PART I

Problem Statement

The problem statement defines the contents of the book and gives a statement of the problem – network based high speed product development. In the problem statement a discussion of network based high speed product development is carried out, and a systematic and precise description of the problems and issues pertaining to network based high speed product development is generated. The problem statement also delimitates the focus of this book on network based high speed product development. This includes the main questions and the main hypotheses for network based high speed product development.

This part is completed with an overview of the structure of the book.

1

Project Introduction

The chapter will describe the studies which the book project has finally featured and how the analysis and thesis forming part of the book have been arranged. The chapter will describe and show how the thorough study of the subject – **High Speed Product Development Processes and Models Based on Networks (NB HS PD)** – together with the explorative analysis of the product development system of generic industrial case businesses including related models and processes have come up. The aim was to describe and analyse the current context in 2000–2003 of network based high speed product development and make an identification and introduction of the NB HS PD problem – **what is the problem?**, an identification and introduction of **why NB HS PD is a problem?** The aim was further to describe **when NB HS PD is a problem** and give an introduction to the theoretical model apparatus for high speed product development processes and models, Further the chapter gives an introduction to **when NB HS PD models and processes can be used?** with preference.

The chapter gives an introduction to how the theoretical framework outlined above was subsequently empirically tested in case Businesses, focus groups and survey with an explorative focus. The chapter introduce shortly the empirical part and study of Danish and foreign international case businesses which had established network based product development processes and models and which employ and try to employ HS PD based on networks. This chapter explains how the study contributed towards an explanation to processes and models for product development carried out at high speed and deeply rooted in networks.

On the basis of the above the chapter finally will describe how the final part of the book is concluded.

1.1 Context for NB HS PD in 2000–2003

In the first decade of the 21st century product development in networks was predicted to be of ever-increasing importance to businesses of all sizes because of changes in markets, in technology, in networks, and in the competences of Businesses (Nonaka & Takeuchi, 1995) (Sanchez, 1996) (Coldmann & Price, 1998) (Child and Faulkner, 1998). The growth in new products' share of businesses' total turnover and earnings were increasing at an unprecedented speed.

The entrepreneurial innovations and technological improvements had resulted in the increasingly fast development of new goods and services. Businesses and industries in different countries became more and more linked and interdependent in networks with respect to materials, business operations and particularly product development to match the wants and needs of the global market environment to high speed product development.

Businesses were therefore encountering increasingly dynamic market fragmentation, shrinking time in market, increasing product variety, demands of production to customer specifications, reduced product lifetimes, and globalisation of production. In the years up to the 2000–2003, many industrial businesses had seen the necessity of applying network based high speed product development in order to compete on the global market.

Previously, Businesses "simply" had to match their product development competences to the market and the technology, but now a match to the network component on the "field of product development" was vital. Networks were vital because the competition in the 21st century was not business against business, but network against network. Networks were vital because an increasing part of product development was carried out in all types of networks containing physical, ICT, dynamic, and virtual networks (Goldman & Price, 1998).

Speed and pressure on time in product development seemed to continue to increase because customer demands for new products seemed to continue to increase. However, a Business seldom possessed all needed competences, and managers therefore saw product development based on networks as an important solution to meet the strong competition of the future global markets and the strong demand for innovation and innovativeness (Grunert & Harmsen, 1997) (Boer 2001).

The evolution of market demands and focus (required) on competencies of businesses could be characterised as a development from a focus on efficiency,

to a focus on quality and flexibility, to a focus on speed and innovativeness. This is shown in Figure 1.1.

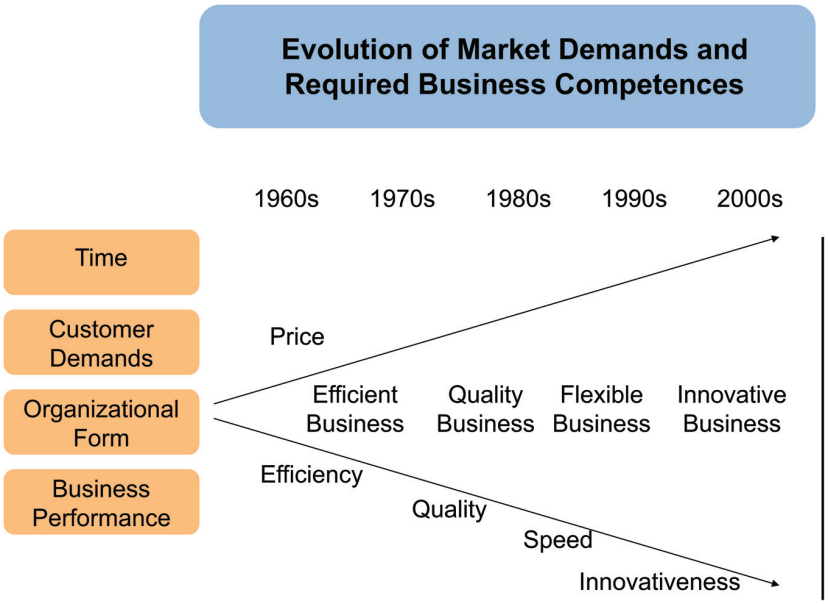

Figure 1.1 Evolution of market demands (model adapted from Harry Boer, 2001).

Source: Harry Boer, 2001 (adapted from Bolwijn and Kumpe, 1998).

Speed, uniqueness, innovativeness and the innovative business was said to be a must for all businesses who wants to join the global market (Baker & Hart, 1999) (Sanchez, 2000) (Albaum, 1994) (MacCormack, Verganti & Iansiti, 2001) but researchers claimed that businesses have to do even better for the future. Researchers claimed that in future, businesses had to show efficiency, quality, flexibility, speed and innovativeness (Boer, 2001) at the same time.

A constant high introduction ratio and "high speed to market" of new products, based on new available and stable technologies was an important competitive parameter (Baker & Hart, 1999) and

> *"Dozens of large businesses had fallen victim to competitors with faster, more flexible new-product development programmes."* (Kotler, 1996) (Case No. 1 Zara)

A major task, a major problem and a strong strategic demand therefore seemed to be to develop, implement high speed product development based on network cooperation.

> *"To speed up their product development cycles, many businesses were adopting a faster, more agile, team-oriented product development approach."* (Goldman, 1998)

> *"Businesses were dropping the sequential product development method in favour of the faster, more flexible simultaneous product development approach. to save time and increase effectiveness."* (Kotler, 1996)

As a result of the above, industrial businesses who wished to operate on the global market faced a more intensive and much fiercer competition and demand on speed in new product development from both OEM, end-user customers as well as from competitors.

This was why it was interesting and important to research and discuss product development and especially to understand high speed product development of individualised products in fragile market segments. (Goldman, 1998) (Child & Faulkner, 1998) (Sanchez, 1996). Consequently, findings and learning on:

1. Enablers
2. Management tools
3. Technological tools
4. Product development models
5. Product development processes
6. Network tools

to speed new product development were central. Likewise, it was important to understand how and when to speed new product development.

1.2 The Need to Improve Speed and Join Network to Gain HS PD – Why?

The book has initially put two main questions to NB HS NPD:

- Why do SMEs need to improve speed in NPD?

and

- Why do SMEs need to join networks to speed NPD?

These two questions are of main importance.

1.2.1 The Need to Improve Speed within New Product Development at the Idea and Concept Stage – Why?

The need to improve speed within NB NPD particularly in the idea and concept phase was of special interest because many SMEs had a very good performance on the lower part of the product development model and process prototyping, tests and marked introduction (Cooper, 1995) (Wheelwright & Clark, 1992) (Baker & Hart, 1999). Firstly, due to long and intense research (Sanchez, 2001) and to strong investment, the lower part of the NPD process was well investigated and defined. Secondly, due to clever and hard work by engineers and production managers this had been systemized and formalized. Yet, there was still a long way to go before the optimal model and process for each NPD project were defined.

The scenario was different when it came to the upper part of the NPD model and process. Many businesses had seen especially the idea stage as a "black box" without structure, filled with creativeness, costs and a lot of trials and errors (Verworn, 2002). Often management at SMEs have realised that trying to formalise, systematize and structure these phases of the PD model and process turned out to be a failure and very difficult to manage.

On the other hand the demand from market, customers, and pressure from competitors to introduce new products at increasingly higher speed had coerced the management to focus on this particular area of the PD model and process.

This was why many SMEs today had realized the importance of generating and collecting new ideas and quickly conceptualize these ideas into new product concepts to the lower part of the PD process.

It was the hypothesis of our research project that the ability to handle speed in this upper part of the NPD model would give the involved SME a major competitive advantage which would give them the opportunity to:

- "harvest the markets first"
- "introduce the products when customers were ready" to buy and consume
- in a long term perspective with continuously high speed PD bring the SME into a strong strategic competitive position where NB HS PD was a strategic competitive weapon.

1.2.2 The Need to Do Join Networks to Do High Speed Product Development – Why?

Networking has always played a major and central role in economy. Networks, knowing about networks, and how to do networking has always been central in

business (Håkansson & Johanson, 1992) (Child and Faulkner, 1998) (Kotler, 2000) (Albaum, 1994) (Hollensen, 2003). So why were networks and PD suddenly important, and what was new about joining networks to achieve high speed product development in 2000–2003?

The new issue about networking was that there were an increasing understanding in industries and individual SMEs that the individual SME faced a global competition and world economy (Goldman, 1998) (Child & Faulkner, 1998) (Kræmmergaard, 2002) in which different competences were necessary to develop the customers' increasing demands for new products.

The individual SME could choose to develop and hold all necessary competences inside the Business and inside the existing network of the businesses. The consequences would be high costs, vertical and horizontal integration, inflexibility and diminishing speed. (Goldman, 1998) (Child & Faulkner, 1998). On the other hand, the businesses could choose to open up and join networks the consequences of which would be opportunities to diminish costs, increase performance, and develop at high speed.

Therefore, in a high speed global market economy it was vital for SMEs to manage competences related to networks. SMEs had to decided which competences were important to hold inside the Business and which competences it was more preferable to "buy" outside or "network". As previously mentioned, it was the thesis of the research project that networks and the ability to do networking – also globally – was one of the enablers of high speed product development.

It was in this context that NB HS NPD were examined.

1.3 Overall Definitions in the Book

The high speed product development focus in literature was until 2003 centred on the lower part of the stage gate product development model (Cooper, 1993) – the process development phase as seen in Figure 1.2.

Focus and tools to speed product development had mainly been on product modularisation, process optimisation, cost improvement of prototyping and prototyping models, improvement of product performance and creation of variance (Hansen & Thyssen, 2000) (Sanchez, 1996) (Bohn & Lindgren, 2002).

The focus had been more fragmented on the upper part of the product development model and process – the innovation and the first part of the product development phase. Also the phase before the "formal" innovation phase had not in particular been in focus of high speed. Due to more creativity,

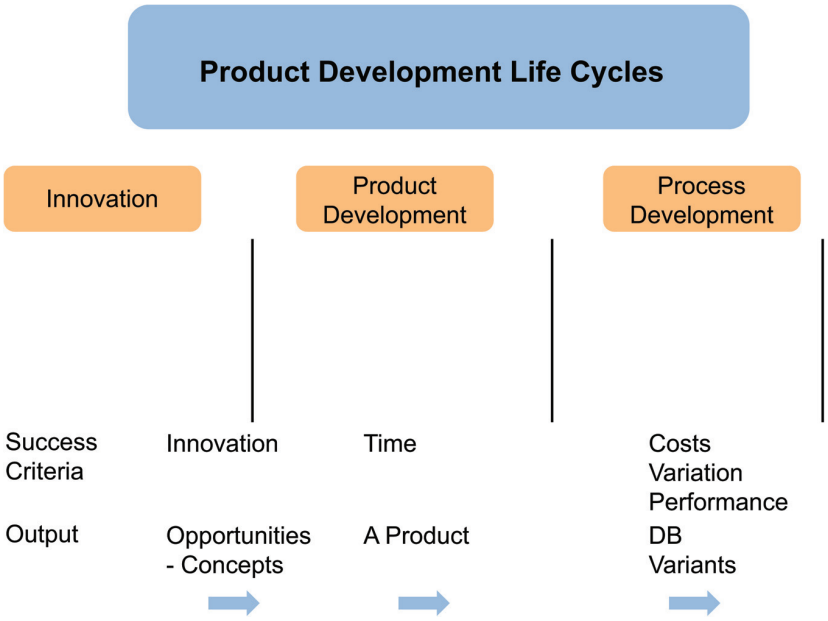

Figure 1.2 High speed in product development until 2003.

more unstructured-ness, and more complexity, the need for flexibility in these stages and gates had not until now been subject to high speed (MacCormack & Verganti 2002) (Verworn, 2002). Many businesses had "closed their eyes" looking into this area of high speed product development possibility because no models and no frameworks had until then been available. Additionally, until 2003 the management trend had been that this stage could not be a subject for high speed.

> *"Product development at the idea and concept stage always takes its time and it always will."* (Engineer employed at LSI Denmark 2002)

However, many business cases (Case No. 1 Zara, Case No. 11 Rossflex) had shown the importance of focusing on time and high speed in the initial phase of the product development stage. It was important in the initial product development phase – the idea and concept phase – that the businesses organise for high speed in PD (MacCormack & Verganti, 2002) in order to be able to speed product development both in a short term and a long term perspective to stay competitive in the market. However, the innovation phase was strongly

related to the after phase of product development – when the product was on the market.

The focus on high speed in product development "on the market" had not been centre of attention neither for researchers nor for industry.

Consequently, the idea and concept phase and the transition phase from idea/concept phase to the phase during which the product was realized had been chosen as the focus point of this research and this book (see later) because time and speed was especially critical here (MacCormack & Verganti, 2002) (Sanchez, 2000).

The above-described problem required the use and implementation of new product development processes and models, which could at one time manage high speed, lowest possible cost, best performance (Bolwijn & Kumpe, 1998) (Boer, 2001) and product development in network. A strategic outlook characterised by special consideration for product development management in when product development was under pressure of time and speed.

1.3.1 The Product

There can be a tremendous difference between the nature of a product development process and the product which is meant to be created through the process.

On the basis of the above discussion, we have in this book chosen to define the product as follows:

> *"a business to business product that can be offered to a market for attention, acquisition, use or consumption, that might satisfy a want or need both tangible and intangible."*

Accordingly, it has been chosen to pay main attention to business-to-business products; both the material and the immaterial parts of the product. In this way the book and the research encompasses the entire business-to-business product.

1.3.2 Product Development Model and Process

In a previously published article (Bohn & Lindgren, 2000) as well as in Chapter 3 of this book various product development models are described. It was also decided to describe the development since the 1960s until 2003 in order to understand and describe the research in product development processes and models. On the basis of this work, the following analytical framework for NB HS PD emerged.

At an early point in the process it became apparent that the framework had to contain two basic elements:

1. The functions involved in the NB HS PD – i.e. both the internal and external departments/functional areas involved in product development
2. The core of the NB HS PD – i.e. the mission, the objectives, the strategies, and the resources controlling the product development project.

Thus, the initial generic processes are the focus of this book and its research. It is also among these processes that according to Cooper we found the greatest need not only for improvement but for continuous improvement and learning (Cooper, 1993) (Sanchez, 2000) (Bessant 1999) (Ulrich & Eppinger, 2000).

Relevant literature also described the entire product development course as an overall process (Booz, Allen & Hamilton, 1982) (Cooper, 1993) containing certain generic activity stages. As previously mentioned the project also focused on the first activity stages in the entire product development process, i.e. mainly the idea and concept phase.

1.3.3 Network Based Product Development Model

The framework of this research project and book determines that the point of focus should be on network-based product development. The network perspective is interesting in that study of literature (Ulrich & Eppinger, 2000) (Wheelwright & Clark, 1992) (Goldman & Price, 1998) (Caffyn, 1998) (Baker & Hart, 1999) as well as most of the cases (Part 7) indicated that product development subject to time pressure were employed and toke place in networks. Thus, the use of network could be the explanation for higher speed in product development but networks could also be the explanation for a lowering of speed in product development. Networks can be defined as both physical, internal networks within the Business, external networks established together with customers and suppliers – or the whole supply chain. Networks can also be defined as digital and virtual networks and the mixture of these kinds of networks.

1.3.4 High Speed Enablers

Through the PhD project the explorative analyses of secondary case businesses claiming that they did network based high speed product development found that the businesses used different enablers to speed product development.

These enablers were used in businesses to speed product development at different levels and at different intensity in the product development as shown in Figure 1.3.

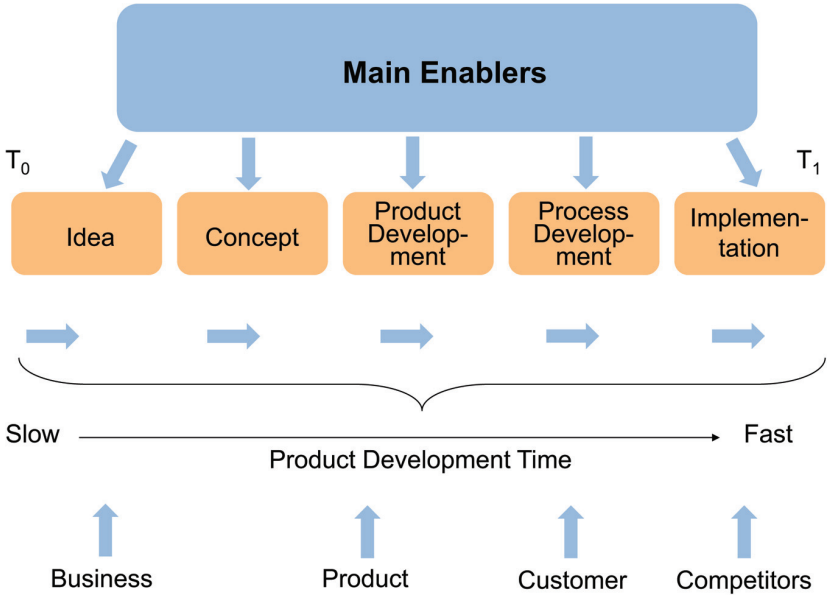

Figure 1.3 Differences in product development time.

The research and book investigate the existence of and the difference in importance and use of the high speed enablers through the product development phases.

1.3.5 The Success Criteria

It was decisive for the businesses that they were aware of how to find new product ideas and concepts first, how to get the concepts down "the product development funnel" (Wheelwright & Clark, 1992) and finally how to introduce new products to the market at high speed (Sanchez, 1996).

However, it was also important to be able to "produce" and "introduce" the new products with less costs, and with the best performance (Rosenau, 1993). Thus far, it had been evident (Roseneau, 1993) that product development of the Business must match at least these three success constraints. The match of these success constraints was vital – otherwise the customers would find other suppliers to patronise (Goldman & Price, 1998) (Sanchez, 2001).

Furthermore, in a long term perspective it was the hypotheses that businesses focused on other success criteria. These success criteria could be continuous improvement (CIM), continuous innovation (CI) and learning

(Gieske, 2001) (Smeds, 2001) (Corso, Martini, Pellegrini & Paolucci, 2001) (Boer, 2001) (Bohn & Lindgren, 2002). The different product development components of the businesses had to be improved continuously to match the competition on the market. CI must be brought into focus because the businesses needed continuously to innovate products to the markets (MacCormack, Verganti & Iansiti, 2001) because Businesses were expected in the future to not be able to survive with ad hoc innovation activities. As a consequence of the above, learning in product development had to be brought into focus as a major success criteria because future CIM in product development and CI demands development of knowledge and competences of product development (Child & Faulkner, 1998) (Nonaka & Takeuchi, 1995) (Gieske, 2001). However, the learning success criteria was expected in the future to be gained from network partners and within networks. The research project and book focus on all success criteria but with particular emphasis on the time and speed criteria in product development.

1.3.6 Industrial Conditions and NB HS PD

The conditions for product development have always been influenced by the industrial conditions. However, during recent years up to 2003 the conditions had turned out to be more dynamic and unstable than ever seen before.

Changing Industrial Conditions

Industrial conditions had changed radically during the last 15–20 years. In this time technology, market conditions, and customer demands changed at a speed and in a direction barely seen before e.g., dynamic market fragmentation, shrinking time in market, increasing product variety and production to customer specifications, reduced product lifetimes, and globalisation of production (Riis & Johansen, 2001).

Diminishing PLC

The change and pressure on speed in the development process were, i.a. due to the fact that the product life cycle had been considerably diminished and delimited (Fine, 1998).

Pressure on Existing PD Models and Processes

This challenge put pressure on existing product development models and processes to find faster and new product development models and processes

that could match the demands for the future global market. High speed product development became increasingly central in the global competition. Businesses that were able to continually develop and focus on value adding elements or improvements to their products with high speed would be able to attract and hold customers and thereby gain a competitive advantage.

Businesses like Microsoft, Ryan Air, and the Zara Inditex group were international showcases to this argument in 2003.

Focus on Continuous Innovation and Continuous Improvement

By continuous incremental and radical innovation (CI) and by continuous improvement (CIM) of their product development models and processes, the above-mentioned businesses had fulfilled their shareholders' demand for profit, survival and growth.

Pressure on Competences of Businesses

The pressure on the businesses ability to develop new product had at the same time created a pressure on businesses competences. The change of markets and technologies were so dynamic and fast that one single businesses competences seldom were enough.

From Hierarchy Structure to Network Structure

Successful businesses changed their way of organising product development from a rather hierarchical structure to a network based structure.

The businesses tried to solve the product development challenge by increasing their network activities in a global perspective. Outsourcing, joint development and improvement on the supply chain had been elements in the network activities of the businesses.

The barriers to international trade and investments had changed and minimised at the same time thanks to WTO. Thus, WTO had increased and supported the trend and ability to develop products in global networks.

Product Development Turned into Global Networks

Product development had therefore been characterised by an increasing amount of openness and by many network operators possessing diversified qualifications and kinds of competence (Hamel and Prahalad, 1994)

(Goldman & Price, 1998) (Child & Faulkner, 1998) (Baker & Hart, 1999). Businesses realised that some kinds of competence had to be procured from outside the Business by means of networks. Therefore, the present years witnessed the establishment of many new and often dynamic network oriented high speed innovation environments, innovation models and high speed innovation processes. It was therefore undoubtedly important that SME businesses became active participants in such global networks.

Focus on Network Based Knowledge Transfer in Product Development

In order to conduct faster product development, businesses would realise that access to external competence was essential. The Businesses would be met with a demand for the surrender and transfer of competence and knowledge to other product development environments (Child & Faulkner, 1998) (Corso, 2001). Such aspects emphasised the importance of analysing and describing how businesses in a strategic comprehensive view were able to take part in such network based product development processes and in a long term perspective to learn or establish knowledge transfer from these processes (Boer, 2001) (Corso, 2001). The combination of network based high speed product development and learning were therefore a major challenge for SMEs in 2003 to gain continuous improvement, continuous innovation and continuous learning to secure high speed product development.

However, the above-mentioned tasks and challenge initially demanded a new understanding of network based high speed product development models and processes because of the new global context of product development.

Summarising on the above-mentioned context for product development showed the following Table 1.1.

Context of Product Development 2003 and in Future

As can be seen in Table 1.1, the global industrial context was changing and was preparing for more speed and more network in product development. Both researchers and industrial businesses were convinced of this challenge, and focus on speed and network in product development was therefore increasing.

However, not many had defined, observed, and analysed the relationship between high speed and network based product development or the impact of high speed on network based product development. Not many in 2003 had

Table 1.1 Context for product development

Context for Product Development	Until 2003	Trends for the Future
Market	National Stable Common	Global Fragmented Dynamic Individualised
Technology	Single technology Expensive Data power low Unstable	Mix of technology or multi-technology Cheap Data power over capacity Stable
Network	Closed networks Stable networks	Open networks Dynamic networks Virtual networks Global networks
Competences of the businesses	Stable competences Competences developed inside the Business or in narrow networks	Dynamic competences Competences continuously under development and pressure Competences developed with network partners and in open and many networks
The product	Mostly physical products and to some extent immaterial products The product is stable The product is used in the same way	A mixture of physical, immaterial digital and virtual products The product is continuously developing and changing form The product is used in many new ways
The product development model	Stable models Stage and gate models	Many product development models Stage and gate models Flexible models Dynamic models Process models
Success criteria	Speed, cost and performance	Speed, time, cost, performance, efficiency, Quality, CI, CIM, Learning

investigated the effects of high speed product development or answered the question why high speed was required in network based product development.

> *"Speed is the new competitive weapon"* although *"I will never recommend cutting corners of executing in a sloppy fashion in order to save time – it just does not pay off" "Speed is important, but it is only one component of our overarching goal of profitable new products."* (Cooper, 1993)

Furthermore, not many had investigated what enablers businesses could use to speed product development and finally what success criteria businesses could use to measure network based product development.

Cooper stressed very well the importance of managing a business's product development activities with more than one success criteria in mind – speed and time.

Management of Product Development was Changing

Product development management had until 2003 focused on short term management thereby success criteria such as time, cost, and performance. The major part of available literature on product development showed a major focus on the management of the product development process within the process at a relatively tactical and operational level (Wind, 1975) (Wheelwright & Clark, 1992) (Cooper, 1993) (Ulrich & Eppinger, 2000) (Baker & Hart, 1999). This focus was merely due to the practical and theoretical challenges to manage the product development process through the product development process from idea to market introduction. The management focus had been on the process within the development process and very seldom on other product development projects inside or outside the Business the centre of attention. Management had not paid particular attention to the management of product development in network because the possibilities, conditions, and the "field of product development" had not applied to this management constellation until 2003. The research project focus on the management area indicated above because the global market for the future as can be seen would apply for this network management in future product development projects.

1.3.7 Theoretical and Practical View to Network Based Product Development

Looking through literature and practitioners' statements on network based product development we found in 2003 some explanations of the appearance of network based high speed product development. The main context and the "product development game" in 2003 could be characterised as shown in Table 1.2.

A dynamic and "interactive picture" of the four main components on "the field of product development" – markets, technology, networks, and competences of the businesses playing in "the field of product development" was therefore central.

Table 1.2 The shape of the main components in the product development game

The Main Context of Network Based High Speed Product Development	Characteristics	Example of Markets 2002
Market – (Sanchez, 1996)		
Stable markets	Stable market preferences	Food industry, Furniture industry
Evolving markets	Evolving market preferences	Agriculture industry, environment industry
Dynamic markets	Dynamic market preferences	Software industry, Bio and gene industry
Technology (Sanchez, 1996)		
Stable technology	Stable and known technologies	Audio and video technology
Evolving technologies	Evolving technologies	Biotechnologies
Dynamic technologies	Dynamic and mixed technologies	Nanotechnology
Network (Child & Faulkner, 1998)		
Stable networks	Networks mainly based on physical and stable networks often internal and dominated network	Industrial groups, branch groups
Evolving networks	Networks based on a mix and evolving system of networks: Physical networks, ICT networks, virtual networks	PUIN network group, EU community
Dynamic network	Networks based on a mix of dynamic networks with high degree of dynamic where network partners constantly comes in and goes out. Often there is no formal network leader.	Virtual network groups, Ambia's
Business competence context (Hamel & Prahalad, 1994)	Support competences Complementary competences Core competences	

The interaction of market and technology in product development had been known for several years (Wind, 1975) (Hein, 1985) (Ulrich & Eppinger, 2000). What was new was the interaction that market and technology had

with different types of networks and their relation and influence to the competences of the businesses as shown in Figure 1.4. This interaction created "the future field of product development". It was therefore central to overview and understand the main components in "the field of product development". Each main component could be of different shapes both prior to the product development project and during the product development project.

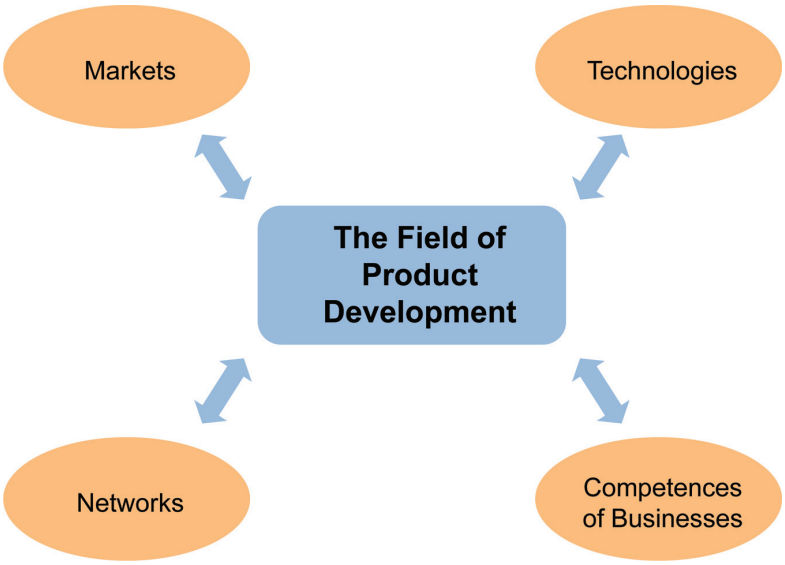

Figure 1.4 The context and main components of "The field of product development".

Until now it seemed as if many businesses had developed a "blind" high speed product development strategy seeking speed, uniqueness, and innovativeness without reading and analysing the characteristics and the development on characteristics of the component in "the product development field". To a large extent, the management of product development had concentrated their efforts on the establishment of high speed product development and on being an innovative business. This was partly due to the tendency to regard such a strategy as the survival in future competition (Bolwijn & Kumpe, 1998). Unfortunately, the combination of high speed product development, uniqueness, and being the network based innovative business had proved to be far more difficult to implement than originally expected (Bessant, 1999) (MacCormack, Verganti & Iansiti, 2001). Many businesses had realised several failures and problems with a strong focus only on high speed in NB PD.

1.4 NB HS NPD in the Future Global Market

Network based high speed product development was a necessity to compete in the future global market **Network** because the competition in the 21st century were expected not to be business against business but network against network (Goldman & Price, 1998), **high speed** because customer demands for new products would continue to increase, and **product development** because product development was an important solution for businesses to solve such heavy demand and competition on high speed on the product development area for the future (Grunert & Harmsen, 1997).

Although there was strong evidence that market wants and needs for new products, increased levels of product variety, and accelerating rates of product changes were different (Fine, 1998) (Sanchez, 1996) (MacCormack, Verganti, Iansiti, 2001). The differences in the needs for speed of market introduction of new product were due to differences in product/market contexts, technology contexts, network contexts, and in the competences of the businesses.

I claimed therefore in 2003 that the choice of speed was critical to the success of the product development project of the business.

As can be seen, all focus both in research and practical terms was mainly on speed or high speed in product development up to 2003. I claim that high speed in network based product development was not the issue. When products entered the market too early, the alternative cost of e.g., waiting for the market, showing the competitors the product, or "repairing" the unstableness of the technology inside the product causing failure was too high on the other hand. When products entered the market too late, the alternative costs of e.g., not being able to enter the market and not being able to harvest the market were fatal to the Business.

I therefore claimed that businesses must find an optimal speed. I call this "right speed and right time in network based product development". If Businesses could find the optimal time to do the market introduction not once but continuously, a major competitive advantage had been gained.

Some businesses had managed to find this critical point of time and speed in product development. The result on market share and turnover but more interesting net profit had been significant. A case for this example is the clothing industry where the Spanish textile Business Inditex by its retail chain Zara had set new standards to right speed and right time of product development.

The hypothesis in 2003 was that businesses who continuously find the right time and right speed of product development would develop a core competence which would be difficult to compete.

Speed and time in product development is therefore more complex than both researchers and Businesses realised in 2003. I claimed that in industry in 2003, speed and time were very much related to cost.

> *"The winners are concentrating on cash-generation, cost controls and subscriber margins."* (Tim Burt, Financial Times, Monday 25 November 2002)

I claimed that it should be focused both on value and cost instead of only on cost as seen in below.

I also claimed that value and cost had to be defined by the individual business related to the look of "the field of product development". The characteristics of "the field of product development" must define the value of speed and time of network based product development.

When businesses speed product development, the consequences were fairly well known in the traditional product development world. However, when high speed was added to network based product development, the effects were mainly unknown. Therefore, high speed and time also had to be defined in relation to network based product development. Furthermore, the impact and the enablers to high speed on network based product development should be verified and investigated.

However, there were different views to speed and time in product development in 2003. The market (customers and competitors), the technology, the network and the Business had different views on this issue. I claimed that the new marketing view should be the optimal view on speed and time in product development. In the new marketing view perspective speed and time in product development are related to bringing the customer into the Business via a strong network relationship with the customer. Thereby the customer becomes a part of the Business's strategic product development foundation. The customer hereby develops the future new products together with the Business and its networks partners (supplier, other network partners and organisations, and even competitors) by focusing on the value of the customer related to wants and needs.

The Business hereby formulates the speed of product development together with the businesses they collaborate with.

I therefore claimed that high speed in product development was not the issue and not always advantageous. It can even be advantageous to "hurry slowly" when characteristics in market, technology, network, and the competences of the businesses are in a certain position.

The question of speed was therefore in 2003 more complicated than outlined by former researchers and practicians. The claim was that during the product development process the speed sometimes has to be increased and sometimes has to be decreased. The main components in the field of product development can turn out to influence and make radical changes to the optimum choice of speed in product development. Therefore, the hypothesis was that businesses have to alter speed during the product development process.

Until 2003 there were only fragmented knowledge of and research about the types of speed and speed tools that were available and appropriated in different situations of network based product development. My claim is that there were more enablers, tools, and views to speed in the product development process than verified in 2003. Learning had to be established in all areas of high speed product development to find enablers and tools to speed in NB NPD.

The critical issue before talking about speed in product development was however, the ability of the management to analyse "the game of product development" and learn from one product development project to another how to define the speed advantageous to this specific product development situation. Even more critical was the ability of the product development managers to learn throughout the product development process. The last learning area concerns the development process from idea to market introduction as well as the span of time before, during, and after market introduction as shown in Figure 1.5.

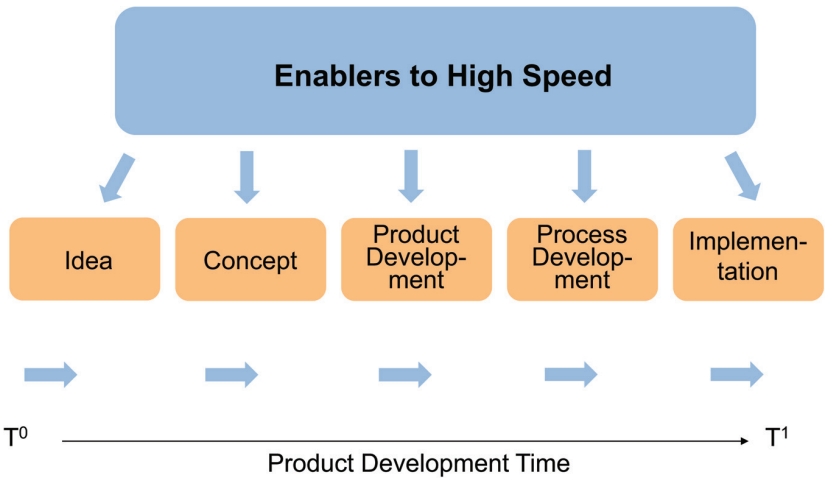

Figure 1.5 Speed in network based product development.

My claim was therefore that learning should be the optimum success criteria in network based high speed product development seen in a long term perspective. Furthermore, businesses should move their focus from short term success criteria to long term success criteria. My hypothesis was that a focus on long term success criteria in network based product development will develop right performance, right cost and right time and speed to the businesses product development activities.

How to establish learning of speed in network based product development across networks in the product development process was therefore an essential and important question. However, it will not be a focus area in this book. Future research was planned on this topic in 2003 and can be seen in my publication up to 2016.

1.4.1 Technical Field of Study and Initial Research Purpose

A strategic match of product development in time, with optimal costs and with the right performance within a dynamic competitive network environment was of interest to my research in 2003. More specifically, the time perspective and the high speed perspective of network based product development were of interest of my research. More specifically what was the right time and right speed related to right performance and right cost as shown in Figure 1.6.

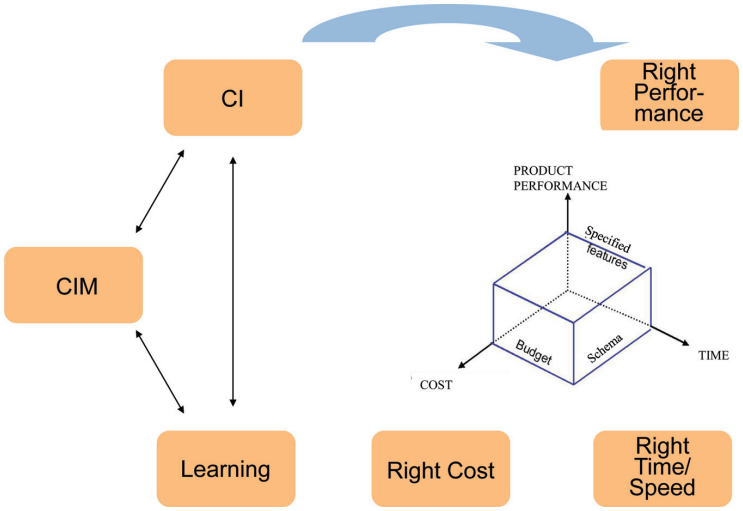

Figure 1.6 Relationship between long term success criteria in network based product development.

Source: Lindgren & Bohn, 2002.

In other words, it was the hypothesis of my research that the businesses must possess the competence and the abilities of incorporating high speed into their product development processes. It was therefore important to analyse if and how the strategic, tactical and logistic elements of high speed product development are and could be incorporated into the idea and concept phase.

It was the hypothesis of the PhD project that normative check lists for guiding a close interplay in networks during the product development process or during the product preparation phase together with the forming and draft of models for network based high speed product development were an essential factor in the success of future businesses. Among other things, the above-mentioned aspects justify the problems of the thesis and why the study of the above-described focus point: – network based high speed product development processes and models – is the prime objective of this research project and book. Furthermore, the final discussion for the research purpose of the research project can now be carried out in accordance with the framework outlined in Figure 1.7.

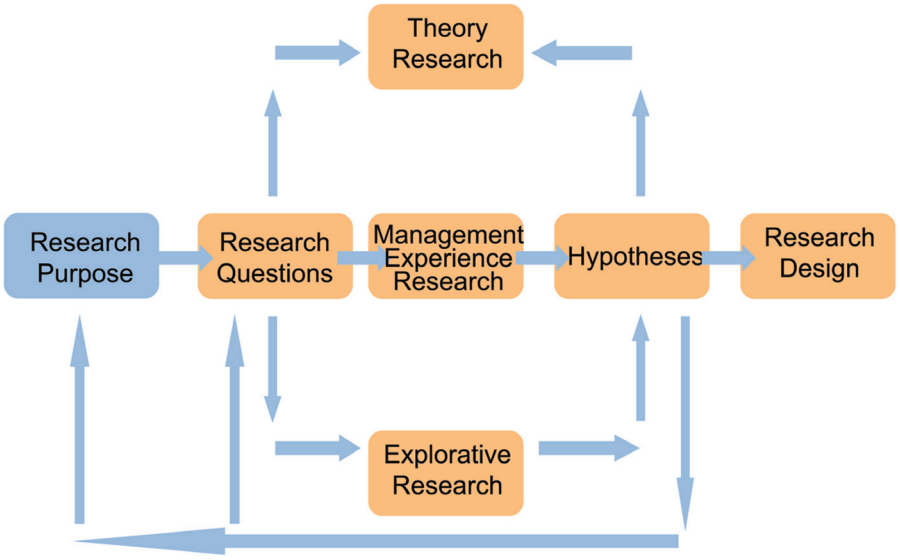

Figure 1.7 Research purpose.

1.4.2 Perception of Problem in Detail

This paragraph will deal with the motivation for the problem and its formulation. This paragraph will define the research purpose and the research question and research subquestions as shown in Table 1.3.

Table 1.3 The question for the research on NB HS NPD

Key Questions of the Book on NB HS NPD
What is the product?
What is network based high speed product development?
What is a high speed product development model and which NB HS product development model can be identified?
What is a high speed product development process and which NB HS PD can be identified?
What is a high speed product development enabler and which enablers can be identified?
What are the success criteria for network based high speed product development?

Initially, the research project therefore focus on defining the "key words" of the book "Network Based High Speed Product Development Models and Processes".

What Is NB HS PD?

The first of the Research Questions was very often asked in 2003. The hypothesis was that high speed related to product development could be seen from different points of view – e.g., the macro environment view, the market and customer view, the technology view, the network view, the Business view, the product view or the competitive view – as sketch out in Figure 1.8.

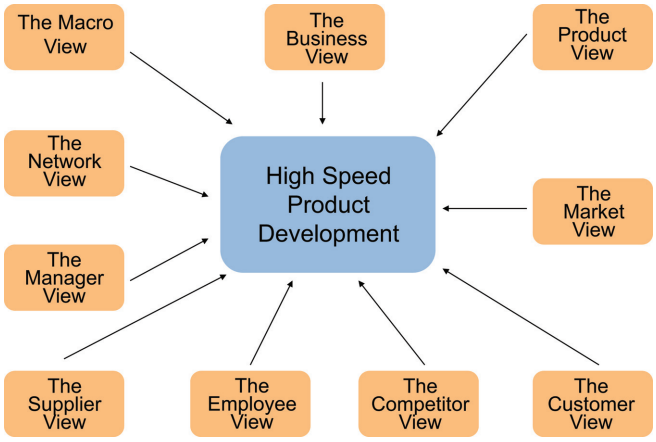

Figure 1.8 Views on HS NB PD.

This book will look at high speed product development formulating thesis from a market view – combined with a maximization of net profit – the new marketing view.

The hypothesis is that high speed is not only a question of developing new products fast to the market and the customers but a question of developing new products at and within the right speed and right time – this means when the market, the technology, the network and the Business are ready for product introduction.

The hypothesis is that high speed to NB PD can be seen both in a vertical, a horizontal, and a network perspective. **The vertical perspective** covers high speed PD from idea to implementation of a product on the market at the highest possible speed – with less amount of time. **The horizontal perspective** covers high speed PD for as many or as complex PD projects as possible from idea to implementation on the market. **The network perspective** covers high speed PD in network both vertically and horizontally as shown in the model in Figure 1.9.

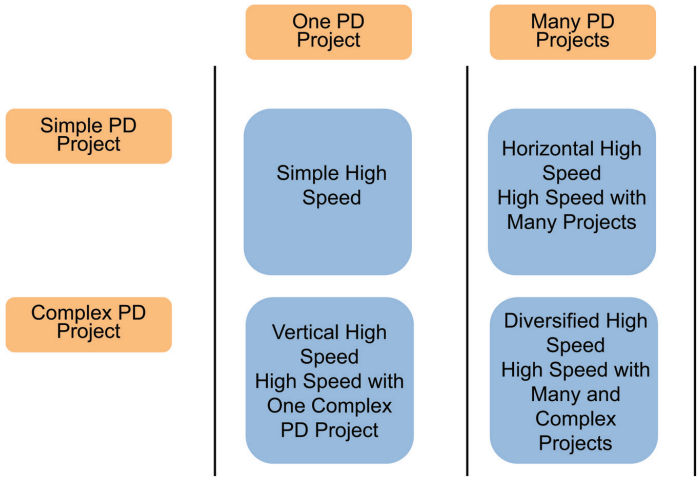

Figure 1.9 High speed product development matrix.

However, the book will mainly deal with PD projects in the incremental, vertical, and network based high speed area.

As can be seen until 2003 product development has primarily focused on the product development process inside the product development model – from idea to market introduction. However, speed in product development is also very much related to the activities taking place before and after the product development process.

It was my hypothesis that speed in product development is influenced by the handling and activity of the Business before and after the product development process. Still, this is not the major focus in the present book.

Identifiable High Speed Enablers

Case studies, Business interviews, and literature search showed numerous ways to gain high speed in product development as sketch out in Figure 1.9. These enablers to high speed can be seen as catalysts to speed product development as sketch out in Figure 1.10.

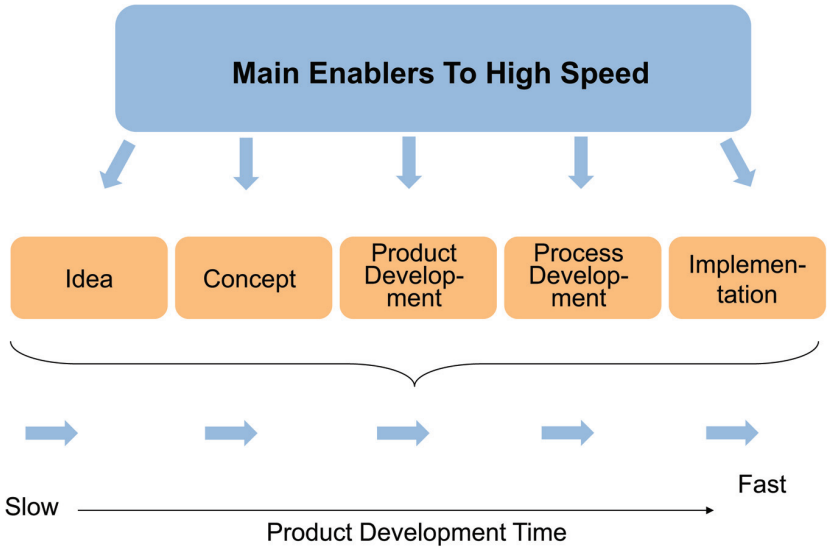

Figure 1.10 Enablers to high speed.

Some SMEs use modularization (Hansen & Thyssen, 2000), other electronic development tools – E-development (Lindgren, 2001), and other new product development models and networks (Cooper, 1985) (Goldman & Price, 1998) (MacGormack & Verganti, 2002).

The hypothesis was that there are more enablers to speed the product development. The research and the therefore aims at finding and verifying enablers to high speed product development.

Additionally, the hypothesis was that the enablers will play a different role depending on which product development situation the particular Business faces. The role of the enablers are not a main focus of the book but when it is possible to register such roles, they will be described.

When the definitions above have be clarified and the enablers of high speed PD have been found, the book will proceed to find a generic framework for models and processes in network based high speed product development. The idea and concept stage will be in prime focus in the book.

Measurable Models and Processes

The research on product development was intense and manifold (see Chapter 3 for further elaboration) and showed some generic models for product development and product development processes.

The book tires to bridge the domains of former NPD and network research/theory by taking pre-existing conceptual models of NPD and network theory, and rebuilding them into an analysis model which can be used to describe and explain the application of HS within NB PD models and processes. There are two main stages in this process of model development.

First, the existing PD model is re-interpreted theoretically in terms of a NB and HS context, with reference to literature and case investigations as can be seen in Figure 1.11 with only a single Business including internal networks.

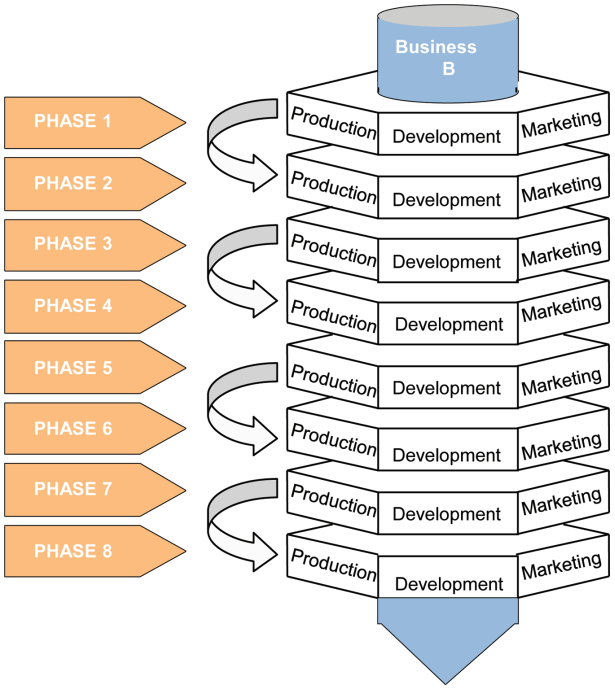

Figure 1.11 Analysis model for product development in networks.

Then data generated using a triangle of research methods are analysed to provide a picture of the application of HS models and processes within NB PD practice.

The current context will be shown as a research for NB HS PD models and processes, focusing on the need for finding and verifying NB HS PD models. The hypothesis is that businesses follow a different PD model when developing at high speed.

The problem perception process which has been largely iterative constitutes an initial process for the perception of a hypothesis model for network based high speed product development model and processes as shown in Figures 1.11 and 1.12. The first part of the model was already shown as

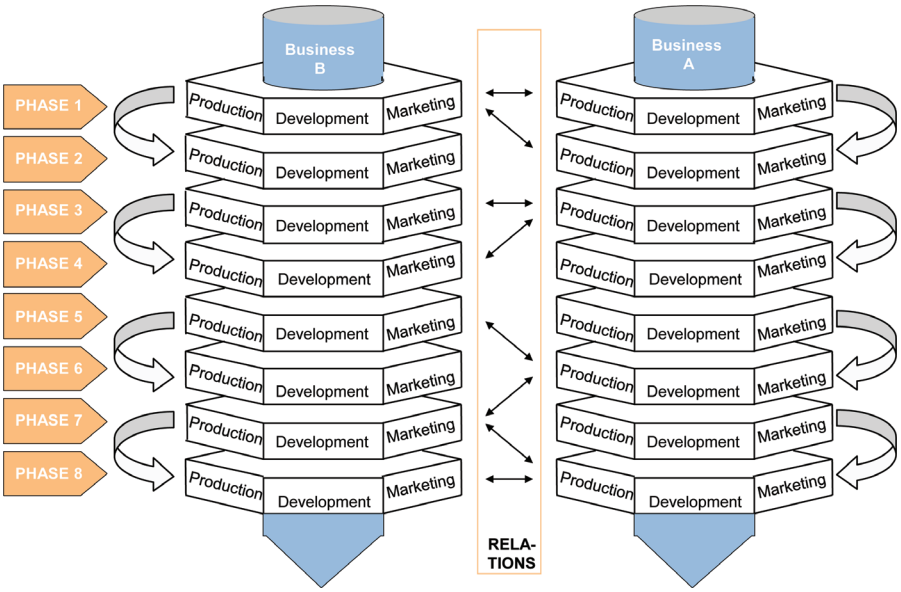

Figure 1.12 Product development in networks.

Source: Bohn & Lindgren, 2000.

in Figure 1.13 and also described in articles (Bohn & Lindgren, 2000).

Subsequently, additional development and research of this model on behalf of further studies were the objectives of the research project.

Firstly, with the above-mentioned in mind, the hypothesis was that there was one generic model for radical NB HS PD and one for incremental

NB HS PD. Radical PD takes place when the PD project faces new markets, new customers, new technologies etc. Incremental PD takes place when the Business faces related markets, related customers, related technologies as shown in Figure 1.13.

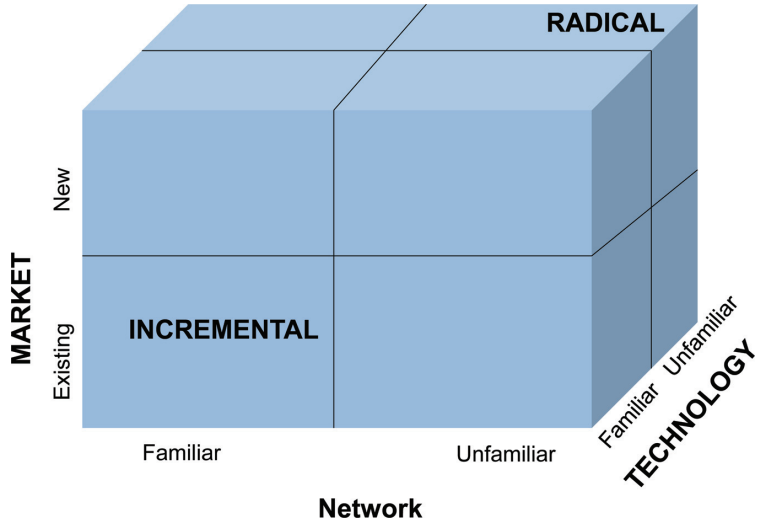

Figure 1.13 Radical and incremental product development.

Source: Inspired by Balachandra, 2000.

The hypothesis is that the formulation of success criteria of NB HS PD is related to the generic NB HS PD project – radical or incremental – which the SMEs face. It is therefore relevant to ask the question: "What success criteria can be used for measuring high speed product development based on networks?"

Possible Success Criteria for Measuring NB HS PD

The hypothesis was that the time success criterion – to achieve high speed or to shorten the time by which the product development process is done – was essential. However, the hypothesis was also that performance and cost are still essential success criteria, also in NB HS PD, and that a pressure on time will have impact on the other two success criteria either by improving earnings, reducing costs, and improving performance (Goldman & Price, 1998)

or the opposite. The research wanted to clarify when high speed will have positive effects on profitability and performance.

The hypothesis was also that there are more success criteria for NB HS PD than time, performance and cost. On a short term and a long term basis there must be different success criteria. The final aim of the research is to find the success criteria dependent on NB HS PD project and find their importance both on a short and a long term basis.

The hypothesis was that network based high speed product development should be evaluated in a short term perspective with the same success criteria as product development had been evaluated until 2003. However, in a long term perspective NB HS PD should be combined with other success criteria such as:

1. continuous improvement (CIM)
2. continuous innovation (CI)
3. learning (L)

Otherwise, a Business using network based high speed product development will not be able to reach and meet the success criteria – time, cost and performance neither in a short term or a long term perspective. This is shown in Table 1.4.

Table 1.4 Short and long term NB HS PD criteria

NB HS NPD Success Criteria Short Term Perspective	NB HS NPD Success Criteria Long Term Perspective
Time	Right Time
Cost	Right Cost
Performance	Right Performance
	Continuous Improvement and Continuous Innovation
	Learning
	Right Speed

The research wanted to verify these success criteria in the businesses involved in the research.

The above-mentioned key overall research questions finalise the first part of the phase of formulating the research questions. The second part where research questions in details are elaborated, will now be presented.

1.5 Research Questions – When?

The final question to ask is: when is it preferable to use NB HS PD? The answer to this question must be fully fathomed in order to understand the essence of NB HS PD.

The research project thesis is that the use of NB HS PD must depend on:

- Market characteristics
- Technology characteristics
- Product characteristics
- Network characteristics
- Business competence characteristics

The research will try to map out and give an answer to the question: When was NB HS PD used and under which circumstances should NB HS PD be used? The research questions were formulated by theory research, management experience and explorative research. This will be commented on at a later point in this chapter.

Summing up on the hypotheses to be tested, the following plan in Figure 1.14 shows the overall research questions and related theses formulated and shown in Table 1.5.

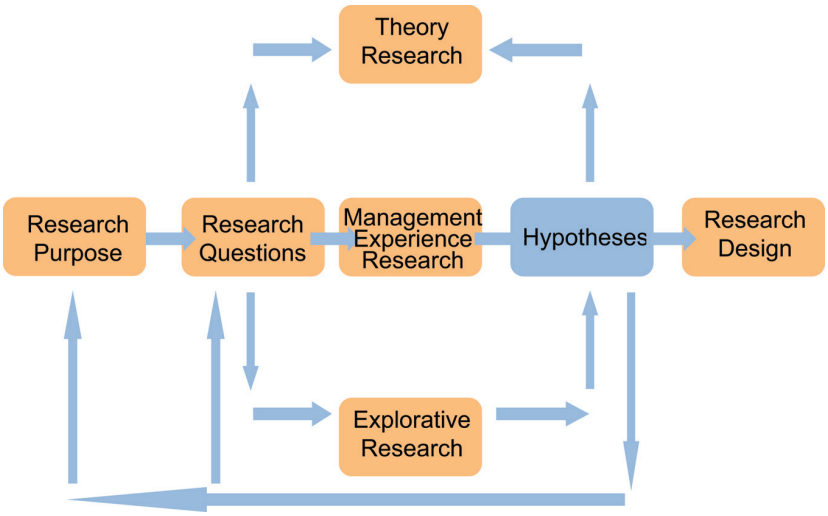

Figure 1.14 Research hypothesis.

Table 1.5 Overall research questions

Overall Research Questions	Hypotheses to be Tested
1. What is network based high speed NPD?	1. HS NPD can be seen from different view (Macro environment, Business, product, market, customer, technology, competitive and network view) 2. HS NPD is a matter of right speed and not high speed.
2. What enablers to NB HS PD can be identified?	1. Businesses use different HS enablers. 2. HS enablers are identical to the 10 enablers – 1–10 3. There can be more than these 10 enablers to HS PD. 4. The enablers will play a different role according to the PD situation and project (Secondary focus) 5. The customer enabler, the network enabler and the PD model enabler plays an important role in the upper phase of the HS PD phase.
3. What framework models and processes in the idea and concept stage/gate of high speed product development based on networks can be measured?	1. The HS PD projects can be divided into to radical and incremental PD projects. 2. The radical and the incremental PD projects follow different generic HS PD models and processes and can thereby be described by different generic frameworks. 3. A HS PD model follows another PD model than the normal PD model of the Business.
4. What success criteria can be used for measuring high speed product development based on networks?	1. The success criteria for HS PD are dependent on the specific PD project – radical or incremental. 2. HS PD success criteria can be formulated as short term and long term success criteria 3. Time, cost and performance are central success criteria in a short term perspective 4. Continuous improvement (CIM), continuous innovation (CI), and learning are central success criteria in a long term perspective to reach right time, right cost and right performance in NB HS PD.

1.6 Methodology

This paragraph discusses the structuring of the problem, gives a description of the scientific methods regarding the problems, and explains how the methodology is applied.

The book is divided into six parts. The first part formulate the Problem Statement. The second part will describe the theoretical foundation of the research project and will present an empirical explorative secondary Business case part, which will help to construct a framework for the research on network based high speed product development models and processes in SMEs in accordance with the preliminary theoretical foundation and analytic approach.

The third part – Analysis Model – will elaborate the research methodology, empirical methods and analysis tools. The fourth part – Empirical Results – will describe and analyse the research findings, and the fifth part – Comparing Theoretical Framework and Empirical Results – will discuss the application of NB HS PD together with criticism and implications. Finally, the sixth part – Conclusion – will summarise and present an agenda for future research. Please see the structure outlined in paragraph 1.9.

1.6.1 Problem Identification and Theory

In the second part of the book a thorough study of relevant literature on the subject – **Network Based High Speed Product Development Processes and Models** up to 2003 – is carried out together with an explorative secondary case analysis of the product development system of generic industrial businesses including related models and processes. Hereby the book endeavours to describe, make an identification of the problem, and produce a theoretical model apparatus for network based high speed product development processes and models. The preliminary process for the study of relevant literature and the explorative analysis of specific case businesses were characterised as a problem conception which followed an iterative perception of problem, processes and models.

In the third part of the book a further theoretical study endeavours to reach an understanding of the problem area. This understanding formed the necessary basis for a final identification of the problem and for a final delimitation as regards the theoretical framework of the empirical part.

The second and third part form the basis for the fourth part – the empirical research.

1.6.2 Empirical Part

The theoretical model outlined above was subsequently empirically tested in different ways as recommended by Wind (1975) and Aaker & Day (1980).

The sources of the hypotheses were both theoretical research, management experience (senior researchers and industrial managers dealing with product development) and explorative research as shown in the model in Figure 1.15.

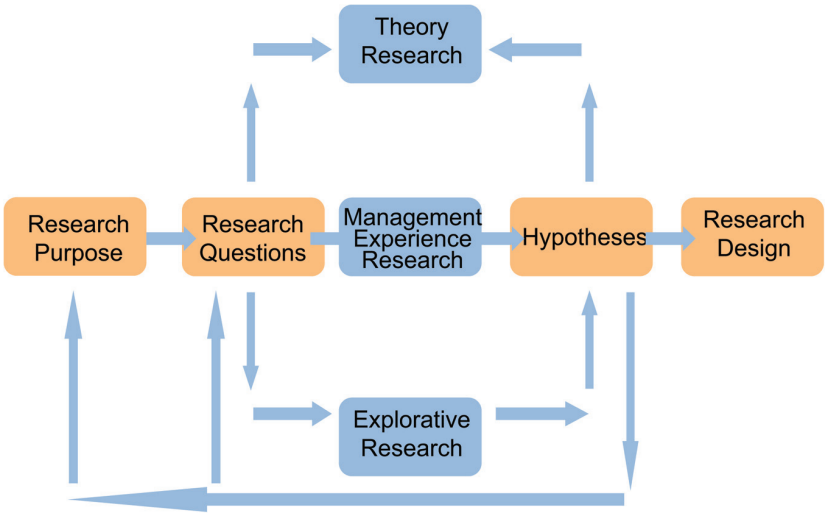

Figure 1.15 Sources of hypothesis.

1.6.3 Theory Research and Experience

Specific Case Businesses with Explorative Focus

The empirical part comprises an in-depth case study of Danish and international case businesses which claimed to have established network based product development processes and which employ such high speed product development types. These cases are presented as secondary cases. An overview of the cases can be seen in the collection of cases.

Literature Research

The literature research comprises an in-depth literature research of Danish and international publications on network based product development carried

out both in Denmark supervised by associated professor Kim R. Bohn, Poul Kyvsgaard Hansen, Professor Harry Boer and associated Professor Frank Gertsen, associated professor Poul Dreisler together with at my stay at the Polytechnico di Milano, Italy supervised by Professor Roberto Verganti and Professor Mariano Corso.

Specific Case Businesses with Explorative Focus

The empirical part comprises an in-depth case study of Danish and international case businesses which claim to have established network based high speed product development model and processes and which employ such product development types. These businesses were Lyngsø Industires, Lindholst, TLC, GSI Lumonics and AKV Langholt.

In-Depth Focus Group and Newsgroup Interviews

This analysis was supplemented with in-depth focus group and newsgroup interviews with 13 different case businesses. The representatives and businesses in these focus group interviews were:

- Managing Director Svend Lindholst, Linco Trading A/S
- Managing Director Henrik Olesen, Wolfking Scanio
- Development Manager Kristen Laurbach, Wolfking Scanio
- Managing Director Frank Sørensen, Ansager Møbler A/S
- Managing Director John Chr. Aasted, AKV Langholt AmbA
- Sales Manager Kjeld Ole Nielsen, Lyngsø Industries
- Solution Manager Nils Bundgaard, Tele Danmark Internet
- Personnel Manager Lars Thomsen Tele Danmark Internet
- PT-Project Manager Wolfgang Schröder, Grundfos A/S
- Planning Manager Erik Lou, Grundfos A/S
- Technology Manager Peter Karlsen, Grundfos A/S
- Product Manager Simon Whitley, GSI Lumonics, Rugby England
- Consultant Boris Wortmann, Dansk Teknologisk Institut
- Project Manager Steffen Sørensen, NEG Micon A/S
- Product Development Manager John Sahlertz, LEGO SYSTEM A/S
- Development Manager Bjarne Gedsted, Bang & Olufsen A/S
- Strategic Manager Carsten Christensen, Danfosss Controls

This research was both a management research and an explorative research.

Research PUIN and DiSPU

The research of PUIN is documented in Chapter 11 together with the research of DiSPU in Chapter 13. A survey research called PUIN together with a research called DiSPU carried out at the Danish Technological Institute and Centre for Industrial Production are documented here.

The Book – Network Base Product Development

The result of the work in PUIN and DISPU mentioned above became a book "Netværksbaseret højhastighedsproduktudvikling" (Bohn and Lindgren 2013). In this work some of the hypotheses could be verified for the PhD project.

The TIC Network

The above-mentioned empirical study objective has contributed towards an explanation to processes and models for product development carried out at high speed and deeply rooted in networks. These studies have among others been documented and tested in a number of SMEs in Viborg Amt together with TIC Viborg described in details in Chapter 12.

Joint Research with Polytecnico di Milano

A joint research together with Polytecnico di Milano in the Italian and Danish SME industry has been carried out in relation to "The TOM Project" and the "SALSA" project.

Observation and Action Research with TIP Project (The Aarhus School of Business)

Research on a high speed joint product development activity carried out by students from The Aarhus School of business, Arkitektskolen i Århus, Ingeniørhøjskolen i Århus and their professors together with major industrial businesses in Denmark (www.tipprojektet.dk). 18 different product development projects were established and documented.

Observation and Action Research with Industrial Businesses in Denmark, Germany and Czech Republic

Through the research I had the opportunity to observe and carry out action research within different industrial businesses developing new products

in the areas of E-business projects (www.bestcom.dk, www.langcen.dk, www.deluca.dk, www.design.dk, www.nap.dk, www.damb2b.dk). The experience and observation are documented in this section.

1.6.4 Indication of "State of the Art"

The book presented in 2003 a new analysis framework of network based high speed product development processes and models.

The project presented a new descriptive framework model for network based high speed product development in a process perspective and developed an analysis foundation which could form the basis of understanding network based high speed product development processes and models at the upper part of the PD model – the idea phase and the concept phase.

Additionally, the research project and the book presents main enablers to network based high speed product development and analyses such enablers important to create state of the art network based high speed product development specifically in the idea and concept stage in the product development process in 2003.

The research project and book also presents generic short and long term success criteria which can be used for measuring NB HS PD. This study toke as its reference point both the research programs for the Centre for Industrial Production and the holistic production concept programme (Strategy for Centre for Industrial Production, 1999).

Analysis and Thesis Forming Part

On the basis of the above-described studies, the book will finally feature an analysis and thesis forming part.

Thus, the above constitutes the general preliminary methodological framework for the actual research project, which was defended as a PHD project in 2003. The model in Figure 1.16 illustrates the phases and time schedule of the aforementioned research project.

All experiences and results obtained from the first year of the research were described in books, articles, conference papers, and working papers, which are included in this description as enclosures. An overview of these can be seen in the following list.

1. Hypoteser til forståelse af netværksbaseret produktudvikling under høj hastighed Center for Industriel Produktion Aalborg Universitet, Kim Bohn & Peter Lindgren (2002).
2. Begreber i netværksbaseret produktudviklingen under høj hastighed Kim Bohn & Peter Lindgren (2000).

3. Product Innovation in Networks – Analysis Framework for Case Studies Center for Industrial Production, Aalborg University Kim Bohn & Peter Lindgren (2000).
4. E-development – Center for Industriel Produktion Aalborg Universitet Peter Lindgren & Kim Bohn (2001).
5. Right Speed not High Speed (Lindgren & Bohn, 2001).
6. Continuous Improvement and Learning in Network Based High Speed Product Development (Bohn & Lindgren, 2001).
7. Right Speed in Network Based Product Development and the Relationship to Learning, CIM, and CI (Bohn & Lindgren, 2002).
8. Knowledge Management and Product Development (Lindgren, 2002).
9. DiSPU research (Bohn and Lindgren, 2002).
10. Produktudvikling i Netværk (Bohn & Lindgren, 2002).
11. Inter-organisational Project Management in SMEs (Hørlück, Kræmmergaard, Nielsen & Lindgren, 2002).

1.7 Time Schedule for the Research Project

The accomplishment of the project was related to a preferable time schedule which is schematically shown in Figure 1.16.

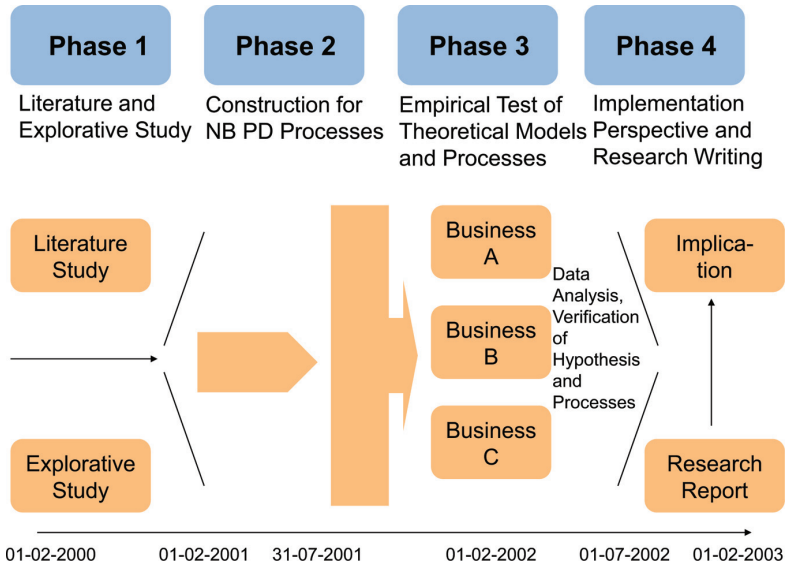

Figure 1.16 Time and phases schdedule for PhD project.

The time schedule for the research project was suggested to last for three years to commence on 1st February 2000 and to be completed on 1st February 2003. The model in Figure 1.16 outlines the phases and time schedule of the project.

As can be seen from the Figure 1.16 the research project was fixed to pass through four phases. Each phase contained specific tasks and demands which had to be satisfied to reach the overall objective and time schedule of the project.

1.8 Presentation of Book

The book is organized by means of the overall table of contents shown in Figure 1.17.

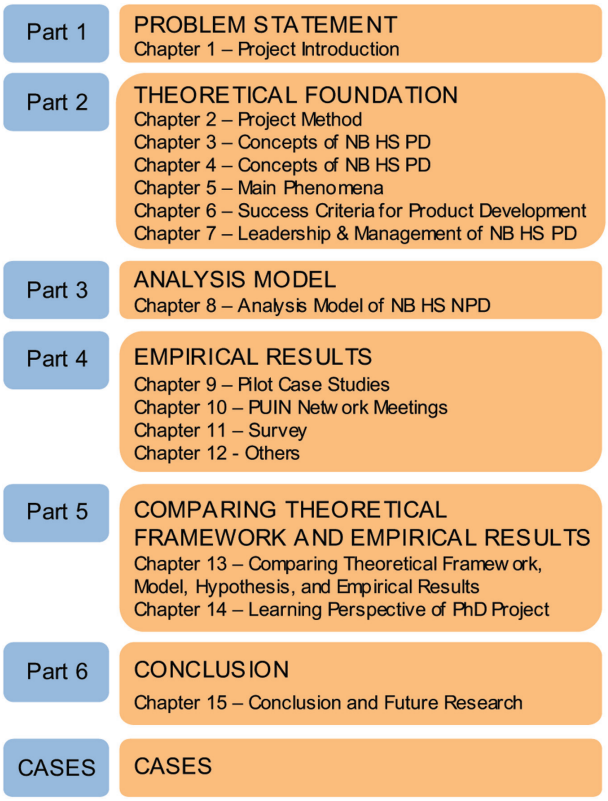

Figure 1.17 Structure of the book.

The book can be supplemented with books and articles written during and after my PhD project, particularly "Produktudvikling i netværk – Refleksioner omkring produktudvikling i høj hastighed" (Bohn & Lindgren, 2002), "Organizing for Networked Information Technologies – Cases in Process Integration and Transformation" (Hørlück, Kræmmergaard, Rask, Rose & Lindgren, 2001), Bohn & Lindgren (2002) and Hørlück, Kræmmergaard, Steendahl Nielsen & Lindgren (2002). For further information, see list of references in Chapter 15, my CV and Linkedin profile.