

PART VI

Conclusion

The conclusion defines the contents of the research project 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 research. 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 research project.

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Conclusion

The conclusion will comprise three major areas:

1. The results and findings of the research on NB HS NPD
2. The comments on and analyses of the research methodological performing
3. Proposal for further research

15.1 Results and Findings of Research on NB HS NPD

Through the research significant results and findings could be verified in NB HS NPD.

Firstly, the research identified that time and speed in NPD were measured in businesses up to 2003 as physical time and subsequently transferred into cost. The businesses measured time of product development as the time from idea generation to market introduction. The businesses did not measure time and speed in accordance with time before the idea was generated and after the implementation point of entry for the new product.

However, the research verified that the businesses had difficulties in placing the beginning and the end of a product – the market introduction. This caused major problems when trying to clarify the exact physical time of a product development project and also when comparing two product development projects – the physical speed of the product development projects. The research therefore concluded that time and speed of product development measured in physical time and speed was not relevant if the businesses could not define the beginning of a new product – the exact time that a product idea was born – or the end of a product – the time when a product was implemented to the market. Secondly, through the cases and PUIN focus group meeting the research verified that “the field of product development” never had the same characteristics from one product development project to another. This meant that in terms of speed it was not theoretically possible to compare two product

development projects or the work of two product development teams to a new product because the conditions were not the same.

Furthermore, the views on time and speed in product development both by industry and by theorists up to 2003 did not pay attention to speed and time before and after the product development process. The research verified that the product development process runs both before and after the product development process and that product development should not be seen as a project with a beginning and an end but as a continuous product development process.

I therefore firstly proposed another view on the speed and time of product development. This view had a more relative approach to speed and time in product development. This view defined the time of product development as relative time depending on which view you take of the product development process – whether it was the macro view, the business view, the product view, the customer view, the competitor view, the technician's view or the network view. The research verified that these views were very different and present very different pictures of time and speed in NB PD. A competitor could e.g., regard the product development process of one business as running at high speed whereas the customer could at the same time regard the same product development project as running at slow speed.

Thus, in my definition of time and speed was achieved when “a business continuously *hits* the optimal point of entry to the market”. This meant the point of entry where it was most business optimal to enter the market with the new product. This was called *right time*, and businesses who continuously achieve the above-mentioned, move at the right speed in product development – which was called the optimal speed and time of network based product development.

The research verified that businesses did not only prioritise HS in the second phase of the PD process – the PD phase. Businesses also prioritised time and speed in the first general phase and even in the last product development phase. When the characteristics of the product development task and of the field of product development were of a certain quality, the businesses also focused on time and speed in these phases.

The research project fully verified how important it was for businesses to focus on right speed and not high speed. However, it was verified that most businesses participating in the empirical part of the research did not focus on right speed but instead narrowly on high speed.

The research verified that the framework of the idea and concept stage/gate of high speed product development based on networks could be preferably measured with a generic model as shown in Figure 15.1.

The measurement of whether the innovation task had an incremental or radical innovation character was proposed to come out of the classification related to market (existing/new), technology (familiar/unfamiliar) and network (Familiar/unfamiliar). The innovation task had further to be related to the business competences, whether the business had the competences or needed to adapt new competences.

The research verified that HS PD projects could be divided into radical and incremental PD projects/tasks. Most product development projects were classified as incremental product development projects but the research verified very clearly that the radical and the incremental PD projects do not follow different generic HS PD models and processes in businesses. Consequently, they could not be empirically verified by different generic frameworks in my research.

The research showed that HS PD projects always had a formulated PD core where mission and goals were generally formulated beforehand. The strategy of the product development project was often formulated but at a later point of time in the product development process. In all the business cases the organisational resources and network boundaries were normally formulated initially when the product development project took place in network. This formulation of network boundaries was mostly formulated within the existent, narrow network.

The research verified that the HS PD model followed another PD model than the ordinary PD model of the business. Formally, the businesses always used the same product development model and process, but when the management stressed speed, several informal product development models and processes turned up and made the product development model and process very "fuzzy". The informal model and processes looked very different from one business to another.

The research verified 8 enablers of the originally, hypothetically identified 10 enablers to HS PD. These were

1. The ICT enabler
2. The customer enabler
3. PU model enabler
4. The Network enabler
5. The HRM enabler
6. The product to process enabler
7. The modularisation enabler
8. The E-development enabler

The innovation enabler and the process enabler could not be indisputably verified. Instead, two new enablers were verified in the case and PUIN research activities together with the other research activities. This was the Management Enabler and the Informal Process and Model Enabler. The informal process and model enabler could also be verified in the survey.

The research verified that businesses used different HS enablers which were very much identical to the HS enablers mentioned above. The use of HS enabler was narrowed down considerably in the individual businesses to one of very few HS enablers. However, the businesses showed that they did not let the HS enablers play a different role according to the PD task or to the characteristics of “the field of product development”. The businesses’ knowledge of the different roles and possibilities of the HS enablers was insufficient and therefore they did not “play” with the HS enablers in a strategic business economically optimal way. The research could not verify that the businesses mix the HS enablers in an business economically optimal and strategic way as seen in some of the secondary cases.

The customer enabler and the PD model enabler were verified to play the most important role in the upper phase of the HS PD phase. The network enabler could not be verified in the same significant way. It was verified that the businesses use the network enabler very narrowly and with very little use of alternatives to the physical network – e.g., digital and virtual networks.

The research verified that the success criteria for measuring high speed product development based on networks were mainly measured by businesses as short-term success criteria. These were verified as time, cost and performance. The long-term success criteria as CIM, CI and Learning were hardly existent in the businesses. Businesses do not focus particularly on these success criteria.

The success criteria for HS PD were also verified as not significantly dependent on the specific PD project – radical or incremental. This meant that the businesses did not change success criteria dependent on the characteristics of the product development task.

As mentioned above, the right speed PD success criteria could be formulated as short-term and long-term success criteria. However, as verified by my research the businesses only used the short term success criterias. As mentioned above, time, cost, and performance were central success criteria in a short-term perspective.

Finally, the research verified the importance of distinguishing between PD leadership (PUL) and PD management (PUM) when operating NB HS NPD.

The research showed that businesses focusing on product development leadership gain significant business economical result and competitive advantage.

The following impact on NB HS NPD could be verified through the research.

Firstly, my research verified that the pressure on time in NPD created informal processes and models within the business but also within the network. These informal processes existed in nearly all businesses and were most often known by the management level. The management even “relied” on the informal product development processes. Unfortunately, most businesses did not know about the value and cost of these informal product development processes and especially on the alternative costs of these informal product development processes. Furthermore, the learning from these informal models and processes were not transferred to the formal product development system to create value in the formal product development system.

The pressure on time in NPD created both first mover advantage and first mover bad advantage. Both were verified in the empirical research. Most often, the pressure on speed and time in NPD would result in an increase of total costs because pressure on speed and time often diminishes quality and – more essentially – increases alternative costs. However, the secondary literature claimed that costs diminish when speeding time in NPD. Yet, the secondary literature seemed to lack a calculation of alternative cost. The research verified that high speed pressure on product development was seldom related to actual demands in the market and it therefore resulted in unnecessary, high, alternative cost.

The research showed that a focus on right time increases performance and diminishes costs. Right speed in product development also offered the businesses competitive advantage, e.g., first mover advantage, attack on competitors when most inconvenient or keeping the competitors always out of the market. Right speed also offered internal advantages as e.g., liquidity advantage when the business played for the supplier’s money.

However, the research also showed that the major part of the businesses tried to obtain high speed and time focused on cost and not value. I claimed that this was a dangerous way of working with high speed in product development because the businesses used an inside out perspective which

- was not most favourable to the optimal point of entry to the market
- was too cost consuming in relation to both direct costs and particularly alternative costs

- forgot to calculate and use the value and perceived value which market opportunities offered the business

The research verified that high speed in network based product development was often miscalculated in relation to radical and incremental product development projects. The research showed how the business used the same focus on speed regardless of whether it was a radical or an incremental product development project. Furthermore, the research showed how many businesses run the same product development model and process on all product development projects independent of incrementalness and radicalness.

Pressure on speed and time would therefore often be impossible to optimise or achieve because of the businesses' failure or lack of possibility to choose the right PD model for the particular product development project. In this respect, my research also showed how a wrong choice of product development model could be fatal to subsequent changes in the demands on the PD project as a result of changes in the field of product development. A stage-gate model had considerable difficulties in relation to cost and time when it came to changing direction and to radically changing the product in the middle of the product development process. Initially, a flexible model would result in higher costs. However, the flexible model would more easily, at a higher speed and at lower costs be able to change direction later in the product development process. None of the two types of product development models were optimal and definitely not to all PD task. We therefore had in 2003 to look into new models of NB RS NPD (Network Based Right Speed New product Development).

My research verified that NB RS NPD could be a very strong competitive weapon. However, it could give both first mover advantage and first mover bad advantage as shown in the research. The result depends on careful leadership by product development management. Another peculiar thing was that NB RS NPD may increase quality when focus was on right speed. If customers, suppliers and other internal and external network partners were involved in the product development process in the right "spots", then the product would perform at a higher level and would enter the market at a business optimal time. This was verified by my research.

The research showed examples of businesses who were pushed into radical PD because of pressure on high speed in product development. This was the case even when the product development task initially seemed to be very incremental. This case showed one of the bad effects of high speed product development when the business did not carefully interpret the product development task or the characteristics of "the field of product development".

The impacts on market, technology and networks by network based high speed product development were verified to be numerous. The research showed evidence of diminishing product lifecycle, continuously lower prices on technology and continuous introduction of new technological features, products and process possibilities. Furthermore, high speed product development proved to push the businesses on the global market into more and often unknown network activities both in the physical network area and in the digital area. However, according to my research the virtual network area had not yet been particularly developed.

The above-mentioned resulted in the hypothesis that another product development model and process had to be developed to achieve right speed of network based product development in the future. I therefore propose the following normative guideline to businesses who want to work with NB RS NPD:

1. Define the task of product development – Incremental or radical
2. Define “the field of product development”
3. Define the success criteria – time and speed – related to relative time and speed – related to right speed and right time
4. Define costs related both to direct and alternative costs
5. Define speed related to right speed and value instead of high speed and direct costs
6. Focus on both value and perceived value
7. Define the product development model – stage-gate and flexible model – but choose the right model according to the task of the product development project
8. Try to be more agile and flexible in the choice of product development models and processes
9. Choose to focus on long-term success criteria and not only on short-term criteria
10. Choose to relate the long-term criteria to both value, perceived value and direct costs and alternative costs
11. Choose to focus both on product development leadership (PUL) and product development management (PUM)
12. Formulate the core of the product development task with a focus on CIM, CI, and Learning
13. Choose the contact limits to network partners by value and advantage and improve the use of network partners to optimize and gain right time and right speed

14. Choose to involve all functions and actors in the product development activities of the business to help improve the product development within right time and right speed
15. Choose to use the high speed enablers with an outside in focus and choose to mix and use more of the HS enablers but in an optimal, right speed way
16. Change the product development focus from a focus on reaching an “encapsulated product” to a focus on a process with many product and process encapsulations

With these proposals for normative guidelines to NB RS NPD I hereby finish my comments on the results and findings of the research project on Network Based High Speed Product Development models and processes.

15.2 Comments and Analysis of Research Methodological Performance

The methodological performance of the research can be commented on in different ways. I have chosen to comment on the following areas:

1. To what extent did I fulfil my ambition in terms of a generalisation
2. Comments on the validity of the research
3. Comments on the reliability of the research
4. Comments on the strength and weakness of the research method
5. Summarising the generalisation, validity and reliability of the research

Ambition of Generalisation

The ambitions of the research were very high, primarily in the generalisation area and the realism area. Through the research project I tried to reach this ambition via a method of triangulation where I focused on the object from different angles and with a multitude of caseresearch, focusgroup, survey and other research methods. Although none of the research methods could be claimed to give a representative picture, I still claim that the collective research methods enabled me “to climb” high on the generalisation axis. This is verified by the fact that each research method produced many identical results and findings to the initially put research hypotheses and questions.

However, as already indicated by Jick’s dilemma (McGrath et al. 1982) presented in chapter two, my research would be at risk of not being able

to reach as high on the validity arrow. In the following, I will comment on the results of this challenge and will explain how the research covered this dilemma.

Validity Parameter

The challenge on the validity parameter turned out to be just as difficult as predicted. However, a validity discussion in relation to the research project is not considered relevant for all four validity aspects:

Predictive validity, which evaluates the ability of a research instrument or method to predict the future, was not considered relevant in 2003, since the purpose of the research on NB HS NPD was to grasp the present status of businesses involved and draw a picture of NB HS NPD in SMEs up to 2003.

Concurrent validity refers to the extent to which the results of an analysis correspond to results of similar analyses made at approximately the same time. For NB HS NPD and NB RS NPD, no standard of reference exists. Some researchers had elaborated important results on parts of product development and to some extent on product development in network. However, no one had until 2003 focused on NB HS NPD and NB RS NPD.

Another argument for the irrelevance of concurrent validity was that NB HS NPD was dynamic, and results from later research. Observations, interviews, focus group discussions etc. could necessarily be somewhat differently carried out in e.g., another business focus group, another TIP student group etc. according to the task of product development and the characteristics of the field of product development. However, I claimed in 2003 that the generic results and research findings would be the same. On the basis of the research architecture which sought to meet the demands of a triangulation research method I believed that the generic results would be the same if the same analysis was carried out in the same way and at the same time.

Content validity was important for the management of the research on NB HS NPD, since it referred to the extent to which the analysis was representative. An analysis which was not considered representative had a low content validity, whereas a high content validity meant a good balance between analysis and reality. With regard to the research on NB HS NPD, the content validity was only to some extent obtained. The case and focus group interview can by nature never be said to be representative. The survey can be said to be representative; however, the number of SMEs participating in the survey was too small to meet the representative demand. Still, the survey must be said to have a good response rate.

The case interviewed was carried out in five businesses with a general and a specific case analysis in each business. The case research was carried out in most case businesses with an interview with two or more persons responsible for or involved in the product development activities of the business. Of course it would have been better to have had all actors involved in the product development activity represented in the interview, but due to time limits this was not possible. Furthermore, it would also have been better to follow a case from start to end because the memory of the respondents could be influenced by time, policy and other components. However, when speaking to the respondents I had no impressions that this was the case.

Obviously the case interviews could only be representative within the single business but combined with other case, a stronger representativeness could be obtained. Of course it would have been better to carry out more than five case researches but this was not possibly within the time given.

The focus group interview was carried out with persons responsible of product development in ten different businesses. The selection of businesses was carefully made with a view to business-to-business businesses and to different lines of business. The last criterion was made because it was essential to the research in an explorative perspective to get as many aspects of NB HS NPD as possible. A major difference in lines of business proved to give the intended many aspects of NB HS NPD which surely could not have been obtained if all businesses had been in the same line of business.

The survey was distributed to a representative amount of SMEs in the business-to-business market. However, as will be verified later in this project, the amount of answering businesses was not high but still allowed me to draw an explorative picture of how NB HS NPD was carried out in SMEs. However, it was not possible to make general conclusions on specific lines of business.

Some other research activities have been carried out on the subject NB HS NPD. None of these activities could be said to match the criteria of representativeness. However, neither was this my intention. Instead it was my intention to find add-on information to NB HS NPD and additionally to support findings in some of the other research activities. Furthermore, especially the TIP project allowed me to come closer to NB HS NPD and to closely observe the process of NB HS NPD.

My visit to Italy added new dimensions to NB HS NPD although this could not be characterised as representative add-on to the research.

The Licentia case supported my earlier findings in the case, focus group and survey research.

Summarising on the content of validity it could be verified that each individual empirical research activity could not be said to be representative. Yet, some of the activities were more representative than others. However, this was not my intention considering the fact that the research was carried out in an explorative perspective.

Altogether the research activities try to match a triangulation on the research focus NB HS NPD. In this perspective, the general, generic findings must be said to have succeeded to the highest degree.

The construct validity refers to the extent to which the analysis maps the construct that it was intended to map. The construct validity was a complex matter and forms a general idea of something formed in the mind by combining a number of pieces of information. This could be defended by expert opinion. The expert opinion related to the construct validity of my research project comes firstly from my supervisors of the research project, colleagues at the CIP Centre and from discussions with Professors and seniors at the Polytecnico di Milano. Secondly, expert opinions come from those individuals accessing my research project. I claimed that this had succeeded to some extent, but could have been improved.

The explorative and semi-structured interview approach was exactly what Wind (1973) and Aaker and Day (1983) propose when researchers and businesses deal with product development and marketing research tasks that were into the radical and new to the market area. This was my immense inspiration for choosing this way of researching along with the fact that I felt that I had to try out and use the solutions and methods of the science of product development on a rather radical area of product development.

Reliability Parameter

With regard to reliability and instruments used in the research on NB HS NPD, the question was whether or not another researcher or research group would have developed a significantly different action plan for researching on NB HS NPD. The argument defending the reliability of the models and processes of the research project is found in:

1. The data collection, which includes not only a few businesses, but nearly 180 individual businesses.
2. The strong involvement of businesses, participants, students in case reasearch, focus group interviews, survey interviews, student NB HS NPD projects etc.

3. The strong involvement of management of product development in businesses involved in the research project.
4. The strong involvement of other researchers in the research project.

Collection of data included all phases of the product development process; however, with a strong focus on the upper part of the product development process. A high degree of verification was demanded of e.g., the enablers to high speed product development due to the number of participants involved in the research process.

The strong involvement of businesses was explained by the degree actuality of the project and by intense discussions in business networks, internal businesses and in research. All parties were interested in discovering how to perform high speed within network based product development.

The strong involvement of product development management was important in the discussion of relevance and priority of the suggested hypothetical models and processes to NB HS PD. Since costs, benefit and priority of each suggested model and process to NB HS NPD were discussed or considered at several meetings with the persons responsible of product development and with the management, only the significant model and processes survived and were verified.

Therefore it was not considered likely that a similar research would have given significantly more or different findings and suggestions than the findings presented in Chapter 16.

All in all, it could be concluded that the research undertaken in the research project NB HS NPD fulfils the aspects regarding validity and reliability. This supports the credibility of the research on NB HS NPD and the results obtained.

Strength and Weakness of Research Method

Previously, I had stressed the strength of my research on NB HS NPD: I will now comment on some of the weaknesses I had discovered when reflecting on my research.

Firstly, I had to some extent reflected on the question if the participants in the research had always understood the questions put to them. Some of the questions could be said to be complicated and to some extent only understandable by experts or researchers.

Another of my concerns was whether I had influenced the respondents by my cooperation with him/her. Throughout the research I had to be careful not to give answers and solutions to the respondent. This has been a difficult task

for me as a researcher. Especially, when I could see businesses having major difficulties formulating a new NB HS NPD strategy. I had to be careful both in this research result and to future investigations.

In the focus group discussions held together with my colleagues, it was a major challenge for me not to influence the participants although the discussions were very close and intense.

I also hesitate in the evaluation of my findings because I saw the danger imbedded in the fact that most of my cases were made on persons responsible of product development management. My reserach could have been improved if I had conducted more interviews with diversified respondents as I did e.g., with GSI Lumonics. Due to time limits this was not possible in any of the other cases.

The last fault I would stress was the analysis and understanding of the answers I got in the research. I may have misjudged and misanalysed some answers. However I felt very convinced that the answers were given in an open and honest way. Additionally, when I received the same results and findings through more investigations it must be claimed that the risk was not significant.

Summarizing on Generalisation, Validity and Reliability

When summarizing on generalisation, validity and reliability of the research project NB HS NPD I claimed that the research was challenged with exactly the same problems as predicted in Chapter 2. My research was challenged on the validity dimension but reached very close to my ambition on the generalisation and realisation axis. I did not reach as highly as I wished on the generalisation axis because the survey did not produce as many answers as I would have wished. This was an additional challenge to my further research to reach a deeper understanding of NB HS NPD and NB RS NPD to reach a higher level on the generalisation axis.

Looking back on the research, I realise that my research very much relates to the area of the the UK OM tradition of research as shown in Figure 15.2.

I must say that not every part of this research did originally intend to reach this profile of research tradition. Parts of my research project turned out to develop like this by coincidence. A major reason for this was my own curiosity to know science and to a continuous understanding of different views on the understanding of NB HS NPD.

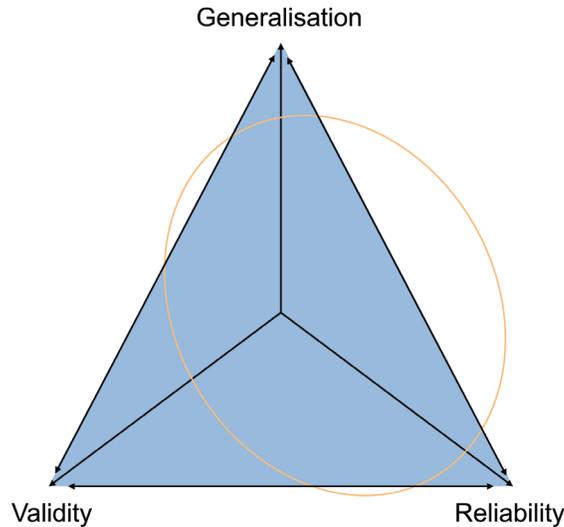


Figure 15.2 Trade-offs for scientific research.

Source: Adapted from McGrath, J. E., 1982.

With these comments I finalise my comments and considerations of the research methodology.

15.3 Proposal for Further Research

On the basis of my research project the following further research activities had come up as important in order to reach a higher and increased understanding of the research area. Some of these further research activities were already running or under establishment. Nevertheless, I will comment on some of the important ones.

Tom Project

During my stay at Polytecnico di Milano I followed the Tom Project as described in Chapter 13. In this connection I agreed to carry out joint research together with researchers in the TOM project on knowledge management and knowledge transfer in NB HS NPD. At this point in time in 2003, the research plans had been agreed upon and we began to formulate the questionnaire. The research was conducted in Italy, Germany and Denmark hereafter.

E-PUIN Project

The E-PUIN E-development project – a national product development research project – had been developed. On 25 February 2003 the project was approved. One of the interesting HS enablers to product development in networks was the e-development enabler. We had therefore proposed a project focusing on e-development in network product development to four councils to collect four clusters with each 6–8 SMEs to do a joint research together with these businesses.

EU-EPUIN Project

Research on new network based product development models focused on European SME networks in Europe – EU 6th framework programme seemed to be an important focus area in the future to develop European SME businesses to stay competitive on the global market.

Together with Dansk Industri (an association of major Danish businesses) as contractor we had proposed this new research project on new network based product development models. We hope the project may form the basis for major research findings to develop competitive advantage to European SMEs.

The projects were joint research projects with highly esteemed universities in Europe, with industrial organisations and with first class SMEs who all focus on the subject.

New Journal Article on E-development

One article for a journal on E-development in the spring 2003 was intended to be prepared together with research network partners who had met during the research project.

Learning in Entrepreneur Businesses

The RESME research group www.RESME.dk had become a new project on learning in entrepreneur businesses. This project was initiated in Spring 2003 and would be running for the next 2–3 years. I contributed with journal and conference writings in this research. I was particularly interested in learning in NB NPD by entrepreneurs.

E-Content Entrepreneurship

During my participation in the research group RESME www.RESME.dk I developed a new EU project on entrepreneurship. Because of my considerable

interest to understand the first phases of a product development project, this project offered more access to how entrepreneurs performed NB HS NPD in the initial phases of product development.

One Journal Article on Right Speed, Right Performance and Right Cost in NB HS NPD

One article for a journal of right speed in network based product development was planned for Spring 2003. The article was prepared and published in cooperation with research network partners.

Book on Network Based Right Speed Product Development

Finally, I began to prepared a new book on the basis of my findings in this research project on network based right speed product development. My ambition was to finish this book in the Autumn 2003 but because of a change in my research interest and research focus into business model innovation and multi business model innovation this book is still waiting to be finished.

With these proposals for further research, I hereby finish my comments on further research on Network Based High Speed Product Development. At the same time I finalise and finish the conclusion on Network Based Product Development Models and Processes.

