background.

5 Conclusions and Recommendations

In the context of this thesis project the objective is "To study the robustness of WIAT in assessing innovation projects, by (1) analyzing the WIAT database and (2) assessing the influence of personal competencies in innovation projects, both in order to improve innovation assessments (Chapter 1; section 1.1.1). It is useful to investigate how reliable and robust the innovation assessment tool is and thereby improve on it. The resulting recommendations can further improve innovation assessment using WIAT. The objective allows for a study of a database that has a wide variety of subgroups such as LEs and SMEs, ex ante and ex post projects. Hence it can provide recommendations on how WIAT can be effective across different groups.

To realize this objective a research framework (figure 2; section 1.1.3) is designed with the steps that are followed in studying the tool. Part A initiates the theoretical study of the project. In this review innovation assessment is studied and in particular the principles and theories upon which WIAT is based on. A review of past studies on innovation assessment and tools for innovation assessment is done. External and internal factors that influence innovation are also outlined. Eventually the theoretical review is on the individual competencies that influence innovation.

Part B which forms the empirical study involves an in depth statistical analysis of the WIAT database. Finally part C provides the conclusions and recommendations to improve on innovation assessment of WIAT.

The next sections are presented corresponding to the research questions divided in sub questions. This section provides the answers basing on the results from the theoretical and empirical analysis of the WIAT database.

5.1 Research Questions

5.1.1 Research Question Part A

"What are the principles upon which WIAT is built on?"

This question is divided into three sub questions aiming at identifying the principles upon which the tool under study is based on; and the factors that influence innovation. Scientific literature on innovation management is studied in order to answer this question. Based on the work of Cooper & Kleinschmidt (1979:2007), Brown & Eissenhardt (1995) and Ernst (2002) the review outlines the background on innovation assessment studies.

"*What are the background and assumptions behind the WIAT instrument?"*

To answer this question innovation is defined since WIAT is involved with innovation assessment. The background of innovation assessment is outlined beginning with the early works of Cooper & Kleinschmdt (1979) and mentioning the need for innovation assessment. The following issues are identified:

- *Past research and findings on product development* which are categorized into three streams of research, i.e. rational plan research, communication web and disciplined problem solving. WIAT falls under the communication web in view of the three streams of research. This implies that it deals more with the team and communication among project team members. Therefore it also relies on the objectivity of the team.
  The findings on past researches helped to understand the factors that are used to build innovation assessment tools and the measures that were previously used and are now used. For instance the factor, 'innovativeness' which is named after the analysis was not in the WIAT conceptual structure; but it is mentioned in past researches such as Cooper (2007) in Table 4. Market oriented factors are found constantly in the studies and we concluded with two factors that are market oriented in the WIAT. These are market potential and market competition; we find them in the studies by Cooper & Kleinschimdt (1979-2007), Fortuin et al (2007), Hollander (2002) and others (see Table 4). This strengthens the constructs of WIAT as they are related to other studies in innovation management.
- *Innovation assessment tools that have been in use before WIAT* are described focusing on the background, assumptions and how they have been implemented. WIAT's preceding tools, namely Newprod and Genesis are detailed. Genesis tool was developed based on insights from the Newprod and it tried to improve on weaknesses encountered with the previous tool. Consequently, WIAT is also based upon concepts from the Genesis tool. The tools are detailed in Chapter 2, section 2.1.4.
- WIAT is detailed as a tool for monitoring innovation projects within firms. It is built upon success factors which were originally identified by the well known Cooper (1979).

"Are there any external and internal factors that could influence innovation assessment of WIAT?"

This sub question is answered by defining external and internal factors which influence innovation, with more emphasis on internal factors as these are crucial to success in innovation. Internal factors are categorized into four major categories namely market-related, product-related, new product development process-related and organization-related factors. The following general key factors are identified (see section 2.2.2 of chapter 2):

- Strategic factors (product advantage, marketing synergy)
- Development process factors (protocol, predevelopment activities, market related activities, technological activities, top management support, speed to market, financial/business analysis)
- Organizational factors (internal or external communication, organizational climate, size)

It is valuable to look into these factors since WIAT; the tool under study incorporates these factors in innovation assessment. These factors influence innovation; hence they do consequently influence the assessment of innovation using WIAT.

Most of these factors have been incorporated in WIAT for instance the 'factor, 'innovation team' falls under organizational factors, whereas the other factors, 'product superiority, market potential, market competition, market volume, company-market fit, innovativeness and resources' fall under strategic factors. However, WIAT does not fully incorporate development process factors such as 'protocol' which could also enrich the tool.

"Which competencies within organizations and individuals support the success of innovation?"

Competencies that influence innovation are described and these are categorized into two forms; which are individual and company wide competencies. Individual competencies are discussed in detail as the project focuses on these as second part of the objective. The aim is to assess the influence of individual competencies on innovation projects thereby trying to improve on innovation assessment. Ten individual competencies are described which are: Team work competence, Key components of trust, Negotiating, Novelty generation or creativity, Political skill, Skills of self-directed learning, Copying with chaos tools, Learning competence, Entrepreneurial competence and Competencies for Boundary Spanners (Table 5). Since WIAT consists of the factor, 'innovation team' which addresses the integrated individual skills, the competences can be incorporated into this factor. The team factor had

high loadings which signal that it is an important factor. Therefore, incorporating individual competencies into WIAT could strengthen the tool.

5.1.2 Research Question Part B

"How reliable and robust is WIAT in innovation assessment?"

This question is divided into three sub questions with the aim of analyzing WIAT through an in depth statistical analysis. This enables the project to show how reliable and robust the tool is.

"What are the measures necessary to study reliability and robustness of WIAT?"

As regards to this sub question, the project describes the statistical methods that are used in analyzing the WIAT database. Business research terms which focuses on the measures necessary for the purpose of this study are defined, which include the reliability and robustness as they are mainly used in the research (see Chapter 3; section 3.1).

- *Reliability* refers to the degree to which a measure of a concept is stable. It reveals the extent to which a variable or set of variables is consistent in what it is intended to measure (Hair et al, 1998). Reliability of the tool is analyzed to show whether conclusions drawn out of WIAT assessments are reliable. To check on reliability of the WIAT constructs, reliability tests are carried out using the Cronbach's alpha test.
- *Robustness* is defined as the effectiveness of a measure across sub-groups and is described as one form of external validity among two other aspects which are realism and statistical generalizability. The study focuses on analyzing the effectiveness of WIAT across sub-groups since it is being used in the business world.
- *External validity* is referred to as the power of a study to show generality of its findings (Krathwohl 1993). The research aims on this aspect of validity in order to show how widely the tool can be applied so that the objective of enhancing its effectiveness can be met.
- The aspect of *construct validity* is interpreted as another key aspect of the analysis. This involves checking how valid the constructs that form the tool are. This gives a true picture of how well the constructs and factors are translated into actual measures in the assessment of innovation.

- Exploratory factor analysis and reliability analysis are used to test on construct validity; while comparison tests and reliability analysis are used to test on robustness or external validity.

Categories identified in the dataset include sector, market, respondents, inter organizational cooperation, stage during measurement, technological innovation, product/process innovation. There are 46 conceptual questionnaire items. The dataset is divided principally into three sets which are the *overall set*, *Genesis subset* and *WIAT subset*. Other sub divisions include *ex ante versus ex post and LEs versus SMEs subsets.*

"How adequate is WIAT in assessing innovation projects?"

The results of the statistical analysis correspond to this question. Through exploratory factor analysis at respondent level, an optimal structure is obtained for WIAT using the overall dataset. Eight factors are derived and the corresponding Cronbach alphas which are shown in Table 34.

Table 34 Overall set structure in comparison to WIAT's conceptual structure

Conceptual factor	*alpha*	*No. of variables*	Overall set factors	*alpha*	*No. of variables*
1.Company-market fit	0.77	8	1.Company-market fit	0.70	4
2.Project resources	0.85	7	2.Marketing resources	0.82	3
			3.Other resources	0.67	3
3.Team communication	0.81	8	4.Innovation Team	0.82	8
4.Product superiority	0.75	5	5.Product superiority	0.80	3
5.Product aspects	0.78	4	6.Innovativeness	0.83	6
6.Market competition	0.69	6	7.Market competition	0.74	5
7.Market volume	0.85	5	8.Market potential	0.84	6
8.Environment	0.45	3			
Total variables		46			38

The factors are named in conformance to existing literature on innovation management which is detailed in chapter 2. The factors reassessed are presented against the WIAT conceptual factors. 'Innovativeness' and 'market potential' are new terms that are not used in the conceptual structure. However, we find them under factors found in literature as such in studies by Cooper(2007), Hollander (2002), Fortuin (2007) and others (see Table 4, Chapter 2).

There is significant improvement on the factor structure in comparison to the conceptual structure. The variables fit well theoretically and statistically in the new factor structure and they are reduced from 46 to 38 variables. This makes the questionnaire convenient for users

as it has fewer variables. The reliability levels are above 0.70 which considered optimal statistical except for the factor 'other resources' which is just below 0.70. The factor 'environment' is truncated in the initial analysis because the variables could not fit in the structure. Its reliability level (α=0.45) is too low as shown after calculating with the conceptual structure (table 5.1). However, this factor we find it mentioned in existing literature on innovation management.

The WIAT structure had small differences with the overall set mainly on the factor 'innovation team' which is split into two in the WIAT structure. This could explain why WIAT is in the communication web stream because of the emphasis on team and communication factors.

Next the overall set structure is imposed on the other subsets, i.e. WIAT and Genesis and the reliability levels are calculated. The reliability levels are optimal hence the decision to use the overall set structure as the model. It can be imposed on the subsets giving optimal reliability levels and this gives stability to the results.

Reliability levels for ex ante and ex post projects are presented. Ex post projects has a lower alpha on innovativeness as compared to ex ante projects. This can be attributed to the fact that it might be difficult to predict how innovative a project is after it is completed.

With regards to LEs and SMEs, there was a significant difference on the factor 'market resources'. SMEs had a lower alpha (0.53 versus 0.67) on this factor. This can be attributed to the fact that SMEs usually do not have well defined marketing resources; therefore this factor is not a key factor for SMEs.

The question on adequacy of WIAT is also answered by the results of the comparison tests that are carried out on the different subjects and pertaining to the status of the projects. In general successful projects exhibit positive averages than failed projects and running projects. Projects where there is inter-organizational cooperation have higher construct averages as compared to those without cooperation. For ex ante and ex post projects, the construct averages for ex post are higher than ex ante projects; with the exception of the factor 'innovativeness'. This corresponds to the results of the reliability levels where it is lower again for ex post projects.

WIAT projects also show higher averages than Genesis projects which implies that for agrifood projects people are more positive in comparison to non-agrifood projects. There are significant differences found with the factors; 'innovation team, innovativeness, market competition, company-market fit, marketing resources and other resources'.

Generally considering all the groups, significant differences are found in the factors; *'innovation team, market potential, company-market fit, and other resources'*. This reflects that they can be critical success factors for innovation projects. As reported in the literature section these factors appear in most of the studies on new product development. 'Innovation team' factor is part of organizational factors; 'market potential, company-market fit factors and other resources' being part of strategic factors.

Finally one can conclude that the tool is adequate enough in assessing innovation projects since we managed to derive an optimal factor structure through statistical analysis using the collected data. Furthermore the reliability levels for the optimal structure are optimal. The tool can also detect differences in sub groups for example the ex ante and ex post; LEs and SMEs. To a great extent the tool is proved reliable and robust. There is some further analysis which can be done to improve on this work. This is given in the second part of this chapter as recommendations.

"Should individual competencies be incorporated in the WIAT?"

This sub question can be answered partially as there were bottlenecks in the project. From the analysis the team factor came out as one of the key success factors; therefore we can conclude that to some extent individual competences are essential in WIAT assessment as the items in this factor relate to individuals. Because of the high loading on the team factor, individual competencies might be meaningful to incorporate in WIAT.

5.2 Recommendations

The last research question pertains to the recommendations of the research; therefore in answering this question the recommendations of the research are given.

"How can the reliability and robustness of WIAT innovation assessment be improved?"

In order to answer this question, recommendations are given on how the tool can be improved to make it more reliable and robust having analyzed the current WIAT dataset.

Firstly reducing the number of statements in the WIAT questionnaire can make it more effective and efficient as respondents have to fill out to fewer questions. Thus in this project we used factor analysis and thereby reducing the variables from 46 to 38. A potential questionnaire with the 38 variables is recommended. The potential variables are presented in Appendix 4.

The WIAT tool can be used for companies of different size, that is, LEs or SMEs. As shown by the comparison tests, SMEs score lower on the factor 'marketing resources' and the reliability level for SMEs on this factor is low (0.53).As a result, we recommend that a questionnaire without the questions on the factor 'marketing resources' should be administered since SMEs have no defined marketing departments or additional questions can be made for SMEs on this factor.

Secondly, further statistical analysis can improve the eight-factor structure that is arrived at in this project. A follow up with confirmatory factor analysis will help improve the structure to a larger extent. This provides for an explicit fitting and testing of the hypothesized factor structure, where the hypothesized structure is defined in terms of the number of factors and the hypothesized pattern of their relationships to each other and to the surface attributes (Tucker and MacCallum 1997). Results of the confirmatory analysis will give an indication of the goodness of fit of the hypothesized structure to the data and provide information to help evaluate what problems, if any still exist. Positive results from the confirmatory analysis will support the factor structure hypothesized as well as the construct validity of the test results (Tucker and MacCallum 1997).

For instance, we find that one factor has an alpha which is just below 0.7, that is, the factor 'market competition'; further analysis can assist in removing the variable which when removed, the alpha of the factor increases. In this case it is considered important for theoretical reasons hence it is left as part of the factor. With further analysis it may be removed and a new variable added.

The factor 'innovation team' has a substantive number of variables, which could be reduced with confirmatory factor analysis. Some variables could be rephrased and try to reduce them. In this analysis it is left as such because the reliability levels for the individual variables do not affect the factor negatively if removed out of the structure. The variables are also important attributes pertaining to new product development; but with further confirmatory analysis they can be reduced.

Thirdly, in future analysis using the WIAT, more data should be collected on the sub groups such as SMEs, ex post projects, which had a lower number of total cases. This might enhance further analysis on improving reliability and robustness of the tool. Other sub groups can also be added in collecting data such as the type of innovation which could be process or product innovation and other types. For this analysis the number of cases is too low to perform an optimal analysis. This can improve the factors in WIAT and its effectiveness across sub groups.

Fourthly, regression analysis which involves checking the factors with the performance measures can also improve on the tool. This will give more information which adds value to the assessment tool, and more so considering the subgroups. It is important to check how the factors relate to performance regarding the sub groups such as the LEs and SMEs, ex ante and ex post. Performance and certainty scores were not used in this research because they cannot be used in factor analysis; hence they can be used in further analysis of the tool

6 Discussion

The following section gives a reflection on the thesis project. It points out the strengths and weaknesses of the research project.

One of the major strength of this project lies in the theoretical study. In this part of the study an in depth review of past research on new product development, outlining the constructs and critical success factors is given. This is useful in building up the construct of the measurement tool. It enhanced the statistical analysis that is carried out in this project as it eventually coincide with the critical success factors mentioned in the theoretical section(chapter 2). The summary of past researches on new product development is worthwhile and can be a reference point for future research.

The second strength of the project is found in the statistical analysis performed on the database. This is crucial as it provided information on how reliable and robust the tool is. The main method used; factor analysis is powerful in providing order and structure to a dataset. It is important in bringing out an underlying structure from a group of interrelated variables. This is essential in enhancing the effectiveness of WIAT by reducing the number of variables whilst giving order to the structure; for instance the result comes up with eight factors after going through several iterations and eventually resulting with an optimal structure.

In addition to factor analysis, reliability tests are run in the analysis. If you use factor analysis to validate a questionnaire it is necessary to check the reliability of your scale. Cronbach's alpha which is the most common measure of scale reliability is used (Field, 2000). Therefore the reliability levels of the factors are checked and they are all optimal.
The statistical methods used are the recommended ones for this type of analysis and this forms one of the strengths of this project. WIAT is used in the industrial sector; it becomes crucial to check how reliable it is so that it can continue to add value in the industrial world. Nowadays, innovation is a hot topic for companies and WIAT is involved with innovation assessment, hence the tool should be proved that it is reliable and robust. To prove this the database has to be tested statistically and this is what is performed in this project which is a major strength of the project. It is worthwhile as it adds value to a tool which can soon be launched to increase the potential of innovation projects of companies.

With regards to the WIAT database it is large enough to perform factor analysis. There are 550 respondents which is a high number to carry out factor analysis thereby it reflects that

the results of the analysis can be relied on. The number of projects is significantly large to perform comparison tests; it comprises of 127 projects in total.

Finally, the new factors arrived at have meaning and link very well to existing literature on innovation management. For instance the factor, 'innovativeness' which relates to newness of the product or project comes out in the analysis. Literature has shown that success in innovation relies heavily on the newness or novelty of a product because of the dynamism of the current status of the world. Hence it is impressive to have this factor in WIAT's innovation assessment. The 'innovation team' factor is another crucial area that most studies on key success factors have dealt with. It is highlighted in many studies such as Calantone & Weiss (1994), Blindenbach & Ende (2006) and Cooper (2007). Market related factors are also another critical success factors in literature on innovation management (Calantone&Weiss, 1994). In this research 'market potential' and 'market competition' factors were derived in the analysis. The comparison tests also point out factors that can be key success factors which show significant differences in the comparison tests results. These are innovation *team, market potential, company-market fit, and other resources*.

On the other hand there are some limitations in the project. The major limitation being that we could not carry out empirical studies on the 10projects of an organization which had been agreed to. Thus the project ended up only with statistical analysis without any field work on its own. This gave a limitation on the competencies area since the study would have involved some competences tests. In addition to this the competencies database could not be availed for confidentiality reasons, hence the competencies research question is answered partially. This can be looked into in future research with more time and planning since the team factor is important in WIAT assessments, there could be more empirical analysis on individual competencies.

Regarding the theoretical study which serves as basis of the comparisons, there are few studies on critical success factors that relate to agri-food. This is important since WIAT deals primarily with agri-food sector and most of the literature is based on other industrial sectors or is not specific to the sector. Once there is sufficient literature on key success factors dealing with the agri-food sector the theoretical framework can be built on and comparisons becoming clearer. On the other hand, this is strength of the project which makes it original as the literature section and analysis incorporates the agri-food sector.

To conclude, despite the setbacks that pertained mostly to lack of any empirical analysis; this study is worthwhile as it adds value to the measurement tool. It is a step further in reviewing the tool and has shown that the tool can be relied on and is effective across sub

groups. The primary aim of the study is achieved and the literature base on past research on new product development gives a lot of background information on the tool and how it can be improved.

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Appendix 1 Variable names and meaning

Variable	Statement
1. Gteam7	Team - focused on collecting knowledge for our project
2. Gteam1	Member - enough communication with team to do my work efficiently and effective
3. Gteam8	Member - completely satisfied with the product development process used
4. Gteam3	Member - performance requirements are clear
5. Gteam4	Member - wants to participate in a new project with the same team again
6. Gteam5	Member - completely understands the potential problems of the project
7. Gteam2	Management - explicit expressed commitment to the project team
8. Gteam6	Member - if doubt opinion team member I will surely confront member
9. Gmavol3	Market - potential customers great need for product
10. Gmavol5	Product - high potential, can create additional products
11. Gmavol4	Product - will definitely be used by the customer
12. Gmavol2	Market - growing very quickly for product
13. Genvir1	Project - contribute to the competitive advantage of the company
14. Gmavol1	Market - monetary value of the market for product is large
15. Gprasp2	Product - high technology one
16. Gprasp1	Product - innovative and new to the market
17. Gfit1	Company - new product type
18. Gprasp3	Product - mechanically and/or technically complex
19. Gfit2	Company - satisfy new type of customer needs
20. Gfit4	Company - new technology required (R&D) for development
21. Gmacom1	Market - a highly competitive one
22. Gmacom2	Market - with many competitors
23. Gmacom5	Market - frequent new product introductions by competitors
24. Gmacom6	Market - characterized by intense price competition
25. Gmacom3	Market - with one strong dominant competitor
26. Gfit6	Company - new distribution system and/or type of sales-force
27. Gfit7	Company - new type of advertising and promotion required
28. Gfit8	Company - new competitors in the market
29. Gfit3	Company - new potential customers
30. Gresou6	Project - advertising and promotion resources and skills
31. Gresou5	Project - marketing research skills and people
32. Gresou7	Project - sales force and/or distribution resources & skills
33. Gprsup3	Product - unique features or attributes
34. Gprsup4	Product - do a job customer cannot presently do with what is available
35.Gprsup1	Product - superior to competing products customers needs
36. Gresou3	Project - engineering skills and people
37. Gresou4	Project - production resources or skills
38. Gresou1	Project - financial resources
39. Gresou2	Project-management skills

Appendix 2 Missing values before and after imputation

Descriptive Statistics	**Before**		**After**	
Variables	Analysis N	Missing N	Analysis N	Missing N
1.Company - new product type	540	19	554	5
2.Company - satisfy new type of customer needs	553	6	554	5
3.Company - new potential customers	554	5	554	5
4.Company - new technology required (R&D) for development	553	6	553	6
5.Company - new production process	553	6	554	5
6.Company - new distribution system and/or type of sales-force	554	5	554	5
7.Company - new type of advertising and promotion required	554	5	554	5
8.Company - new competitors in the market	553	6	553	6
9.Project - financial resources	554	5	555	4
10Project - management skills	555	4	555	4
11.Project - engineering skills and people	555	4	555	4
12.Project - production resources or skills	470	89	553	6
13.Project - marketing research skills and people	553	6	554	5
14.Project - advertising and promotion resources and skills	482	77	553	6
15.Project - sales force and/or distribution resources & skills	484	75	554	5
16.Member - enough communication with team to do my work efficiently and effective	528	31	528	31
17.Management - explicit expressed commitment to the project team	532	27	538	21
18.Member - performance requirements are clear	540	19	540	19
19.Member - wants to participate in a new project with the same team again	527	32	527	32
20.Member - completely understands the potential problems of the project	540	19	540	19
21.Member - if doubt opinion team member will surely confront member	528	31	528	31
22.Team - focused on collecting knowledge for our project	514	45	528	31
23.Member - completely satisfied with the product development process used	544	15	544	15
24.Product - superior to competing products customers needs	553	6	553	6
25.Product - higher quality than competing products	539	20	553	6
26.Product - unique features or attributes	553	6	554	5
27.Product - do a job customer cannot presently do with what is available	554	5	554	5
28.Product - reduce customers overall costs compared to present time	547	12	553	6
29.Product - innovative and new to the market	555	4	555	4
30.Product - high technology one	472	87	486	73
31.Product - mechanically and/or technically complex	483	76	485	74
32.Product - first on the market	553	6	555	4
33.Market - a highly competitive one	538	21	552	7
34.Market - with many competitors	553	6	553	6
35.Market - with one strong dominant competitor	552	7	553	6
36.Market - high degree of loyalty to existing products	550	9	551	8
37.Market - frequent new product introductions by competitors	552	7	552	7
38.Market - characterized by intense price competition	553	6	553	6
39.Market - monetary value of the market for product is large	552	7	553	6
40.Market - growing very quickly for product	552	7	553	6
41.Market - potential customers great need for product	549	10	550	9
42.Product - will definitely be used by the customer	462	97	553	6
43.Product - high potential, can create additional products	529	30	551	8
44.Project - contribute to the competitive advantage of the company	545	14	545	14
45.Product - will meet the applicable laws	545	14	545	14
46.Product - will have positive effect on environment	543	16	544	15

Appendix 3 Comparisons at respondent level

Table 35 Constructs scores; WIAT & Genesis at respondent level

	WIAT n=225		*Genesis* n=310		
Factor	Mean	Std.dev	Mean	Std.dev	p-value
Innovation team	7.55	1.31	7.00	1.24	*
Market potential	6.92	1.57	6.51	1.43	*
Innovativeness	6.12	2.05	4.76	2.12	*
Market competition	5.82	1.81	4.90	1.79	*
Company-market fit	6.20	2.15	5.62	2.00	
Marketing resources	6.53	1.69	6.18	1.64	*
Product superiority	7.40	1.93	6.70	1.88	*
Other resources	6.89	1.58	6.58	1.57	

* presents significant differences $p<0.05$

Table 36 Constructs scores; Ex ante & Ex post at respondent level

	Ex ante n=474		*Ex post* n=61		
Factor	Mean	Std.dev	Mean	Std.dev	p-value
Innovation team	7.11	1.27	7.68	1.43	*
Market potential	6.64	1.50	6.85	1.74	
Innovativeness	5.06	2.20	5.52	1.89	
Market competition	5.29	1.85	5.52	1.99	
Company-market fit	5.95	1.95	6.75	2.36	*
Marketing resources	6.28	1.63	6.49	1.99	
Product superiority	6.91	1.91	7.14	2.15	
Other resources	6.66	1.57	6.83	1.78	

* presents significant differences $p<0.05$

Table 37 Constructs scores; LEs & SMEs at respondent level

	LEs n=488		*SMEs* n=66		
Factor	Mean	Std.dev	Mean	Std.dev	p-value
Innovation team	7.12	1.32	7.84	1.08	*
Market potential	6.65	1.52	6.87	1.56	
Innovativeness	5.03	2.16	6.23	2.03	*
Market competition	5.29	1.80	5.43	2.22	
Company–market fit	6.03	2.00	5.94	2.28	
Marketing resources	6.28	1.70	6.53	1.37	
Product superiority	6.86	1.94	7.99	1.70	*
Other resources	6.65	1.64	7.35	1.26	*

* presents significant differences $p<0.05$

Appendix 4 The proposed 38 variables

Factors and variables
Innovation team
1. Team focused on collecting knowledge for project
2. Enough communication with team to do work efficiently and effective
3. Member completely satisfied with the product development process used
4. Member performance requirements clear
5. Member wants to participate in a new project with the same team again
6. Member completely understands the potential problems of the project
7. Management explicit expressed commitment to the project team
8. Member if doubt opinion team member will surely confront member
Market potential
9. Potential customers have a great need for product
10. Product's high potential can create additional products
11. Product will definitely be used by the customer
12. Market for product growing very quickly
13.Project contributes to the competitive advantage of the company
14. The market monetary value of the market for product is large
Innovativeness
15. The product is a high technology one
16. The product is innovative and new to the market
17. Product type is totally new
18. Product mechanically and/or technically complex
19. Product satisfy new type of customer needs
20. New technology required (R&D) for product development
Market competition
21. The market is a highly competitive one
22. Market filled with many competitors
23. Market has frequent new product introductions by competitors
24. Market is characterized by intense price competition
25. Market has one strong dominant competitor
Company fit
26. New distribution system and/or type of sales-force required for product
27. Type of advertising and promotion required for product totally new to company
28. Competitors for the product completely new to company
29. Potential customers for product totally new to company
Marketing resources
30. Project advertising and promotion resources and skills are adequate for project
31. Project marketing research skills and people are adequate for project
32. Project sales force and/or distribution resources & skills are adequate for project
Product superiority
33. Product - unique features or attributes
34. Product - do a job customer cannot presently do with what is available
35. Product - superior to competing products customers needs
Other resources
36. Project engineering skills and people adequate for project
37. Project production resources or skills adequate for project
38. Project financial resources adequate for project

Appendix 5 WIAT conceptual questionnaire

The Statements

Nr.	Statements	Answer 1… 10	Certainty 1… 10
Project-company fit			
1	The product type is totally new for our company.		
2	We have never made or sold products to satisfy this type of customers need or use before.		
3	The potential customers for this product are totally new for the company.		
4	The technology required to develop this product is totally new to our company.		
5	The nature of the production process is totally new for our company.		
6	The distribution system and/or type of sales-force for this product is totally new to our company.		
7	The type of advertising and promotion required is totally new to our company.		
8	The competitors we face in the market for this product are totally new to our company.		
Project resources			
9	Our financial resources are more than adequate for this project.		
10	Our management skills are more than adequate for this project.		
11	Our engineering skills and people are more than adequate for this project.		
12	Our production resources or skills are more than adequate for this project		
13	Our marketing research skills and people are more than adequate for this project.		
14	Our advertising and promotion resources and skills are more than adequate for this project.		
15	Our sales and/or distribution resources and skills are more than adequate for this project.		
Team communication			
16	I have enough communication with my team members to do my work efficiently and in an effective way.		
17	The portfolio management has explicit expressed its commitment to the project team.		

18	The performance requirements for this project are clear for me.		
19	In a new project I surely want to participate in the current team again		
20	I completely understand the potential problems of the project.		
21	If I doubt the opinion of a team member I will surely confront this member with it.		
22	All our team members are focused on “collecting” knowledge for our project.		
23	I am completely satisfied with the product development process used.		
Product superiority			
24	Our product will be clearly superior to competing products in terms of meeting customers’ needs.		
25	Our product will be of higher quality than competing products.		
26	Compared to competitive products, our product will offer a number of unique features or attributes to the customer.		
27	Our product will permit the customer to do a job or do something he/she cannot presently do with what is available.		
28	Our product will permit the customers to reduce their overall costs, when compared to what they use now.		
Product aspects			
29	Our product is highly innovative totally new to the market.		
30	Our product is a very high technology one.		
31	Our product is mechanically and/or technically very complex.		
32	Our product will be first into the market.		
Markt conpetition			
33	The market is a highly competitive one.		
34	There are many competitors in this market.		
35	There is a strong dominant competitor – with a large market share – in the market.		
36	There is a high degree of loyalty to existing (competitors’) products in this market.		
37	New product introductions by competitors are frequent in this market.		
38	The market is characterized by intense price competition.		

Markt volume			
39	The monetary value of the market (either existing or potential market) for this product is large.		
40	The market for this product is growing very quickly.		
41	Potential customers have a great need for this type of product.		
42	The customer will definitely use the product		
43	This product has a high potential (i.e can additional products, multiple styles, price ranges).		
Environment			
44	This project will contribute to the competitive advantage of the company.		
45	This new product will surely meet the applicable laws (e.g product liability, regulations, and product standards).		
46	This new product will surely have a positive effect on the environment		

		Probability 1… 10	**Certainty** 1… 10
Performance			
47	What is the probability that this project will be completed within the original planning?		
48	What is the probability that this project will be completed within the original budget?		
49	What is the probability that this project fulfils all its objectives?		
50	What is the probability that this project will directly benefit the end-users (either through increasing efficiency or effectiveness)?		
51	What is the probability that this project will earn more money for the company than it costs?		
52	What is the probability that this project will have a major spin-off or springboard effect, a step in the development of a new generation of products?		
53	What is the probability that this project will improve customers' loyalty to the company?		