TURKU SCHOOL OF ECONOMICS
AND BUSINESS ADMINISTRATION
Department of Accounting and Finance

MANAGEMENT ACCOUNTING IN NEW PRODUCT DEVELOPMENT

Case Study Evidence
from Process-Oriented High Technology R&D Environment

by
Jani Taipaleenmäki[1]

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[1] Turku School of Economics and Business Administration, Department of Accounting and Finance, Rehtorinpellonkatu 3, FIN-20500 Turku, Finland. Email: jani.taipaleenmaki@tukkk.fi

FOREWORD

> *"For an engineer, I think, the product is never ready, there are always things that can be done better. You might face the same thing with your thesis."*
> (Product Marketing Leader Denise De-Leeuw, Nokia Mobile Phones)

My study accomplished, every now and then having burnt the midnight oil, I am indebted to great many individuals, organizations and institutions who have given intangible or tangible support and hence contributed in one way or another to the work presented here.

First of all, I would like to offer my sincere gratitude to my supervisors Professor Pekka Pihlanto and Professor Kari Lukka for their learned professional guidance and valuable comments on wide variety of issues. Furthermore, I wish to thank all my colleagues at the Department of Accounting and Finance. It has been a pleasure to work with you. Especially I wish to express my utmost gratitude to Ph.D. Markus Granlund for the invaluable encouragement and intellectual support on my journey into the scientific research. I feel privileged to have such a proficient scholar as my friend.

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Finally, my greatest debt of thanks is owed to the people closest to me, who have all endured my research process with an incredible amount of patience and understanding and to whom I dedicate this study.

After the four-year period of work spent studying management accounting and new product development during 1997-2001, I found that this experience provided also a way of developing my personal abilities and character for combining curiosity and analytical skills to explore the phenomena in the unfathomable but intriguing world – and above all – acts as a never-ending stimuli for intellectual pursuits and aspirations in the future.

Helsinki, December, 2003

Jani Taipaleenmäki

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1. RESEARCH SETTING

1.1. Introduction

Research and development is frequently considered the very first activity in the value chain of a company. The R&D activity may be organized for example into an R&D center or into R&D teams with representatives from the different functions of a company. Nixon (1998a) states that it is difficult to assess the contribution of good product design and development to corporate performance. He refers, however, to some recent surveys, according to which a vast majority of British businesses now agree that design helps to produce competitive advantage and that it can increase profits[2] and help diversification into new markets. The results show that managers ranked the New Product Development (NPD) activity as the primary source of competitiveness (see also Nixon & Innes, 1998a and 1998b; and Quinn, 1992).[3] Especially this is the case in the high technology companies, but NPD has major significance in traditional industries as well.

Continuous new product development can thus be considered as a strategic source of competitive advantage for most companies. Management accounting, on its behalf, is one of the most important systems of managing the strategic resources of companies. In spite of that, the in-depth interlinkages between management accounting and product development have received only marginal interest among practitioners and academics. In many companies these interlinkages can be seen as series of phenomena that have become formed more or less by accident during the business processes.

Lately, there has been quite a lively public discussion around the changes in the organization of management accounting and the role of business

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[2] It is also worth mentioning that a badly managed NPD activity may threaten the existence of a company. NPD activities are of great importance for service operations, too (see e.g., Bitran & Pedrosa, 1998).

[3] This is because of the fact that companies cannot compete only with the technology. New product development and the differentiation opportunities it provides are of paramount importance to a company's competitiveness. Furthermore, it may even be suggested that R&D operations are located in the interface of natural and technical, sciences, technology and manufacturing, but also in the middle of politics, sociology, psychology, economic life and commercial sciences, as well as arts, architecture and design (see e.g. Jokinen, 1999).

controllers. Some research evidence on the issue has been published in the late 1990s. Granlund and Lukka (1997b) have stated the following:

> *"A characteristic tendency in Finnish management accounting practice of the last decade or so is the felt need to be increasingly business oriented [...][4] Overall, the working and flexible communication over the functional and departmental borders is nowadays regarded as one of the key success factors. Even though these borders have obviously become on average lower in Finland recently [...] they are still considered too high. [...] In Finland [...] controllers should ideally [...] act as adviser of the company, divisional or profit center management, at best being members of the managerial team. In Finland one encounters controllers most often in profit centers, and only seldom in the centralized accounting departments of the corporate level. Controllers' most important task is to bring the financial perspective into managerial decision-making situations and to take care that this information will truly be received by the participants of the organization."*

According to this interpretation, the organization of management accounting has been affected by the characteristic business trends, such as customer-orientation, process-orientation[5] and time focus towards the present and the future. These trends have been creating pressure to locate management accountants closer to business (cf. business controllers) and other processes and functions (e.g. marketing controllers) (see also Cooper, 1996c and 1996d, Granlund & Lukka, 1997a, 1997c and 1998b; IMA, 1996, Olve, 1990 and Siegel & Sorensen, 1999; Sillince & Sykes, 1995). The existing studies on the role of management accountants do not, however, capture the context of new product development.

R&D is typically recognized as a very knowledge intensive activity. Recently, companies have explicitly started to consider knowledge as one of the strategic resources and critical success factors.[6] Knowledge management, which aims among other things at controlling the organization's knowledge requirements and acquirement and processing of knowledge, has emerged in the public discussions. One of the areas of knowledge management is knowledge

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[4] Granlund and Lukka (1997b) continue by stating that "*Probably this tendency is a response to the continuous debates of customer orientation and of the need to replace the functional or departmental approaches of management by the process-oriented one".*

[5] Process-orientation aims at identifying company's core processes and organizing its activities on the basis of this identification.

[6] Companies have also faced major change pressures towards to accounting information in the decision-making. The new financial information may reflect for example critical success factors, core competencies, and knowledge or intellectual capital. In addition, this information should be timely. It has been mentioned that the new information environment leads to virtual accounting (see e.g. Shields, 1997, 37). For intellectual capital, see e.g. Taipaleenmäki, 1998.

creation[7,8] that can more widely be connected to organizational learning[9] and continuous innovation and thus to companies' competitive advantage. Nonaka and Takeuchi (1995) have defined knowledge creation in a way that includes also transferring and utilizing the knowledge that has been created:

> *"By organizational knowledge creation we mean the capability of a company as a whole to create new knowledge, disseminate it throughout organization, and embody it in products, services and systems."*

Nonaka and Takeuchi (1995; see also Nonaka *et al.*, 1996) assume that an organization cannot create knowledge by itself. Thus, the basis of the knowledge creation process lies in the tacit (implicit) knowledge[10], which is possessed by individuals, whereas the opposite of tacit knowledge is explicit knowledge, which can be articulated in formal language.

With good reason, it can be argued that studying the organizational knowledge creation is relevant in order to understand the quite evident knowledge gap that might be also a potential reason for the chasm between management accounting and R&D literature. On the other hand, the new product development in a knowledge intensive company is a field in which the major knowledge-related issues of this research are considerably intertwined and to which they may be applied in practice especially from the viewpoint of management accounting.

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[7] Some authors use the concepts of knowledge creation and the concept of learning interchangeably (cf. e.g. Roth *et al.*, 1999). In this study, the knowledge creation is defined according to Nonaka & Takeuchi (1995) to include especially the conversion from tacit to explicit knowledge and vice versa.

[8] Mårtensson (1999) argues that the major role of knowledge management is to make tacit knowledge more explicit and to transform individual knowledge so that it becomes an integral part of the organization's knowledge. For the time being, knowledge creation has been studied mainly in the context of research and development (e.g. Davis, 1986 and von Hippel, 1994) and to some extent in relation to organizational learning (see e.g. Nonaka & Takeuchi, 1995; Kulkki, 1997). Kerola and Reponen (1996) have combined the theory of organizational knowledge learning by Nonaka and Takeuchi with the Experiential Learning theory by Kolb (1984). For tacit knowledge embodied in a technology product, see Breite *et al.*, 1999. For knowledge capital and knowledge management, see e.g. Ståhle & Grönroos, 1999 and Tuomi, 1999.

[9] See e.g. Argyris, 1992; Argyris & Schön, 1978 and 1996; Moingeon & Edmondson, 1996; Morgan, 1989; Schein, 1993; Senge, 1990a, 1990b and 1992. For accounting and organizational learning, see e.g. Argyris, 1990; Argyris & Kaplan, 1994; Jacobs, 1995; Järvenpää, 1998; Kloot, 1997; Partanen, 2001, and Shields & Young, 1993.

[10] Tuomi (1999, 332) illustrates the argument by explaining that knowledge is created simultaneously by individuals, and between individuals. On the organizational level, knowledge thus needs to be internalized by the individual actors before it can be said to be organizational knowledge. Furthermore, Ensign (2000) stresses that the knowledge in a company must be understood as a social interaction process. Similarly, Gopalakrishnan *et al.* (1999, 150): "All knowledge is initially crated by individuals, and does not become 'organizational knowledge' until it is transferred throughout the organization such that it can be stored in the organization's memory and institutionalized." It has been commonly accepted that the introducer of the tacit knowledge concept is Hungarian medician Michael Polanyi (1966). According to Polanyi (1964), if there is no tacit knowledge, there exists no explicit knowledge either.

1.2. The purpose of the study

In this section, the research objectives are presented with the more detailed research questions. **This study aims at enhancing our understanding of the relationship between management accounting and new product development by analyzing literature and current practices.** Furthermore, it is presumed that this relationship becomes realized especially in the knowledge creation interface between various functions of a company.

The first research objective is to understand current management accounting practices in new product development. This objective can be divided into the following research problems:

1. In what ways can *management accounting function be organized to support company's new product development*? How is it organized in the case-company and why is it organized the way it is?
2. What is the *management accountants' role* in the new product development? How does this become manifested especially in the case-company and why is that so?
3. What are the *management accountants' tasks,* including the management accounting techniques, in supporting the new product development especially in the case-company?

The second research objective is to understand the interface between management accounting and company's other functions in the new product development and especially organizational knowledge creation in this interface by providing some illustrative examples. The following questions arise as the research problems:

4. How the NPD staff may experience *the cross-functional interface especially between management accounting and company's other functions*? How does this become manifested especially in the case-company and why is that so?
5. *What are the major elements in management accountants' tacit (implicit) knowledge relevant in the NPD and how this tacit knowledge can be converted into explicit knowledge and vice versa to be used more widely*? How does this become manifested especially in the case-company?

As there is only little information available on accounting in NPD, an additional objective related to the third research problem is to provide detailed theoretical description and discussion on the relevant management accounting and control practices, especially techniques and their use in R&D environment.

1.3. Methodological considerations

The choice of research methodology[11] depends on the fundamental assumptions of ontological nature (reality, the very essence of the phenomena under investigation), epistemological nature (grounds of knowledge and truth), and human nature (in particular, the relationship between human beings and their environment) (see e.g. Burrell & Morgan, 1979). The choices that the researcher makes considering these together with methodology (ways of inquiring knowledge about the social world) reflect the choice that has been made about the continuum between subjectivism and objectivism (Morgan & Smircich, 1980). In addition, the choice of the methodological approach has to be compatible with the purpose and the initial outlooks of the research (see Pihlanto, 1988 and Mäkinen, 1980).

A commonly used methodology classification system in Finnish accounting research is the framework introduced by Neilimo and Näsi (1980, see also Lukka 1986, and Lukka *et al.* 1984). The framework includes conceptual, nomothetical, decision-oriented, and action-oriented approaches to study. Later, the constructive approach was brought to the classification system by Kasanen *et al.* (1991 and 1993).[12]

In this study, the nature and construction of **reality** are assumed to be linked with the conceptions, interpretations and subjective observations of individual actors. Thus, the study leans heavily on *social constructionism*[13] (see especially Hines, 1988).[14] **Knowledge** is assumed to be possessed by human

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[11] The words methodology and research approach are considered here synonymously. Though research approach is usually considered as a broader definition including methodology, identification of assumptions concerning the nature of reality, knowledge, truth, and man are assumed to precede the choice of a methodology.

[12] The constructive approach highlights empirical parts of a study and the problem solving by applying the construction into practice. It is characterized by normativeness.

[13] According to Pihlanto (1988), the concepts in accounting are already so institutionalized that they are conceived as reflections of reality, however, somewhat vaguely. Lukka (1990, 245) remarks on the role of social constructionism in accounting research that ”[…] the adoption of social constructionism seems to offer a potentially fruitful ontological basis for increasing the understanding of both the roles of accounting in its social and organizational settings and the fundamental nature of accounting concepts in their various uses”. Furthermore, it should be mentioned that Hopwood (1983, see also 1988) has also presented the idea of connecting accounting system to its organizational and social context. Hopwood has used the expression ”constitutive role of accounting”. (see also Morgan, 1992).

[14] According to social constructivism people create their social reality. When applying social constructivism to a company, it can be mentioned that the decision-makers create the very organizational situation in which they operate (Pihlanto, 1988). According to Hines (1988), accounting function and its representatives create reality by disseminating the accounting information that reflects reality. Hines points to the role of the accounting and states that ” […] social reality exists tangibly, and accounting practices *communicate* that reality, but in so doing such practices play a part in creating, shaping and changing, that is, in *constructing* reality” (Hines, 1988, 259). Hines continues, however, that at the same time the concepts, norms, languages and behavioral models people use become institutionalized (Hines, 1988).

beings, from whom it may be obtained. It is also assumed that reality may be understood on the basis of this knowledge. This view has to be adopted especially considering tacit knowledge.[15] **Human being** is considered a relatively autonomous man who is capable of doing free choices. Because of the above-mentioned reasons, the **research methods** of this study have to provide the researcher with an access to investigate the inherent world of individual actors as profoundly as possible.

The previously mentioned fundamental assumptions and choices that have been made for this study are in line with the subjectivist approach in the Burrell & Morgan (1979) framework (see also Pihlanto, 1988). In the **subjectivist approach** *ontology is based on nominalism*, according to which, on the contrary to realism, the social world external to individual cognition is made up of concepts which are used to structure reality. According to *the anti-positivistic epistemology* of the subjectivistic approach, the social world is essentially relativistic and can only be understood from the point of view of individuals. Thus, both the knowledge and the conception of reality are subjective in nature and bound to individual actor and his actions.[16] In the subjectivist approach*, the nature of man and his actions are based on voluntarism*, which is the opposite of determinism. Furthermore, the ideographic approach to social science is applied in the subjectivist approach. It suggests that the social science is based on the view that one can only understand the social world by obtaining firsthand knowledge of the subject under investigation. *Research methods should, thus, be ideographic*, e.g. qualitative case methods, such as in-depth interviews.

Because of the above-mentioned facts, it is reasonable that the starting point of this research is mainly based on *subjectivism and action-oriented approach* which aims at profound[17] understanding of individual actor's behavior (see Pihlanto, 1994c). The action-oriented approach has its *philosophical*

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[15] "Underlying the immersion of a researcher inquiring from the inside is a very different set of epistemological assumptions from those of inquiry of the outside. Fundamental to it is the belief that knowledge comes from human *experience*, which is inherently continuous and *nonlogical*, and which may be *symbolically representable.* It is close to what Polanyi [1964] has termed 'personal knowledge'. The danger here is normally considered to be that the findings could be distorted and contaminated by the values of the researcher. This bias is has been referred to by Russell [1945] as the 'fallacy of subjectivism'. " (Evered & Louis, 1981, 389)

[16] See also Hopper & Powell, 1985.

[17] In action-oriented approach, the construction of reality is bound to subjectivist conceptions, observations, and interpretations of individual actors. It aims at *profound understanding of the studied phenomena in the light of its historical background and context* (Pihlanto, 1988; Pihlanto 1994c; see also Ihantola, 1997; Ikäheimo, 1991; Partanen, 1997). According to Lukka (1991) the subjectivist action-oriented approach aims at analyzing particularly interesting individual cases in an ideal situation as thoroughly and comprehensively as possible. In addition, teleologism and intentional concept of man are included in action-oriented approach (Neilimo & Näsi, 1980).

underpinnings mainly in hermeneutics (Lukka, 1991). The research approach and the methodological choices of this study can also be seen to be associated to some extent with the humanistic psychology which philosophical roots may be found in phenomenology and existentialism. Thus the study has some common features with *humanistic accounting research* (cf. Pihlanto, 1994a; 1994b; 1992; and Birnberg & Shields, 1989) with its in-depth approach.

The topic of this study is extremely current. Action-oriented approach is a justified choice to this kind of study because of its *human-oriented nature* and the fact that *explorativeness* and aim at both *constructing interpretations* in the form of holistic frameworks from the human behavior and *presenting new ideas and suggestions*, belong to the very characteristics of action-oriented research (Lukka, 1988; Ihantola, 1997; Partanen, 1997). The action-oriented approach is also compatible with the *purpose and research problems of the study.* Because of the novelty value of the topics of this study, there is always a potential to produce interesting results both to business life and academic community.

According to Pihlanto (1994c), action-oriented approach may be applied when investigating ”behavior of people in real-world organizations”. This study is thus *empirical*. The study is mainly *descriptive*, but has also interpretative nature. Considering these facts, the study was conducted in one case organization. Furthermore it should be mentioned that some slightly prescriptive issues arose during the empirical case study. [18] In addition to the case study, there is a conceptual part of the study, in which the theoretical interlinkages of the topics will be discussed and analyzed comprehensively.

Hence, on one hand, the approach of this case study can be considered action-oriented particularly in the sense that more abstract interpretations are to be made on the basis of the knowledge, which is acquired through individuals. On the other hand, recognizing the strong aim at describing management accounting practices especially in the empirical part of the study, it has to be noted that some parts of the study include also more detailed illustrative systems descriptions.

The study was conducted in a way that can be described with the hermeneutic circle, presented in Figure 1, (see Tamminen, 1993 and Ihantola, 1997), which highlights the iterative nature of increasing understanding in a research process.[19]

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[18] Action-oriented research may also lead to normative recommendations of future actions though it has not been pre-specified as a purpose of a study. (see e.g. Partanen, 1997).

[19] Burrell and Morgan (1979, 237) end up stating that ”in this way the methodological rules of hermeneutics were seen to move in a circular and iterative fashion towards an increased understanding of the objectifications of mind”.

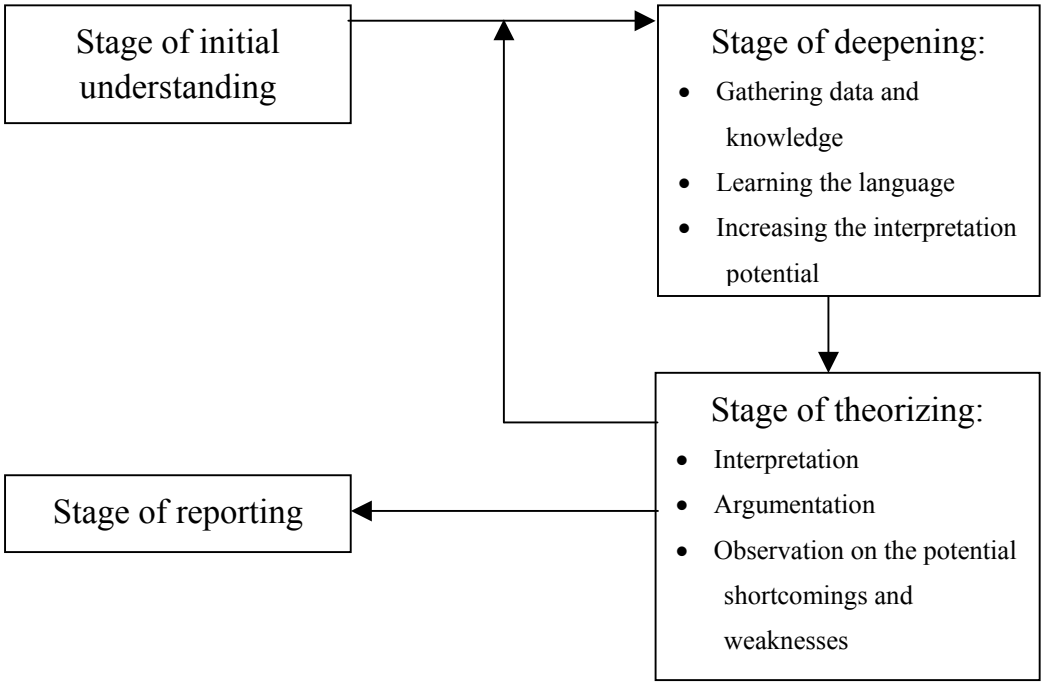

Figure 1. The Hermeneutic Circle

This empirical case study is a justified choice as a research strategy of the study, because it is in line with the action-oriented approach.[20] Case studies are particularly suitable for research adopting socially oriented approaches as they allow the researcher to adopt an approach that achieves a deep and profound understanding of organizational phenomena (see e.g. Scapens, 1990, Granlund, 1998; Pihlanto, 1996; Salmi & Järvenpää, 2000). Considering the classification of case studies presented by Scapens (1990), this study is close to the *descriptive case studies*, which aim at providing a description of the nature and form of existing accounting practices, and may attempt to determine the extent of the gap between accounting theory and practice. Moreover, the somewhat explorative nature of this study should be emphasized here. Hence, the study includes also features of an *illustrative case study* (ibid.; cf. Lukka, 1999) that partly aims at bringing new and innovative accounting practices into the academic discussions.

One of the particular benefits of a case study is that it will imply triangulation of available methods for gathering and analyzing different kinds of relevant data concerning the case organization (Yin, 1991).[21] Furthermore, its ability to provide the researcher with a possibility to profoundly understand complex phenomena, is

[20] According to Pihlanto (1993), if the action-oriented approach and the subjectivist approach, to which case study is a typical way of inquiring knowledge, are applied simultaneously, it is natural to think that there is, in principle, no crucially significant difference, whether the practical problems of a company are approached as a researcher or as a manager of the company in question.

[21] Yin (1991, 20) suggests that " […] the case study's unique strength is its ability to deal with a full variety of evidence – documents, artifacts, interviews and observations."

considered one of the significant strengths of a case study, too (see e.g. Yin, 1991).[22] By using a case study as a research strategy, the contact to current practices is maintained, because the data obtained has also the flavor of real-life events.[23] In the next section, conducting the empirical research is discussed in more detail.

1.4. Empirical research and research design decisions

The initial contacts to the case company, Nokia Mobile Phones were made in November 1997. The first meetings and pilot interviews were held in April and September 1998. The major case study method applied has been semi-structured interview (see Appendix 1). All the conducted interviews have been tape-recorded and transcribed by the researcher. Achieving the advantages of triangulation, which support the validity and reliability of this study, (see e.g. Yin, 1991) has been done through direct observation, the saturation effect from the semi-structured and some open interviews as well as reviewing internal documents. Both formal and informal discussions (face-to-face, telephone, email) with the R&D controllers provided the researcher with a more natural way of obtaining data. The data has been collected mainly in 1999. Final gathering and updating of empirical data took place in a corroborative and integrative group interview in 2000. It should be noted that in the final analysis the access in the case company can be considered very satisfactory regardless of the sensitive business secrets related to NPD.

In order *to acquire empirical data*, the themes and questions for semi-structured (see Appendix 2) interview were formed in the spirit of previously illustrated hermeneutic circle. The very first topics emerged from the purpose of the study and the more detailed research objectives and questions, after achieving the initial understanding of the topic through reading literature, which was considered relevant for the study. The drafted themes and questions

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[22] "[T]he distinctive need for case studies arises out of the desire understand a complex social phenomena. […] the case study allows an investigation to retain the holistic and meaningful characteristics of real-life events – such as […] managerial processes […]" (Yin, 1991, 14). This means also aiming at understanding empirical observations through developing and integrating theories (see e.g. Partanen, 1997).

[23] According to Pihlanto (1996) when the study is conducted in a particular case organization and in co-operation with certain managers, the results of the study are likely to have relevance for these managers. In other words, the results are suitable for their worldview and situation. This knowledge may be relevant also to other managers with adequately similar situations in other companies, for the knowledge in question has the very contact to the real-life events, which ties it to practice. This connection to the real-life events is usually missing in the knowledge to be generalized. (Pihlanto, 1996; see also Pihlanto, 1994c).

were pre-tested in initial meetings in the case company and modified to reach their more advanced format. It should be noted that more detailed questions were of complementary nature, only to support the themes in the semi-structured interviews if considered necessary. When commenting the themes of more general level, the interviewees were frequently carried away with the issues close to their own work and every now and then these particularly interesting subjects guided the interviews quite strongly. It was quite typical that after the interviews there were informal conversations or change of email messages, in which the content or interpretations of the interviews were discussed in more detail. This was especially the case with the R&D controllers. The direct observation of complementary nature was carried out occasionally. Typically the procedure of observing the daily operations of R&D controllers in the accounting department took place on the day of interviewing the very same person and lasted approximately half a day. This occasional observing thus covers the R&D controllers on both local and global level of control but does not include any observations of the R&D project team meetings. The reason for this is twofold. Firstly the meetings were inaccessible to the researcher due to business secret reasons. Secondly and most importantly it should be noted that R&D controllers were not present in these meetings of non-accounting R&D project teams.

Although the general description of the case company will be presented at the empirical part of this study, here it is relevant to introduce some general facts of interviews[24] and interviewees in the case company. The interviewed persons were:

R&D business controller
R&D program controller (global)
ex- R&D program controller (global)
R&D controller (global)
R&D center controller (local)[25]
product program manager, and the "LEADER TEAM"
- Aftermarket service leader
- Logistics project leader
- Operations project leader
- Product marketing project leader
- R&D project leader
- Materials project leader (sourcing)

The job descriptions of R&D controllers will be presented later. The product program manager is responsible for managing the entire concurrent engineering (CE) program (i.e. project) and the NPD team, whereas the

[24] The direct quotes from interviews in Finnish are translated to English by the researcher, except for the interview of the native English speaking product marketing project leader.

[25] Since the interviews of the non-accounting leaders from various functions were assumed to bring cross-functionality into the study, no other accounting staff than the R&D controllers were interviewed, especially because one of the local R&D controllers interviewed was a former sourcing controller.

members of the leader team are in charge of the sub-projects in the program.[26] The R&D leader, who is responsible for the design, schedule and the technology of the new product, has the most extensive sub-team with some 50 people including the head designers (e.g. mechanics, software). The logistics project leader provides the team with the mass production and logistics perspective for e.g. the outsourcing and variant product design decisions. The operations project leader ensures that the new product is suitable for production and that the production is ready to take the product from CE process, because some new products require also new production technology. The materials project leader, who acts as an interface between the NPD project and the sourcing function, is responsible for the materials sourcing and implementation of the supply line management strategies into the CE program. The aftermarket service leader, on the other hand, ensures that the service and repair activities can meet the needs of the product to be launched, and also gathers the feedback information from the markets. The product marketing project leader has to make sure that the product under development is in every respect made according to the market requirements. When the CE program proceeds, the role of the product marketing project leader changes towards the launching the product, which means interaction between R&D with sales, business region organization, and advertising companies, etc.

In order *to analyze empirical data*, all the interviews were transcribed to text files. The analysis was facilitated with re-summarizing the transcribed interviews into a collage table where every single question received a row and every single interviewee received a column. The advantages of the table became evident as conducting the empirical study proceeded. It became possible to ask totally new and more detailed corroborative questions after the interviews on the basis of this particular analysis. The major benefit of the table was that by finding the key words and patterns in both the messages and underlying motives from the summarized interview extracts, the emerging issues started to take their shape little by little in the mind of the researcher. Furthermore these identified patterns guaranteed finding the saturation effect in the empirical data where it was possible. In case there were controversies, the underlying motives were subject to critical evaluation. In addition the cross-functional analysis was done with this table, to identify the similarities and differences in the empirical data acquired from R&D controllers and non-accounting managers involved in the R&D project. Finally the re-summarized table facilitated even in outlining the reporting of the analyzed empirical data.

[26] Similarly, McGrath (1996) uses the concepts of the core team and the full project team in NPD.

In reporting, the interview extracts are used both in illustrating the identified patterns and where relevant, reporting both of the contradictory views.

Certain *research design decisions* had to be made concerning the empirical case study.
(1) The first design choice is to limit study to the high technology industries in order to gain access to a R&D intensive environment.
(2) Secondly, the single case selection is made on a most-likely basis (cf. Keating, 1995 and Lukka, 1999) for this case study to achieve a research setting where the case company's current R&D control and management accounting practices are relevant both for the academic discussion and for the practitioners. Thus, the study is conducted in a globally operating MNC, representing the telecommunications industry, Nokia plc., in its mobile phones division NMP.

(3) Thirdly, the focus of the study lies in the new product development phase of R&D. Focusing on one phase reduces the noise that would result from gathering and interpreting data related to multiple phases. In terms of the case company, the study is conducted in the concurrent engineering (CE) process environment (cf. Dávila, 2000).
(4) The fourth research design decision is to specify the scope of study geographically. Since the case company has global R&D activities and typically a CE program is carried out in a single research center, for research economy reasons it is decided to conduct the empirical case study in a single Nokia research center locating in Salo, Finland.

(5) The fifth research design decision relates to the hierarchical level of the R&D inside the case company. With regard to the management accounting function, it is decided to cover the R&D control function as a whole. When it comes down to the non-accounting product development staff, it is considered relevant especially for the sake of studying the cross-functional interface to include in the study all the key persons in NPD from the various functions in the line organization.
(6) Sixthly, the researcher desired to gather empirical data from a single product program in order to be able to discuss the issues related to the cross-functional interface and to gain saturation in the empirical data related to the shared experiences of the non-accounting NPD staff regarding for example the role of management accounting. Furthermore, this brings an easy limitation to the number of persons involved in the interviews. The case product under development during this research was Nokia 8850 (see Appendices 3 and 4), a very typical mobile phone from NMP, which was introduced in 1999.

(7) The final research design decision relates to the time span of the study and timing it in relation to the lifecycle of the case product (cf. also the 3rd research design decision). Since the study can to a certain extent be considered as a longitudinal case study, it was desired that the CE program to be studied is on-going at the beginning of the study to avoid the possible inexperience of the development staff, and that the CE program will be finished during the empirical data gathering of this study in order to cover the potentially relevant initial market expectations as well as the product launch experiences – and especially to gain a comprehensive picture of the CE program in question.

In sum, the study is an in-depth case study, which is mainly descriptive but has also interpretative, illustrative (cf. Scapens, 1990) and slightly prescriptive and somewhat explorative features. According to the new classification of case and field studies in accounting proposed by Lukka (1999) the study finds its methodological origins mainly in ethnography. Thus, when describing and analyzing e.g. the management accountants' task and current accounting practices in NPD, the researcher has minimized the intervention and to some extent used theories and previous findings as tools in interpretations. These parts of the study are to some extent characterized by explorativeness. In addition, the parts of the study, which deal with analyzing and describing the role of the management accountants are also conducted with ethnographic approach, i.e. the intervention is minimized as well, but the focus is more on existing research findings and how they are applicable to the specific situation. In this case, it is illustrated how the current business controller role trends are applicable in the situation of the R&D controllers, so the question is actually of refining previous findings. Furthermore, there is part of the study, namely the knowledge creation section of the empirical case study, where the researcher finally identifies development potential and suggests, some measures be taken to promote profit consciousness and business orientation in the cross-functional NPD teams. This part of the study has thus to some extent minor features of action research, i.e. this implies features of minor intervention where both theory and practical solutions development are on demand (ibid.).

1.5. Theoretical background and organizational knowledge creation theory

The theoretical underpinnings of this study consist mainly of the relevant academic and to some extent also the professional R&D literature and literature of accounting practices especially related to the new product development. The discussion based on the literature is presented in the Chapter 2.

Theory of organizational knowledge creation, which is adopted to facilitate the empirical observations as well as the reporting of the results that relate to the cross-functional interface and knowledge creation, is developed by Nonaka & Takeuchi (1995). According to this theory, tacit knowledge and explicit knowledge are not totally separate but mutually complementary entities. They interact with each other in the creative activities of human beings. The authors' dynamic model of knowledge creation is anchored to a critical assumption that human knowledge is created and expanded through social interaction between tacit knowledge and explicit knowledge.[27] Nonaka and Takeuchi call this interaction "knowledge conversion" which has four modes, which is illustrated in Figure 2 with the knowledge spiral.

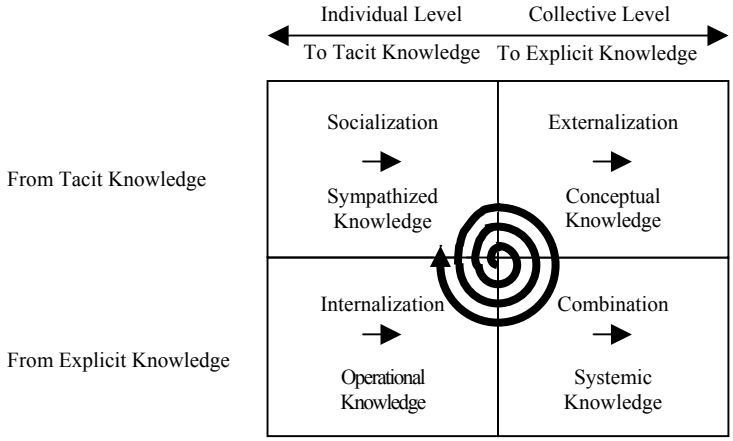

Figure 2. Four Modes of Knowledge Conversion and the Contents of Knowledge

1) *Socialization* is a process of sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills (e.g. apprentices through observation, imitation and practice). Similarly an assistant controller can make observations in a decision-making situation and imitate the controller of a firm.

2) *Externalization* is a process of articulating tacit knowledge into explicit concepts (i.e. tacit knowledge takes shapes of metaphors, analogies, concepts, hypotheses, or models). E.g. a controller can develop a new tailor-made method of budgeting or rolling forecasting, based on his past experiences.

3) *Combination* is a process of systemizing concepts into knowledge systems (i.e. sorting, adding, combining and categorizing different bodies of explicit

[27] In an advanced discussion by von Krogh, Ichijo and Nonaka (2000) suggest that knowledge cannot be managed, only enabled. Their point is that managers need to support knowledge creation rather than control it. The authors list five knowledge enablers, which are (1) instill a knowledge vision, (2) manage conversation, (3) mobilize knowledge activists, (4) create the right context, and (5) globalize local knowledge.

knowledge through, various media, such as documents, conversations, meetings, etc.). E.g. a controller collects different pieces of financial information and combines the pieces in one value-adding report.

4) *Internalization* is a process of embodying explicit knowledge into tacit knowledge (i.e. closely related to learning by doing) initiating another 'SECI' process (socialization-externalization-combination-internalization). The model is a spiral because it combines a cycle with an expansive process of knowledge diffusion.

Furthermore Nonaka and Takeuchi mention that for organizational knowledge creation to take place, however, the tacit knowledge accumulated at the individual level needs to be socialized with other organizational members, thereby starting a new spiral of knowledge creation.[28]

Tuomi (1999, 326-340) is one of the few, who criticizes the model of knowledge creation and points out some areas where it might be clarified and improved. Firstly, according to Tuomi, for Polanyi (1966), tacit knowledge is a precondition for meaningful focal knowledge, and there can be no explicit knowledge without tacit meaning structure that underlies focal knowledge. Furthermore, Tuomi suggests that in contrast to Polanyi, who distinguished tacit knowledge as peripheral background or meaning context that is required for explicit knowledge to stand out, Nonaka and Takeuchi contrast tacit knowledge with articulated knowledge. He continues, however, that this reading of Polanyi is, of course, possible but that it might easily reduce tacit knowledge into procedural skill.

Secondly, Tuomi (1999) points out that the organizational knowledge creation model takes language and culture as given. Thus, it is not clear what happens when the spiral hits the boundaries of meaning creation space. Tuomi suggests further that a more theoretically robust view would be that the knowledge does not flow through the community barriers, but that there is a translation process between the communities.

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[28] Some of the ideas of autopoiesis theory and its notion of knowledge are also considered relevant to this study – although they have been applied only as supporting mental models of the researcher. Autopoiesis theory was developed in the field of neurobiology to characterize living systems. The theory suggests the composition and structure of individual cognitive systems, and has gradually developed into a general theory of systems. The theory's main thesis is that the components of an autopoietic system are used to produce new components and their relations so as to recreate the system (von Krogh *et al.*, 1996). According to von Krogh *et al.* (1996, 163), *"unlike the cognitivistic perspective, autopoiesis theory suggests not that the world is a pre-given state to be represented, but rather that cognition is a creative act of bringing forth the world. Knowledge is a component of the autopoietic (self-productive) process - - - knowledge is embodied in the individual."* They present that in autopoiesis theory knowledge and observation are closely related, since observing systems are autopoietic systems. This is the major proposition of the autopoietic epistemology.

Thirdly, Tuomi (1999) argues that on a closer look, it is difficult to see how the conversion modes of combination and externalization differ. Tuomi agrees that in some cases (e.g. reports that combine "meaningless" pieces of data and information are created from several databases) various sources of explicit knowledge can be mechanically combined to produce new knowledge and that thus the tacit preconditions of this conversion process can be neglected. However, he suggests that explication in the model seems to mean both generation of concepts and organization of meaning structure as focal models etc., whereas combination seems to equal merging the created concepts into a pre-existing conceptual system, and meta-level processing of created focal knowledge by sorting, clustering, and categorizing it. He argues further quite agreeably that new concepts are not created in isolation but instead emerge against an existing meaning structure, which includes tacit background. The explicit critique here is that the explication is possible only against a background of tacit knowledge and that combination of already articulated knowledge into new articulated forms does not seem to fundamentally differ from explication in this sense. In addition, according to Tuomi, similarly it could be argued, from a cognitive point of view, that internalization of conceptual knowledge equals to combining and connecting a new idea within an existing conceptual system.

It has to be pointed out, however, that this part of the critique by Tuomi (1999) is vague, to certain extent. This is due to the fact that he has replaced the concept of externalization (Nonaka & Takeuchi, 1995) with a notion of explication and in addition he does not seem to pay attention to the procedural nature of knowledge creation process by Nonaka and Takeuchi. Their model might also be interpreted in a way that assumes tacit background for the combination, because externalization from tacit to explicit knowledge precedes that mode of knowledge conversion. However, here Tuomi attacks the fundamentals of the knowledge creation theory and argues that difficulties emerge due to the very fact that the modes of knowledge creation follow one another. He suggests e.g. that explication and combination should be viewed as articulation that happens through simultaneous development of abstraction and generalization. Similarly, he analyzes the other modes of knowledge conversion and suggests further that the appropriate distinction between the modes of internalization and socialization is not between tacit and explicit knowledge, but between the use of linguistically articulated knowledge products, such as textbooks, and knowledge that is embedded in social practice.

Fourthly, Tuomi (1999) focuses on the organizational aspects of the knowledge conversion model and states that as a side effect of connecting

various organizational levels in the model, it is not easy to distinguish when the level of analysis is individual or collective. He criticizes further that as the model lingers somewhere between a social and individual point of view it can be argued that the process of knowledge creation is social whereas the concept of knowledge is personal and intra-personal. He continues the piece of critique by arguing that the concept of knowledge being intra-personal, truth becomes a necessary aspect of knowledge, grounding intra-personal knowledge into inter-personal reality. Tuomi claims even that despite their attempt to play down the importance of truth as a constitutive factor in knowledge (1995, 58), the conception by Nonaka and Takeuchi of individual knowledge makes such objective unavoidable. Tuomi concludes that Nonaka and Takeuchi do not really explicate their epistemological position, which leads to number of problems, e.g. to the fact that the role of communication in the creation and sharing of knowledge is difficult to discuss within the model. In addition, he mentions that it is not clear, why learning-by-doing is reserved in the model for explicit-to-tacit conversion, as it would also seem natural that much of it occurs as socialization (i.e. tacit-to-tacit conversion), and also as articulation (i.e. tacit-to-explicit conversion). This can be argued to be very true, if it is considered that the individual actor in question articulates something to explicit knowledge or participates actively in socialization process of sharing experiences and simultaneously learns something new and adds new tacit knowledge to his or her own knowledge base.

As a consequence, Tuomi (1999, 340) concludes that when we try to understand knowledge creation in multicultural organizations with several communities of practice that use electronic collaboration tools to develop new forms of meaning processing and activity structure, we need to augment and extend the organizational knowledge creation model by Nonaka and Takeuchi (1995). As a result, he introduces a new model (articulate-appropriate-anticipate-accumulate-act) that tries to address these issues. This model is, however, not discussed here in more detail.

Despite the above discussion, the original knowledge creation theory has received only limited amount of critique and it has been widely applied in numerous fields of especially business sciences. It should be stressed here that the knowledge conversion model by Nonaka and Takeuchi (1995) is used only as a tool of outlining and analyzing the empirical findings of the cross-functional interface in NPD.

As it was previously mentioned, the second chapter is dedicated to theoretical discussion on the basis of R&D and management accounting literature.

1.6. Structure

Chapter 1 is the introductory part of this study, in which the background and the topics of the study are presented. In addition, in the first chapter, there is an argumentation on the relevance of the study. Furthermore, the research setting is presented in the form of purpose of the study and detailed research problems, methodological choices and methods. In addition, details concerning the empirical research and the theoretical background are described and some concepts are defined.

In the Chapter 2 of this study the new product development is examined at the general level. Issues about the processes, management and organization of the product development are raised. The second chapter expands further to analyze theoretically the current management accounting practices in new product development. Management accountants' role and tasks, current accounting and control practices in product development as well as the ways management accounting can be organized to support product development are discussed. Furthermore, the interface between management accounting and various functions involved in new product development is analyzed theoretically and finally, an initial conception of the organizational knowledge creation in product development especially from the viewpoint of management accounting is presented.

In the Chapter 3, the empirical evidence from the investigated case company concerning the major issues discussed previously in this study is presented and analyzed. Furthermore, in the third chapter, the case findings regarding the current management accounting and control practices in the new product development are interpreted. The internal structure of this chapter follows the structure of the second chapter.

The Chapter 4 is for summarizing the empirical findings of the study and reflecting them back to the previously discussed theory. The results and final interpretations of the study are presented in line with the research objectives and the emerging issues from the case study are brought up.

In the last chapter of this study, Chapter 5, the study and its limitations are evaluated against the commonly accepted criteria of good scientific research. Generalizability of the case findings and interpretations are discussed together with the contribution of the study. Furthermore, some suggestions for the future research potential are made and they are reflected back to the research design decisions of this study and finally some concluding remarks are given.

2. MANAGEMENT ACCOUNTING IN NEW PRODUCT DEVELOPMENT

> *"Today's effective product development organization is characterized not only by creativity and freedom, but also by discipline and control in scheduling, resource use, and product quality."* (Clark & Fujimoto, 1991)

In this study, an above stated additional objective is to provide detailed theoretical description and discussion on the relevant management accounting and control practices, especially techniques and their use in R&D environment. Nixon & Innes (1997) observe that the extensive R&D literature seldom accords the same status to the accounting function as it does to other NPD team members such as R&D, design, engineering, manufacturing, and marketing. They continue that the NPD literature suggests that the links between accounting and NPD are most often made by cost engineers rather than by accountants with an engineering or NPD perspective. They state that the reason for the virtual exclusion of accountants from the NPD teams or the literature lies in the fact that accounting has traditionally emphasized control rather than planning and there is a plethora of anecdotes about tension between accountants who argue numbers and product managers who argue taste and instinct.

Shields and Young (1994) present a brief literature review on management accounting related to R&D. They suggest that there are three streams of literature, which are to a certain extent considered theoretically relevant to this study: (1) Analyzing the links between financial controls and R&D expenditures[29], (2) Studying cost and management control issues related to R&D, e.g. capital budgeting, costing, financial reporting, and performance evaluation in R&D organizations[30], and (3) Determining the importance of budgetary, social and technical controls and how these vary with characteristics of the R&D environment.[31]

Similarly, Dávila (2000) has reviewed the past work on management control systems, which he argues to follow two approaches. One line of research focuses on how R&D organizations use financial measures (e.g. Brownell, 1985; and Rockness & Shields, 1988), whereas another line of research adopts a broader view of control systems (e.g. Abernethy & Brownell, 1997; and Rockness & Shields, 1984).

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[29] See e.g. Lin & Vasarhelyi (1990) and Ellis (1980)
[30] See e.g. Anthony (1952), Rockness & Shields (1984 and 1988), Villers (1964), and Gambino & Gartenberg (1979)
[31] See e.g. Rockness & Shields (1984 and 1988)

Thus, it is easily noted that despite the promising anecdotal evidence of the true role of management accounting in NPD, the studies with in-depth approach that aim at understanding thoroughly the complete interface between management accounting and NPD projects, especially in process-oriented environment, are practically missing in the current academic literature (cf., Olson, 1999). The empirical results of this study may provide new knowledge of these topics.

2.1. Management and Organization of New Product Development

> *"Product development in high-technology industries is often carried out in projects. Managing such projects is a matter of both promoting creative knowledge generation processes and controlling progress towards global goals and time limits."* (Lindkvist *et al.*, 1998, 931)

Understanding anything related to new product development requires understanding of the NPD context. Management accounting being in the focus, especially managerial and organizational issues rise as the most important themes here. For this study, the current literature related to NPD management is reviewed and further categorized into (1) people and knowledge-oriented, (2) project and process-oriented, and (3) product and production-oriented studies. Major issues related to management accounting or accountants, and organizational knowledge creation, from these categories will be discussed briefly. Partly, there can be observed significant overlap in these categories. For example, Gopalakrishnan *et al.* (1999) examine the characteristics of product and process innovations and their strategic implications using a knowledge-based view. They mention that process innovations are new tools, devices, and knowledge in throughput technology that mediate between inputs and outputs (see also Utterback & Abernathy, 1975). Product and process innovations are associated with knowledge that may be embedded and stored in equipment, tools, organizational systems, operating procedures, routines, and the individual operators. Especially they propose that product innovations will be more explicit because (1) product innovations are generally more observable than process innovations as the product innovations are the outcomes themselves and process innovations are related to the production and delivery outcome; and (2) product innovations require companies to clearly accumulate customers' needs into the design and manufacture of the product. In their empirical survey, Gopalakrishnan *et al.* did not detect significant differences in the tacitness of product and process and innovations. However, they found that process innovations are more often

internally sourced, more costly, and are perceived to be more effective. They conclude that it might be more useful to categorize innovations based on continuous dimensions of knowledge rather than dichotomous typologies (e.g. product or process innovations may differ from their average profile of tacitness).

People and knowledge-oriented studies

Innovation activities are strongly dependent on the past. Things that have been done in the past affect the very things that can be observed in the future. At the beginning of a NPD project, the product or technology related knowledge is typically possessed by only few individuals. There may be a great deal of tacit knowledge, which necessitates knowledge creation and transfer (Lindeman, 1997; see also Nonaka and Takeuchi, 1995). Knowledge management plays thus a major role in NPD (e.g. Daniele, 1998; Sanchez & Mahoney, 1996).

According to Nixon and Innes (1998b) the design profession is divided between in-house designers and consultants.[32] In addition, there are many "silent designers"[33] – people outside the formal design process, like R&D and production specialists, marketers and accountants who can provide essential information and assistance in managing design parameters.[34]

It is evident that managing interdisciplinary NPD teams is very challenging (e.g. Caudill & Roberts, 1951; Cooper, 1995; Donnellon, 1993; Epton *et al.*, 1984; Henke *et al.*, 1993; Hoch, 1990; House, 1991; Kilburn, 1990).[35] Frequently, it is suggested that the ability to manage multi-disciplinary teams is widely acknowledged as one of the features most closely associated with effective product innovation. It is even suggested further that the specialized professional attributes result in a plethora of problems and limitations in NPD (i.e. lack of attention to product quality, excessive development lead times, lack of integration between project and production phases, lack of customer-focus, etc.). Process-orientation has been proposed to overcome these problems, because the closest formalized way of representing the holistic

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[32] These consultants concentrate mostly on graphics, corporate identity, interior design and, to a lesser extent, industrial design (Nixon & Innes, 1998b).

[33] The concept of "the Silent Designer" has been introduced by Dumas and Mintzberg, 1991.

[34] According to Nixon & Innes (1998b, 9), "It is a common perception that the key functions involved in NPD are 'marketing, followed by R&D and to lesser extent manufacturing'. Even if it is assumed that the industrial design activity is part of the marketing function and design engineering is included in manufacturing, this view of the NPD team still understates the pivotal role of design in linking existing and latent customer requirements with technological capabilities."

[35] For example, Cooper (1995) argues that the multifunctional teams tend to create their own barriers to extreme innovation. Cooper suggests various reasons (e.g., same customers, educational backgrounds, and techniques) to the similarity of competitors' products.

vision is considering a company as a collection of business processes (cf. da Silva & Rozenfeld, 1999). The challenges arising from the cross-functional co-operation as well as some culture-related issues will be discussed in more detail together with knowledge creation later in this study.[36]

The R&D literature related to management control may also be regarded as people-oriented.[37] For instance, Omta *et al.* (1994) emphasize the importance of personnel control in NPD. Similarly, Abernethy and Brownell (1997) argue that where the task uncertainty is highest, the reliance on personnel forms of control has a positive and significant effect on performance. Nobel and Birkinshaw (1998) express the characteristics of international R&D operations and state that the challenge facing many large multinational corporations (MNCs) is how to effectively make use of their far-flung research and development operations. Thus, it is critical how to best manage the relations between R&D operations around the world. The communication becomes more difficult, when the R&D units are located far from each other.[38] They categorize R&D units into (1) local adaptors, which are always local in scope, and with a rather limited development mandate. The essence of their role is to ease the transfer of technology from the parent company to the subsidiary manufacturing location; (2) international adaptors, which provide backup for a local producing unit, but aspires to a more fundamentally creative role. Their role is substantially broader in scope; and (3) international creators, which provide inputs to a centrally defined and coordinated R&D program, with no necessary connection with host country producing operations. Furthermore, Nobel and Birkinshaw (1998) present three different modes of control: (1) centralization, in which decision-making power is retained at the headquarters; (2) formalization, in which decision-making is routinized through rules and procedures; and (3) socialization, whereby organization members develop common expectations and shared values that promote like-minded decision-

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[36] For an integrated model of new product and process development, which includes cultural and strategy-related issues, as well as organizational processes, see Nixon, 1995, and Handy, 1978. In their empirical field study on transnational team functioning, Earley & Mosakowski (2000) found that the analyzed NPD team, which represented a team of highly heterogeneous nature, was characterized by open communication, mutual understanding, strong sense of confidence in the team effectiveness, and strong sentiment of unity.

[37] Cf. the results, action and personnel forms of control in business organizations (Merchant, 1985). The forms of management control may include also e.g. establishment of lower managers' responsibilities, decision-making constraints, organization design and co-ordination mechanisms, performance measurement systems and reward policies, interventions, some human resource management policies (e.g. recruiting), and belief system (Kerssens-van Drongelen *et al.*, 2000).

[38] In their literature review, Nobel and Birkinshaw (1998) note that there is a small but significant literature dealing specifically with the management of R&D in MNCs. This literature has focused predominantly on the extent of multinational involvement in R&D and the factors affecting it, while paying relatively little attention to the organizational and managerial aspects of the phenomenon.

making. Their results indicate that local adaptors[39] are managed with significantly high levels of formalization, international adaptors are managed predominantly through centralization, and international creators are controlled through relatively high levels of socialization.

People and knowledge-oriented studies include also issues such as leadership, human resources, motivation, creative climate and communication in NPD.

Project and process-oriented studies

A consistent, classical management theory was developed to underpin functional hierarchical line management, and some of it basic premises were adopted almost as axioms of management. Turner and Keegan (1999) argue that after the shift in the management paradigm throughout the latter half of the 20th century, from the functional, bureaucratic approach and the classical theory of management, to the process and project-based approaches, these new approaches do not have a strong theoretical basis. Turner and Keegan report the chronological development of management paradigm as well as some advantages and disadvantages of the different management approaches. They highlight that project teams could meld the skills of those working in different functions, which was necessary in creative work such as product development. Further, they suggest that in the process approach, procedures are written to describe projects as processes, which convert inputs into desired outputs (ibid.). Larson & Gobeli (1988) argue that project management structures in NPD may vary between functional (coordinated by functional and upper levels of management), functional matrix, balanced matrix (project manager shares the responsibility and authority with functional managers), project matrix, and project team (functional managers have no formal involvement). The R&D operations, were they organized in processes or otherwise, typically take place in specific R&D centers or laboratories.

According to Hertenstein and Platt (1998), at many firms, product design was a process where the new product was thrown "over the wall" from one department to another in sequential fashion. These departments may appear as follows: (1) R&D / Concept Formulation, (2) Engineering / Industrial Design, (3) Product Testing, (4) Production, (5) Marketing, and (6) Distribution. Along with the

[39] Nobel and Birkinshaw (1998) make a point that the local adaptor units are the most problematic to manage. These units appeared to be rather disconnected from the central R&D activities of the corporation.

cross-functional product development teams[40], Hertenstein and Platt point out the change in the typical product development project. Instead of throwing the product "over the wall", the new tollgate process style may include four phases with go / no go decisions between each phase. Phase 1: Design development, Market research and feasibility, Visualization; Phase 2: Technical development, Production design / tooling, Product prototyping; Phase 3: Production and distribution, Quality testing, Marketing campaign; Phase 4: Postproduction audit, Customer satisfaction. Quite similarly, Seiferheld (1999) identifies four typical phases in the development of new products: (1) A concept phase, (2) a construction phase, (3) a technology phase, and (4) an evaluation phase.[41]

Thus, in managing complex inter-relations in new product development, a type of project organization that is characterized by interactive problem solving of a trial-and-error type may be called for (Lindkvist *et al.*, 1998). Lindkvist *et al.* suggest that NPD processes can be seen as a predictive series of steps or as a very uncertain process where short lead time will be accomplished by a design allowing for flexibility, improvisation and iterative processes, instead of careful planning and rationalizing each step (see also Eisenhardt and Tabritzi, 1995).

Lindkvist *et al.* (1998) suggest a new fountain model, which is closely related to the ideas of concurrent engineering. Their case study has been conducted with Ericsson's mobile phone NPD operations under investigation. The basic idea was to move from the so-called sequential waterfall model towards a more concurrent fountain model, in which much of the development and design work had to be driven by downstream phases. Explicitly, Lindkvist *et al.* argue that the fountain model would require a more network-like organization, based on inter-functional integration and continuous dialogue. This very point cannot be emphasized too much. Reflecting to the issues regarding time-based competition, it can be argued further that time-to-market pressures have driven

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[40] Hertenstein and Platt (1998) mention that the team members are often drawn from marketing, industrial design, product engineering, and manufacturing.

[41] Seiferheld (1999) defines the process phases as follows: Concept Phase includes product features and configuration; technical demands on the product and demands regarding capacity, materials supply, and quality; and estimates on product costs, initial costs, project related costs, and profit. Cost estimates are usually prepared using standards based on experience from previous projects. Construction Phase includes product design and architecture; product specifications; and documentation for all parts of the product and for the manufacturing processes. Technology Phase includes selecting, establishing, and preparing the necessary manufacturing of the new product. Evaluation includes evaluation of the product, the project, and the process for learning purposes, and updating the empirical databases and standards. For generic NPD processes, see also e.g. Ulrich & Eppinger (1995), who identify the following five phases: (1) Concept development, (2) System-level design, (3) Detail design, (4) Testing and Refinement, and (5) Production ramp-up.

companies towards concurrent engineering in NPD, and this necessitates new approaches to both organization and cross-functional co-operation.[42]

One of the most popular practices in management control of new product development activities is the milestone management (see. e.g. Tani, 1998). This is closely related to the previously mentioned new tollgate process style presented by Hertenstein & Platt (1998) and to the management accounting, target costing in particular. In a milestone management of target costing, milestone meetings from the members of various functions and departments are held at critical points in product development. The process of milestone management can also be described as the process of sharing value and information among members involved in product development (Tani, 1998).[43]

It should not be forgotten that NPD operations face nowadays typically enormous time-to-market pressure due to the time-based competition. In many companies, Just-In-Time (JIT) techniques are expanded to encompass the product's entire value chain, time has been made the principal basis for measurement, and deadlines are being extensively used (see e.g., Hall & Jackson, 1992; Lindkvist *et al.*, 1998). The latter, though, has received quite justified critique (e.g. Dávila, 1998; and the acceleration trap argument by Curtis & Ellis, 1997, which will be discussed in greater detail later). However, the time-based competition and its implications deserve here a special discussion. Blackburn (1991b, 1991c) writes that time-based competitors focus on bigger picture, in other words in the entire value-delivery system. They attempt to transform an entire organization into one focused on the total time required to deliver a product or a service. The solution to the problem, according to Blackburn, is not to devise the best practice to perform a task, but rather to either eliminate the task altogether or perform it in parallel with other tasks. A time-focused business attempts to use time as its most precious resource. However, it is not just about shrinking the response time, but the picture is wider. From the customer's point of view, what matters is the total

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[42] According to the theoretical interpretation by Lindkvist *et al.* (1998), organizing NPD activities in projects may generally be conceived as implying that these are decoupled from the rest of the organization in much the same way as with decentralization and departmentalization efforts. They mention that such an arrangement has the potential of simplifying a situation by cutting off relations and interactions to make it possible to handle existing problems within the limited cognitive abilities given to man. Moreover, they argue that this simplifying effect may make action and learning from experience possible, but only on a local level (cf. Levinthal & March, 1993).

[43] Tani (1998) states that in the milestone meeting, functional people engaged in one stage of product development infuse the other functional people of the subsequent or proceeding stage with innovative idea and information to achieve cooperatively the targeted costs, time-to-market, market-orientation, and quality. This style of product development is sometimes called "rugby-style product development" (Takeuchi & Nonaka, 1986) or simultaneous engineering.

time required to deliver the product or service. Thus, fundamental changes have to be made in every function, R&D included, that affects the delivery process to the customer. It should be noted, however, that accelerated product development typically includes some hidden costs that may lead to serious outcomes. Crawford (1992) lists these hidden costs to include e.g. the many mistakes that happen when skipping some steps, the mismatch of the rest of organization not speeding up with the NPD, and the fact that the strategic view is changing to include seeking more incremental innovation, scheduling planned obsolescence (replacing products more frequently than demanded in the market), etc. What is then the difference between JIT and time-based management (TBM[44]) and competition (TBC)? Blackburn (1991c) states that they both have identical objectives in eliminating the time waste. JIT is characterized by small production runs, quick changeovers, and low inventories, while TBM aims at eliminating idle or dead time wherever it exists, processing work in small batches, and maximizing the value-added time. However, Blackburn argues that TBC goes one step further than JIT and encompasses not only manufacturing but also the complete value-delivery chain of the product or service, as discussed above.[45]

Furthermore, R&D management has recently faced strong market pull instead of the research push approach. Business units buy the services of R&D units. This shift in approach has a tendency to increase both performance and cost efficiency in R&D operations (Grady & Fincham, 1991). In addition, NPD processes are widely under continuous improvement efforts (Couchman *et al.*, 1999; see also Adler & Nguyen, 1996; and Turney & Anderson, 1989). The NPD processes are typically very closely related to the product under development. Each type of new product will involve different resources and different activities. The complexity of the product, e.g. the amount of components[46], may vary to great extent, and this is the case also with the product novelty. The new product may be improved version or it may consist

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[44] For TBM in NPD, see also Karagozoglu & Brown (1993) who identified several acceleration methods in their study covering 35 high technology companies, and a company case Xerox by Kharbanda (1991).

[45] Some authors arguing that JIT is also a more comprehensive concept and philosophy may disagree on this but it should be evident that JIT is not an end itself for a company, as TBC may be, but rather it is an evolutionary step toward the long-term goal of total time compression. On the significance and relevance of TBC, Stalk (1991) writes that time-based competitors typically grow faster, and with higher profits, than their cost-based competitors. Time-based competitors most often set the pace of innovation in their industries. Also Blackburn (1991a) points finally out that to be an effective time-based competitor in seeking ways to remove time from all segments of the delivery chain, the joint efforts of all functional groups are required – and to be most effective, the business needs to be organized around processes, rather than functions.

[46] In addition, NPD operations may have great distinctions in different industries, e.g. consumer electronics and dairy products.

of a totally new product line. The third dimension adding complexity to the nature of product innovation processes is that of the customer. NPD processes may have significant differences in industrial markets and consumer market products. Despite these differences, the above-mentioned concurrent engineering has been widely accepted in NPD (Couchman *et al.*, 1999).[47]

Project and process-oriented studies also include issues such as, the use of advanced design techniques, and partnerships in NPD projects.

Product and production-oriented studies

Some of the product-oriented literature related to the NPD (e.g. Breite *et al.*, 2000; Hebeler & Van Doren, 1997; and Wang *et al.*, 1998) emphasize the knowledge that is embodied in a product. However, more frequently, product's other characteristics and properties are the main issues in this field of literature.

Lean enterprises can deliver products with higher quality and functionality at lower costs than mass producers, which leads to improved customer satisfaction. Because they do not have sustainable competitive advantages, lean enterprises are forced to seek out competition. They adopt a generic strategy of confrontation, i.e. they adopt a new competition philosophy and compete head-on by selling equivalent products (Cooper, 1995) and thus developing and exploiting temporary competitive advantages. Confrontation is necessary because the reaction time of lean enterprises is fast enough to render product-related competitive advantages too fleeting to be sustainable. Product-related characteristics with there strategic influences are presented comprehensively by Cooper (1995).

Cooper (1995) suggests that three product-related characteristics, known as the survival triplet[48], play a critical role in the success of firms that have adopted a confrontation strategy. These three characteristics are cost (or price from external perspective), quality, and functionality. Cost includes all lifecycle costs, quality is defined as performance to specifications, and functionality is defined by the specifications of the product. Functionality is multidimensional because it is possible to differentiate products (1) vertically by accelerating the rate at which increased functionality is introduced, (2) horizontally by

[47] See also Nellore *et al.* (1999), who combine the product properties and NPD processes and suggest that the product development process can be seen as a flow of specifications and that this highlights the need for improved communication between all involved actors – external and internal.

[48] Cooper (1995) emphasizes that the survival n-tuplet is an simple intellectual construct, not an attempt to model reality.

satisfying customers' preferences or taste, as opposed to offering increased functionality at increased prices. The willingness of the customer to make trade-offs among the characteristics that make up the survival triplet defines a product's survival zone.[49]

As the gap between the minimum and maximum levels widens, the ability of firms to create distinguishable products that have high values on one characteristic and low values on the other increases. When the gap becomes large enough, companies must choose to compete on either the price characteristic with cost leadership strategy or the other two characteristics with differentiation strategies.[50] Collusion strategies are adopted when the survival zone is large and competitors can be disciplined not to shrink it through independent actions. In addition, Cooper (1995) mentions that time is a critical component of the survival triplet. While all three characteristics have a time-based coefficient – the rate at which they can be improved relative to other competitors – the only one that is separately named is the time-based aspect of functionality, which is frequently called time-based competition. Furthermore, Cooper suggests that five major factors that shape the position of a product's survival zone are: (1) customer preferences, (2) the differential ability to manage the survival zones of the company, competitors, so-called non-competitors in the same industry, and competitors for the same funds.

According to Cooper (1995) it was the emergence of the lean enterprise that shaped the competitive environment in Japan in the 1950s. As quality and just-in-time (JIT) programs reduced costs, prices began to fall and thus became a competitive issue. With their adoption of JIT production and total quality management (TQM), team-based work arrangements, and supportive supplier relations among other things, lean enterprises react much faster than their mass producer counterparts to changes in the competitive environment. These

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[49] A product is inside its survival zone, when its continued production is justified by the number of customers who are willing to buy it. A product's survival zone is identified determining the survival range for each dimension in the survival triplet. For quality and functionality, the minimum allowable level is the lowest value of each characteristic that the customer is willing to accept regardless of the values of the other two characteristics. The maximum feasible values for quality and functionality are determined by the capabilities of the firm. The maximum values are the highest values that the firm can achieve without inducing significant penalties in the other characteristics. The maximum allowable price, in turn, is the highest price the customer is willing to pay regardless of the values of the other two characteristics, and the minimum feasible price is the lowest price the company is willing to accept for the product if it is at its minimum allowable quality and functionality levels. Thus, from a company's viewpoint, this is the cost dimension (Cooper, 1995).

[50] Cf. the generic strategies by Porter (1980 and 1985) of cost leadership, i.e. having a lower cost position than competitors, differentiation, i.e. distinguishing products from the competitors' products by creating something that is perceived as unique, and focus, i.e. focusing on a particular market or product line segment. Reaching the competitive advantage is the aim at the business level and enhancing this very process is in focus in the strategic management accounting (Järvenpää, 1998).

critical product-related characteristics of the survival triplet should, thus, from very strategic reasons, be taken under consideration in the early stages of NPD projects. [51]

Product and production-oriented studies also include issues such as, technical and technological environments for product development, product line planning, and linking NPD to business strategies (see e.g., Billington et al, 1998).

To sum up the importance of the above discussion based on R&D literature, as the decision-making in new product development includes several complex managerial issues, the consequences of these decisions, costs included, are difficult, if not impossible, to identify in the early stages of NPD. This only emphasizes the role of management accounting in NPD. As can be seen in the Figure 3 (adopted from Seiferheld, 1999) below, the product lifecycle and related lifecycles comprise an entire supply chain, in which there are great problems with the anticipated decision consequences, especially in the long term.

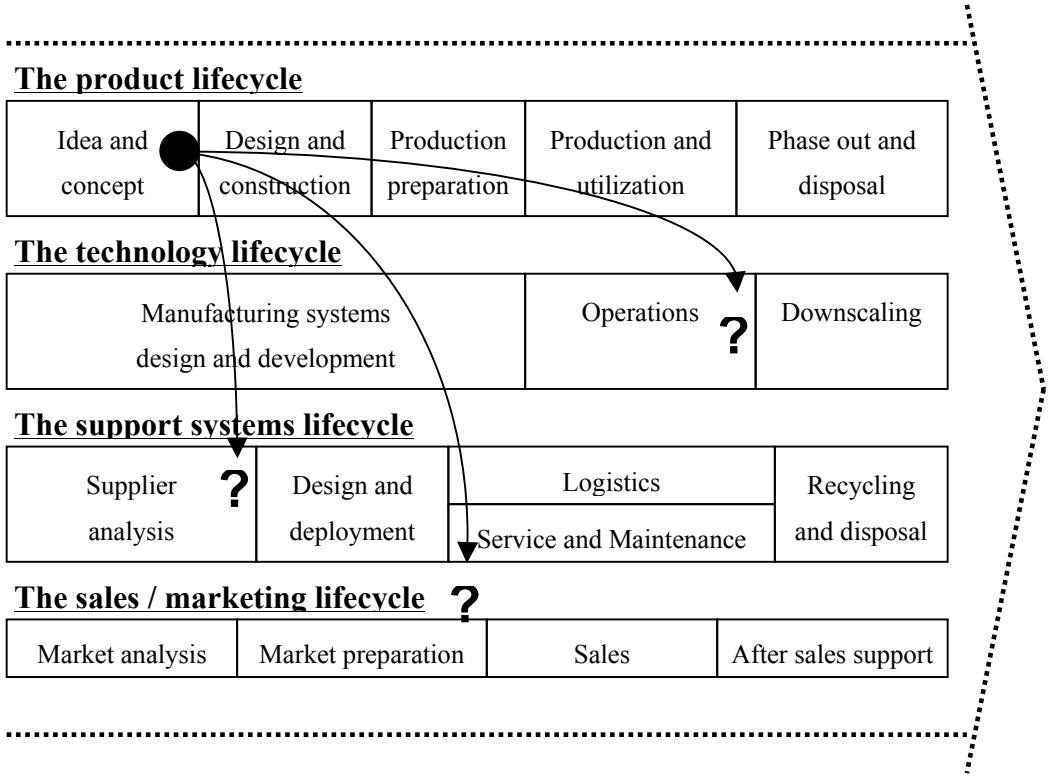

Figure 3. The problem of anticipated decision consequences

[51] On quality issues in NPD, Hamilton (1991, 199) comments that "As many people now have realized, there is no trade-off between cost and quality. Focusing on quality – and doing it right the first time – leads to lower costs". It should be noted also that TQM practices may be adopted in order to promote institutional and quality culture rather than for purely technical reasons (see e.g., Hoque & Alam, 1999).

The above discussed problem of cross-functional co-operation may be extended to the co-operation between functions and processes in NPD, since new product development itself is one of the principal customer-focused business processes which includes all the major generic business functions (see e.g., Hatten & Rosenthal, 1999). The problem, evidently, in the organization of new product development, appears to be in the control activities: How to combine two apparently contradictory aims, encouraging a climate of innovation[52] in new product development, while at the same time exercising enough especially financial control in order to meet stakeholder objectives (see e.g., Gleadle, 1999)? Thus, on one hand, people and knowledge related – on the other hand, project, process and product related issues become critical. This leads directly to the questions concerning management accounting and management accountants.

2.2. Management Accountants in New Product Development

2.2.1. Organizing Management Accountants to Support NPD

According to Granlund and Lukka (1997a and 1998b), accounting has been traditionally organized as a centralized staff function in Finland (see also, Emmanuel *et al.*, 1990). Recently the tendency has been towards an increasing decentralization, in particular with regard to management accounting. Thus, management accountants are believed to function nearer the business operations and the other functions. Moreover, they argue that Finnish management accounting functions have traditionally been directed to the inner processes of firms (e.g. production) instead of co-operation with people who have external orientation (e.g. sales and marketing).

Nixon (1998a) states that although historically the accounting role in new product development has been mostly a minor one – that is frequently characterized as a tension between accountants who argue numbers, and product managers, who argue taste and instinct – nevertheless there are several strong reasons for favoring closer links between functions, especially management accounting and marketing, in a product development project: (1) The high percentage of a product's lifecycle costs that are locked in once a design is frozen, (2) Competitive pressures are forcing companies to anticipate and design to market-determined target-prices, rather than simply add a margin to costs, (3) Speed-to-market pressures have caused a move from

[52] About the social construction of innovations, see e.g., Coopey *et al.*, 1997.

designing and developing products on a one-by-one basis to developing technology platforms for an entire family of products, and (4) Management accounting information is needed at an early stage of a product development project, because the task of integrating the many dimensions of the product design and development activity has become more complex, and management accounting information can help the team to define design parameters relating to a product's function, form and ergonomics. Customer's quality, performance, price and lifecycle cost requirements need to be balanced with the company's profitability requirements.[53]

Hertenstein and Platt (1998) argue similarly that through interactions among the management accountants and members from other functions, the cross-functional team can ensure that the appropriate balance is maintained between cost and other important product characteristics such as quality, function, appearance, and manufacturability. It should be noted, however, that the views of NPD team participants frequently differ regarding e.g. (1) when stage-gate or go/terminate decisions are required and on the criteria at each stage; (2) the company's risk management policy; and (3) the relative importance and implications of three related cost categories, namely the cost of developing the product or range of products, the cost of producing the product, and the lifecycle costs of the product for the customer (Nixon & Innes, 1998b). Nixon & Innes (1997) mention also that the close cross-functional collaboration and the flow of information in one of their case companies are partly the result of its relatively small size, and more especially they result from a top management style that fosters trust, openness, and confidence.

Hertenstein and Platt (1998) categorize three fundamentally different ways of organizing management accountants to support new product development. They suggest that the most traditional alternative is to simply assign a management accountant from the financial organization as a member of each new product development team. The major advantage of this approach is its simplicity. In addition, there is an opportunity to introduce many management accountants to the new product development process and the approach is very similar to the way of assigning representatives from other functions. On the other hand, this approach may be inefficient because of the fact that each

[53] According to Nixon (1998a), the management accounting information is required for early design decisions relating to, for example, the cost and value of maintaining design flexibility to accommodate quick and economic redesign over the product's lifecycle, as well as the degree of modularity, which has implications for outsourcing, maintenance and module interface arrangements. Ask (2000) reports that Volvo Car Corporation used their own project gate system, which is similar to the milestone management system.

management accountant should go through the same learning process in order to work effectively in the new environment.

The second alternative is to assign a management accountant to work "dotted line" in industrial design, a key product development function, while still retaining a direct reporting relationship with the financial function. The major advantage of this approach is that a management accountant, who participates in multiple new product development projects, can leverage the new learning acquired and increase the understanding of the overall product development project as well as the industrial design function. Another advantage is that this approach also facilitates interactions between industrial design and financial function on a variety of financial subjects (Hertenstein & Platt, 1998).

The third alternative, used by a few firms, is that industrial design managers have hired their own management accountants. It is then assumed that the direct and permanent connection between management accountants and industrial design develops significantly the expertise of the management accountants in question – and thus benefits the industrial design function as a whole. According to Hertenstein and Platt (1998), in these instances, the management accountant's responsibilities focused more on helping the industrial design function understand its costs, allocate its resources, and communicate its value and contributions to corporate management. This, in turn, is closely related to performance measurement.

In Ask's (2000) teaching case based on the experiences from Volvo Car Corporation, three organization functions provide specialists to the cost control activities. (1) Cost Engineering function provides cost engineers that support the product development with cost analyses, and especially the setting of cost requirements. The function consists of persons with long-standing experience from product development and construction work, and who have developed experiential skills in costing and cost control. They participate in the late concept development stage, pre-study and early in the project stage. (2) Cost Management function provides project or the project leaders with project controllers that verify the cost requirements, i.e. control that the actual costs are in accordance with the requirements. (3) The Platform Organization provides business controllers that control and verify that the development project remains profitable (i.e. they need to adopt both revenue and cost perspective, whereas the cost engineering and cost management functions only need to adopt a cost perspective). Thus, the business controllers are responsible for the profitability during the entire product development project and they report to the business area managers.

As can be seen from Ask's (2000) case company, this is the way of organizing management accounting in NPD in even a more complex environment, potentially in a matrix organization. The responsibilities and tasks are divided into the controller organization, and even further to the engineering function. If this way of organizing management accounting to support new product development is carried out successfully, i.e. with well-managed communication, co-operation and complexity, the many dimensions included in a NPD project may be taken into account even in a more comprehensive way than with the traditional models which usually include assigning management accountants directly to the projects. The potential advantage here lies, thus, in the possibility to include the many perspectives and functions of a NPD project in the accounting information and control aspects.

Organizing management accounting in new product development virtually has effects on the very role management accountants can play in the development projects. Furthermore, the organization can affect directly the tasks management accountants have. At the general level, Granlund and Lukka (1997a and 1998b) mention that the centralized part of accounting function is typically focused on the consolidating corporate reporting, in which the distinction between financial and management accounting is not so significant. The decentralized part of management accounting – today more and more named as the controller function – takes care of the production of standardized and timely financial information for the use of corporate reporting the financial control and decision support in the local units as members of their managerial teams. In other words, in the local part of the line organization, a controller is the business-oriented member of the managerial team and a financial adviser but in the global level of accounting organization, a controller is more like the local guardian, ensuring that the corporate interests are not forgotten (Granlund & Lukka, 1998b). Ask (2000), in turn, reports that in the NPD context of Volvo Car Corporation, the central management accounting staff was focusing their efforts to the breakdown calculation, while the more local project controllers had their focus on the build-up calculation.

In this study, the focus is on the relationship between management accounting and new product development projects and processes. In process-oriented organizations, there may be business controllers – or even R&D controllers – who are assigned to new product development projects and processes in order to bring financial perspective to these projects.

2.2.2. The Role of Management Accountants in NPD

It has been widely acknowledged that the role of management accountants is changing. This change process has been identified to be the shift from the scorekeeper's role to become an essential part of the organization's value-adding team (Anastas, 1997; Johnson, 1995; Kaplan, 1995; Sheridan, 1998; Weaving, 1995). Instead of collecting information, management accountants are expected to use the freed-up time to analyze it (Siegel & Kulesza, 1996). Cooper (1996a, 1996c, 1996d) argues that as companies move to cost management, they will need more management accounting information, but fewer management accountants with additional skills in e.g. systems design and implementation, change management, and strategy, and who will play a supporting role.

According to the interpretation by Granlund and Lukka (1998b; see also 1997a, 1997b, 1997c, and 1998a) the organization of management accounting, and thus the role of management accountants, has been affected by the characteristic business trends, such as customer orientation, process-orientation and the time focus towards the present and the future. They identify the expansion of the management accountant's job description in Finnish companies from a historian and a watchdog towards an adviser or a consultant and a member of the management team or even a change agent.[54] Granlund and Lukka (1997a and 1998b) describe the traditional management accountant's role with the bean-counter archetype. Also Lyne & Friedman (1996; see also Friedman & Lyne, 1997) argue that bean-counters typically do not understand the business, but see everything as exact numbers. On the other hand, the new management accountants are able to produce relevant information, because they understand the business.[55]

The characteristics that management accountants are expected to have are various. For example, from the inter-personal skills set, Lebas (1994) emphasizes communication skills. The changing role may require also professional skills other than management accounting. These may be information technology skills (see e.g. Banerjee & Lloyd, 1995; Banerjee & Kane, 1996; Caglio, 1999; Granlund & Malmi, 2000; Hrisak, 1996; Maccarone, 2000; Scapens *et al.*, 1998). In addition, a more creative role of management accounting is widely welcomed (e.g., Bromwich, 1990, and Pihlanto 1988b).

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[54] See also Partanen (2001) who suggests a more individual-oriented and socialization-driven role categorization for management accountants, instead of the task-oriented role continuum.

[55] Johnson & Kaplan (1987a and 1987b) questioned the relevance of accounting information in decision-making. It was argued that the relevant information may also be produced by e.g. marketing and manufacturing, without the management accounting function (see also, Hopwood, 1986, and Lord, 1996). Järvenpää (1998) mentions that organizations' information needs are also changing towards new dimensions such as activities, processes, quality, and time.

According to Järvenpää (1998, 38), management accountants should be convincing performers with deep knowledge and holistic view of the company's business, and they should be able to see the big picture beyond the number crunching. Hopper (1980) mentions that the role behavior of a management accountant is a result from his or her own desires and orientations, requirements set by other people and the current and potential techniques or methods.

Järvenpää (1998) argues that the management accounting function is surrounded by an uncertainty over the core of its role, whether it lies in supporting decision-making with accounting information or acting as tool of management control (see also, Caplan, 1991; Hopwood, 1974; McKenna 1978). Järvenpää has conducted his case study of strategic management accounting and management accountant's changing role in Nokia Telecommunications (today Nokia Networks). He identifies the human expansion (i.e. increasing the active participating instead of the passive scorekeeping and control role) and the technical expansion (i.e. transfer from the traditional operative accounting towards the strategic management accounting methods).[56] Also Bhimani and Keshtvarz (1999) state that while conventional management accounting adopts a historical orientation coupled with a focus on single decisions, single periods, and single entities, strategic management accounting is oriented towards to future. This means that the strategic management accounting and its techniques is one of the underlying factors in the changing role of management accountants (see also, Järvenpää, 1998).[57] Hrisak (1996), in turn, argues that by using technology innovations, controllers are turning data into knowledge for decision-making and their role as business strategist. This thinking can be expanded to include the whole data-information-knowledge-continuum. It can be argued that data, together with analysis and decision context can be turned into information. The true business controllership role becomes fulfilled when the information is combined with reasoning in order to create new knowledge.[58]

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[56] Järvenpää (1998) sees the technical expansion as a narrow interpretation of the changing role. He suggests that management accounting should be brought to the organizational context through communication, interpretation, explanation, co-operation, and participation. Thus the human dimension should be considered as dominant factor in the changing role of management accountants. Moreover, Järvenpää (1998) has analyzed the role change with the help of Minzberg's (1994) framework. He states that according to this framework, the role of management accountants is expanding from traditional, indirect and administrative management through an information style into one, which emphasizes much more management through people and management of actions themselves.

[57] For strategic management accounting, see e.g., Bromwich, 1990; Shank & Govindarajan, 1988 and 1993; Simmonds, 1981 and 1983.

[58] Cf. Von Krogh *et al.* (1996, 165): "Information is dependent on the manager, who makes use of it to create knowledge." Cf. also Von Krogh *et al.* (2000) who suggest that total search costs consists of data search costs, information search costs and knowledge search costs.

To sum up, the role, including the requirements and responsibilities of the management accountants, at the general level, has expanded enormously during the last few years. The traditional management accountant's role should not, however, be forgotten. Next, the management accountants' role will be discussed in the NPD context.

It has been claimed that the participation in the new product development team early in the design and development process may necessitate subtle changes in the role of management accountants (see e.g. Hertenstein & Platt, 1998). The new role may require management accountants to take more creative, proactive, flexible approach to cost and financial analyses than they are used to. A problem may arise, because of the fact that management accountants are trained to be precise and exact.[59] This will surely cause inconvenience both for themselves and the others in the team. Management accountants should, thus, become more relaxed, more collaborative and more service-oriented, have initiative, and bring as much creativity to the financial aspects of new product development as industrial designers bring to the appearance and functionality aspects.

Furthermore, Hertenstein and Platt (1998) mention that new product development work is also fast-paced compared to routine reporting of month-end closing statements. It should not be forgotten that the management accountant has to appreciate and understand the different functional perspectives and how they contribute to the overall product. To be an effective part of the team requires that management accountants develop effective team and interpersonal skills in addition to their financial skills.

Ask (2000) has some very interesting views on the management accounting change and non-change in NPD, over a longer period of time in a large organization. He suggests that the triggers for change towards a new cost control system have been e.g., (1) overspending in NPD and the perceived loss of control of the future product costs, (2) intra-industry benchmarking, (3) change towards a more process-oriented organization, (4) internal requirements and distrust in the old cost control systems, and moreover (5) some important persons who became inspired by target costing practices. Furthermore, Ask (2000) identifies e.g. the following barriers to change in the case company: (1) Engineers, who have strong power in the organization, not wanting to get

[59] For example, management accountants may be reluctant to provide early, rough estimates, fearing that they will be chastised later as the situation changes (Hertenstein & Platt, 1998). In addition, there is anecdotal evidence about tensions between product managers who argue taste and instinct and accountants who argue numbers (see e.g. Nixon & Innes, 1998a).

obstructed in their development work with cost targets; (2) cost control was a low priority area, because the company was doing financially well; (3) the case company did not have an organization structure that supported a successful implementation of change; and (4) some important people were not interested in the management accounting change. Ask argues that many arguments for change can be related to a contingency theoretical perspective in which new or changed circumstances have induced change pressure.[60]

Nixon (1998a) suggests that the role of management accounting and management accountants in NPD teams depends in large part on:

1. *The relative importance of different design parameters to the competitiveness of the company.* For example, if price and / or lifecycle costs to customers are central to competitive advantage then management accountants are more likely to be members of the core product development teams.
2. *The culture of organization.* For example, the structure, systems and management style of the company may encourage job rotation and the acquisition by individuals of multiple perspectives of the business. This, in turn, may facilitate cross-functional communication and collaboration. Management accountants are more likely to play a central role in the NPD process if they have a good appreciation of the design and development processes.[61]

Furthermore, Nixon (1998a) states that management accounting can assist both (1) the evaluation of NPD expenditure proposals and (2) the detailed design and development process. Empirical evidence suggests that the role and focus of management accounting changes over the development lifecycle – from strategic and risk evaluation in the idea generation and concept definition stages to achieving cost targets in the prototype and pre-manufacture stages.

Moreover, Nixon and Innes (1998b) suggest that the management accountant can, for example, help to translate a direct operating cost requirement of a customer into non-financial measures like direct labor hours, machine hours, material and energy usage rates that make operational sense to design engineers.

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[60] For contingency theory, see e.g., Otley, 1980. For management accounting change, see e.g., Granlund, 1998 and 2001, and Scapens & Roberts, 1993.

[61] Similarly, designers with an appreciation of price-driven competition and of management accounting techniques are more likely to understand the value of accounting information and profit management in the early stages of design. In addition, Nixon (1998a) mentions that the factors regarding organization and management are a prerequisite – along with understanding customers' needs – to a good product development as such.

Tanaka *et al.* (1993) argue that Western management accountants in general become involved in the costing of new products after the initial design stage. In contrast, Japanese management accountants, with their cost tables, can quickly provide answer to what-if-questions relating to product design alterations. This ability has helped the Japanese management accountants to become an integral part of the design team even at the planning stage for a new product.

According to Horváth and Tani (1997), referring to the responsibility for the introduction of Target Cost Management (TCM), management accounting function was a member of the development teams in every German company in their study. In Japanese companies, the departments of detailed design and production engineering most frequently joined the development teams and the department of management accounting has the least influence throughout the whole product development process whereas the department of detailed design has a great influence from the beginning of product development, even in the stage of product definition. In German companies, the increasing influence of controller from the product planning stage to the development stage was more than the influence of a professional from purchasing and product engineering functions. In fact, the influence in the development stage was almost the same as with the professionals from development and product planning function. Thereafter, the controller faced only a minor decrease of influence in the detailed design stage. Horváth and Tani (1997) claim that the significant difference may be explained by the different management accounting cultures in the two countries. Management accountants in Japan are mainly held responsible for budgeting whereas the task of cost management is dedicated mainly to engineers both at the development stage (target cost management) and at the production stage (kaizen costing).[62]

Nixon and Innes (1998a) divide the role of management accountants in new product development into a strategic and an operational one. *At the strategic level*[63], management accounting can help: (1) To balance the cashflow and

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[62] Shank and Fisher (1999) argue that in contrast with target costing, kaizen costing does not explicitly focus on market prices or planned profitability, but is internally focused on continual incremental product cost improvements. In their study, Horváth and Tani (1997) have included product planning, development, and detailed design stages, and the role and influence of controller and professionals from product planning, development, production engineering and purchasing departments in examining the influence of functional people in new product development.

[63] Batty (1988) describes the importance of accounting in R&D and highlights the accounting information as a significant element of R&D strategy. ”[M]anagement information system which can provide a full assessment of a company’s external environment including its legal, social, and economic elements, and its internal environment, including utilization of resources, organization effectiveness, and cost and pricing structures, can make a highly significant contribution to the development of corporate strategy, and R&D strategy in particular.”

contribution requirements of top management with the cost and value requirements of customers, (2) To evaluate in a corporate strategic context proposals for new products and product platforms, and (3) To develop performance measures and criteria for the new product design and development activity. *At the operational level*, the management accounting techniques and concepts exist, such as target costing, lifecycle costing, and cost tables. These techniques and concepts can: (4) Support in a very proactive way the entire new product design and development activity from idea generation to marketing and after-sales service, (5) Assist communication and collaboration among the many disparate participants in new product development by translating all their requirements to a single financial language, and (6) Help make explicit the financial implications, including the risks of key product specification decisions.

It should be taken into account that there is a significant terminological overlap in this approach. The roles in the strategic – operational role continuum include various tasks management accountants may have on these levels of their role. Similarly, later in this study, the terms management accountant's tasks and management accounting techniques appear abreast, as they both can be considered to be a part of management accounting practices.

Effective accounting support for new product development requires, nevertheless, good understanding of the management processes in all stages of the design and development processes. When designing a management accounting information system to support new product development, the extent should be established to which the existing new product development process needs to change.[64] Once some consensus view on the existing and the

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[64] This need of change may be due to e.g. time-based competitive pressures, a trend towards greater modularity in design, greater reliance on platforms or perceived weaknesses in the process (Nixon, 1998a). From a product family perspective, the development of base architectures may take a long time to complete, but once finished, should serve as the foundation for rapid development of derivative products. Product platform can be defined as the technological foundation of the product family. A platform is the physical implementation of a technical design that serves as the base architecture for a series of derivative products. Any single product has its architecture comprised of subsystems and interfaces between subsystems and the users. The architecture of any single product has the potential of becoming a platform if it serves as the foundation for creating several or more derivative products. The platform also embraces the manufacturing technologies and processes employed in production. The point here is that strong platforms provide leverage in the sense that each derivative product can be developed at incremental cost relative to the development of the initial product architecture (Meyer *et al.*, 1997). In other words, the platform approach reduces the incremental cost of addressing the specific needs of a market segment or of an individual customer, enabling the market needs to be more closely met. All this takes place, if the new products under development use the platform, i.e. a shared collection of assets, which include e.g. components, processes, knowledge, people, and relationships. For modularity in product design, see also, Robertson & Ulrich, 1998; Sanchez & Mahoney, 1996.

optimum new product development processes has been reached, management can decide where on this continuum the accounting system should focus. Moreover, he claims that there are some topics[65], upon which the views of NPD team participants frequently differ and on which an agreed understanding should be established (Nixon, 1998a; see also Nixon & Innes, 1998b).

There is some anecdotal evidence that management accounting has a proactive, strategic role in new product development. For example, in his case study, Nixon (1998b) reports that the case was an example of very proactive accounting support for NPD. Accounting played a pivotal role in the iterative search for a design that reconciled the customer's performance, quality and cost requirements with the company's contribution and cash flow needs and with product portfolio and strategic considerations. Accounting also provided a channel of communication for project team members that supported coordination of the many disparate activities over the duration of the project.

Nixon & Innes (1997) report in their case study that accounting can play a very proactive part in both planning and controlling individual and portfolio product development. They argue that accountant's role is to (1) assist the evaluation of the risk and financial implications of new product development proposals, and similarly to Nixon (1998b), (2) support the search for designs that balance the customer's requirements with the company's contribution and cash flow needs. In their case company, the financial controller was not initially formally involved in the NPD, because the non-accountants believed that they had a reasonable approximate idea, based on long experience, of the cost of both developing and producing this machine. Thus, the first three years were only monitoring expenditure against budget and helping to refine the opportunity cost and the value options. The following years, the financial controller helped to plan and control the project schedule by evaluating the costs and benefits of alternative ways of resolving various problems and he assisted the ongoing efforts of the designers to (1) minimize the total number of parts; (2) simplify the design to ensure that the remaining parts were easy to fabricate, assemble and service; (3) standardize where possible in order to reduce the time and costs of assembly and service; and (4) evaluate the impact of different design possibilities on the cost of developing, producing and operating the machine (ibid.). The finding of the active controller's role in this small company (50 employees) is somewhat surprising. This may, however,

[65] In addition, Nixon and Innes (1998b) mention that it is easy to appreciate why many NPD participants resist an accounting technique like target costing because it deploys the cost pressure that is placed on the firm by the marketplace throughout the NPD process.

be due to the personality of the financial controller in question or some other context-specific factor, which is not reported in the study.

Seiferheld (1999) emphasizes the role of management accounting as a language in the multiple foci decision-making related to new product development (see also Nadig, 1998). She mentions that decision-making is a core issue in the development of new products, and thus an important aim of management accounting in NPD is to support decision-making. Seiferheld argues further that from an engineering point of view management accounting plays an important role in all of the activities related to NPD. The decision scenarios must be enhanced with accounting information, and the identification of consequences includes identification of economic consequences that allow of decisions to be made. Seiferheld (1999) suggests three areas of consideration for management accounting in the NPD: (1) External element (The interaction with parts of the company outside the development project), (2) Internal element (The interpretation and preparation of scenarios), and (3) Information element (The creation and provision of necessary information).[66]

Despite the promising anecdotal evidence the true role of management accounting, management accountants and accounting information in new product development has been dealt with only in few academic studies. In sum, management accounting can play an important integrating role in the whole new product design and development process under favorable circumstances (e.g. Nixon & Innes, 1998b).

To sum up, the role of management accounting and management accountants has been changing. Since the importance of NPD operations has been increasing and simultaneously companies are becoming more and more process-oriented, cross-functional co-operation and the financial issues are becoming emphasized in developing new product. That brings management accountants into the picture. Management accountants may act with an integrating role, balancing

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[66] Seiferheld (1999) lists the tasks in the three areas as follows: The tasks in External Element are the compilation of detailed knowledge about different supply chains and corporate objectives and the translation of this into accounting information to support decision-making in the development project. The tasks in Internal Element are the compilation of preconditions and constraints related to different decisions, the analysis of decision problems and a selection of appropriate models, and the preparation and presentation of the consequences of different alternatives. Thus, includes an interpretation of the consequences into accounting terms that allow one scenario to be compared to another and, moreover, to relevant corporate objectives. The tasks in the information element are the translation of decisions into accounting terms, the presentation of decision consequences as accounting information that appear reliable and undistorted, and the reporting of consequences on the development project, which meets corporate regulations after the new product has been developed.

the needs and requirements surrounding the NPD project. They may have both operational and strategic role. As Nixon & Innes (1997) write, there is also some evidence that accountants are breaking the functional mind-set, acting more as information managers and adopting a more strategic perspective in new product development. Moreover, communication becomes critical issue, and accounting can be taken for a language.

The role of an organizational actor emerges in his or her actions. Thus, the role of management accountants in new product development will be discussed in more detail together with their tasks and accounting practices.

2.2.3. The Tasks of Management Accountants in NPD

Since the management accountant's role emerges in his or her actions, it is important to describe the tasks of management accountants, especially in NPD. According to the changing role of management accountants, it is often stated that management accounting should move from the traditional scorekeeping and control tasks to ex-ante planning and control, potentially with strategic management accounting techniques (Järvenpää, 1998).

According to Järvenpää (1998), accounting can provide knowledge and skills for the strategic models and decisions and serve as a tool in implementing strategic visions. Strategic management accounting (SMA) can be characterized by long timespan and future-orientation, and the fact that also company's external environment is included in the considerations. The attention in strategic management accounting is, thus, focused on the market and on the other hand a company's relative costs compared to its competitors (Simmonds 1981 and 1983). Järvenpää (1998) mentions that in addition to the strategic linkages this is intelligible because the current nature and trends of business operations are emphasizing customer-orientation, quality, time, and cost control. Apart from strategic management, there are concepts like manufacturing-orientation (new manufacturing techniques, philosophies and quality) and especially strong market-orientation behind the strategic management accounting. Both market-orientation and manufacturing-orientation, in particular, have been linked with cost management ideologies (Järvenpää, 1998; see also Morrow, 1992; Roslender, 1995; Shank, 1989; Shank & Govindarajan, 1988 and 1993; Young & Selto, 1991 and 1992).[67] SMA in NPD context may also include benchmarking, competitive

[67] Strategic Management Accounting, see more e.g. Allen, 1986, 1992, 1994a, 1994b; Bromwich, 1990; Bromwich & Bhimani, 1994; Goold, 1986; and Wilson, 1991.

intelligence, and competitor-focused accounting (cf. Guilding, 1999) operations with regard to the major competitors in the industry.

Here the tasks of management accountants are discussed by first classifying the tasks to cost management and financial planning together with control. Then, under these classes the management accounting methods and techniques related to new product development and many of which belong to the field of SMA, are discussed theoretically. In other words, management accounting practices including tasks and especially more detailed descriptions of accounting techniques related to new product development are covered here.

2.2.3.1. Cost Management

In this study, *cost management* is considered an all-inclusive, customer-oriented attempt to achieve continuous cost-consciousness in all organizational levels. Cost management can be seen as an issue of the organization as a whole – not just management accounting. It can be seen even as a management philosophy (Tanaka *et al.*, 1993). In other words, it is the actions undertaken by managers in order to satisfy customers while continuously reducing and controlling costs (see e.g. Horngren *et al.*, 1997). Although costs are also related to performance measurement, this chapter deals only with cost management and product costing techniques.[68] Performance measurement is described in the next chapter under financial planning and control.

Tanaka *et al.* (1993, 13) argue that cost management involves initiating and making decisions, which will improve the cost-effectiveness of an organization. Thus, managers need e.g. to understand the concepts of cost, have a basic knowledge of the factors which influence and drive costs and know how their decisions change costs. This requires the provision of a regular flow of reliable and relevant cost information, which can be clearly communicated to the relevant individuals. Cost management should be continuous and an integrated activity throughout the whole lifecycle of an organization's products and services. To be effective, cost management has to

[68] Cost systems serve two primary functions. Firstly, they provide measures of performance and the second function is to assign indirect production costs to products. Thus, cost systems in manufacturing companies usually assign indirect expenses to products by a two-stage procedure. In the first stage, indirect resource expenses are assigned to cost centers. In the second stage, the expenses accumulated in the cost centers are assigned to products or services (Cooper & Kaplan, 1991). The first stage serves the very performance measurement of the cost centers. Assigning costs to products, on one hand, served financial reporting requirements for inventory valuation and, on the other hand, product-related decisions, such as pricing and product-mix decisions.

be accepted as a policy by company management. A policy of systematically managing costs on a continuous basis provides an alternative for management, which can bring more stability, strength and growth potential to a business. (Tanaka *et al.*, 1993).

Hertenstein and Platt (1998) state that management accountants are focusing on the relationship between cost and the design of products prior to production. Furthermore, they mention that according to experts, between 75% and 95% of a product's costs are predetermined when the product design is finished.[69] This is why it is of great importance that management accountants participate in new product development providing useful cost data and their financial expertise especially from the cost management's viewpoint. Hertenstein and Platt argue further that management accountants need not be experts in product aesthetics or product engineering.

According to Hertenstein and Platt (1998), the cross-functional product design team provides the ideal opportunity for the management accountants to participate to ensure control of product costs. Management accountants can contribute a broader perspective on costs than, for example, purchasing managers. Management accountants are trained not only to assess the costs of purchased items but also to consider issues such as which activities drive costs; to estimate not only initial product costs but also costs incurred by the manufacturer, the distributor, and the customer over the lifecycle of the product; the cost of complexity, indirect costs, the relationships between processes and costs, and so on. This role for management accountants on the product development team converges with emerging changes in the roles and responsibilities of the management accountant from "statement preparer to decision-support specialist".[70]

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[69] Burrows & Roberts (1998) argue that the estimated time and cost overruns have generally three causes: (1) over-optimistic initial estimates of resources required to complete the project, (2) the difficulty establishing how far the project has progressed and the related issue of resources required for completion; (3) inefficient use of resources applied to the project.

[70] In order to examine more closely the role of management accounting and management accountants in the new product development process, Hertenstein and Platt (1998) undertook a study in where they interviewed product development team members from two functional areas from about 20 manufacturers in variety of industries. These areas were management accounting and industrial design. The interviews and discussions focused on the new product development process, industrial designers' and management accountants' role in and contributions to the product development process, information flows among members of the new product development team and design performance measures.

Hertenstein and Platt (1998) argue that one responsibility of management accountants is to assess the financial feasibility of the product[71]. Another responsibility for management accountants is to help the product development team to anticipate and develop financial information – for example product cost estimates or projections of required investment. Their empirical findings indicate that management accountant serves as a constant reminder to all team members that the cost of the product and the financial success of the product were the major objectives that the ultimate product design has to satisfy. One of management accountants' key tasks is to monitor the progress that the engineers and industrial designers make toward meeting the cost targets[72] that are established at the beginning of the product development process. There is a strong consensus that the value of the contributions can be maximized if industrial designers and manufacturing engineers – as well as management accountants – are involved early in the new product development process.

Shields and Young (1994), in turn, identified three styles of R&D professionals managing innovation costs in their survey:

1. *Line item watching style* entails monitoring the purchase and use of resources in relation to the (expenditure) budget. This approach to managing costs derived either from the fact that R&D professional's superior used the same approach or from the lack of information how costs (inputs) are related to outputs, which then reduces R&D professional's ability to use a more complete cost management style.
2. *A balanced perspective* of managing innovation costs is used by those who have a broader understanding of how costs relate to outputs and other important variables (e.g. quality, speed); generally this perspective is thought to arise from economic-management experience, training and education.
3. *A customer-based cost management* style stems from demands and requests made by key customers concerning how they want the costs of their future products managed.

In addition, Shields and Young (1994) give examples of R&D cost management methods and methods to improve R&D cost management, with

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[71] This responsibility begins during the conceptualization or advanced concept stage of the design process.

[72] Hertenstein and Platt (1998) reported two different ways to react to cost targets in new product development. Some people assume that setting strict cost targets may curtail the very creativity required to achieve the best product. On the other hand, some believe that cost targets challenge designers to develop innovative ways to achieve all product objectives. These people assume that creativity is born out of constraints.

both of these relating to external relationships, organizational design, R&D personnel, and technology.[73] They also list some perceived obstacles to improving innovation cost management. These obstacles include lack of top management attention, few ties to rewards, and the scientific-orientation (as opposed to business-orientation) of many R&D professionals.

Interorganizational cost management

Cooper and Slagmulder (1997, 1998 and 1999b) analyze cost management from the viewpoint of lean enterprises. Lean enterprises have developed cost management systems that help initiate cost-reduction activities across the entire lifecycle of products. The greatest opportunity for cost reduction is in the design stage of the product's lifecycle. Cooper and Slagmulder state that cost management in product is especially challenging for lean enterprises, since these firms outsource as much as 70% of the value added of their products and most of the associated tasks.[74] The high level of outsourcing means that the lean enterprises only control a limited percentage of the total development process for their products.[75] The high dependence upon the suppliers has emerged attempts to reduce costs during new product development and design and thus some companies have developed cost management programs that operate across organizational boundaries. These

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[73] R&D cost management methods were categorized as follows (Shields & Young, 1994): (1) External relationships (customer volume, to spread the cost of innovation over a larger base; global information systems; partnerships with suppliers; speeding-up the regulatory approval process; and subcontracting innovation activities and lab services); (2) Organizational design (centralizing services for economies of scale; direct charging for services; communication networks, formal and informal; concurrent activities when speed is important, e.g. concurrent engineering; modular labs, sequential activities when the risk of failure is high, standardizing processes, materials and parts, synergistic research projects); (3) R&D personnel (cross-functional teams; multi-skilled employees; reducing headcount; training; working smarter); and (4) Technology (automated lab testing; automated software design; computer-aided design, CAD, and engineering, CAE; design-for-manufacturing). Methods to improve R&D cost management were, in turn, categorized as follows (Shields & Young, 1994): (1) External relationships (benchmarking; early focus on the marketability of innovative products; partnerships with competitors, customers, suppliers and universities); (2) Organizational design (continuous operations, around the clock, everyday; core or synergistic projects; earlier identification of false leads); (3) R&D personnel (job rotation, including non-R&D assignments; linking cost performance to valued rewards, e.g., pay and promotion; training); and (4) Technology (better experimentation, e.g., more computer simulation experiments, fewer physical experiments).

[74] The demand for quick development work is the reason why companies started outsourcing (see e.g., Hansen *et al.*, 1999).

[75] This has to be emphasized by pointing out that the suppliers influence also not only on the cost of the new product, but also on other NPD targets related to e.g. quality, technology, and time-to-market. In their study, Handfield *et al.* (1999) argue that effective integration of suppliers into the product value/supply chain will be a key factor for manufacturers in achieving the improvements necessary to remain competitive.

are called *interorganizational cost management* (IOCM) programs[76] (see also Cooper, 1995; and Kubota, 1999).

Based on empirical evidence, Cooper and Slagmulder (1998) have come to the conclusion that IOCM relies on two types of mechanisms, those that *discipline* the cost management process and those that *enable* it. The aim of the disciplining mechanisms is to transmit the cost reduction pressures faced by the end-firm in the supply chain to its suppliers. If the desired level of cost reduction cannot be achieved using just the disciplining mechanisms, then the enabling mechanisms are initiated.

Results of the study reveal that the effectiveness of the IOCM process depends upon three major factors, including (1) the buyer-supplier environment, (2) the level of buyer-supplier relationship, and (3) the nature of the outsourcing problem. The core findings regarding the buyer-supplier environment are that IOCM can only be successfully implemented when the relationships are cooperative, stable, and mutually beneficial and when they extend across the entire supplier network. The degree of sophistication of the IOCM technique appears to vary as buyers and suppliers establish different levels of relationships depending on the necessary degree of interaction between their product development teams. Finally, observations showed that the type of IOCM approach used depends upon the value-added of the item outsourced, the mature of underlying technology, the magnitude of the anticipated cost overrun, and the timing of the IOCM intervention.[77]

At the core of IOCM lies *target costing*. Target costing acts as a disciplining mechanism for the product development process by establishing the cost-reduction objectives that must be achieved for new products and their components to ensure that the products are adequately profitable when launched. By setting cost-reduction objectives based on market-driven selling prices, target costing transmits the cost pressure the marketplace places on the

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[76] In their literature review, Cooper and Slagmulder (1998) note that a considerable amount of literature has been published in recent years about various cost management techniques, but the majority of this literature focuses on the use of a single cost management technique by an individual firm. Few if any of these writings discuss how companies extend their cost management programs beyond the boundaries of the company. Respectively, the literature on supply chain management is focused on the ways to make the interfaces between buyers and suppliers more efficient and deal primarily with logistics and buyer-supplier relationships.

[77] The higher the value-added to a specific item by the supplier or the larger the cost overrun, the more sophisticated the IOCM technique demanded. The more mature the underlying technology, the lower the cost saving opportunities typically available. The most sophisticated IOCM technique is only available in situations where the cost overrun is identified early in the product development process (Cooper & Slagmulder, 1998).

end firm to everyone involved in the new product development process, both inside the company and to the associated first-tier suppliers. Target costing will be discussed in more detail later in this study.

In *chained target cost system*, where the target costing system of the buyer is connected to that of its suppliers, the target costing discipline can be extended from the first-tier suppliers to the entire supplier network. Thus the network is subjected to the pressures of the marketplace and motivated to find new ways to reduce costs while simultaneously increasing functionality and quality of the end products and the components they contain.

According to the empirical evidence, just setting cost-reduction objectives is not sufficient. Cooper and Slagmulder (1998) state that value engineering is the primary technique used by companies in order to identify ways to achieve the cost reduction objectives set by the target costing system. However, if the product development and design teams of the different companies involved act in isolation, then opportunities for cost reduction that transcend organizational boundaries are often missed. In IOCM this problem is solved by introducing a number of enabling mechanisms that help the teams of various companies in the supplier network to coordinate their activities.

Thus, when one or more companies find that the target costs cannot be achieved, it is the product development teams' responsibility to recommend the initiation of the appropriate enabling mechanism of IOCM. The simplest and least invasive of the enabling mechanisms is *Functionality-Price-Quality (FPQ) trade-offs*. Under FPQ trade-offs suppliers explore ways to provide their buyers with products whose functionality and quality (but typically not price), while below the levels originally requested, are still acceptable. Successfully achieving this trade-off – lowering the functionality and quality of a component without decreasing the value of the final product – allows these suppliers to find solutions to a customer's product requirements while still meeting their target costs and thus generating adequate returns (Cooper & Slagmulder, 1998).[78] Occasionally, FPQ trade-offs are used to get buyer to increase component-level target costs by adding value to the components. Value can be added either through increased functionality and quality or through decreasing buyer's costs.[79]

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[78] FPQ trade-offs are only feasible when the supplier can differentiate its products in some way from those of its competitors.

[79] FPQ trade-offs may suffer from two significant limitations: Only minor changes could be made to the specifications of the outsourced item and intervention occurred relatively late in the process.

In *interorganizational cost investigations,* unlike in FPQ trade-offs, engineers are included from more than two companies. Increasing the number of companies allows more fundamental cost solutions to be identified. There are two ways in which costs can be reduced in interorganizational cost investigations. First, the location of where activities are performed can be changed so that they are performed more efficiently. Second, the need to perform activities can be reduced or avoided by redesigning the product and the component it contains to take full advantage of the manufacturing skills located throughout the target cost chain (Cooper & Slagmulder, 1998).[80]

The evidence suggests that the enabling mechanism used to address the timing limitation of all previous techniques is *concurrent cost management*, which is achieved by completely outsourcing research and development for a major function or a component. Concurrent cost management is the ultimate step in interorganizational cost management. It creates the highest levels of mutual interdependence. There are two different approaches in concurrent engineering. In parallel engineering, the buyer provides the supplier with high-level specifications for the major function, whereas in simultaneous engineering, the buyer's and supplier's new product development teams work together to identify mutually beneficial designs for both the product and the outsourced major function.[81]

In their case study of two companies, Hansen *et al.* (1999) report that the companies had been successful on their respective markets, but after outsourcing they both experienced a gap in knowledge, insight and control – as if they had lost touch with the processes. As a result, the companies started developing a management technology in relation to inter-organizational processes. One company began to develop target costing and the other open book accounting. In both cases it turned out that very specific organizational conditions had their impact in the role of the installed management controls.

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[80]The two primary implications of interorganizational cost investigations are (1) the potential shift in the balance of power between buyers and suppliers and (2) the intensive sharing of cost information. This cost information sharing, however, risks having the more powerful members of the chain use that information to their own advantage.

[81] One of the advantages of parallel engineering lies in the ability of the supplier to uncouple its own product development activities from those of the buyer. This uncoupling gives the supplier more time to develop new products. The advantage of simultaneous engineering is the ability for each team to recommend design changes that alter the high-level specifications of the product and the major functions it contains. Simultaneous engineering, however, can be very costly. The primary disadvantage of the two concurrent cost management techniques is the lost ability of the buyers to differentiate their products based upon any proprietary technology. Simultaneous engineering creates a middle ground between keeping the research and development in-house and outsourcing it completely. It allows the companies to take advantage of the design skills of their suppliers by getting them involved early in the new product development process (Cooper & Slagmulder, 1998).

Furthermore, Hansen *et al.* argue that inter-organizational management control does not merely capture a state of affairs to be modeled. They suggest that surprises of strategic and fundamental nature turn up.[82]

Lifecycle costing and Target costing

Product lifecycle management[83] provides a wider entirety for product lifecycle cost[84] concept (see e.g. Susman, 1989). Lifecycle costing tracks and accumulates the actual costs attributable to each product from start to finish. The concept can be divided into two categories: (1) customer's lifecycle costs, i.e. the costs that are incurred to the end-user during the whole lifecycle of the product, and (2) manufacturer's lifecycle costs, i.e. the costs that are incurred to manufacturer during the whole lifecycle of the product. Customer's lifecycle costs can derive for example from late delivery, installation, use, service, maintenance, and replacement.[85] Manufacturer's lifecycle costs can arise from research and development activities, production, logistics, marketing, guarantee, and service (Artto, 1994). Lifecycle costing can be used particularly in comparing the cost elements that are associated with different alternatives in trade-off decisions (Taylor, 1981).

The advantage of the lifecycle costing is the ability to take into account not only the price of the product, but also the product properties related to e.g. quality and time. In addition, lifecycle costing provides a possibility to make visible all costs attributable to the product, and to highlight the relationships between the actual costs. For example, decreasing the R&D costs may lead to increased service costs. Present value method is applied in calculating the lifecycle costs and revenues of the product. The costs associated with upstream areas (e.g. R&D) can be highlighted, because typically they tend to receive less attention than the costs associated with the downstream areas (e.g.

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[82] For management accounting in networks, see e.g. Dahlgren *et al.*, 2001. For both wider perspective to inter-organizational management control, see Dekker, 2001; and Langfield-Smith & Smith, 2001.

[83] The product lifecycle spans the time from initial R&D to the time at which support to customer is withdrawn. Shortening product lifecycles are consequences of e.g. the fast phase of technological developments. Industrial manufacturing companies have faced pressures in their production philosophies and technologies, which force them to make faster product decisions concerning manufacturing and introducing the product in the markets.

[84] Alternative English terms are cradle-to-grave-costing and womb-to-tomb costing (Horngren *et al.*, 1997). For lifecycle costing, see also, Czyzewski & Hull, 1991; Harvey, 1976; and Shields & Young, 1991.

[85] Järvenpää (1998, 143-144) mentions that in Nokia Telecommunications, the R&D costs were the major problem in calculating the customer profitability. He continues that the mutually intertwined R&D costs from various product generations and product families were difficult to allocate and on the other hand the R&D costs were actually not allocated to the products that were in the market at the moment. The issue was dealt with various simplified allocating models.

manufacturing) (see. e.g., Horngren *et al.*, 1997, and Artto, 1994). The model is, thus, very flexible and it makes possible both long-range planning and budgeting – and short-term cost controlling by the product lifecycle phases (Gutshelhofer & Roberts, 1997). Of paramount importance is to distinguish the costs that have been committed (locked-in costs[86]) from the actual costs. This can be illustrated with the following graph (Figure 4) that has been adapted from Kaplan and Atkinson (1989; see also Mévellec, 2001). Furthermore, Susman (1989) states that the boundaries between the different phases of the product lifecycle are disappearing, which can be due to e.g. computer-aided manufacturing and design.

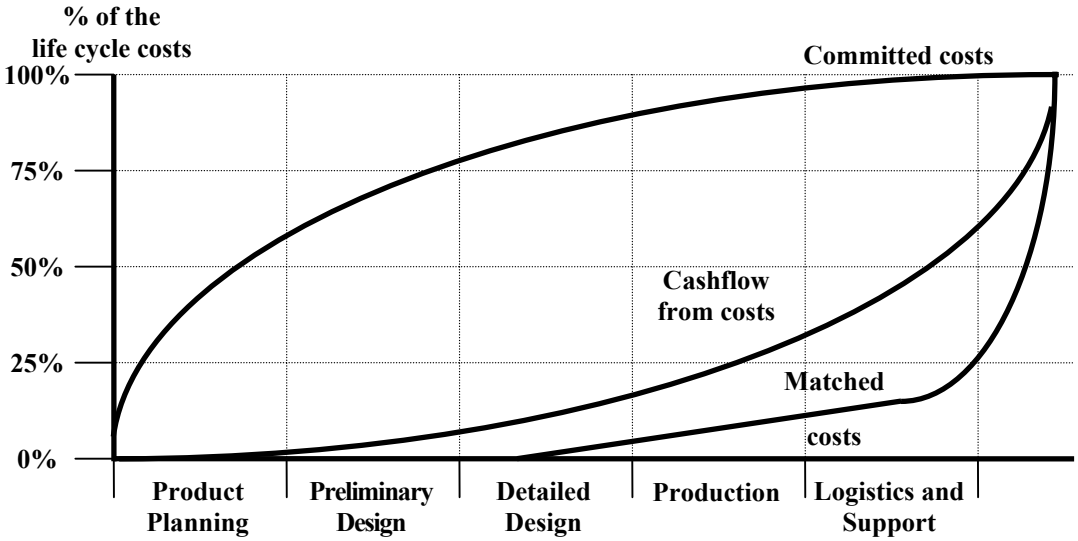

Figure 4. Pattern of Costs Committed and Costs Incurred over Product Lifecycle

Artto (1994) describes the organizational significance of the lifecycle cost concept and states that the cross-functional product development teams should be responsible for using lifecycle analyses. Even though a single member of the team cannot be held responsible for developing new products effectively and efficiently, the team as a whole can. Artto mentions that companies should be organized according to the product lines and not for example according to the market areas or functions.

Target costing can be considered a special form of lifecycle costing. In the most typical target costing method, the starting point lies in the requirements for the product properties and the target market price through which the

[86] Locked-in costs will determine how costs will be incurred over several years.

desired market share can be reached.[87] After this, a standard profit margin is subtracted from the estimated sales price to identify the product's target costs. Finally, the project team involved in research and development decides the properties of the product and manufacturing process, by which the calculated target costs can be achieved (see e.g., Kaplan & Atkinson, 1989).[88] Thus, target costing is an iterative optimization process that has to be taken before manufacturing and investment decisions (Artto, 1994; see also Cooper & Chew, 1996; and Järvenpää *et al.*, 2001).

Kato (1993) presents the following model (Figure 5), according to which the target cost may be computed by determining the sales price, target profit and as-if costs. In other words, the internal input information comes from actual costs and value engineering process that may bring up potential for cost reduction, and the external input information comes mainly straight from the competitors, which emphasizes the market-orientation, taking into consideration also the targeted profit level. Thus, the target cost after immediate cost reduction would be the value-added cost together with the non-value added cost, which should be subject to future cost reduction.

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[87] Cooper (1996), whose research has focused on the cost management techniques of Japanese companies, has divided the target costing process into (market-) price, product and component levels (see also, Cooper & Slagmulder, 1999a). Järvenpää (1998) states that companies use in advance value engineering and after the manufacturing has started Kaizen, i.e. continuous improvement, in order to reach the desired target cost levels. Value engineering can be defined as systematic cross-functional investigations of the factors affecting the product's cost. The purpose is to reach certain product properties and costs. It is not necessarily attempted to minimize the costs, but reach the desired cost level. The main sphere of influence is in the costs deriving from direct material, direct labor, and acquired components and the main approaches are analyses concerning new product development and design, product properties, and profitability. Kaizen, on the other hand is not focused on single products but on improving business, especially manufacturing, processes in general. The difference between target and kaizen costing lies in stage of lifecycle the techniques are applied, and what their primary cost reduction objective is. In other words, whereas target costing is applied during the design stage of the product lifecycle and achieves its cost reduction objective primarily through improvements in product design, kaizen costing is applied during the manufacturing stage of the product lifecycle and achieves its cost reduction objectives primarily through increased efficiency of the production processes (Cooper, 1996b). See also, Clinton and Graves (1999), who propose the integrating concept of product value analysis, which integrates product lifecycle analysis, value chain analysis, competitive advantage analysis and cost driver analysis.

[88] Tanaka *et al.* (1993) describe three basic methods of target costing: (1) the first method is the subtraction method, which is based on the price of competitors' products. This method works backwards from the market price to derive the target cost; (2) the second method is the addition method, which is based on the existing technology and past cost data of the companies and subcontractors. It may result in a target, which is quite achievable, and thus not competitive, because it is basically an extension of what has already been happening; (3) the third method is the integrated method, mixture of subtraction and addition methods, which involves solving many difficult problems and conducting a great deal of negotiation. The basic idea is that the integrated target cost should provide a reconciliation of the two methods and give a resultant target, which is set from a long-term point of view. In addition to the various methods of target costing, there may be company-specific ways in implementing and organizing TCM and differences in the cost elements considered.

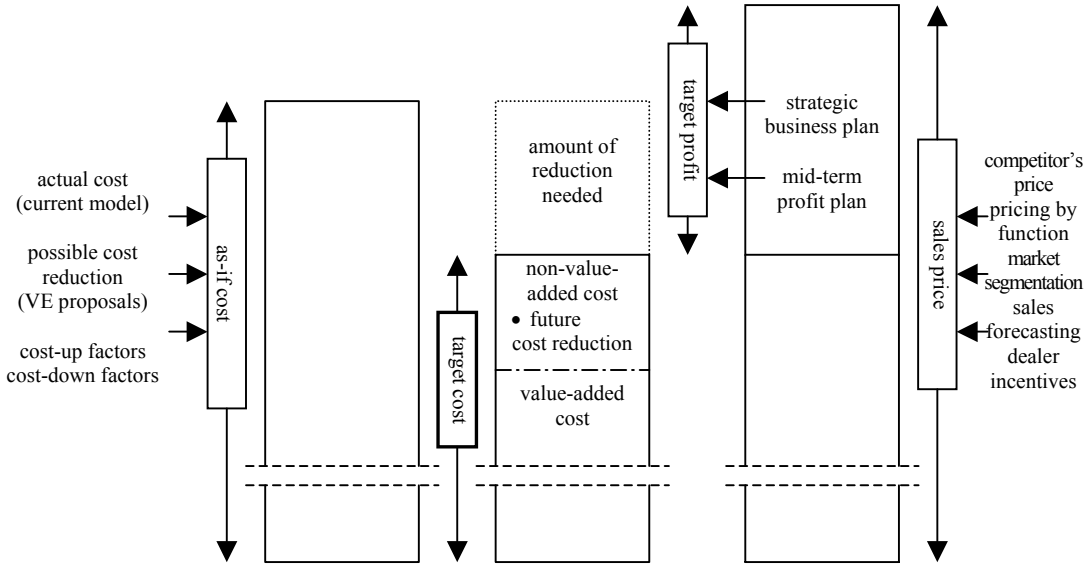

Figure 5. Target Cost Computation

Nixon & Innes (1998b) suggest the following major categories for target cost (Figure 6). These categories evidently implicate the need of cross-functional collaboration in setting target costs.[89]

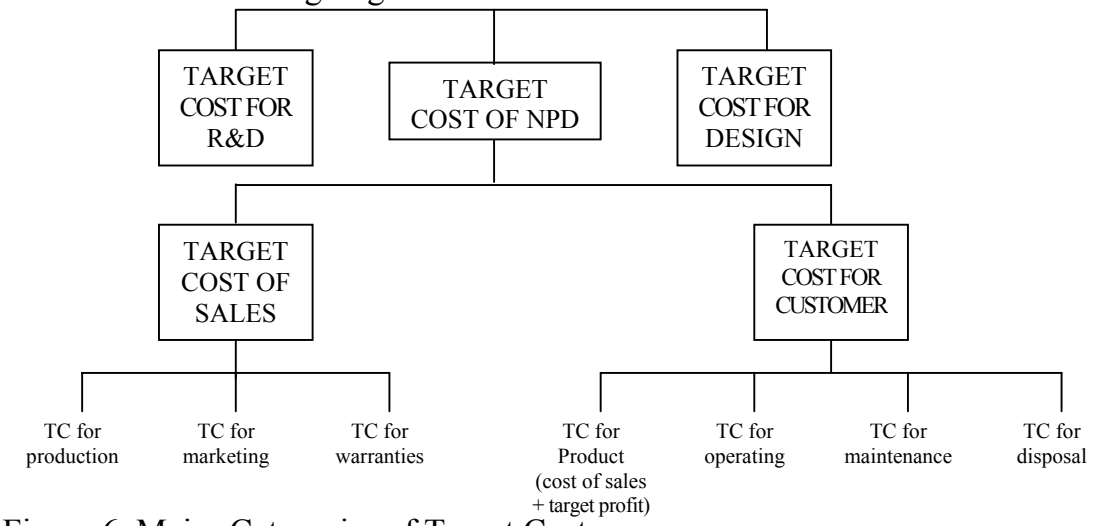

Figure 6. Major Categories of Target Cost

However, target costing has to be seen as a more comprehensive concept than just a technique in setting cost targets. In fact, it can be seen as a strategic cost management philosophy, which includes emphasized customer-orientated and cross-functional thinking, and organizational learning perspectives (Järvenpää, 1998, 123). Target costing is not a costing system as such. It is rather an activity which is aimed at reducing lifecycle costs of new products, while

[89] In other words, this conceptual model illustrates how target cost can have breakdown not only into component level, but also into various organizational functions, depending on the viewpoint. Furthermore, the target cost is not necessarily the same for each interest groups involved in new product development.

ensuring quality, reliability, and other customer requirements, by examining all ideas for cost reduction at the product planning, research and development process (Kato, 1993).[90] Tanaka *et al.* (1993) define the target cost management (TCM) as a management technology using scientific principles and technologies to establish a cost target, breakdown the cost target, and improve cost. [91] TCM adopts these technologies through the development and design phases in order to achieve product specification cost within the cost targets that are included in the lifecycle cost. Horváth & Tani (1997) mention similarly that TCM is not just a method of computing cost objectives for product development. In advanced application, it is used as a cost management system to plan and influence the cost structure before it is fixed. They define three constitutional elements for a minimum indication of TCM: (1) market oriented definition of product functions and target price, (2) method of setting target costs for functions, parts or departments, and (3) usage of supporting tools (e.g. value engineering and cost tables) to achieve target costs systematically (See also e.g. Tani, 1995 and Tani *et al.*, 1994). According to Ask (1999), target cost management is an iterative company-specific phenomenon, which includes parallel processes.

As one of the objectives of this study is to provide detailed theoretical description on the relevant management accounting techniques and their use in R&D environment, the process of target costing, and the way how it is commonly perceived to be, are both regarded here as worth presenting. Tanaka *et al.* (1993) list the following steps and items in target costing: (1) Product

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[90] Kato (1993) states that in general, cost reduction strategies are one of the most significant ways in which Japanese companies gain competitive edge. Leading Japanese manufacturers are focusing on the upstream of production, i.e. design, R&D and product planning, because they have learned from their Just-In-Time (JIT) practices that the most fundamental cost drivers are in the earlier stages of new product development. Curtis and Ellis (1997), in turn, report that the negative financial impact of target costing is of particular concern. However, there is only single survey year in their study. This may exclude the companies' learning curve effects from adopting target costing.

[91] Target costing may be considered a mechanism for control and connecting a company's functions. In target costing information is disseminated flexibly between market studies, new product development and design, manufacturing, and management accounting. Target costing is closely related to strategic planning and management processes (Järvenpää, 1998). Kato (1996) has listed the disadvantages of target costing: Possibly attention becomes too focused in markets and customer, potential problems with subcontractors, the stress of designers, and organizational conflicts. For target costing, see also, Everaert *et al.*, 1999; Kaplan & Cooper, 1998; Monden & Hamada, 1991; and Suematsu, 2000; for company case descriptions, see e.g. Bhimani & Neike, 1999 (Siemens) and Cooper, 1994 (Olympus). Design to Cost (DTC) method is a method to ensure that product designs meet a stated cost objective. Cost is addressed on a continuing basis as part of product or process design. The technique embodies early establishment of realistic but difficult cost objectives, goals, and thresholds and then manages the design until it converges on these objectives (CAM-I, 1999). See also Woodlock (1999), who argues that companies should focus on how the targeted costs are met, and not solely on achieving these targeted costs. In the TC process it should be identified, how wide a range of optional actions is available and how each of the proposed actions affects the product's variable and fixed costs.

Planning, (2) Concept Design, (3) Basic Design, (4) Detailed Design, and (5) Manufacturing Preparation.[92] Similarly Cooper & Chew (1996) present the following picture (Figure 7) to illustrate how the target costing process may deal not only with costs but also with issues such as quality, and functionality.

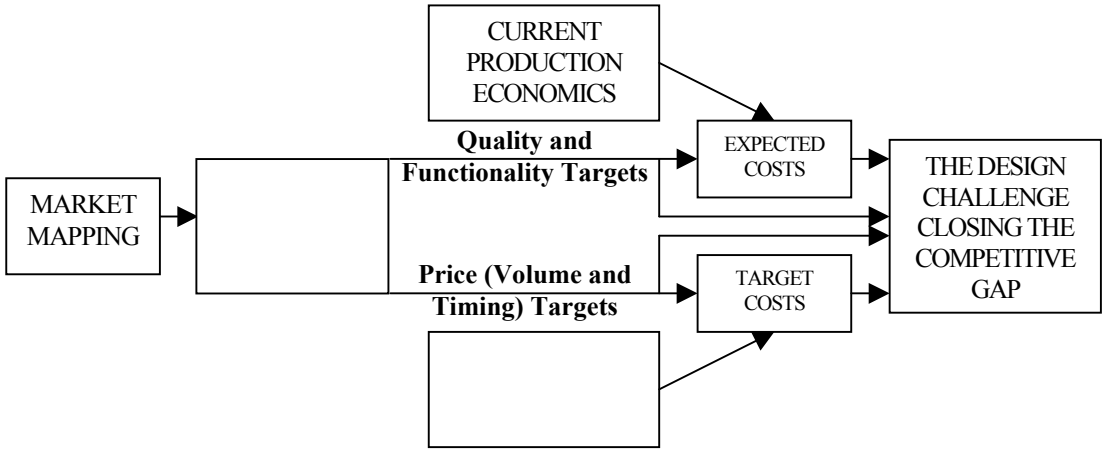

Figure 7. The Target Costing Process

The behavioral aspects and implications of target cost management, e.g. its important motivational element, cannot be forgotten. Tanaka *et al.* (1993) mention that two set of factors must be taken into consideration:

1. General management consideration
   - The scope of the target cost must be defined (planning, design, manufacturing, selling, etc.)
   - The choice of full, partial (e.g. direct cost) or variable cost must be made
   - A decision on how tight the target cost is must be made
   - Expected production volume, production period, production speed and cost reduction rate must be decided

[92] According to Tanaka *et al.* (1993) the target costing steps include the following sub-tasks: (1) Product Planning: Outline of the mission and concept of the product, primary performance specifications, and design schedule, manufacturing and marketing activities for the product, cost target, selling price, sales volume and profitability study for the product; (2) Concept Design: Formulation of main function areas, assignment of the cost target to the top level function areas, designing the basic concept of the product under the assigned cost target, ascertaining whether or not the basic concept of the product is designed to fit the cost target by using a rough cost estimation, and a profitability study of the project; (3) Basic Design: Assigning of the cost target to the top and middle function areas or main components, framing a general drawing under the cost target, ascertaining whether or not the general drawing of the product is designed to fit the cost target by making use of the rough cost estimation; (4) Detailed Design: Drawing up the details of design (manufacturing specification) under the cost target, ascertaining whether or not the manufacturing specifications of the product are designed to fit the cost target by using a detailed cost estimation; (5) Manufacturing Preparation: Manufacturing system and variations of the product are designed, and manufacturing methods and processes are determined under the cost target. For target costing, see also Sakurai (1989)

- Basis for the target cost must be set, for example the production cost of pilot production, the product cost of first batch or during main production

2. Specific product and situational considerations
   - Characteristics of the specific planning and design teams (e.g. prior experience, planning schedule, novelty of the product, existing and proposed technology, type of production system) for a particular product must be taken into account

Finally, it should be highlighted that some authors have explicitly suggested that target costing may also promote empowerment, communication and organizational learning (see e.g. Bhimani & Neike, 1999) and it can also act as a tool in strategic management (see e.g. Shank & Fisher, 1999).[93]

Activity based costing

Activity-based costing (ABC) can be considered to be somewhat related to lifecycle costing and target costing. ABC is a technique in which activities, processes and cost objects are identified. Activities can be grouped together into higher-level business processes. Thus, processes consist of activities, which in turn use resources. In activity-based costing, attention is paid especially to all resource usage, which can be causally traced to cost objects. Thus, ABC differs from traditional cost accounting techniques in its resource-orientation. Both pre-manufacturing costs and all costs thereafter are relevant.[94] (See e.g. Brimson 1991; Cooper, 1988a, 1988b, 1989a, 1989b; Cooper & Kaplan 1987, 1988, 1991; Johnson & Kaplan, 1987a and 1987b;

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[93] Horváth & Tani (1997) argue that the Japanese approach of TCM is a soft system to influence human behavior whereas the German approach seems to be a technocratic system to structure information and to support clear decisions. They continue that in most German companies the management accounting department was responsible for the introduction and implementation of TCM while in Japanese companies, TCM is mainly an engineering domain. However, they mention that in both Japanese and German companies, the development teams took responsibility for the application of TCM. For more differences between Japanese and German TCM (philosophy and supporting tools), see Horváth and Tani, 1997. Wijewardena and De Zoysa (1999) have conducted a comparative survey of management accounting practices among Australian and Japanese companies. They argue that the Australian companies emphasize the cost control tools at the manufacturing stage, whereas the Japanese companies devote a much greater attention to cost planning and cost reduction tools, such as target costing, at the product design stage. They state that the critical cultural and environmental features in Japanese organizations are the collective decision-making and unique company philosophy, which exceeds the functional background. In addition they mention that cost accountants are produced primarily through extensive in-house education and training programs, and the university degree of cost accountants may be in any discipline, but it is unlikely to be an accounting degree. For target costing and strategic cost management, see Ewert & Ernst, 1999. See also, Cooper, 1995, 135.

[94] ABC information can be used across the entire value chain, to reduce the total costs of production and support, not just the obvious costs of direct materials, labor, and machining (Kaplan & Cooper, 1998).

Kaplan, 1985 and 1995; Partanen, 1997; Vehmanen, 1994). Controlling and managing costs should, therefore, be initiated during the product development phase. (Järvenpää, 1998; Vehmanen 1994; see also e.g. Berliner & Brimson, 1988; Lumijärvi, 1993; and Morrow, 1992). With the help of ABC system it is often possible to assign costs to cost objects more accurately.

Whereas traditional cost systems answer to the question "how can the organization allocate costs for financial reporting and for departmental cost control", ABC systems address an entirely different set of questions (Kaplan & Cooper, 1998):

(1) What activities are being performed by the organizational resources?
(2) How much does it cost to perform organizational activities and business processes?
(3) Why does the organization need to perform activities and business processes?
(4) How much of each activity is required for the organization's products, services and customers?

Blocher and Berry (1998) describe briefly the connection between ABC cost drivers and product design (see also Kocakulah *et al.*, 2000; and Sandström, 1999a and 1999b).[95] They state that design activities can have a dramatic impact on unit-level costs as well as batch- and product-level costs. According to the case-study evidence by Kaplan and Cooper (1998), when product designers and engineers had only the distorted cost signals from the traditional standard cost systems, they often made decisions that led to unexpectedly high indirect cost and support costs. In other words, traditional cost systems ignore the enormous cost savings and efficiencies of final-stage assembly processes and high-volume common components. Kaplan and Cooper (1998) report that the information from ABC systems informs product designers of the potential benefits from efficient design, as well as high costs associated with producing low-volume final products with components and production processes dedicated for that one application alone. Similarly, Innes and Mitchell (1995) argue that ABC can have a motivational impact on the designers through provision of cost driver rates in NPD.

Kaplan and Cooper (1998) argue that the potential for cost reduction especially for new products may be even more dramatic with activity-based management (ABM). They mention that by understanding batch and product-sustaining costs, engineers could incorporate the economies of using existing

[95] For cost drivers, cost modeling and multi-dimensional cost analysis, see Collini, 1999; cf. also Karjalainen, 2000). For cost estimation using neural networks in NPD, see Otzen *et al.*, 1999.

parts, especially those ordered and used in high volumes, into their design decisions.[96] Thus, using ABC to influence product design decisions requires a balance between two important objectives, (1) to provide accurate product cost information and (2) to provide information that product engineers can understand and use in their design decisions (Kaplan & Cooper, 1998).

ABC cost model should enable the integration between ABC and target costing. By integrating those two, designers can make trade-offs between direct and indirect costs that are impossible with only target costing or with a combination of target and traditional costing (Kaplan & Cooper, 1991). This means that the target costing system enables product designers to reduce the direct unit-level costs by focusing attention on new products' material, labor, and assembly costs. Simultaneously, the designers manage indirect and support costs with an ABC system that reports activity cost driver rates they can use to make cost benefit trade-offs between indirect and direct costs. In other words, the ABC system gives product designers and developers a model of manufacturing support costs that enables them to balance the functionality and quality of the final product with economics-based decisions about component selection and design characteristics (ibid.).

In addition, as mentioned before, activities can be grouped together into higher-level business processes. Thus, another application of activity-based analysis to product development occurs in the cost of design and development process itself (see e.g., Kaplan & Cooper, 1998).

Cost tables

Tani (1998) links the usage of cost tables to target costing. He argues that target costs are normally fixed by adjusting the allowable costs (estimated sales price – desired profit) against forecasted actual costs or drifting costs (expected costs when every opportunity for cost reduction is considered, but yet before any measures of target cost management activities are taken). Cost tables are used for estimating the forecasted actual costs. Therefore, one of the objectives of cost tables is the setting of targeted costs. In the breaking down process of target costs, cost tables are necessary to estimate costs of function, component and lastly department. Thus, according to Tani (1998), cost tables are originally developed in value engineering and they are necessary in the process of milestone management to determine if the target is attained.

[96] For ABM and R&D, see also Maccarone, 1997 and 1998; and Ray & Schlie, 1993.

According to Tanaka *et al.* (1993), one of the major differences between Western and Japanese management accounting is the cost table. They suggest that Western management accountants have a great deal of costing information on existing products but usually they conduct special one-off exercises to cost new products. Furthermore, Western management accountants in general become involved in the costing of new products after the initial design stage. In contrast, Japanese management accountants and cost estimators have very detailed cost tables or cost databases, which provide most of the costing information for new products. With their cost tables, Japanese management accountants can quickly provide answer to what-if-questions relating to product design alterations. This ability has helped the Japanese management accountants to become an integral part of the design team even at the planning stage for a new product.

Sato (1965) defined the cost table as a measurement to decide cost and to be able to evaluate the cost of not only existing products but also future products at the very beginning of the design process. In contrast, the definition by Tanaka *et al.* (1993) suggests that a cost table includes data summaries to estimate costs quickly and easily with a certain degree of accuracy for cost estimation purpose such as pricing decisions, decisions for product specification and decisions for product methods and means. Cost tables may also contain data essential for cost estimation purposes such as time estimates. The data may be in graphical form, tabular for and/or an algebraic expression, depending upon the particular application. A further note is that the compilation of cost tables requires a great deal of work.

Tani (1998) divides the cost tables into two categories: (1) functional cost tables used in earlier stages of product development and (2) engineering cost tables used in the latter stages of product development. He states that when cost tables are used for process engineering, engineering cost tables are powerful tools both for cost reduction and shorter time to market. In this method, costs are minimized by simulation. Another important use of engineering tables is purchasing management, because it is necessary for purchasing department to estimate not only the price but also the cost structure of purchased parts and components. Functional cost tables[97] are applied in the earlier stages of product development in order to set and break-down the target costs, to promote emergence of innovative ideas for product development and to evaluate emerged ideas, i.e. alternative technologies, processes, materials

[97] See also Yoshikawa *et al.*, 1990, 1995 and 2001; and Tanaka *et al.*, 1993.

and so on. Furthermore, Tani (1998) presents the objectives and the classes of cost tables as follows in the Figure 8:

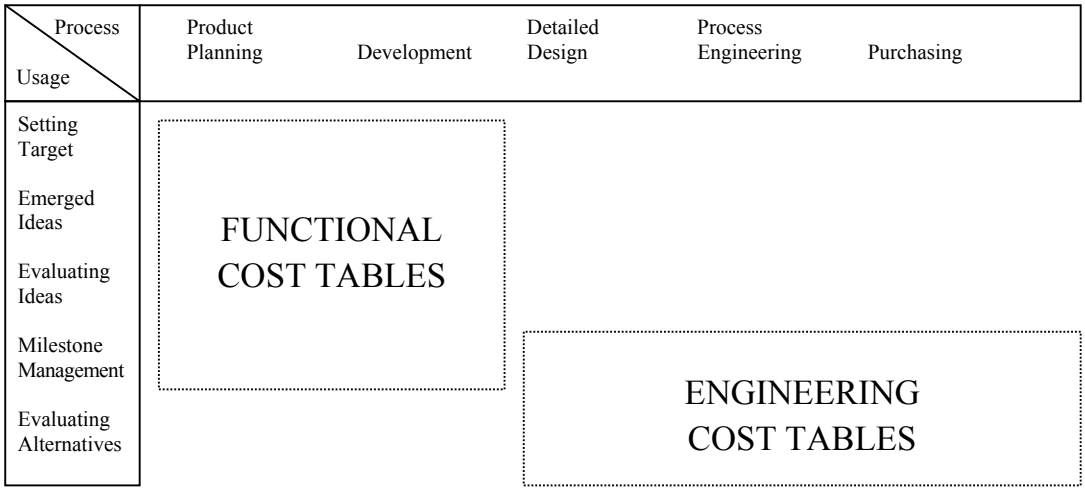

Figure 8. Objectives and Classes of Cost Tables

Other philosophies and techniques related to product cost and value in NPD

Nixon (1998a) mentions that effective management accounting support for the design and development activity requires not only a good understanding of the process but also a profound understanding of the philosophies and techniques employed in product development, several of which require financial data and all of which have direct implications for costs, cashflows and profit margins. Nixon states that possibly the greatest scope for management accounting development is through a further fusion of extant management accounting concepts and techniques with those employed to manage the new product development process and provides the following list regarding this: (1) Quality Function Deployment (QFD)[98], (2) Function Analysis System Technique

[98] QFD is a comprehensive design and development technique that aims to identify customer needs so that they can be translated into design targets and major quality assurance points. The technique pays attention to the needs of the end-customer, and also those of every supplier and intermediate customer in the value chain, and their mutual relationships. Nixon (1998a) states that QFD provides a powerful framework for balancing quality and function requirements so as to achieve target profit margins. Ross (1994, 161) highlights the importance of cross-functional co-operation and defines QFD as follows: "QFD is a group of techniques for planning and communicating that coordinates the activities within an organization. It is a dynamic, iterative method performed by interfunctional teams from marketing, design, engineering, manufacturing engineering, manufacturing, quality, purchasing, and accounting and in some cases, suppliers and customers as well. […] The primary technique is a visual planning matrix called the house of quality which links customer requirements, design requirements, target values, and competitive performance in one easy-to-read chart." QFD is a structured matrix approach to documenting and understanding customer requirements and translating them into technical design characteristics for each stage of product development and production (CAM-I, 1999). For quality control and management, see e.g., Bergman & Klefsjö, 1994; Evans & Linsay, 1996; and Mitra, 1993.

(FAST)[99], (3) Value Engineering (VE) and Value Analysis (VA) [100], (4) Design for Manufacturing and Assembly (DFMA) [101], (5) Manufacture and Design Evaluation (MADE)[102], and (6) Evaluation of Expenditure[103]. In addition, Nixon (1998a) lists the following philosophies and techniques: Benchmarking, Critical Parameter Management (CPM), Computer Aided Design (CAD), Rapid Prototyping, Design-for-Cost (incl. target costing and Kaizen costing), Design-to-Cost, and Taguchi methods.

To sum up, according to Nixon (1998a) an understanding of new product design and development aims, parameters and processes is a prerequisite for the use of various evaluation methods and management accounting information. With these elements combined, balancing the many dimensions and perspectives – such as customer and corporate needs, strategy and operations, core and emergent technologies and qualitative and quantitative dimensions – that new product development decisions entail becomes possible. Furthermore, the integration of management accounting concepts and methods to the philosophies and techniques related to new product

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[99] FAST is the primary tool used in QFD to decompose the overall functional requirements of a product so that the network of higher and lower level functional relationships can be identified and charted. A systematic examination of why each function exists and how it occurs provides a good basis for evaluating the relative efficiency and effectiveness of different possible solutions as well as their costs.

[100] VE complements FAST and it aims to find ways to achieve the specified functionality at the required standards of quality and performance and at the target cost. Once production commences, VA continues the search for the lowest overall cost consistent with product attributes Thus, it supports Kaizen that also supersedes target costing in the production phase of new product development. Value engineering consists of the following three steps: (1) analysis of function, (2) search for the alternatives to realize the defined functions of products, and (3) selection of the alternative to realize the minimum costs. It may be argued that value engineering plays a major role in achieving the target costs and that target cost management has its origins in value engineering (see e.g. Tani, 1998). Value engineering is a systematic method of evaluating functions of a product to determine whether they can be provided at a lower cost without sacrificing the features, performance, reliability, usability, and recyclability of the product. VE is generally used at the design stage of a product to improve customer value and reduce costs before production has begun (CAM-I, 1999). In other words, VA is concerned with 'find and fix' solutions after capital expenditure and after the product has been put into production, and VE is used at the design and development stage prior to capital expenditure and tooling (McDowell, 1994). See also, Cooper 1995, 165.

[101] DFMA focuses on the transition from the design and development stage to full volume manufacture. The many processes that DFMA encompasses, including FAST and VE, aim to reduce time-to-market by making easier to manufacture and assemble parts and components. DFMA is a simultaneous engineering process that optimizes the relationship between materials, manufacturing technology, assembly process, functionality, and economics. It seeks to ease manufacture and assembly of parts or eliminate parts (CAM-I, 1999).

[102] MADE includes software packages developed to model the complex interactions that exist among R&D, design, production and operation costs and simulate the impact of design changes on the respective cost categories.

[103] The background of these techniques lies on the general unanimity of the limitations of the conventional capital investment appraisal techniques. For example, the discounted cashflow (DCF) and payback methods discriminate against investment in innovative development projects. The perceived limitations of DFC have caused many of its critics to advocate the option pricing theory (OPT) approach for e.g. those decisions that entail a great deal of uncertainty.

development should be done at the early stages of the NPD project in order to maximize the value creation and cost savings. Nixon and Innes (1998b) suggest that one of the reason for this is also the fact that management accountants are technically and organizationally suitable for presenting the financial relationships between products, product families, company's product portfolio, as well as both the corporate and the competitive strategies.

Actually, it can be argued that some management accounting tools (e.g. target costing and cost tables) are somewhat similar to the engineering philosophies and techniques (e.g. QFD[104] and value engineering), in the sense that both may aim at translating customer requirements for product and process development as well as production by taking into account the technical and financial requirements.[105]

In this discussion, the purpose was to describe management accountants' cost management and accounting tasks that may include various approaches and techniques, many of which have a strategic nature and thus belong to the field of strategic cost management. According to the literature, target costing with entire lifecycle perspective lies in the core of NPD cost accounting. Furthermore, it should be noted that these cost accounting techniques serve both product costing and performance measurement, and moreover with a more comprehensive cost management thinking, management accountants may promote the cost consciousness among NPD personnel.

2.2.3.2. Financial Planning and Control

> *"Systematic and continuous learning about how a firm creates new products is the basis for more rapid and commercially successful product*

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105 Sandström (1999b) suggests that the engineering-oriented methods to communicate production cost information to design engineers may be roughly categorized into four groups, which can also be combined: (1) formulating (mostly qualitative) information about various design alternatives; (2) using the costs of the previous products (variant cost estimation); (3) analyzing direct cost with a general assembly drawing of the proposed product; and (4) analyzing the total costs of the product with a product drawing and estimated process plan. She mentions also that recently there has also been a strive to integrate cost information to 3D CAD systems. Practices of formulating quantitative (2, 3, 4) cost information can be classified further to simplified or detailed breakdown methods and regression-based cost estimation, which aims at finding the dependence relationships between costs and product characteristics. In addition, Sandström (1999a) argues that the parametric models presented in engineering design literature use the cost driver principle although the terminology does not include cost drivers as in the activity-based costing literature. Even though the parametric models search for cost driving parameters with analytical means, their weakness is the fact that some of the costs are analyzed in great detail, while all the costs are not taken into consideration. However, also in ABC the historical correlation between the cost driver and cost information can be analyzed statistically.

> *development. In turn, learning cannot be achieved without clear and purposeful measurement"* (Meyer *et al.*, 1997).

R&D centers in companies are frequently regarded as discretionary expense centers (see e.g. Kaplan & Atkinson, 1989).[106] Discretionary expense centers, whose budget is at the discretion of a higher level management, are typically characterized by the fact that their results are not measurable in financial terms or that there is no significant relation between the resources the unit has used and the outputs the unit has produced. The latter case is the problem with R&D centers. The outputs of R&D function, i.e. its effectiveness, can be measured, for example in terms of new innovative products and improved production technologies, but whether or not the R&D center is operating efficiently, cannot be measured. Efficiency arises from the very relationship between the minimally required inputs and the actual outputs. Since this is the case, budgeting in R&D centers is extremely difficult. One potential way of solving this problem is benchmarking the resources a company has employed in R&D to the figures of companies in the same industry. Frequently, companies express their R&D budget as a percentage of sales (Kaplan & Atkinson, 1989).

Dávila (2000) notices that some authors and researchers find only marginal relationships between management control systems and NPD project characteristics. For example, Abernethy and Brownell (1997) conclude that reliance on accounting controls has significant positive effects on performance only where task uncertainty is lowest whereas behavior controls appear to contribute to performance in no situation. According to Dávila (2000) this evidence suggests that management control systems have, at most, a minor role in product development. He identifies three main types of uncertainty in NPD research, namely market-related, technology-related and project scope related uncertainty, and argues, however, that management control systems have proven to be useful tools in environments characterized by high levels of uncertainty (e.g. Khandwalla, 1972). Dávila (2000) suggests further a possible explanation for the apparent contradiction, according to which R&D studies interpret the management control systems as tools to reduce goal divergence rather than as information tools to deal with uncertainty. In addition to these uncertainties characterizing a NPD project, Dávila (2000) suggests that the design of management control systems in NPD depends on the strategy as well as the organizational structure.

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[106] Kaplan and Atkinson (1989) categorize the decentralized units as follows: (1) Standard cost centers which are usually production units; (2) Revenue centers which include marketing activities; (3) Profit centers whose managers have nearly complete autonomy on the operational decisions; (4) Investment centers which are similar to revenue centers, except that their managers are responsible for capital and working capital investments; and (5) Discretionary expense centers, which include, in addition to R&D centers, other support activities, i.e. general and administrative departments, such as personnel and accounting departments.

It should be mentioned here that although the tasks of management accountants in NPD may include also financial accounting activities such as consolidating and financial reporting, these tasks are excluded from the theoretical part of this study for relevance reasons.

Budgeting

Traditionally, the management accounting related to R&D has been driven by financial accounting, and the performance of new product development has been emphasized mainly through project budgeting and follow-up (see e.g. Curtis, 1994; Pawar & Driva, 1999; and Sandström & Toivanen, 2000). Pogue (1998) has defined the objectives of an R&D budget as follows[107]:

(1) To identify clearly the individual R&D projects and R&D periods
(2) To put a budget money value on the items which can be clearly identified as R&D costs so that they are not lost in e.g., general salaries, wages or material costs.

Kaplan and Atkinson (1989) speculate the situation where the budget of an R&D center has been determined. They claim that no great benefit can result from pressuring the local manager to bring actual costs under budget. This is not necessarily favorable nor a sign of efficiency or not even a good approach regarding the innovative work. A positive budget variance may be interpreted that the center has operated at a lower quality level and thus also on a lower performance level.[108] Kaplan and Atkinson continue by stating that a discretionary expense center is a typical unit where information asymmetry may exist between the center management and the top management. They summarize by the following words which may considered relevant to this study (ibid., 532):

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[107] It is also important to note a contemporary downward trend in importance of traditional annual budgeting (cf. Wallander, 1995 and 1999). However, Ekholm and Wallin (2001) report that the annual budgeting ”is not yet ready for the scrap heap” even if there has been a managerial shift away from management of resources. Currently, the budgets seem to be combined into a hybrid system with forecasts, and other new instruments as balanced scorecards.

[108] In R&D environment, which is characterized by great uncertainty in general and even mutual competition of resources between various development projects, there can also be very good opportunities for budget biasing (see e.g. Lukka, 1988a and 1988b), i.e. creating deliberately difference between the budgeting actor’s ex-ante forecast (“honest budget estimate”) and his or her submitted budget figure (bottom-up proposal). For example, a project manager of a single NPD project can create budget bias according to the resource or performance evaluation intention. The outcome may be fully used biased expense budget or ex-post slack identification. However, in latter case, the project manager may argue that in the following evaluation periods it might be more optimal to use all the R&D expense budget including the potential slack, rather than eliminating it.

> *"Ultimately, the control of discretionary expense centers requires the informed judgement of knowledgeable professionals on the level and quality of service the centers are producing."*

Nixon and Innes (1998b) suggest that whether the design budget and proposals for design expenditures are evaluated ex-ante and/or ex-post, depends on several factors including industry features, inherent risks and the views of top management on performance measurement and, particularly, on whether product development teams take precedence over functions in an organization's structure, management processes, and reward system.

Budgeting is also related to planning on longer-term, and that is why it is worth presenting the unexpected viewpoint by Twiss (1984) who suggests that technology forecasting in determining the anticipated market size and market growth rates for new products can be of real value once it is accepted that it is essentially concerned with modeling human behavior.

Performance measurement and incentive systems

According to Hauser & Zettelmeyer (1997), the importance of R&D performance measurement lies in three key areas. Firstly, they document the value of R&D and they are used to justify investments in R&D operations. Secondly, performance measurement supports the top management decisions, especially regarding effective resource allocation. Thirdly, performance measures have their effects on organizational behavior in R&D units.

Meyer *et al.* (1997) have made a comprehensive R&D measurement literature review. They classify the measurement techniques to be comparative, scoring, benefits contribution, schedule analysis, or individual and group analysis methods of measurement. Furthermore they divide the measurement following the sequential stages in a product's lifecycle as follows: product planning, development control, R&D cycle performance, market cycle performance, and full lifecycle performance. Meyer *et al.* found numerous, some seventy-five in total, measures of R&D effectiveness proposed in the literature. They argue that the most commonly used R&D metric, the gap between expected and actual project time, has too much short-term focus in the sense that it does not support learning leveraged from the product platforms, which may take longer time to complete, but which have great advantages thereafter in the form of lower cost and faster development times. Meyer *et al.* (1999) have the overriding goal to help managers better understand the technical and commercial effectiveness of R&D on a product family basis.

Geisler, in turn, (1995) reviews the previous R&D performance evaluation models published in the R&D management literature and classifies the models into four categories. (1) The first includes models assessing the economic impacts of research[109]; (2) the second includes models of research performance in terms of the productivity of individual researchers and their groups[110]; (3) the third includes models of valuation of research measured by selected outcome indicators, such as counts of publications, citations and patents[111]; and (4) the fourth includes models of evaluation which employ subjective assessments, primarily in the form of peer review by individuals or panels of experts[112].

Furthermore, Geisler (1995) divides the models into two types: (1) input (cost) models and (2) output (performance) models. He argues that the input models do not assess performance of R&D, but the data they utilize are also used in the economic outputs model listed above.[113] A cost model is essentially an input model in which the inputs to R&D are calculated in the form of indices of direct investments in R&D and their ratios to other outputs. A performance model, on the other hand, is based on the development of key output indicators for each of the stages in the downstream process of R&D impact assessment.

Geisler (1995) presents an integrated model of R&D evaluation, which links the cost of research with its various outputs. The model differs from previous models in that it consolidates both cost and performance assessment. The indexes of cost-performance proposed in this model reflect the relative cost-effectiveness of the R&D activity throughout a substantial portion of the

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[109] See e.g. Mansfield, 1991 and 1992; Griliches 1984, and McGarth & Romeri, 1994.
[110] See e.g. Callon *et al.*, 1986.
[111] See e.g. Tijssen, 1992.
[112] See e.g. Bozeman *et al.* 1993; and Robb, 1991.
[113] Geisler (1995) states that the economic outputs model is the only category of the four listed above that relates inputs to outputs from R&D in an attempt to assess the benefits derived from R&D. He continues that these models have two kinds of methodological problems: (1) isolation of the economic / financial benefits of R&D to the organization from other effects, such as efficiencies in manufacturing, management and marketing; and (2) imputation problems of the time lag between R&D and economic benefits to the organization. These models make strong assumptions to allow for a causal link between inputs and outputs. Much of the uncertainty and the gap resides, according to Geisler, in the research activity and its link to measurable benefits, and less in the development portion of the innovation process. The integrated model is an attempt to overcome some of the shortcomings of the previous models.

innovation process.[114] In Geisler's integrated model, the indices provide a company for a mechanism to assess the impacts of its research on its products, services, processes, and its clients, and to compare these impacts with the costs it incurred in the research activity, and per scientist and engineer. They provide a possibility to intercompany comparisons, as well as comparisons over time for the same program or company (Geisler, 1995).

Similarly, Brown & Svenson (1988, 1998) complete the picture by integrating inputs, activities, outputs and finally outcomes in the measurement system, which is implemented in R&D environment. Figure 9 illustrates how the measurement can take place either on the in-process level or how the focus can be on the relationship between the inputs and outputs or the outcomes.

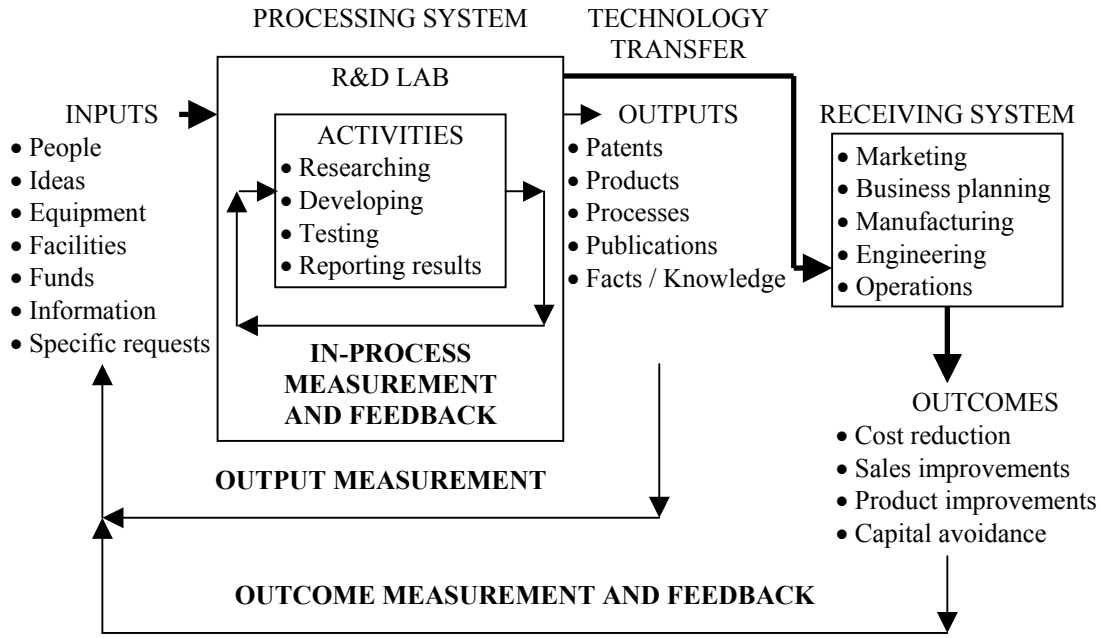

Figure 9. The R&D Unit as a system

Werner and Souder (1997), in turn, suggest that while qualitative metrics should be used at the basic and applied research stage, both quantitative-subjective and quantitative objective measures may be used at the product development stage.[115] Nixon and Innes (1998b) report the results of their case study research concerning performance measurement in new product

[114] European Industrial Research Management Association (EIRMA, 1995) classifies the R&D evaluation models as follows: (1) Ratio methods, (2) Economic score index methods, (3) Financial score index methods, (4) Mixed score index methods, (5) Mathematical methods, (6) Matrix methods, (7) Checklists, (8) Relevance trees, (9) Multicriteria and table methods, (10) Consensus methods, (11) Project appraisal methods (PAM), (12) Quality function deployment (QFD), (13) Experience-based methods, and (14) Vision. (See also, Nixon, 1998b). See also Robb's (1991) model and Szakonyi's approach to measuring the R&D effectiveness (1994a and 1994b).

[115] Here, quantitative subjective metrics is based on intuitive judgments that are quantified (Werner & Souder, 1997; see also Pappas & Remer, 1985). The underlying key factor is the uncertainty at each stage of R&D.

development and suggest that the balance between quantitative and qualitative measures of design performance depends on:

1. *The nature of design;* for example, the objectives and measures for a design engineering project were much more quantitative than those for an industrial design project which related to product identity and were mostly qualitative.
2. Whether the design is *innovative or more incremental;* the greater the uncertainty the more qualitative the measures.
3. *The stage in the product lifecycle;* according to the empirical results of the study, there is a movement over time from relatively soft information and strategic criteria to more reliable and operational measures as uncertainty is reduced.

Curtis & Ellis (1997) have addressed the issue of the scarcity of the true innovation-related measures. They argue that only recently there has been a real progress in this area. For instance, the technology value pyramid with a plethora of innovation effectiveness measurement areas and related measures places enhancing shareholder value at the pyramid's top and shows how internal strategies and processes must align with that ultimate outcome (see e.g. Tipping *et al.*, 1993). Curtis and Ellis categorize the desired innovation process outcomes as follows: (1) financial performance, (2) speed-to-market, and (3) customer satisfaction. The results of their study show that the balanced scorecards in new product development may exclude key measures or include wrong measures or measures that have no value. For example, they argue that there is an acceleration trap, which involves a trade-off between speed-to-market and financial performance outcomes.[116] However, as Abbey (1993) emphasizes, measuring product development time is important for at least two reasons. Product life cycles are continuously shrinking and competition is fierce. The use of NPD cycle times is also twofold. Firstly, they help to forecast on the basis of calculated average cycle time and secondly, this information can be used also in identifying whether, and if so, how, changing a part of NPD process has affected the cycle time. Curtis and Ellis summarize that strong empirical support emerges for three management actions: (1) Using

[116] Similarly, Simons (2000, 146) argues that break-even time as a performance measure in NPD may provide very useful information to evaluate the product development process, but in some companies, where the break-even metric is used also in performance evaluation of the NPD managers, these managers might become tempted to game the measure. According to Simons. "to reduce break-even time as much as possible, for example, they could select new products that were simple modifications of existing products. These 'new' products required very little investment, and their success was assured if the original product was already established. Therefore, break-even time was minimized but, paradoxically, the company risked depleting its innovation capabilities as revolutionary products were avoided." For a complete description of the application of the break-even measure in Hewlett-Packard Company, see House & Price (1991).

Quality Function Deployment (QFD); (2) Using stage gate tracking; and (3) Shifting R&D emphasis toward the customer in the value chain.

Also Schumann *et al.* (1995) have adopted the basic ideas of the balanced scorecard and to some extent modified them towards R&D focus.[117] They state that the dimensions in R&D balanced scorecard should be more aligned with people, process, outputs and consequences. They classify the consequences further into internal customers, external customers and society categories. Moreover, they classify the measures into four categories according to the purpose: (1) Performance tracking, (2) Technical productivity improvement, (3) competitor assessment, and (4) benchmarking or best practices. Tatikonda and Tatikonda (1998) present one example of their view on how the visions of top management and the corporate strategy may be translated into the measures of key competitive factors in new product development[118] (Figure 10):

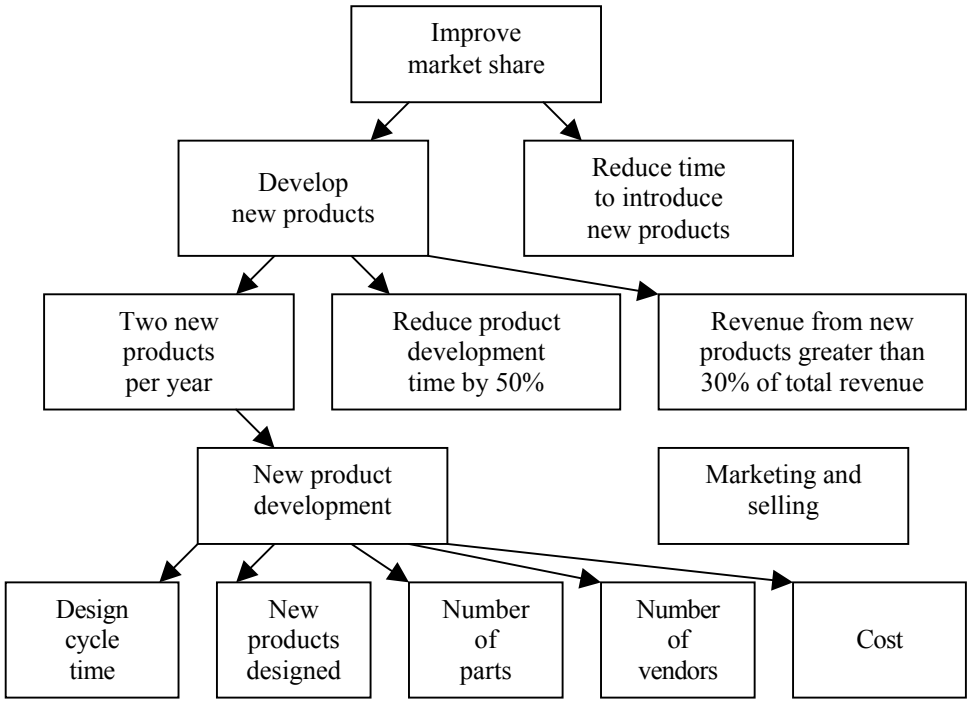

Figure 10. Performance Measurement in New Product Development

Although the consensus is that financial measures do not have an important role in R&D departments other than signaling the commitment of the organization to its R&D efforts (see e.g., Rockness & Shields, 1988; see also

[117] Dávila *et al.* (2001) report from their survey of 325 companies that there is a pattern in the importance of various innovation measures, i.e. managers cluster them into groups similar to the ones that balanced scorecard suggests. Furthermore, they argue that not all dimensions of innovation strategy are associated with all types of measures – as balanced approach would suggest.

[118] Sandström and Toivanen (2000) illustrate similarly the causal chain in the performance measures related to NPD. They mention how the standardization goal was communicated in their case company to the designers by explaining how the goal facilitates manufacturing improvements and customer-oriented manufacturing, and finally increases profits thereby supporting also the financial goals.

Rockness & Shields, 1984), in his study, Dávila (1998 and 2000) assumes that the main role of control systems in new product development is to supply information to reduce project-related uncertainty. The results of the Dávila's study hence suggest that management control systems' design varies with the product strategy, market complexity and organizational structure. According to Dávila, better cost and product design information are the ones used less frequently and which however have a positive association with performance, while time information receives most attention and harms performance (cf. Curtis & Ellis, 1997). The potentially harmful recent over-emphasis may be due to the increased time-to-market pressures. More surprisingly Dávila reports that managers expect that good performance in non-financials will automatically drive good financial performance. Such a relationship has not been established empirically (ibid.; see also Curtis, 1994).

Dávila (1999) suggests that measuring product development performance is difficult for several reasons. A measurement technology problem is the first one. Some of the performance dimensions are hard to measure and it is too costly to contract on them. Another measurement technology problem arises when the measures are noisy.[119] According to Dávila, a second difficulty is the congruity problem. When the measures used are not congruent with the performance dimensions, then the agent is not motivated to deploy all efforts in an optimal way. Some of the companies avoid these problems by offering a flat salary. In this way of contracting the above problems are solved, but the power of economic incentives is totally forgotten. A second solution is to accept the problems and still offer a variable portion of compensation based on an incomplete set of performance measures. Some organizations choose a third alternative and contract on the observed (ex-post) ability and effort of the agent – a subjective evaluation (ibid.).

Griffin and Page (1996) summarize that the problem of NPD performance measurement arises because of the multidimensionality of product development outcomes. On the basis of previous research, they identify three independent dimensions, which are consumer-based, financial, and technical or process-based success. The results of their survey indicate that the most appropriate measures for project-level product development success vary by project strategy, depending on the newness to the company and to market (cost reduction, product improvements, new-to-the company, product repositioning, line extension, new-to-the-world). For example, customer satisfaction and

[119] For example, product profitability can be measured easily, but it includes information not directly related to the effort of the product development manager, such as sales and marketing effort, manufacturing efficiency or industry attractiveness (Dávila, 1999).

customer acceptance were found to be the most useful customer-based measures for several project strategies, but market share was cited as the most useful customer-based measure for projects involving new-to-company products or line extensions. They also hypothesized that the mix of NPD projects commercialized would vary by corporate strategy. Thus, quite similarly, in part of because project mixes varied, they expected the most useful measures of overall NPD success to also vary by corporate strategy (prospector, analyzer, defender, reactor). At the program level, they found that companies with a business strategy that places little emphasis on innovation needs to focus on measuring the efficiency of their NPD program, while innovative companies need to assess the program's contribution to company growth. In other words, they suggest that prospector firms should measure especially e.g. the share of sales and profits generated by new products and all the other companies should focus e.g. on ROI measurement and success/failure rate at the level of overall NPD program (ibid.).[120]

Moreover, organizations can choose a combination of individual and group performance measures (see also Drake *et al.*, 1999; Stewart & Barrick, 2000; and Zenger & Marshall, 2000) as well as objective and subjective evaluation. Organizations can also defer a part of the bonus payment: for example, sales over the product lifecycle are a good measure of the success of a product development effort. According to the empirical evidence by Dávila (1999), better performance in new product development is associated with variable rewards. However, he reports that more variable incentives are not related with better performance.

In their comparative study of developing a reward systems for R&D projects, Rantamäki *et al.* (1999) report that the satisfaction with the incentive system can be gained at least by two ways, i.e. paying satisfactory bonuses or letting the personnel participate in the process and thus gaining understanding of the system. Furthermore, they identified at least the following objectives of implementing a reward system in R&D environment: (1) to equalize the pay structures between divisions, (2) to increase the relative amount of result-based pay in pay structure, (3) to encourage anticipating and accomplishing

[120] See also Loch (2000) who on the basis of his literature review suggests that (1) market characteristics that increase NPD success chance are large and fast growing market, strong position in market, market or technology with high newness is risky, product with high competitive attractiveness; and (2) NPD process characteristics that increase project success chance are customer orientation/demand pull, functional competence and cross-functional cooperation, top management support, formalized project selection, rigorous planning and execution, early specification and tight process with formal measures, strong project manager, and process contingency (use less structure in uncertain projects). For the critical success factors in measuring the success in R&D, see Cooper & Kleinschmidt, 1996.

R&D projects as they are planned, (4) to intensify learning and co-operation, (5) to maintain the current process efficiency in R&D, and finally (6) to keep people and experience in the company.

To sum up briefly, in this discussion the purpose was to describe management accountants' tasks in the field of financial planning and control in NPD, which are various and they are informed by the in-built uncertainty in product development operations, quite similarly as in cost management tasks. For example, Abernethy and Brownell (1997) argue that the distinctive feature of R&D tasks, which potentially influences the effectiveness of accounting controls is their lack of routineness. As Hertenstein and Platt (1998) mention, management accountants could volunteer to develop pro forma statements to show the return on investment or they should prepare what-if analyses. Budgeting in NPD operations may emerge in the form of rolling budgets with latest estimates to be updated regularly. Performance measures which may also serve R&D personnel's rewarding systems should include both financial and non-financial, qualitative indicators. Thus, balance scorecard approach may well be adopted.

After summarizing the theoretical discussion on financial planning and control in product development on general level, there are two arising issues, namely R&D departments as responsibility centers and the issue of integrating cost accounting and performance measurement in NPD, which deserve a more specific discussion. They both describe perfectly the contemporary changes in R&D control and summarize the most relevant issues of management accounting in new product development, as well.

R&D Departments as Responsibility Centers

There is an increasing pressure on R&D to be accountable to the business needs (cf. Nixon *et al.*, 2000). Kerssens-van Drongelen *et al.* (2000) have conducted a case study to investigate the differences in organization, management and activities between R&D cost centers, R&D profit centers and independent R&D businesses. They have observed that a growing percentage of the funding of R&D departments directly depends on the research contracts with business units within the company or even with external customers. Thus, the R&D departments are becoming more and more responsible of generating their own income, which means in accounting terms that they become (semi-) profit centers. From the accounting point of view this leads immediately at least to the need of establishing prices for the R&D services. The theoretical discussion suggests that this development leads to the following implications:

1. *Strategic implications*: R&D organization has the freedom to work outside companies and thus a need to develop its own corporate identity, vision statement and strategic plan.
2. *Implications for the types of R&D activities*: R&D organization may have more freedom to determine the mix of long-range and fundamental research, short-term application research and services (not necessarily negative implications for basic and applied research).
3. *Entrepreneurship:* Managers of R&D organization need to behave as entrepreneurs.
4. *Marketing of R&D services:* R&D organization has to carry out the marketing of its services to the customers.
5. *Project management implications:* A more structured approach to project monitoring and management is required.
6. *Implications for the capabilities and attitude required from the workforce:* Researchers have to be more flexible and prepared to move their skills into new areas or develop new ones.

The empirical outlook by Kerssens-van Drongelen *et al.* (2000) suggests that R&D management is typically considered as general management, which results in no control outside the R&D organization except for the shareholders. The empirical outlook indicates also some facts related to the management control system within the R&D organization. For example, the performance appraisal of the R&D profit centers is typically based on measurable targets. Moreover, the R&D units with own profit responsibility were typically further divided into business areas or units where they usually offered a whole array of R&D services.

Based on their theoretical discussion, Kerssens-van Drongelen *et al.* (2000) categorized various freedoms of choices to examine the R&D cost and profit centers and independent R&D businesses. These choices included (1) financial structure and negotiations, (2) use of positive cash flows, (3) technological areas and markets, (4) mix of activity and product types, (5) competitive strategy, (6) suppliers, business partners and customers, (7) prices for the goods and services, (8) investments in physical assets and human resources, (9) personnel selection, remuneration and rewarding, and (10) operational issues.

The empirical findings indicate that only the independent R&D businesses had the freedom of choice on the financial aspects (categories 1-2), which separated them from the identified semi-profit center, which was however able to make autonomous decisions on the physical assets and human resources. The R&D cost centers had typically freedom of choice only on the operational issues such as working methods and procedures. Overall, there seemed to be

both differences and similarities in the control systems of the R&D centers of different natures (Kerssens-van Drongelen *et al.* 2000).

> *"Overall, we conclude that a move from cost centre control to profit centre control seems to imply several new tasks to be carried out by the R&D organisation, more attention towards maximisation of asset value, new opportunities for researchers to increase their income and to work on projects close to their heart, as long as they satisfy the more stringent demands for personal accountability."* (Kerssens-van Drongelen *et al.*, 2000, 6)

Integrating Cost Accounting and Performance Measurement in NPD

On the basis of the previous theoretical discussion on R&D operations, it is evident that decision-making process in new product development includes various trade-offing dimensions and criteria, such as product costs, product properties and development time. It is also widely agreed that balanced scorecard can act as a balancing performance measurement system, which takes both financial (lagging) and non-financial (leading) indicators into consideration. Despite the fact that the nature of product development is typically acknowledged to be very unique in the above-mentioned sense, there has been only little discussion of integrating the financial information, especially cost accounting and non-financial performance measures. In other words, the discussion of combining the product costing in the early stages of a product's life span together with balanced scorecard approach is practically missing in both the academic and professional literature.

Thus, it would be worthwhile to refer to the theoretical discussion by Nousiainen and Sandström (1999) who attempt to connect managerial aspects with the economic information needs of design engineers. Their idea is to emphasize the cost control aspect of strategic management, which is operationalized with balanced scorecard and activity-based costing. They suggest that the traditional engineering design literature builds cost models for cost estimation using statistical methods or analytical formulae. Whereas the analytical formulae are argued to be most successful when considering the variable or direct costs of a product, with the statistical means it is possible to handle also the fixed or indirect costs. However, the argument by Nousiainen and Sandström is that these engineering-oriented means of producing cost information do not support management practices, but instead they only aim at helping the designer to recognize costs related to their detailed design decision.

In Table 1, adapted and edited from Nousiainen and Sandström (1999), it is proposed what are the information needs and sources as well as how the combination of BSC and ABC can be used both as a control system and decision facilitating information system to increase the cost consciousness of the design engineers in the various phases of the engineering design process. The fundamental idea is that the information is more accurate and company-specific as the NPD project proceeds (see also, Sandström, 1999a).

PHASES OF THE ENGINEERING DESIGN (+ results from each phase)	DEFINITIONS AND DECISION AREAS	INFORMATION NEEDS AND SOURCES	PERSPECTIVES OF BSC TO BE CHOSEN	ABC INFORMATION TO BE USED IN PERFORMANCE MEASUREMENT
Planning & clarifying the task (requirements list)	Requirements, restrictions, design type, functions	Market analysis, meeting notes, competitor analysis, information about previous products. Communication widely, also outside the own organization	Customer and Learning & Growth (Innovation) perspectives; Internal perspective; Financial perspective	• Activities and cost structures of company • Cost drivers of company or customers • Cost drivers of projects
Conceptual design (conceptual sketch and first parts lists); principle solution	Definition of principle solution (architecture, function), analysis of product structure, virtual or physical modeling	Concept sketches, layout drawings, technical calculation models, information about product structure, technical, and economic criteria. Communication across the organization		• Historical project, product, and customer cost data • Cost effects of standardization • Cost effects of sub-contracting or partnerships • Cost drivers of products
Embodiment design (geometry of parts and assemblies); definitive layout	Definition of dimensions, material, etc., parts analysis (prices, storability), Assembly analysis	Rules, principles and guidelines considering designing the product, design calculations, mathematical and numerical models, information about single parts geometry and assembly geometry. Technical and economical criteria and data.		• Part specific cost and cost driver information
Detailed design (complete product information with component and assembly drawings); product documentation	Definition of tolerances, surface quality, etc.	Models, design calculations, manufacturing drawings, bill of materials, tests, specifications, user information		• Parametric cost estimation

Table 1. Performance measurement and cost control in NPD

2.3. Knowledge Creation in New Product Development

"Management accountants should […] have the ability to bring their knowledge to the context of the corporate management and various functions, and in turn express their knowledge in accounting terms understandably" (Järvenpää, 1998, 203; translated by Taipaleenmäki).[121]

As discussed before, the true business controllership role becomes fulfilled when information is combined with reasoning in order to create knowledge. Management accountants' core competence is more and more important because a lot of information is widely accessible by anyone (e.g. due to the enterprise resource planning systems, ERPS), but the analytical use of information takes place on the local level where the business controllers are located. This is the case also with the NPD projects.

Manninen (1994) summarizes in his doctoral dissertation that there are three elements that affect the accountant's the sense of knowing. By the first element Manninen means the user of accounting information, which he calls "the important other". The user of accounting information has the chance to affect on the criteria according to which the relevance of the information is determined. The second element is the classification that bases on prior experience, by which Manninen means the ways that accountants have in dealing with certain accounting issues and events. Thus, any new issues and events are classified according to the classes that are formed by the accountant. Actually, this is the very professional tacit knowledge that is possessed by the accountants. The third element, which creates the sense of knowing, is the ability to see how the real-life business events and accounting reports reflect each other. Also this can naturally be considered as an integral part of accountants' tacit knowledge.

In this chapter, the organizational knowledge creation theory (Nonaka & Takeuchi, 1995) is considered in the context of new product development especially from the viewpoint of a management accountant. There will be initial thoughts of implicit and explicit knowledge and their interplay in the

[121] Järvenpää (1998, 207) reports a comment by a controller at Nokia Telecommunications: "[…] it is not enough that you just sit here an look at the reports. You have to be there in these different functions like R&D, product marketing, new product development, IT […] and production. Somehow you got to have tentacles to see what is happening in there." (Translated by Taipaleenmäki)

knowledge creation interface.[122] First, the cross-functional knowledge creation interface will be discussed and secondly, the focus will be in the knowledge creation process with the help of some potential accounting examples.

2.3.1. The Cross-Functional Knowledge Creation Interface in NPD

Lindkvist *et al.* (1998) suggest that maintaining tight coupling between sub-processes in NPD allows for immediate responses and system-wide error detection. Also some interface learning might be expected to come about, where functional units learn about each other. They continue that, in the context of rapid and multi-functional problem solving, however, the chances of accomplishing deep knowledge generation and learning will be meager. According to Lindkvist *et al.* (ibid.), apart from *in-project learning*, it seems as though *inter-project learning* could also be important, for instance through *trial-and-error*. Such learning and knowledge reside in individuals and remain largely tacit rather than becoming firmly crystallized in impersonal guidelines. Lindkvist *et al.* mention further that managing NPD projects is a matter of *putting together and re-using individuals with suitable experience*. In addition, they argue that learning in project-oriented NPD operations tends to be local.[123]

Grindley & Sullivan (1998; see also Imai *et al.*, 1985) write about the knowledge creation interfaces and argue that the critical cross-functional integration involves communication, knowledge sharing, and substantial understanding within the firm. This may arise from *job rotation* and *cross-training* as well as from routines for involving different areas in the innovation

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[122] The tacit dimension of organizational knowledge has been considered together with global new product development operations. For example, Chang and Rosenzweig (1998) argue that differences in cultures, idiosyncratic tastes and buying habits are tacit and accordingly difficult to describe in precise engineering specifications. As a result, they found that firms were more likely to employ cross-national teams, and include overseas subsidiaries as sources of new product concepts, when they addressed tacit differences among overseas markets and plants for their global product design. Laalo (1999) argues that in a fast changing exports industry, the mental and social reality regarding the product marketing is far more important and thus includes more complex problematics than the physical reality of the product. In addition, he writes that in new mental models, product and service production should be seen as a continuing process of communication. Product design is thus organizing the tangible and intangible product data into understandable pieces of information. (ibid.).

[123] According to Levinthal and March (1993), local learning tends to be myopic and it may lead to various problems, e.g. over-simplified rigid mental maps of the individuals, too strong an involvement in special niches, learning limited to the spatial closeness of current actions, and knowledge generation building only on what already exists. Lindkvist *et al.* (1998) suggest that in NPD projects organized in a parallel rather than a sequential fashion, deadlines and related time-controls appear to have the potential to function as a globalizing mechanism preventing people and organizations from being guided by overly local and atomic perspectives and learning.

process. One of the critical issues for the company is how to learn from one new product development project to all succeeding projects. Similarly to Lindkvist *et al.* (1998), Jönsson *et al.* (1998) suggest that one device to accommodate this is that *about half the development team is transferred to the next team*.[124] Huber, in turn, (1999) presents two practices that can contribute to correct and communicable team learning: (1) The institutionalized *practice of sharing and explicating evolving knowledge* within the team and of subjecting it to examination, critique, and revision as it takes form, and (2) The institutionalized *practice of creating and delivering a lessons learned file*.[125]

Moreover, Huber (1999) argues that the team members will carry in their minds some of the new knowledge, both explicit and tacit, when they move on to the other assignments. Then they will spread the newly created knowledge to the minds of their new co-workers. He suggests that the sense-making and articulation of the two practices contribute greatly to converting tacit knowledge into explicit, communicable knowledge.

Accounting – Marketing Interface

In NPD teams containing various cultural dimensions, it should be taken into account that people representing different professional or national cultures may use the accounting information from the company's accounting systems according to different learning processes. Thus, it can be argued that these cultural dimensions are significant in the organizational knowledge creation process, and especially in the socialization phase. [126]

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[124] This means that half the team is getting acquainted with the new environment while working with technical problem solving tasks under great pressure (time, cost), whereas the other half is still working out what could have been done better the last time. This could be the case within the automotive industry where the NPD times are longer than with the high technology products like mobile phones.

[125] According to Huber (1999), it is critical that the lessons learned files are accompanied by directory information that enables potential users to contact those who were involved in the knowledge creation and codification processes.

[126] See e.g. Mouritsen, 1989 for the relationship between accounting and organizational culture (See also Bloor & Dawson, 1994; cf. Partanen, 1997, and Martin, 1992; Sackmann, 1992). For the relationship between accounting and national cultures, see e.g. Ahrens, 1996 and 1997; Granlund & Lukka, 1998b; Harrison 1992 and 1993; Merchant *et al.*, 1995; Perera, 1989; and Ueno & Wu, 1993. Morgan (1988) describes the relationship between accounting and organizational culture with the help of cost consciousness. He mentions that in hospitals where cost consciousness and strict financial control criteria have been highlighted during the last few years, there has been a shift from the patient-oriented organizational culture towards a more administrative one. He suggests that the humanity suffers whereas the financial performance is replacing it. Granlund & Lukka (e.g. 1997a and 1998b) have stated that the management accounting change is not separate from the environing management and corporate culture. They mention that the importance of the communication over the functional borders is more and more highlighted and appreciated. For management accounting change, see also Granlund, 1998; and for the role of management accounting in corporate crises, see Granlund, 1994.

The discussion of the cultural differences in the tacit knowledge possessed by the individuals is closely related to the discussion concerning the high-low-context continuum (see Hall, 1977). The core idea in the continuum is that in so called low-context cultures the explicit, more open communication dominates, whereas the communication in the high-context cultures is based on more implicit elements.[127] Here, the accounting – marketing interface is taken under more detailed discussion from all of the professional culture interfaces, because the academic literature from this professional interface is most advanced. In fact, there is only little anecdotal evidence of, e.g. accounting – engineering interface. Some of these issues are discussed in the chapter 3.2.

The accounting – marketing interface has been a relatively popular research area in the 1970s and 1980s. Some researchers (e.g. Spiegel, 1974; Harrison, 1979) have taken the marketing point of view, and considered how accounting can support marketing function, and some (e.g. Piercy, 1980) have considered how marketing concepts and orientation have created a new frontier in accounting. Frequently the writers argue that management accounting could have a much more important role in marketing (e.g. Simmonds, 1970; Whatmore, 1972), although there has been also critical approaches (e.g. Bridges, 1971; Ratnatunga *et al.*, 1989). Ratnatunga *et al.* (1989) report in their literature review that some problems have surfaced. First, a cultural lag between these two professions has been identified, and this has emerged for example in the form of resistance to change. Secondly, accountants frequently lack the knowledge and understanding of the information requirements necessary for the marketing function. Thus, a knowledge-gap has emerged. Both the cultural lag and the knowledge gap have usually been blamed on the production-oriented roots of management accounting and the necessary development of effective cross-functional communication has been recognized.

Ratnatunga *et al.* (1989) focused on the extent to which the accounting – marketing interface is developed and they conducted a study, in which they took the organizational titles, location, education and training, and attitudes under consideration. They suggest that a large majority of accountants were in agreement that marketing employees do not adequately understand accounting

[127] Granlund & Lukka (1997d, 7) state that ”the continuum is a tool for cross-cultural analysis, and it principally illustrates the use and significance of verbal and non-verbal (supplementary) communication in different cultures. It essentially tries to reveal where the message ’lies’ in different cultures. In low-context cultures straight communication is important, i.e. you are supposed to use facts, figures, and abundant details to communicate. Creation of a confidential human relationship does not play a major role in low-context cultures. In high-context cultures communication is more implicit, and places a heavier burden on the listener to interpret the message adequately.”

methods and procedures. The answers from marketing staff indicated, quite understandably, the opposite opinions on questions like this. It should be mentioned that about half of the marketers saw accounting's role as only one of routine control, whilst the other half involved them more in providing information for decision-making purposes. Taken the general discussion around the changing role of management accounting under consideration, it may be argued that the latter view accounts significantly for more than 50%.[128] However, the level of plausibility appears to be high, when Ratnatunga *et al.* (ibid.) conclude that if an organization had certain desirable attributes such as organizational roles and titles (e.g. marketing controller), location and knowledge, then the interactive process would be enhanced. More generally, all this calls for organizing accounting close to the function it should interact with, as well as establishing programs that provide cross-functional exposure. According to Ratnatunga *et al.* (1990), the cross-functional exposure necessitates cross-functional assignments, courses, and teams as well as job rotation. Chadwick and Ratnatunga (1981) observe quite reasonably the link between the culture and knowledge gap and argue that the knowledge gap can be closed through formal education, and further this should ensure that cultural gap is reduced.[129]

Foster and Gupta (1994) provide a discussion that links marketing with cost management and management accounting. In their literature review, they report that expositions of both lifecycle budgeting and target costing explicitly include marketing costs but spend most time on manufacturing costs. In addition, they mention e.g. activity-based costing technique, which is focused in allocating overheads, such as marketing costs. In the field of performance measurement, revenue or market share have a long tradition as key indicators instead of cost or profitability related indicators (see also Löning, 1999). Foster and Gupta (1994) argue that significant gaps are perceived to exist

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[128] Ratnatunga *et al.*'s data was collected during the late 1980s, and the previous studies in this area, according to which the most accounting and financial control systems are not designed to meet the specific needs of marketing management, date back even to the 1970sStill there are many companies that apply very simplistic financial control systems to their marketing activities (see e.g., Ward, 1995).

[129] Also Mills and Tsamenyi (1998) recognize the cultural differences and knowledge gap between accounting and marketing. They argue that the diversity of organizational participants (see Laughlin, 1987) puts communication at the forefront for the achievement of organizational success (see also Kelly, 1966). According to Mills and Tsamenyi, who simplify the case, evidence suggests that there is lack of communication between these two functions (see also Moss, 1986). They emphasize the use of language in communication and action in developing and achieving shared, mutual understanding through the communication process (see also Herda & Messerschmitt, 1991). This argument is closely related to the ideas of organizational knowledge creation theory especially in converting tacit knowledge into explicit knowledge. Mills and Tsamenyi's (1988) results illustrate further that the initial knowledge gap between accounting and marketing arises already in understanding of the other profession's role.

between the usefulness of information available from existing accounting systems and the potential value of accounting information in marketing decision. For example, the challenge of improving the assignment of costs to customers and products, and the challenge of collecting and analyzing marketing cost data in a flexible manner are considered the major challenges in better managing marketing costs (ibid.). Thus, also strategic management accounting becomes important in the accounting – marketing interface. Roslender *et al.* (1998) argue that strategic cost management may shed light on the nature of the measures needed to manage customers, competitors and products strategically. They continue that products are the first element of the marketing mix, itself probably the most familiar term in marketing management's conceptual framework.

In order to achieve a wider overall picture of the cross-functional knowledge creation interface, it should not be forgotten that here the focus has been in the relationship between accounting and other functions. For example, the relationship between marketing and other function has received growing interest among both the academics and practitioners (see e.g., Gupta *et al.*, 1986; Ruekert & Walker, 1987; and Olson, 1993). Berthon *et al.* (1999) discuss the cross-functional interface from the decision-making perspective. They categorize problems into two types of generic problems (see Mason & Mitroff, 1973). For structured problems, alternatives are known, while knowledge about consequences varies.[130] In contrast, unstructured problems are characterized by ambiguity where both alternatives and consequences are unknown (see also, Minzberg *et al.* 1976). Furthermore, Berthon *et al.* (ibid.) divide the organizational problem types into operational and strategic (see also, Mason & Mitroff, 1973). Problems of strategic nature typically comprise situations, which deal with the ultimate goals of the organization, the fit or alignment between the organization and its environment, and the organization as a whole. In contrast, operational problems are characterized by e.g. specific courses of action for the immediate future, and local-level influence. Berthon *et al.* (1999) argue that accounting work falls typically into the structured-operational decision-making context with predominance of routine and repetitive problems, whereas technicians and managers working in R&D or NPD might experience unstructured-operational context characterized by a succession of short-term, and localized problems of a unique and novel nature. From the strategic management accounting perspective and considering the changing role of especially management accounting discussion, this argument can be criticized, especially in the new product development context, where

[130] Under conditions of certainty, knowledge of consequences is partial or incomplete. Under conditions of uncertainty, knowledge of consequences is unavailable (Berthon *et al.*, 1999).

management accountants may frequently face strategic and unstructured problems. There is, however, one relevant comment of critical nature where Berthon *et al.* (ibid.) suggest that functions such as sales and marketing deal with soft issues of emotion, persuasion, and the non-quantifiable, whereas functions such as accounting deal with the more logical and quantifiable.

BAs as a shared space for emerging relationship

Nonaka and Konno (1998) use the concept of ba[131] to describe a shared space for emerging relationship. They argue that this space can be (1) physical (e.g. office or dispersed business space); (2) virtual (e.g. email or teleconference); (3) mental (e.g. shared experiences or ideas); or (4) any combination of them. What differentiates ba from ordinary human interaction is the concept of knowledge creation. Thus, ba provides a platform for advancing individual and collective knowledge. Knowledge itself is embedded in ba, where it is then acquired through one's own experience or reflections on the experience of others. Furthermore, if knowledge is separated from ba, it turns into information, which can be communicated independently from ba (ibid.).[132]

According to Nonaka and Konno (1998), each ba supports a particular knowledge conversion process that will be discussed later in the chapter 3.3.2.

1. *Originating ba* is the world where individuals share feelings, emotions, experiences, and mental models, and it is the primary ba from which the knowledge creation process begins. Physical, face-to-face experiences are the key to conversion and transfer of tacit knowledge, and thus it represents the socialization phase.
2. *Interacting ba* is more consciously constructed and it requires e.g. extensive use of metaphors and selecting people with the right mix of specific knowledge and capabilities into a cross-functional team, because a dialogue is key to convert tacit knowledge into explicit knowledge. Thus, this ba represents the externalization process.

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[131] Nonaka and Konno (1998) have adopted this concept from Nishida (1958, 1970) to elaborate the model of knowledge creation. Nonaka *et al.* (1998) argue that ba may refer to a specific time and space or even the space of relations (time-space-nexus), in an existential framework. They introduce the concept of ART (action-reflex-trigger) systems, which attempt to routinize knowledge conversions. In brief, ART systems are highly dependent on enbling conditions, and they can be designed as versatile for linking action to reflection in order to increase quantity of insights or to increase quality of new knowledge (ibid.).

[132] Knowledge of intangible nature is embedded in ba, while tangible information resides in media and networks (Nonaka & Konno, 1998). Similarly, Eppler & Sukowski (2000) list five levels of team knowledge management: communication platforms, norms, processes, tools, and leadership layer. Communication platforms consists of real space that tackles the tangible aspects and virtual space that is frequently an IT-based tool – such as standard groupware applications augmented with additional supplements, e.g. video conferencing or project managment software.

3. *Cyber ba* is a place of interaction in a virtual world and it represents the combination phase. The combination of explicit knowledge is most efficiently supported in collaborative environments utilizing information technology. Thus, the use of e.g. on-line networks, groupware, various databases, datawarehouses, and datamining techniques, as well as enterprise resource planning systems (ERPS) has been growing rapidly over the last decade.
4. *Exercising ba* supports the internationalization phase and means things, such as learning by continuous self-refinement and on-the-job-training (OJT) (Nonaka & Konno, 1998).

As the innovation activity typically takes place in cross-functional teams, the importance of the concept of ba is as evident in new product development as the significance of knowledge creation itself. Eventually, the knowledge generated within each ba is shared and forms the knowledge base of organizations. Nonaka and Konno (1998) mention that just as the ba for individuals is the team; the organization, in turn, is the ba for the teams (see also, Nonaka & Toyama, 2000, and Nonaka *et al.*, 2000).

Individuals as knowledge creators

Coopey *et al.* (1997) argue that the mainstream creativity literature has been concerned predominantly with cognitive processes and personality (see e.g. Barron & Harrington, 1980; King, 1990). They continue that R&D project teams are tasked with bringing new products to market rapidly. According to Coopey *et al.* (1997), the novelty of an innovation, and the degree of individual and social creativity required to achieve it, depend on the difficulty of making sense of disruptive events within the constraints of social relationships in their organizational context. They conclude that a research agenda concerned to achieve a deeper and richer interpretation of innovation in organizations might do well to focus not directly on institutional factors, such as shared meaning systems and power relationships, but on the social construction of innovations driven by the need of individuals experience to make sense of disturbing stimuli in ways that protect and enhance their own self-identities and those of influential others with whom they interact. The main argument in their study is that the process through which individual's innovations are realized can be sensibly interpreted in terms of the concept of sense-making as elaborated by Weick (1995).

Thus, the individual actors in the knowledge creation interface cannot be forgotten – as well as the decision-maker needs to be viewed as an integral part of the decision process. Powell (1987) discusses some problems people

experience in using information. He claims that accounting field has been slow to absorb many of the ideas on human information processing (HIP). Since 1967 a growing number of HIP studies have been undertaken in the auditing field, yet the management accounting area has been relatively neglected.[133] Lately, also accounting related HIP literature has taken tacit knowledge concept under consideration (Tan & Libby, 1997).

Stone *et al.* (2000) explored rank-based differences in technical, industrial and managerial tacit knowledge among management accountants. Similarly, they argue also that nearly all of the research related to the determinants of judgement performance in accounting settings was conducted in the audit context, whereas no recent reviews of behavioral accounting discuss the knowledge or ability required in management accounting. They state that existing accounting research has generally followed one of the two approaches to understand the role of knowledge in auditing and management accounting: (1) identifying the knowledge that is perceived as important by accountants and auditors, and (2) examining the relationships among experience, ability, knowledge, and performance. They also refer to the recent and comprehensive study (Siegel & Sorensen, 1994; Siegel *et al.*, 1997), which suggests that changing practice demands are one possible explanation for the high variability in the perceived importance of specific knowledge among management accountants. The empirical findings by Stone *et al.* (1999) indicate that ascending in the rank of management accountants is associated with (1) decreasing levels of entry-level technical knowledge learned primarily from instruction before beginning full-time work; (2) increasing levels of industry knowledge, and (3) increasing levels of tacit managerial knowledge. The latter two categories of knowledge are expected to be learned on-the-job through e.g. self-study and interaction with colleagues.[134]

HIP research is based on the basic model of man as an information processor. There are four major concerns, namely man's perception of information is selective, the nature of processing is sequential, and both the processing and memory capacity are limited (Horgath, 1980). Libby and Lewis (1977 and

[133] See e.g. Chang *et al.*, 1997; Davis *et al.* 1997; Herz & Schultz, 1999; Libby, 1987; Libby & Luft, 1993; Libby & Yan, 1994; and Nelson *et al.*, 1995; Stone *et al.*, 2000.

[134] See also Powell (1987), who suggests that the accountant actually exists in a world of decision-making. His traditional role is to acquire information, filter it and pass it on to others in a meaningful form. Both the recipients of the information and the accountant make decisions based on the accountant's interpretation of the data. Powell argues that since the organizations are becoming more complex, there are growing problems in acquiring information and processing it accurately.

1982) classified information processing variables into three areas related to input (information set), process (decision-maker), and output (decision).[135]

The holistic concept of man has been introduced by Rauhala (see e.g., 1986, 1988, and 1995; see also; Pihlanto 1990a, 1990b, 1996, and 1997). Rauhala argues that before it becomes meaningful to study human beings empirically, an ontological analysis should be made of how human beings appear and what kind of problems their qualities present to the empirical sciences. Pihlanto (1997) states that this would also hold true in accounting studies. The subjectivist (cf. Burrell & Morgan, 1979) holistic concept of man, which relies on existential phenomenology, is potentially useful as a basic methodological framework in accounting studies, because even those accounting studies that are behaviorally-oriented, have highly mechanistic notion of an individual actor (see e.g., Pihlanto, 1989). Pihlanto (1997) suggests further that it is possible to describe and analyze the relationship between an actor, i.e. a user and an accounting system, as well as the relationship between an accountant and the system.

According to the holistic concept of man, the human being is realized in the following three basic modes of existence, which together form a holistic entity (Rauhala, 1986; and Pihlanto, 1996):

1. Consciousness, or existence as a physical-mental phenomenon, as experiencing
2. Situationality, or existence in relationships to reality[136], and
3. Corporeality, or existence as organic processes[137].

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[135] They also identified four types of study: (1) lens model studies, which describe the decision situation with reference to the interaction between the environment; (2) probabilistic judgement studies, which consider the decision-maker's use of subjective probabilities, (3) predecisional behavior studies, which investigate the processes prior to the final decision-making; and (4) cognitive style studies, which are concerned with the characteristic methods of functioning that individuals exhibit (Powell, 1987). All the above-mentioned issues are relevant to this study. For instance, in line with the probabilistic judgement studies, it may be argued that accountant's job requires the use of probabilities, although human is not very good at using probabilistic information. In addition, human may use strain-reducing activities such as heuristics, which can be defined as rule of thumbs, to fully comprehend a complex situation. These rules of thumb may originate from individual's experiences that are part of his or her tacit knowledge. Moreover, cognitive style is a subset of personality. Powell (1987) states that the majority of cognitive style research in accounting field has focused on how to tune the information system to the need of the user. The most important cognitive style variables can be found in the classification of individuals into high and low analytics on the basis of their ability to differentiate objects from their contexts. A management accountant who is preparing an accounting report from existing accounting information, i.e. explicit knowledge, should take also these issues into consideration.

[136] The situationality consists of both real physical components and abstract components (e.g. values, norms, ideas, cultures, organizational atmospheres, human relations) (Pihlanto, 1991b, 388).

[137] The corporeality is always needed to realize the actions of the two modes of existence. For instance, the sense organs, brain, and nervous system are needed to formulate meanings in consciousness from the objects in the individual situation. It is also necessary to enact physical activities (Pihlanto, 1997)

Thus, the holistic concept of man provides a practical notion of a human being together with his or her various mental and physical activities, and the environment. The theory seems to capture the dynamics existence of human being, since all three modes of existence are intimately linked together. Changes in one are simultaneously reflected in the other two (Pihlanto, 1994a and 1997). Consciousness consists of noemas, i.e. meaningful contents, which help the human being to understand different objects and phenomena of the reality. In the consciousness emerges a meaning relationship, as a consequence of a noema becoming associated with its object. These meaning relationships become interlinked in a network, and thus form the 'world view' of a human being. This description resembles the basic notion of learning process in cognitivistic psychology, according to which an individual constructs actively his or her knowledge of the world and its phenomena by e.g. interpreting, organizing and editing the new information and knowledge on the basis of the mental models that reside in his or her current knowledge base.[138]

The notion of knowledge, as well as that of information, can be defined as an aspect or phenomenon in human consciousness. Pihlanto (1996) argues that in addition to knowledge in a narrow sense (e.g. scientific research results, factual accounting information etc.), in a wide sense, all meaning relationships (human qualities as feeling, will, intuition, faith, and so-called altered states of consciousness) are knowledge. Furthermore, practical knowledge, on the basis of which people deal with everyday life, and also business, can be considered as knowledge in wider sense (Pihlanto, 1996; cf. tacit knowledge by Polanyi, 1966; and practical consciousness defined by Giddens, 1984). Pihlanto (1996) suggests further that in order to understand the production and use of accounting information, i.e. the explicit knowledge that an accountant provides to the knowledge creation interface, the role of human consciousness and, as part of this, 'world views' in these processes should not be forgotten. This role becomes significant, since accounting information is understood in terms of the knowledge stored in the 'world view', which serves here as a point of reference.[139] These above discussed facts of the holistic concept of man as well as the notion of knowledge in wider sense are good to bear in mind while analyzing the organizational knowledge creation in a cross-functional interface among individuals from various backgrounds.

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[138] It should be mentioned that noema is the first step in the process during which a person understands, i.e. knows – or feels, believes, dreams etc., phenomena, objects and situations to be something. (e.g. Pihlanto, 1996). It should be noted further that all this might affect the individual's decision-making (Pihlanto, 1991a and 1991b).

[139] In addition, the role of consciousness is accentuated in information production and use because the knowledge in a wide sense may take part in the process of forming meaning relationships that occur primarily on the basis of accounting information (Pihlanto, 1996)

2.3.2. The Cost Consciousness (Knowledge) Creation Process in NPD

> *"[M]anagement accounting information can help the team to define design parameters relating to a product's function, form and ergonomics. Customer's quality, performance, price and life cycle cost requirements need to balanced with the company's profitability requirements".* (Nixon, 1998a)

As discussed before, in the core of the role of a management accountant in NPD is the attempt to balance the cashflow and contribution requirements of top management with the cost and value requirements of customers. Here, it is assumed on the basis of the previously discussed NPD and R&D accounting literature that promoting business orientation by increasing cost consciousness among the cross-functional team members of an NPD project is a critical knowledge creation task of a management accountant. In other words, the cost consciousness and the relationship between the cost structure and the business as a whole can be seen as the major tacit knowledge possessed by the management accountants supporting NPD (cf. Shields & Young, 1994). It is, thus, taken into focus as a specific example in this theoretical discussion. In brief, cost consciousness can be defined as comprehensive understanding of costs of various cost objects (e.g. products, organizational units, customers, processes etc.) and the underlying cost drivers.

If the cost consciousness is, thus, taken as an example of the sense of knowing (cf. Manninen, 1994) and its elements, it seems that the underpinnings of an accountant's sense of knowing lie in his or her professional background (e.g. education and prior experiences) and thus in the tacit knowledge. Because the above-mentioned tacit knowledge is typically not possessed by other NPD team members, at least compared to the extent that accountants possess it, and because accountants disseminate this knowledge only occasionally, it would be worth pondering, what would be the implications of well-organized knowledge creation to the cost consciousness in the new product development team.

Figure 11 was one of the potential starting points in some discussions as well as the observations in the case company. It includes the phases of knowledge creation process, as well as the type of previously discussed ba[140], together with potential examples.

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[140] The various types of BAs are closely related to the triggers of knowledge creation process. According to Nonaka and Takeuchi (1995), socialization mode usually starts with building a field of interaction, externalization mode is triggered by meaningful dialogue or collective reflection, combination mode is triggered by networking newly created codified knowledge and linking existing knowledge, and finally, internalization mode is triggered by experimentation and learning by doing. (See also Amelingmeyer & Kalvelage, 1999, for knowledge carriers.)

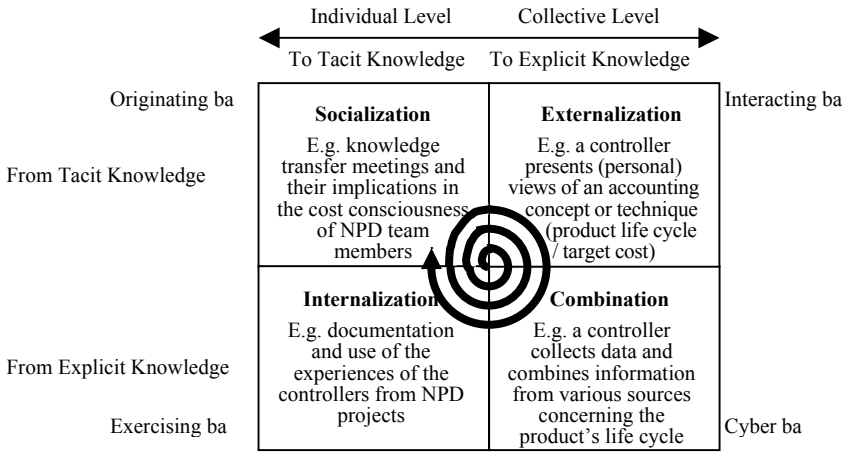

Figure 11. The Knowledge Spiral in Increasing Cost Consciousness in NPD

Socialization (from tacit to tacit)

In the socialization phase of the organizational knowledge creation process, in a NPD project, the representatives from a company's different functions interact e.g. in knowledge transfer meetings and brainstorming sessions.[141] The latter represent informal gatherings, at which commonly shared mental models and thus shared knowledge is expected to be created. Ahrens (1997) suggests that in the discussions, which may well be considered as the integral parts of the brainstorming sessions, the accounting information is disseminated, but what is more important, this is integrated with an individual's tacit knowledge.[142]

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[141] These brainstorm sessions that take place among the persons from different functions are good examples of the microcommunities of knowledge (Von Krogh *et al.*, 1997). Von Krogh *et al.* (1997, 477) mention that these microcommunities are not limited by the possible group, departmental or divisional borders, but instead they can cross these borders and be overlapping. They define a microcommunity as follows: "A microcommunity is a small core group of participants that engage in sharing of tacit knowledge […]" In addition, they list other activities involved the knowledge creation. Further, they mention that the actions of these microcommunities are characterized by own rituals, languages, practices, norms and values, face-to-face interaction, and the fact that the participants in the knowledge creation process gradually learn to know each other. On the formality of cross-functional integration, Haake *et al.* (1999, 10) suggest on the basis of their field study that "In small companies effective integration rests in direct face-to-face guidance on the part of senior management, i.e. on the informal integration through personality of the Managing Director or a small group of senior managers. Given their size, large firms, on the other hand, have to manage this integration through formalized processes as there are too many elements to be informally integrated by any one person."

[142] According to Ahrens (1997, 618), "Accounting talk […] is not just a verbal exchange of information. […] [T]alk can function as a mode of generating financial management information of specific purposes by combining estimates of financial effects of action with operational, more tacit knowledge. Through such combination, talk becomes creative." Nixon and Innes (1997) report from their case study that the basic financial concepts like potential risks and return and simple versions of techniques like scenario analysis and what if analysis, applied to each major risk area – technological, commercial, financial, management, project, portfolio and personal – are part of *the shared implicit knowledge* of all case company staff and are reflected in their everyday communications.

The cost consciousness[143] and the changes that take place regarding it can be considered a good example of how knowledge is created in a new product development project from the management accounting viewpoint. This importance is further highlighted when the socialization phase and the work of multifunctional NPD teams is considered. The team members can have very different views on cost consciousness and in addition their cost conscious behavior becomes manifested. Management accountant's role in the team is to act as a person, whose initial level of cost consciousness is the highest of the team members.

Shields and Young (1994) suggest in their study that the individuals acting in the R&D teams can be categorized to cost conscious ("Spending my corporation's money is like spending my own, and I watch my pennies") and non-cost conscious ones ("Since my corporation has lots of money, I focus on other items which I believe are critical to my job").[144] These approaches represent the very extreme points on the approach continuum. Thus, it seems evident that the management accountant can play a significant role in increasing the cost consciousness in a NPD project. In addition, Shields and Young mention that there are two kinds of cost consciousness. Local cost consciousness seemed to characterize thinking within an R&D unit, while global cost consciousness was an expansive view of the flow of innovation costs downstream and ultimately to the customer.

Shields and Young (1994) list and categorize the determinants of cost consciousness in the R&D environment in the following three classes: (1) Innovation Activity (basic research, applied research, development, engineering, and cost of regulations); (2) R&D organization (top management attention to costs, economic culture, scientific culture, cost-based compensation); and (3) Characteristics of the R&D professional (economic-management experience, hours of cost management education, cost knowledge, cost budget participation, cost budget tightness, cost budget changes, personal spending style). In other words, the nature of innovation

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[143] Järvenpää (1998) mentions in his study (case Nokia Telecommunications) that more widely considered on the industry level, the cost consciousness has increased due to the more and more fierce competition, especially price competition and to the fact that products are becoming partly mass products. Järvenpää (1998) states according to the empirical evidence that increasing the organizational cost and profit consciousness is one of the most important tasks that are included in the role of a controller.

[144] Shields and Young (1994) observed even that the development engineers focus more on costs than the typically non-cost conscious basic researchers. See also Dearman & Shields (1999), who studied 42 managers' cost-related experience, cost accounting knowledge, and cost-related judgement in an experimenter-adapted management case. Their data suggests the value of relevant cost accounting knowledge to managers' judgments.

activity, as well as organization and people involved determine the cost consciousness in the R&D environment. Empirical evidence from the study conducted by Shields and Young support these hypotheses. Especially the factors related to the prior experience and participation of the R&D professionals were seen to be significant determinants. According to Shields and Young (1994) cost management knowledge and cost budget participation had the most significant independent effects on cost consciousness.

As for budget participation in the R&D context[145], Shields & Young (1994) mention that it is an effective and efficient means of facilitating the sharing of, and learning about, diverse and complex information by innovation workers.

To sum up, the brainstorming sessions of multifunctional NPD teams, as well as budgeting participation in R&D context may be considered examples of the socialization phase of the organizational knowledge creation, in which the tacit knowledge (cost consciousness) possessed by the individuals, is transferred to the other people.

Nonaka and Takeuchi (1995) mention that these brainstorming sessions[146] represent a forum for creative dialogue, medium for sharing experience and enhancing mutual trust among participants. Brainstorming sessions can, thus, be considered as effective ways in sharing tacit knowledge and creating new perspectives. All these are very important issues considering the cross-functional co-operation. However, it cannot be forgotten that cultural differences may exist in the tacit knowledge possessed by people from different professional or national cultures.[147]

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[145] See also Birnberg *et al.*, 1990; and Shields & Young, 1993.

[146] Nonaka & Takeuchi (1995) use the term brainstorming camps, and they mention the informal meetings at Honda, called tama dashi kai. They continue that these camps reorient the mental models of all individuals in the same direction, but not in a forceful way. Instead, brainstorming camps represent a mechanism through which individuals search for harmony by engaging themselves in bodily and mental experiences. This may be described also with the help of the holistic concept of man. In the brainstorming sessions, the individuals, who aim at creative co-operation in the situationality of each other's, may reach a state, where they are able to share effectively the experiences that are stored through corporeality and consciousness as meanings in their 'world view'. In such creative co-operation, where the backgrounds and 'world views' of the participants may be extremely different, the dynamics of the holistic concept of man are only highlighted. For the holistic concept of man and accounting, see Pihlanto, 1997.

[147] Koivunen (1997) states that cultural differences and the cultural patterns of various nations play a major role in new product development and marketing, in global business operations. She continues that these patterns may be understood through the tacit knowledge, utilizing the implicit knowledge from one's own culture. Järvenpää (1998) reports that the corporate culture in Nokia Telecommunications is characterized by engineering professional culture, and this has affected also the role of management accounting.

A multinational, multifunctional NPD team can thus include at least three cultural dimensions that can affect the teamwork and learning: national cultures, organizational cultures and professional cultures (Snow *et al.*, 1996).[148] From these cultural elements, the team may form through their shared experiences a network of meanings, i.e. a team culture of their own, during the teamwork processes.[149] Harris and Moran (1991) state that it is essential in creating the subculture of the group that the right people are chosen to join the group. Especially they highlight that the criterion for team selection is the authority of competence – the individual has some knowledge, information, or expertise that can help the group achieve its mission.

Externalization (from tacit to explicit) and Combination (from explicit to explicit)

> *"Strategic management accounting concepts, especially those relating to customer profitability, competitor analysis and investment appraisal, could clearly also help communication and collaboration among the many disparate participants in NPD."* (Nixon & Innes, 1997, 5)

During the second phase of the organizational knowledge creation process, externalization, the management accountant can create awareness of certain accounting concepts, techniques and philosophies among the other NPD team members. The accountant may again base this phase of knowledge creation on his or her prior experiences. One of such accounting concepts can be the Product Lifecycle Cost (and Costing).[150;151] By creating awareness of the

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[148] Granlund & Lukka (1997a, 5-6) mention that "the notion of culture can be viewed as forming a hierarchic structure, consisting of several interacting layers. Even though we can even talk about a global culture (since there are beliefs and values common to all people), the more significant layers of this hierarchy are national and regional cultures; corporate, departemental, and functional cultures; and group cultures." (cf. also Lewis, 1996)

[149] According to the differentiation perspective of organizational culture, it is typical to e.g. the coherence of the various professional groups, functions, fields of tasks and ways of thinking that there are many subcultures in the organizational culture (see e.g. Martin, 1992, and Partanen, 1997).

[150] Similarly, the concepts of cost structure and cost drivers may promote cost consciousness of the non-accounting staff involved in NPD. See also Sandström (1999a) who argues that the activity and cost driver analyses, cost structures and activity descriptions can provide useful insights and play a major role in making engineering design work cost conscious with ABC. Sandström (1999b) suggests also that in her case company, in order to make the design engineers more cost conscious it was considered that the design engineers should be able to recognize those activities whose costs they are able to influence the most.

[151] The importance of management accounting concepts in NPD may be described with the following example. Ask (2000) argues that in his case company there can be found differences in what focus concept takes. Cost target has its focus on cost. He states that using this concept may over-emphasize the costs, as such, and lead the mind to the traditional cost reduction activities. Target cost, in turn, is the concept used in Target Cost Management. Ask states that this concept can have psychological effects on the organizational members, since this may signal a change from the old cost control system.

product lifecycle cost concept the management accountant may increase the cost consciousness of the NPD team members regarding the product lifecycle costs as a whole. Thus, the knowledge content of this externalized knowledge is conceptual in nature. In a similar way, during this phase of knowledge creation process, the product engineers may create awareness of certain product development philosophies and techniques among other NPD team members, or in their own field, a prototype of the product for further development.

During the combination, which is the third phase of organizational knowledge creation, the management accountant can collect and combine financial data and information as well as other items of knowledge in order to create a calculation of the anticipated product costs or the investments needed in the production technology. As a result of this phase, there may be various types of cost reports, trade-off calculations or what-if analyses, which can be used in the decision-making in the NPD project. This kind of knowledge would thus represent the combined knowledge, which may increase the cost consciousness of NPD team members by showing the product cost figures in financial terms where the data is collected and combined in an analyzable form in order to give information that provides perspectives to e.g. product properties and product strategies.

Internalization (from explicit to tacit)

The fourth phase of the organizational knowledge creation process, internalization, deals evidently with the question of initiating another knowledge creation process, i.e. increasing the cost consciousness in the future projects. In order to facilitate internalization it is possible, for example, to document the factors and events involved in NPD projects from the viewpoint of management accountants possibly with the help of accounting information. These documents can be used during the future NPD projects in similar situations. The documentation may be carried out for example through categorizing the experiences of management accountants as follows: (1) Informative issues, (2) problems experienced, and (3) successes experienced. Thereafter, these experiences can be stored in a cumulative database or data warehouse, which could provide, on-line knowledge globally throughout the organization in question. In addition, any underlying trends or association rules between these experiences and other NPD project data may be revealed by using certain data mining techniques. Alternatively, the NPD experiences may be documented from all team members in order to add to the professional dimensions when these experiences are used to increase the cost consciousness

in the future NPD teams. The internalization phase, thus, includes increasing an individual's tacit knowledge and understanding through taking advantage of the explicit knowledge that has been externalized and combined in the knowledge creation process.

2.4. Theoretical summary and NPD Accounting Framework

This discussion outlines and summarizes the key issues of the study in the form of a NPD accounting framework in Figure 12, which was developed in order to conceptualize and organize the above-discussed topics that were considered relevant and to be further used in supporting the gathering of the empirical data.[152] No strict causal relationships are to be captured in this framework. The empirical case findings (Chapters 3 and 4) will be reflected back to the theoretical discussion (Ch. 2). The focus is, hence, in capturing the relevant issues related to the management and organization of new product development, the methods, techniques and current practices included in accountant's job, as well as the essential link to the knowledge creation interface and process. The only exception is with the role of accountants, which are excluded from this framework due to reporting purposes. Another tailored framework will be presented later in this study to illustrate and summarize the case findings in context of the case company.

First, the company is presented with its interest groups that are relevant to the NPD operations. Thereafter, the partly mutually exclusive NPD objectives, so-called trade-offs, i.e. product cost, development time, and product properties are introduced. Customers are assumed to place requirements in order to gain customer value from the NPD objectives, whereas the competitors are assumed to challenge them. The sub-contractors involved in the NPD provide the company with the their core competence, but also bring new problems in control over the outsourced operations. The mutual trust in this relationship is generally expected, whereas the mutual competition exists between the companies in the same industry. Through the sales revenues deriving from the demand, customers eventually contribute to company's profit.

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[152] Theoretical framework aims at conceptualizing, and thus capturing a particular perspective of the reality. It is not mentioned to be a full picture of the reality, but instead it organizes the object in a new fashion. Framework is typically constructed to be an "educated guess" of the field of study presented and outlined in the research setting. For a researcher conducting an empirical study a framework serves as a tool of organizing the ideas from previous literature as well as own ideas and innovations based on the complex reality in order to facilitate the empirical data collection. The usefulness of a framework can be fully assessed only after it has fulfilled its mission in supporting the collection of relevant data (cf. Pihlanto, 1979).

The various objectives of the NPD also raise the issue of different forms of competition and competitive strategies at corporate level (cf. Porter, 1980, 1985). The cost objective brings the cost competition and cost leadership strategy into the picture. The properties of a product face competition based on e.g. product quality and functionality, and thus are related to the generic strategies of focus or differentiation. Finally, the generic strategy of confrontation (cf. Cooper, 1995) is introduced in Figure 12. It is assumed that the lean enterprises, which compete by selling equivalent products, are forced to seek temporary competitive advantages with fast reaction times in market.

Figure 12 is further elaborated with certain critical issues related to time, technology, NPD staff and NPD organization. Time-to-market pressure, the key issue here, is assumed to necessitate platform-based product development as well as concurrent engineering, which in turn requires a new kind of organization and cross-functional interaction (cf. Lindkvist *et al.*, 1998). The cross-functional NPD teams are the social platforms that form the organizational knowledge creation interface. The knowledge creation process in NPD is assumed to aim at introducing a product prototype through innovation by developers, promoting customer-orientation by marketing function employees – and from the management accounting perspective at increasing cost consciousness among those involved in NPD.

The framework will be completed with regard to the job of accountants (dotted-line ovals), which include current management accounting practices. On the first level, revenues and expenses are included in NPD project budgets in the field of management accounting, but also in the financial statements. Externally oriented strategic management accounting techniques may take place with both competitors (benchmarking) and sub-contractors (IOCM). Perhaps the most important management accountant's task supporting NPD, i.e. cost management, together with its techniques (LCC, TC, ABC) is located on the second level, as well as measures and techniques related to e.g. time, functionality and quality (BSC, VE, VA, CT). The critical links between cost accounting and indicators in balanced scorecard should also be noted. Finally, the other important set of tasks, financial planning and control is located at the bottom of the picture. A comprehensive balanced scorecard with its actual values and budgeted targets over the NPD processes, projects, etc. can be considered the indicator of lifeblood of NPD organization, because of the vague relation between the inputs and outputs of the R&D and NPD activities. This performance measurement in the form of a NPD balanced scorecard can serve as the basis for the reward system in order to facilitate profitable, efficient, and fast innovation activities.

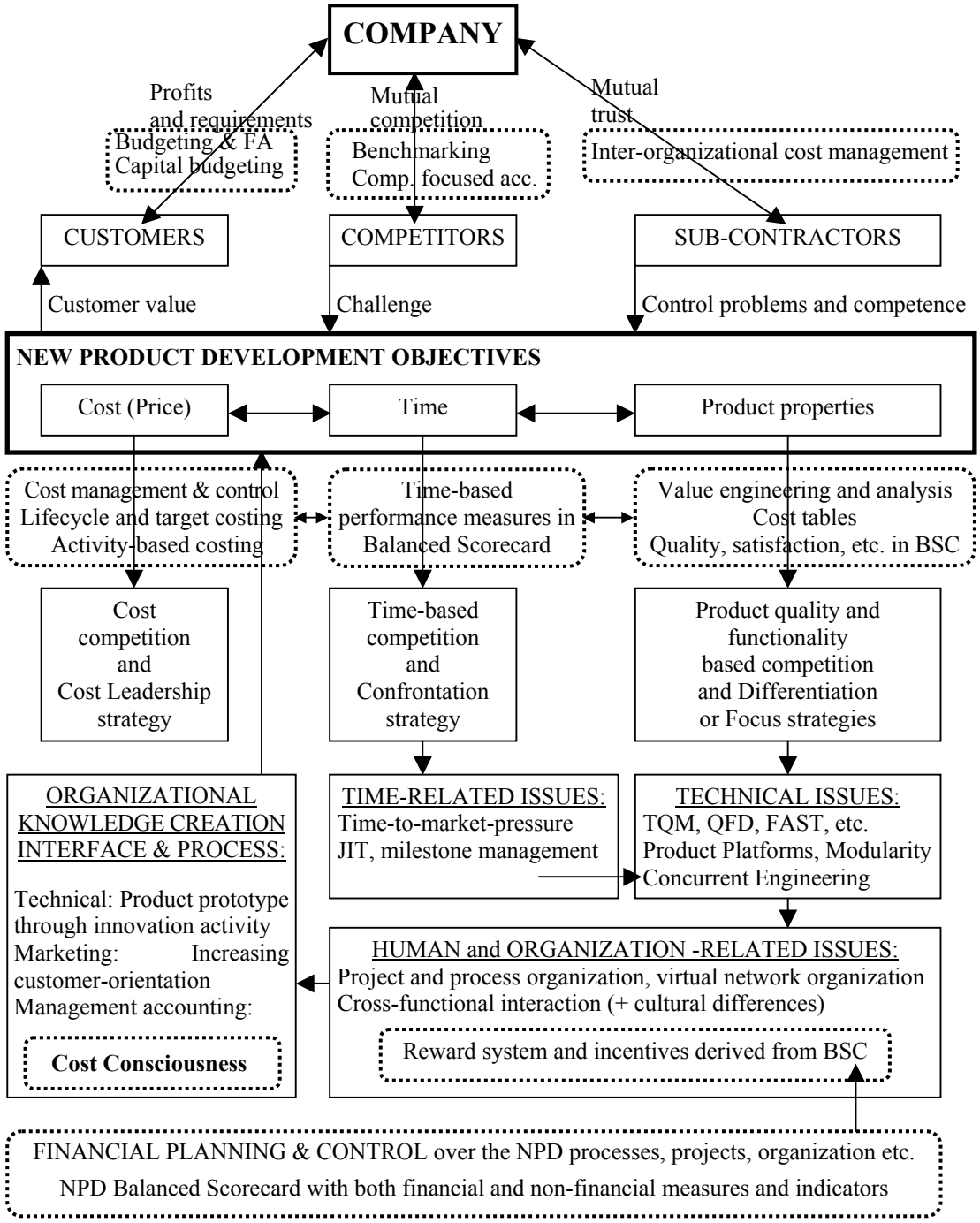


Figure 12. The NPD Accounting Framework

To sum up the theoretical discussion in Chapter 2, it can be argued that a great number of traditional and modern management accounting tools can be seen relevant in controlling the R&D operations. The theoretical discussion revealed also that promoting business orientation by increasing cost consciousness among the cross-functional team members of an NPD project is a critical knowledge creation task of a management accountant. In other words, the cost consciousness and the relationship between the cost structure and the business as a whole can be seen as the major tacit knowledge possessed by the management accountants supporting NPD.

3. MANAGEMENT ACCOUNTING IN NEW PRODUCT DEVELOPMENT: CASE NMP

> *"Developing cellular telephone systems is a matter of managing activities that are inter-related in very complex ways* (Lindkvist *et al.*, 1999).
>
> *"We have to invest lots of money in product development and R&D, and it is worth, people think, you know it is worth the money. If you don't – you stop doing this … We might lose our competitive edge."* (Product marketing project leader)

3.1. Background information of the case company

This description of the case company reflects Nokia Mobile Phones (NMP) as it was during the empirical data gathering phase of this study. NMP's Business Unit (Mobira at the time) was founded in 1979 as a joint venture between Nokia and Salora, a radio producer. The actual sales activities commenced in the year 1981 when the Nordic Mobile Telephone (NMT) network was opened in Scandinavia. Since then the business group has enjoyed decisive growth. The first acquisition was completed in 1991 when Nokia bought Technophone Ltd., the second-largest Cellular Mobile Telephone manufacturer in Europe.

In 2000 NMP's net sales totaled MEUR 21 887 with manufacturing and sales in over 130 countries worldwide. Operating profit in 2000 was MEUR 4 879. NMP accounts for 50.5% (MEUR 1 306) of the Nokia Group's MEUR 2 584 R&D investment (8.5 % of the Group net sales). Nokia Group's over 50 research & development centers are spread in over 15 countries with every three Nokia employee working in R&D. NMP has over 27 000 employees. Nokia is the world's largest mobile phone manufacturer with sales.

In brief, Nokia is a global company whose key growth areas are wireless and wireline telecommunications. A pioneer in mobile telephony, Nokia is the world's leading mobile phone supplier as well as a top supplier of mobile and fixed telecom networks and services. Nokia also creates solutions and products for fixed and wireless datacommunications. Multimedia terminals and computer monitors round out Nokia's expertise in communications technology. With a comprehensive product portfolio, covering all major standards and consumer segments, Nokia is in strong position to lead the development toward the third generation of mobile communications. Building on its know-how in core infrastructure as well as the design of software and user interface, the company is leading the development of new wireless data applications.

The mobile phone industry is characterized by the following factors, which are setting ever-increasing requirements on the management and the mode of operation:

- the industry is a global business with local differentiation
- demand and sales volumes have been growing rapidly
- there is a variety of existing and emerging standards
- high R&D intensity
- great importance of brand, choice of distribution channels and new customer segments

The critical success factors of a company competing in the mobile phones industry include (see Laaksonen *et al.*, 1998):

- deep understanding and utilization of the key customer segments and their corresponding distribution channels
- short product lifecycles and R&D throughput time
- cost effective manufacturing and logistics
- consistent brand and distribution management

These critical success factors can be considered relevant also for management accounting, because they can form e.g. the basis of the performance measurement.

In the following sections, the essential description of organizational changes towards process management in new product development in NMP is taken almost completely from the published article by Laaksonen *et al.* (1998), because much of this information is otherwise considered business secrets and cannot be expressed in any other terms.

3.1.1. Organizational development in the case company: towards process organization

Process management was adopted in Nokia Mobile Phones (NMP) in 1990. Since then the business has experienced very rapid growth. Process management was intended to be an approach and a tool for supporting the change process in engineering and its connections to the other key functions of the company.

During the first 12 years of its history, NMP has undergone several phases of different organizational strategies reflecting the changes in international competition and in daily operations. The guiding principles of the changes have been the following:

Phase 1: Divisional Organization (1985-1988) In the beginning, the company was divided into three technology standard driven divisions (NMT, TACS, AMPS). Some R&D and marketing activities were, however, organized on a global basis.

Phase 2: Functional Organization (1989-1991) After it became difficult to coordinate the operations and growth of the large divisional structure, production, sales and marketing, and R&D activities were centralized in order to have some level of coordination and economics of scale and to avoid duplication of effort. Then the organization started a transition to a more functional and global structure.

Phase 3: Process Organization (1992-1993) The functional organization faced the problem of suboptimatization. Although every function was functioning very smoothly and efficiently, the company as a whole was suffering from the lack of coordination. A process-oriented approach was started with cross-functional business processes and concurrent development of technology, products, marketing and logistics. Basically, the belief that successful management relies on cross-functionality, led to the adoption of a process-based working organization. The shift from the functional management mode to the process-based mode involved many fundamental changes in the philosophy and practice of management, the very first ones of which included a whole new model of the business and mode of operation.

The four main processes (Customer Satisfaction, Concurrent Engineering, Global Logistics, and Competence and Systems Development) were thought of as the phases of the conventional product lifecycle, except for the many interrelationships that stirred the sequential nature of the phases. In fact, it was an axiom of the process approach that the processes are to be managed and developed concurrently. The main processes involved some interesting new tools for coordinating the fast growth of an engineering firm in consumer electronics. In the following, some key features of the Concurrent Engineering Process are described. The Concurrent Engineering process took the marketing concepts and turned them in to the specific product design. Engineering was divided into two parts.

In *product creation and verification* phase there was a place for creative ideas and innovative engineering solutions, which were to be verified for technical and economic feasibility. Concept creation dealt with both the technology designs and the marketing side of business. Once the feasible product ideas had been identified, they were documented in *the concept pool*. In the concept

pool all those concepts and were contained which were found to have potential for implementation if financially justified.

Product concept implementation, the second part of Concurrent Engineering, then took a stand on the financial outlook of the concept portfolio to be implemented. The most promising concepts were selected for implementation. The actual product prototypes and process design were implemented in an effective manner. Tight project management was an essential part of the concept implementation process. All the functions of Concurrent Engineering were working closely together to get the product designed and developed jointly. Parallel development and simultaneous task assignments were tools to cut the total throughput time.

Phase 4: Area organization for sales and logistics (from 1994 on) The first change from the global process organization was to form partly localized operations. The global sales and logistics were considered too slow, inflexible and lacking a customer perspective. After all, the regions where NMP operated were distant to each other, and different by nature. In order to increase customer orientation, speed and flexibility, a so-called local face was created for delivery logistics and sales in 1994. In terms of logistics, this meant the setting up of regional distribution centers.

Phase 5: Development of logistics and creation of business regions (1995-1996) However, in 1995-1996, the company was hit by logistics crisis. Inventories grew too big and customer service was poor. It turned out that the process thinking and team approach were only on a very superficial level, and the production, materials and sales regions had continued to operate according to their own measures and goal-setting. This crisis affected the results drastically and created a burning platform to speed the development of logistics. The result was that the importance of logistics was elevated, the process description of logistics was enhanced and logistics was taken genuinely as a business process.

Phase 6: New process structure In parallel to the above-discussed changes in organization and logistics, the structure of key business processes was changed. The main reason for this change was that the process names did not describe the meaning of processes. This led to difficulties in communicating the meaning and relationships of the processes. Concurrent Engineering (CE) has been seen as a part of the Product Creation Process where it is combined with basic research as well as advanced technology and concept development. The delivery process has changed and it is called the Product Delivery

Process. Its components are Demand Creation, Global Logistics (GL), After Sales Support, and Customer Monitoring.

However, though the key business processes have been changed greatly in detail, the main idea from 1992 has not. This is the idea of processes being managed and developed cross-functionally and end-to-end, serving real, external customers. This is seen especially clearly in the Concurrent Engineering Process, and later in the Global Logistics Process, as well.

Phase 7: Product line organization (Figure 13) After the re-organization of logistics was started and the new business process structure introduced, one more problem still existed. The responsibility for the continuous introduction of new products and long-term profitability of different product lines was unclear and scattered throughout the organization. To correct this, a product line organization was implemented as an addition. The people in the product line organization are responsible for NMP always having a competitive product mix in all major standards. Thus, the current organization contains the following dimensions, derived from the first functional organization: (1) Functions, (2) Business processes, (3) Regions, and (4) Product lines.

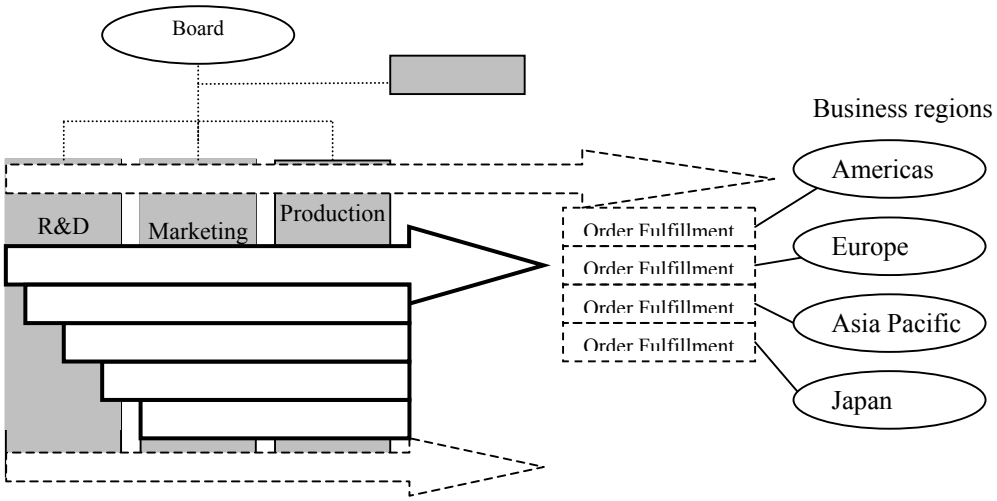


Figure 13. Fourth dimension to NMP organization: Product Lines on the top

The interaction of the four main dimensions of the new organization is delicately orchestrated. Both key business processes have their own subprocesses. The Product Delivery (PD) process development is coordinated globally but implemented by regions. On the other hand, the Product Creation (PC) process is implemented by product lines (GSM, TDMA, for example).
Business regions carry the responsibility for company's success with a 6-12 month horizon. They concentrate on doing business with current products and do not have to worry about long-term product, technology and product

delivery process development. The product line organization in turn has the responsibility for long-term success by ensuring that NMP has the right product mix on the market. Operational interaction takes place in the daily work of the different process teams from product development and product creation. Global functions offer resources – physical, human and financial – to regions and product lines to carry out the processes.

3.1.2. Management and Organization of the Process-Oriented NPD

The development of process management thinking in the Concurrent Engineering (CE) process has gone under several stages: (1) 1989 CE concept development started, (2) 1990 R&D line organization restructured and CE concept launched with all projects restarting as a global roll-out (Product Development manual), (3) 1990 program performance appraisal system was launched, (4) 1993 CE subprocesses were defined, ISO 9000 started as well as CE benchmarking, (5) 1996 creation and launch of Product Creation process, and (6) 1997 creation of product lines. The development has been accompanied with the growth and internationalization of the R&D activity at NMP. Despite the changes and growth, certain features in the CE process agreed on in 1990 have been valid throughout the development process and are still so today. These are: (1) Clearly defined milestones, (2) Cross-functional teams, (3) Breaking up traditional functions, and (4) Clear role of management in decision-making, target setting and performance appraisal.

As stated above, the Concurrent Engineering process has been a leader in exploiting the process approach at NMP. The basic principles in process management were implemented in CE in 1990. The first step, in order to be able to implement processes in an organization, is to define what is a core business process. At NMP, the core business process criteria were the following: a core business process cuts across functions, provides competitive edge, is critical for success, contains strategic relevance, involves top management, satisfies the customers, and is focused on results

The basis for steering the product development projects at NMP is the so-called *Milestone Model* in Figure 14. This can also be seen as a top-level description of the product development process. Details for the CE sub-processes and milestones can be found in Appendix 5 and the program briefs, requirements, plans and specifications for the first milestones can be found in Appendix 6.

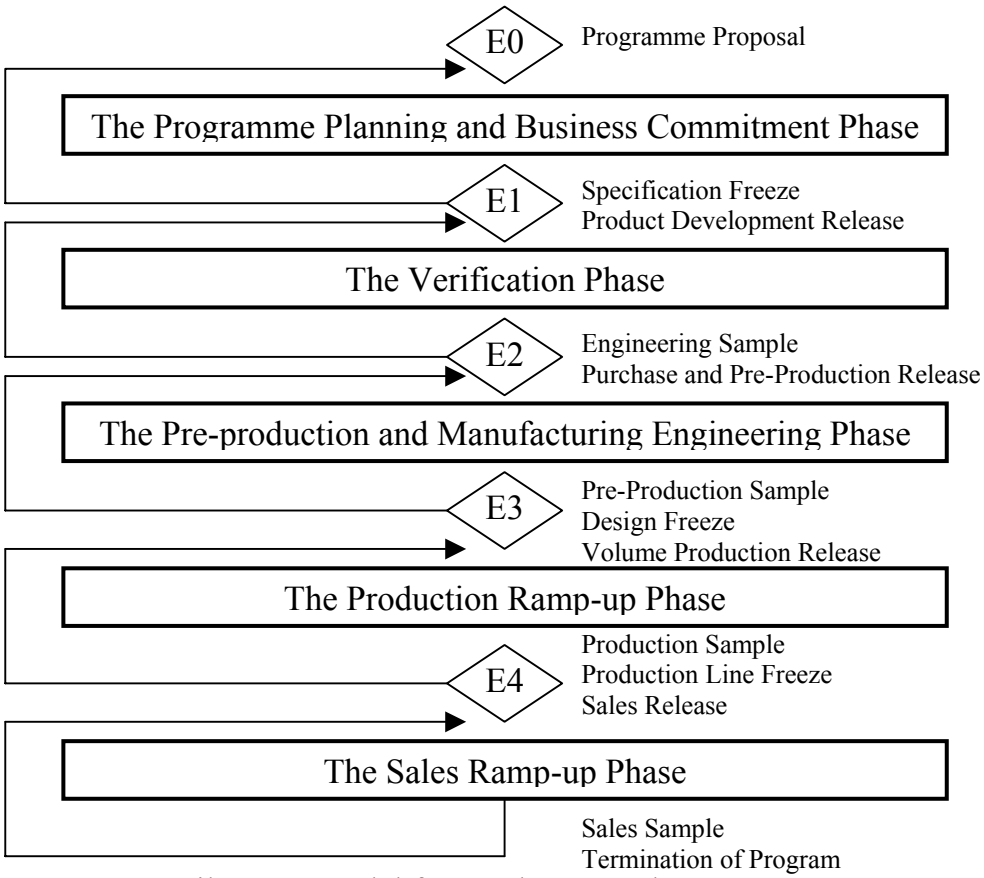


Figure 14. NMP's Milestone Model for Product Development Process

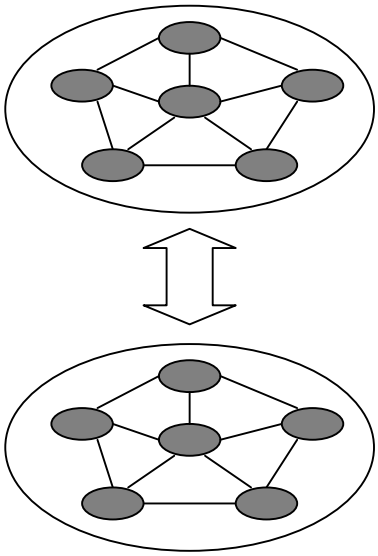
The adoption of *cross-functional teams* in CE started with a move from functional R&D projects to product program teams whose goal is to get the right products in right quantities to market. This was a change in the traditional organization of R&D work where nearly all people involved come from a product development function background. A team's people are drawn from different organizational functions that are needed for the completion of the tasks at hand, and connected by making them work together in order to speed up completion and improve information flow.

In product development the core of activity takes place in teams. The team's job is to define the product commercially, estimate its competitive situation, and be responsible for its technical development as well as technology supplier selection, production technology choices, and implementation. The team also plans for the ramp-up process[153].

[153] Pisano and Wheelwright (1999, 62) define ramp-up as follows: "When a new product is introduced into the factory, it can take some time for manufacturing performance (in terms of costs; the productivity of labor, equipment, and capital; capacity; quality; and yields) to reach normal long-term levels. This period is generally known as the ramp-up. To a large degree, ramp-up speed is a function of the quality of the process technology, which in turn is determined by process development."

Thus, the team is solving the basic trade-offs with four basic attributes (development speed, product cost, product performance, and development program expense) related to product development, however with a business orientation. Sometimes the development speed may be more important, even at the cost of incurring higher expenses. These attributes will be discussed later in more detail.

As a summary, the role of management in the process has been clearly defined (the concept of phased development with clearly defined milestones, go/nogo decisions) to break the power of functions or traditions by process-oriented goals as well as making cross-functional team bonuses possible via the measurement of results. The relationship between the steering team and program team is illustrated in the Figure 15.



STEERING TEAM

- Empowerment[154]
- Business Decisions
- Target Setting
- Performance Appraisal

PROGRAM TEAM

Figure 15. The Role of Management in Concurrent Engineering

The above-presented facts were the aspects of process management that started from the Concurrent Engineering in 1990, and they are still valid today. In addition to the continuous development work in process management, there were also certain problems, which further accelerated the change from the CE process in 1992 to the current one. The problems were the following: (1) shortening of product development cycles, (2) loss of coordination, standardization and economies of scale[155], (3) The CE teams grew too big and therefore were difficult to coordinate, in addition to friction, which occurred, and (4) since everything took place in teams, it was the top management alone that was responsible for controlling the teams.

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[154] For the association of empowerment with positive performance in NPD, see e.g. Gerwin, 1999.

[155] For example, several research centers could be simultaneously developing similar connectors. Thus, a global roll out was needed to avoid the site-specific routines.

The problems were mainly a result of the process approach not being implemented thoroughly. In order to tackle these problems a new approach to *Concurrent Engineering* was started.

Today the name of the product development process is Product Creation (PC), (See Figure 16). It includes four subprocesses: (1) Research and Technology Process, (2) Advanced Development Process (AD), (3) Concurrent Engineering Process (CE), and (4) Product Engineering Process. Thus, ahead of CE, a new process, AD has been established which focuses on creating technology blocks for CE. AD uses in turn the results created by Research and Technology. The trigger for this was the need to radically shorten the throughput time of product development.

Research and Technology Process focuses on doing the very basic research.[156] *Advanced Technology Process*, in turn, strives to form usable technology blocks either from the work of Research and Technology or some commercially available technology. The focus is thus on developing technology, which can be applied to real products. The responsibility for creating actual new products to be sold to consumers lies with the CE Process. Here, the focus is on business and the actual project itself, and the goal is to be able to transfer customer requirements to a new product on the market as fast as possible. The last subprocess is the *Product Engineering Process* and it covers minor product development activities that are needed after the product has been launched and which take place at the production sites.

Thus, the tasks of the previous CE process have been diverged into several subprocesses. This way the actual commercialization of products can happen faster, and in addition, the CE projects can no longer carry the technology risks. These are transferred to the AD process along with the concept creation, for example. The management of Product Creation is conducted by cross-functional teams. As an example, the Product Program has the following team members:

- Production project leader (coordination of product development with production and distribution aspects)
- Product manager (customer's point of view)
- Materials project leader (supplier selection)
- Product development project leader
- The team is headed by Product Program Manager

[156] There are no limits, and visions are allowed to fly (Laaksonen *et al.*, 1998, 73).

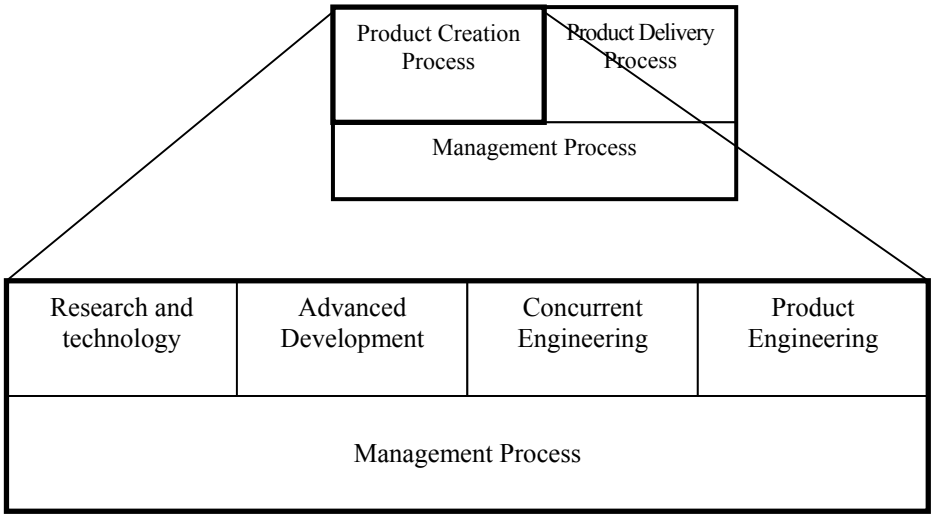

Figure 16. NMP 's business processes, Product Creation (PC) Process

In addition to a separate Advanced Development process, another important development step of the new Product Creation approach was to re-engineer the CE subprocesses, illustrated in Figure 17. They as well, must be genuine processes, not functions.

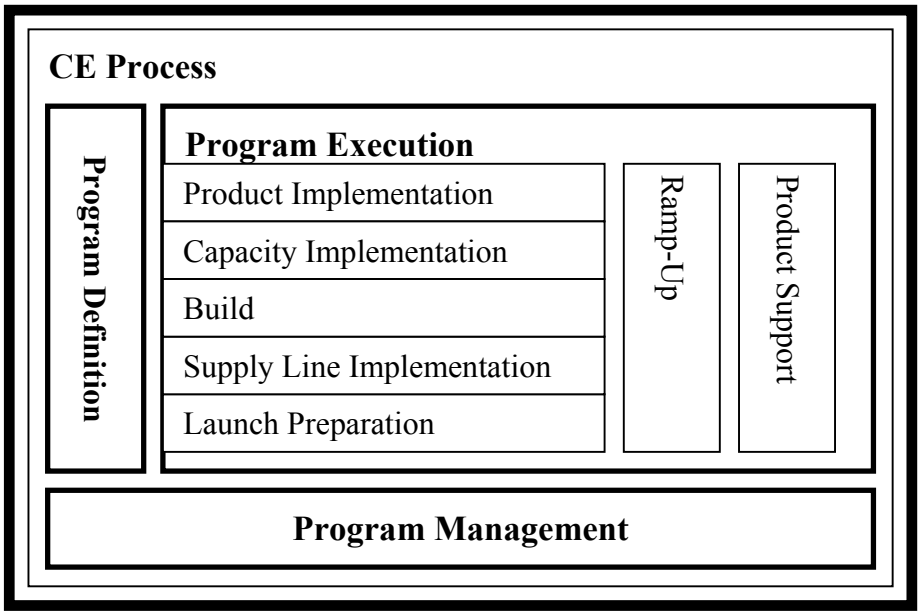

Figure 17. NMP's new Concurrent Engineering Process structure

Actually, processes can be seen as plans with well-defined inputs and outputs. Like processes, plans are descriptions of activities but perhaps more specified. What is critical here is that in the functional organization each function is responsible for its own subtasks and inputs and outputs for each. As these vary between functions, the amount of communication needed is extensive. However, in process organization the inputs and outputs are commonly defined reducing the amount of communication.

The Program Definition Process is essentially the team deciding how to best fulfill the requirements presented by the Product Line Management (Fig. 23 and 24). The procedure includes firstly a *feasibility study* where the representatives of the team, product line organization and R&D staff familiarize themselves with the requirements and verify any business case, technology and concept assumption. Secondly, the *program targets* are set on the basis of the product specifications checked and verified in the feasibility study. These targets must include all relevant targets for time, *cost* and quality. Where appropriate, targets should be prioritized and broken down into lower level targets. After that, *technology and concept selection* takes place and the concept is then refined for the specific product in question. *The product specification* is finalized once it is known what is possible from Advanced Development, New Technology Sourcing etc. Then the project is ready to be presented to the NMP Board for *a go / no go decision* regarding the continuation of the program. In parallel with the specification work, the *program schedule* is planned. The scheduling and specification work is very iterative by nature; each has an impact on the other. Resourcing of the program is a very important issue that needs to be thoroughly investigated at this stage.

The Program Management is the work of the product development team manager and involves a great amount of communication[157]. The manager takes care of *program monitoring* as it is important to know 'where the program is'. This means tracking of the overall program plan, monitoring of open items, errors, actions, monitoring of sub-projects and the management of any change requests that are prerequisites for program success. A systematic and consistent way of *making decisions* is necessary to ensure that programs do not waste time making and even remaking decisions. Program adjustment is also inevitable, but is no excuse for allowing change to take over. The *management of change and the controlled adjustment of the plans, targets and product specification*, regardless of how minor it seems, are important in order to keep the program focused and on track. Finally, *milestone reviews* are the point at which *go / no go decision* is required from a higher authority external to the program.
The Program Execution Process is one in which the actual detailed design, implementation and testing of the product, its launch, manufacturing process and materials supply capability are carried out in a cross-functional fashion. Activities conducted here include *Launch Preparation*, which handles tasks relating to the launch of the product and its support in the marketplace. *Product Implementation* includes integration and testing, while *Capacity Implementation* addresses activities necessary to allow successful mass-production of the product. *Supply Line Implementation* manages the

[157] See also Jassawalla & Sashittal (2000), for NPD team leaders as creators of the social environment and managers of interpersonal dynamics.

acquisition of materials for ensuring the supply capability of materials for mass production. *Build* prototypes the product and verifies the manufacturing technologies. *Ramp-up* does the full-scale integration of the product, production process, and materials supply in order to produce the required volumes at required quality levels. Finally, recently introduced *Product Support* manages the regional activity, which takes place after launch, and provides support for the factory, customers, sales and service; in preparation for the hand over to Product Engineering.

The aspect of logistics thinking can be seen especially in the program execution phase where the assurance and preparation for supply and production of new products is done parallel with planning. Another point, which underlines the ingrained market-oriented flow thinking, is how the teams of the two key processes interact. The responsibility of a new product is gradually transferred from the product program team (PC) to the supply team (PD) (see Figure 18) and it is culminated at the ramp-up phase. Sometimes part of the product program team continues as members of the supply or product engineering team.

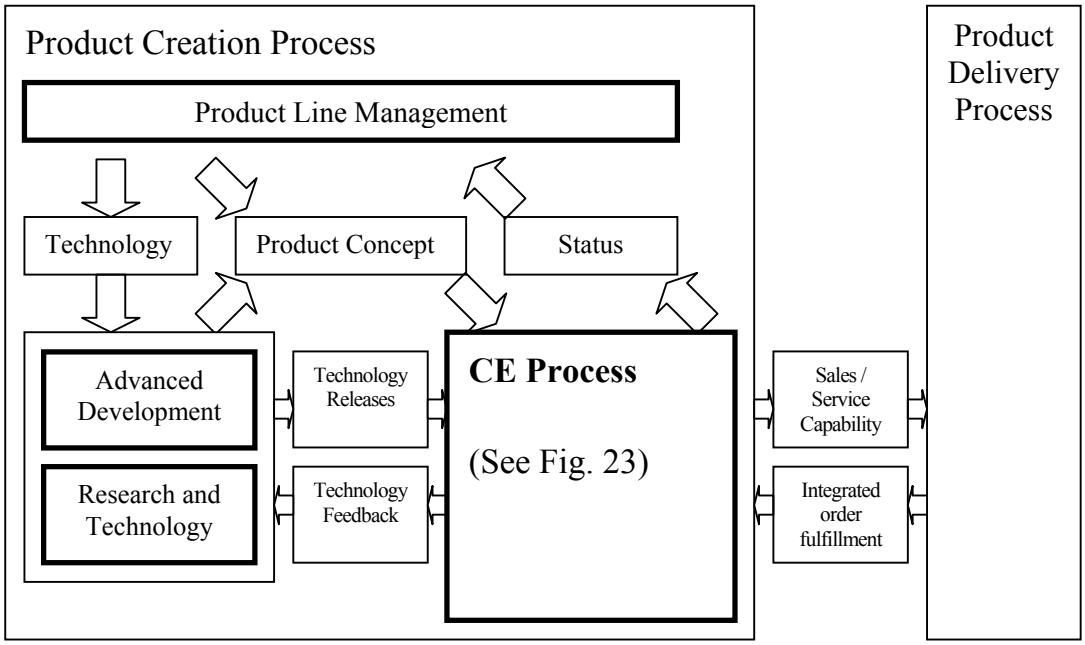

Figure 18. Concept of NMP's CE Process as Part of the PC Process

The responsibility of ensuring that new technology is developed and new products are launched is carried out by the Product Line organization, as explained earlier. It is the Product Line Management that controls the Product Creation activity with the help of technology and product briefings. In practice this is conducted by teams of the Product Line organization with team members from both Advanced Development and Concurrent Engineering (Product Program team). Basically the core people of the Advanced

Development team follow the advancement of technology and product to the Product Program team and commercialization, and then start all over again.

To sum up, in NMP the R&D function as a whole is organized in the form of a multidimensional matrix organization. The first dimension is the actual functional line organization with its own cost centers and the other is the project organization with its distinct cost centers.[158] In addition to these two, the processes are becoming more important objects of control. In an R&D center all these three dimensions are combined.[159] During the completion of this study in 1999-2000, another organizational development was under implementation in the case company. It was determined that R&D is driven by certain profit responsible business units.[160] Process approach has been a significant contributor to the success of Nokia. It has enabled fast decision-making and has speeded up the operational processes in a business environment dominated by fast changing technology, high growth rate and globalization of the organization. The main focus here has been on internal integration and process development. The next challenge is to extend the same principles to cooperation with the supply and channel partners. Internally, there will be a development and implementation of a business-flow specific decision-making process as one new layer above the current business processes.

3.2. Management Accountants in New Product Development

3.2.1. Organizing Management Accountants to Support NPD

In NMP, the management accounting is organized to support new product development as a particular R&D controller function. R&D controllers i.e. management accountants working in NPD projects can be found either on the local level, located in particular R&D centers or on the global level controlling the R&D operations as a whole. The local R&D center controllers concentrate

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[158] Nokia has very global R&D operations, which means a great challenge for the control in a multicultural context, too. Saarinen (19.11.1997) mentions that every R&D worker belongs to his or her ”home cost center” in the line organization, and that the project cost centers are visited as guests, which means that ”project buys and line organization sells”.

[159] Some concurrent engineering programs are carried out as shared NPD projects between two or more R&D centers. This may rise problems in transfer pricing and cost allocation related issues that will not be discussed in this study.

[160] These units are Cellular Mobile Terminals (CMT, i.e. gsm-related products); Digital Convergence Unit (DCU, i.e. communicator-related products) and technology platform management (TPM), which is responsible for technology platform development for modular design use. TPM is more basic research-oriented and thus cannot be held responsible for its profitability. These business units thus include combined product categories according to the product lifecycles and maturity of the business.

on individual NPD projects and especially on the R&D center, whereas on the global level there is one R&D program controller and one R&D controller, who are responsible for the process accounting. In addition, the superior of the R&D controller organization is the global R&D business controller. Furthermore, the R&D controllers as a part of Finance and Control belong to the support function category, which means that there is a resource price for support operations on the basis of which the single product programs "buy" a controller.

In this study, the focus is on the concurrent engineering (CE) projects, called product programs, which produce saleable products. The case study is conducted in the Salo Research Center, which has about 30-40 NPD projects, three or four of which are typically CE programs. These are the very programs that especially the local controllers are working with. The global R&D controllers co-ordinate the controlling of all the R&D processes (PC) from basic research to product engineering.

Nokia has recently introduced a new financial systems platform (FSP) organization, which is responsible for all financial accounting, as well as legislated accounting related issues including tax aspects. It is worth mentioning that, in principle, FSP provides the controller organization with master data and practically the management accounting information in NMP is based on the financial accounts. R&D Center Controller sees both the controller organization and the FSP necessary, but finds their relationships rather problematic:

> *"It is an unfortunate fact that it [FSP] is all too much unaware of for example what is going on in the [NPD] programs. […] They are not able to communicate. Controller is there only in-between […] trying to be between the wood and bark in a way into both directions […] the business needs from the programs are very different from what the FSP organization finds important."* (R&D center controller)

The process-oriented product development adds a new dimension, which brings more complexity to management accounting in the multi-dimensional NMP, especially considering inter-team communication. Since the all management accounting information except the budgeted figures in NMP are based on the master data from the financial accounting information, the multidimensionality means that the total figures from all dimensions should match on the global level. Moreover, the multidimensionality brings some problems to the schedules and accountabilities.

> *"It places a number of requirements […] to our finance and control organization. The dimensions mean more reporting dimensions, from which the figures are analyzed, there are an endless number of them.* (R&D program controller)
>
> *"Processes work quite well in one program, but thinking of many – there are problems in communication."* (Aftermarket service leader)
>
> *"[D]uring the ten years I have been working here, the organization has been turned totally upside-down many times. It is very important in the management accounting when we have this process-orientation that we have also this functional organization in the background. We have had a little bit of friction in making them co-operate, because they [the people in different functions] have so many differences in the way they perceive the world. All the arrangements in the finance and control, they are eventually functionally-oriented."* (R&D controller)

In the R&D controller organization, on both the global and the local level, the multi-dimensionality is, however, understood as a facilitating factor in the decision-making, since the figures may be analyzed from various points of view.

> *"It is a necessity that the information flows to many directions, because we cannot live in a "pipe organization". […] When the organization is confusing, it – in a way – makes possible easier reaction to various incidents."* (R&D center controller)

The controller organization itself is experienced to be quite suitable for the NPD environment in this company. The global R&D controllers take a more comprehensive perspective looking at the global R&D operations, whereas the local R&D controllers focus on the local R&D center and its projects. Historically, the R&D has always been considered as a global operation, and only recently the local level of the R&D controller organization has been introduced to support the NPD staff in programs. The interaction between global and global R&D controllers is sufficient[161], but local controllers located in different R&D centers could be more in touch with each other, in order to leverage e.g. organizational learning and knowledge creation.

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[161] At least, the global R&D controllers have very close relationship to the local R&D controller, who works at the same R&D center in Salo. Three or four times a year, a R&D controller meeting is arranged to 15-20 R&D controllers and their assistants in order to discuss common issues such as budgeting processes and resource planning. There is an aspiration towards globally common management accounting processes as far as possible. Frequently, there is also a presentation by a center manager or a representative from another function. The latest example comes from the meeting in Dallas, where the local center manager gave a speech on the requirements for a center controller.

> *"It would probably be worse if we were too close […] Sometime, we must see things from a little bit further. I think we should be in contact with them [programs] […] A local controller cannot see the big picture like we do.* (R&D program controller)
> *"I think the local – global controller [organization] works well. The local center controllers should change thoughts more often."* (R&D center controller)

In the program, the distance between the NPD staff and R&D controllers can, however, be considered too long. Their location is seen as a background factor for their opinions of the programs.

> *"The management accountants do not have very good knowledge of the programs or products, they treat them similarly and they think that everything goes similarly, but actually it couldn't be that way."* (Product program manager)

Actually, the only interaction between R&D controller organization and the NPD staff is between the R&D center controller and product program manager. Most surprisingly, the local R&D controller has not been in face-to-face contact with any of the leaders in NPD team. Moreover, some of the program leaders brought up the fact that they co-operate more with the controllers in their own functional organization and contact the R&D controllers only in the case of ad hoc queries. The cross-functional co-operation will be discussed together with knowledge creation interface related issues.

> *"In practice, the controller is invisible to all the people in the program, except for me. Of course, for example the sourcing leader prepares budgets that are checked by the controller, but really, the controller discusses only with the program managers."* (Product program manager)

The reasons for the local and global levels in the controller organization derive from the need on one hand to understand more comprehensively and closely the accounting information in NPD and on the other hand control the global processes. This evidence gives a strong support to previous findings according to which the reasons are quite similar in locating business controllers e.g. in business units (cf. e.g. Granlund and Lukka, 1998a). In addition, the size of the case company, as well as the rapid growth of its business, were seen as

background factors for the various needs of management control in the local – global continuum.

> *"The global and local information requirements are mutually exclusive"* (R&D center controller)
> *"The reason is that we are able to serve the local surface and understand it […]"*(R&D program controller)
> *"The cost pressures are increasing all the time when there is a shift towards consumer electronics and the competition becomes more fierce."* (Operations project leader)
> *"It is the most important knowledge, when one understands financial figures […] for example why we should invest in e.g. travelling [in NPD budget]."* (Product program manager)

In the future, it is expected that the process-orientation will be more and more emphasized in the organization with respect to management accounting in NPD. It was even suggested that the controllers in the functional organization could be moved to the process organization as well as to the regional organization and the product line organization. This observation is consistent with the findings of Järvenpää (1998) who suggests that management accounting is changing from the horizontally oriented support activity towards an activity, which passes through the product and customer processes.

> *"There has been a change in the organizational culture. The number of controllers has increased extensively."* (R&D controller)
> *"[O]ne of the challenges to the controller function is the fact that the control activities should correspond to the business structure. If the operations change from the functional structure to the process-oriented one, the controller function should respond to the change immediately."* (ex- R&D program controller)

3.2.2. The Role of Management Accountants and Accounting Information in NPD

Firstly, it should be noted that in NMP the decision-making is externalized from the product programs due to the strategic nature of R&D (Laaksonen *et al.*, 1998). The new product development is considered strategic also in the controller organization. The only exception arise from the comments where it is mentioned that when a product is under development, the NPD operations as well as the role of R&D controllers may be considered operational. Only the

local R&D controller, however, explicitly described the controlling job as purely operational. Moreover, one global R&D controller made a difference between his own role and the role of management accounting information, which he reports even to the NMP board. In addition to the figures, the global R&D controllers may report the result of their analyzes but rarely they provide suggestions forward. It is quite surprising that the NPD staff finds the role of controllers both strategic and operational. There the focus seems to be – not in the strategic relevance of accounting information – but in the dissemination of strategy downwards in the organization. The case data leaves somewhat inexplicable the potential drivers for the strategic role of the R&D controllers, although the global nature of the business operations and the strong future-orientation of the NPD operations were referred to be such factors. The strong future-orientation was, however, quite obviously experienced as the major differentiating factor between the R&D controllers and controllers in e.g. the functional line organization. In the final analysis, it could be argued that R&D controllers typically have an operational role, whereas the management accounting information has a very strategic role.

> *"It [the job] is definitely operational [during the whole program]. It can, however, be discussed, what it should be."* (R&D center controller)
> *"We report the financial data to the big bosses. They are the ones who make the decisions and they are not necessarily interested in hearing our opinions. […] we don't deal with the resource allocations etc., at all. These take place on a different level [of organization]. The only way we can influence is to dress the program into financial information and then to suggest that it makes no sense […]"*(R&D program controller)
> *"Naturally, they [R&D controllers] should communicate down the corporate strategy. Both roles are important."* (Product program manager)
> *"The controllers in the functional organization look things from totally different viewpoints. We have to take a much longer time span in the future."* (R&D business controller)

Furthermore, the R&D controllers and some non-accounting leaders acknowledged the financial information as a language and a tool of communication in NPD. Especially, it has to be highlighted that in NMP, a shift towards a more fact-based decision-making can be identified. However, the quantitative targets from sales and marketing functions emerged as more significant elements among the NPD staff, than the purely financial targets. Even though those are purely non-financial, they can also be regarded as accounting information. The local R&D controller and the R&D leader, who has also been a program manager, brought up the issue of inexperienced new program managers, who are not yet familiar with the accounting information.

> *"In my opinion, we need the financials in the decision-making. In R&D, we should have a total-cost approach and keep an eye on the product lifecycle and then reflect it to what it will cost in the mass production […] We have talked a lot about the fact-based decision-making. I think financials such as the cost information is an essential part of it."* (Logistics project leader)
>
> *"When a person has been in the product development all the time and then receives a new role that includes taking stance on greater issues, then a problem in communication is evident."* (R&D center controller)
>
> *"It seems to me that there are people among the program managers who have a purely R&D background and have no clue whatsoever about the financials."* (R&D project leader)

In addition, the question of correctness of accounting information surfaced frequently. On the global level of control, it was even argued that the top management typically takes the figures as absolute truth. Even though the figures may be true, there is a great number of in-built assumptions in the accounting information. The same argument might be relevant for the reporting between local and global R&D controllers. The underlying logic may be comprehended, but the lack of time may decrease the possibility to routine-check all the accounting information on the global level. In spite of the incorrect figures, the mistakes are, fortunately enough, noticed very quickly. On the other hand, some non-accounting leaders argued that a strive for correct accounting information may be carried out even at the expense of the decision-support objective.

> *"There is a checkpoint at the center controller's, and usually we believe the figures that we receive from there."* (R&D program controller)
>
> *"They [the R&D controllers] ask you to allocate the costs correctly. It only makes difference whether or not the items are allocated to the correct cost objects and periods, according to the bookkeeping legislation. They may give you no guidance for the decision-making…"* (R&D project leader)

The views over the potential role of new business-oriented controllers with various expectations vary to a certain extent. The business-orientation and wide understanding over the business operations is on requirement, which is widely agreed upon by both R&D controllers and NPD staff.

> *"They have to understand the business."* (Product program manager)
>
> *"It is expected that controller knows everything about the company."* (R&D center controller)

The first differences arise in the need of understanding the NPD processes. According to the global R&D controllers, understanding the processes is essential, although they recognize that the NPD staff themselves have better knowledge of the detailed sub-processes. The opinions of the program manager and the leader team, however, varied enormously, with regard to R&D controllers' need to understand the non-accounting processes.

> *"Understanding the processes correctly brings the other aspects [business-orientation etc.] as side-effect. […] Even the communication takes place in the processes. […] the best training and experience cannot replace the lack of outlook over the processes. […] the main processes there, are a kind of constitutions."* (R&D controller)
> *"It is everything. If you don't understand the processes, you don't understand a thing. If a new worker is recruited, the first thing is to […] teach the processes of the company."* (R&D program controller)
> *"I assume that the controllers don't know much about them [the processes], and they don't need to know, at least the details. […] Maybe they have been a bit more active [with respect to processes]"* (Product program manager)
> *"You have to know what are the processes in your own function, and naturally it is good to have the basic understanding of the processes in other functions."* (Materials project leader, sourcing)

Understanding information technology is regarded as an important skill, especially at the local level of controlling, since various information systems play a significant role in reporting. The management accounting change projects include also IT to a great extent. During the interviewing period of this study, the PS-module (project systems) of SAP R/3 for the project cost planning purposes was under implementation, and the R&D controllers were training its use. At the end of the research project the decision was made to use also the HR-module (human resources) in the resource planning process.[162]

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[162] After using SAP R/3 for a year, the R&D controllers claimed that the major advantage of the ERPS has emerged in controlling the global R&D projects with the information that is available faster than it used to be. Previously, it took 3 hours to complete the reports from one R&D center, but currently the system can provide e.g. the global R&D costs driven by the headcount from 17 R&D centers for one month, in 50 minutes. However, they criticized remarkably the present planning functionalities and the interfaces of the ERPS. Especially, the case findings indicate that SAP R/3 does not support the rolling forecasting operations that are necessary in R&D control. The information technology infrastructure in finance and control consisted of Nokia group level system Hyperion (includes Nokia Financial System, also used for financial reporting to stock markets and OLAP-based Product Reporting System, PRS), in-house-developed Budget-Follow-Up system (BFU, under abandonment process as PRS; run with Ingress server and Microsoft Access off-line interface). Both Hyperion systems and BFU are linked to ERP system SAP R/3, which is the company-level system in NMP. It includes bookkeeping information on account level and also acts as a controlling tool of cost centers. Spreadsheets are in wide use in NMP finance.

> *"[C]urrently, we are implementing the new cost planning project […] the IT is emphasized, […] but afterwards, IT plays no more such a big role."* (R&D center controller)

When it comes down to characteristics the management accountants are expected to have, both the R&D controllers and the NPD staff agreed upon the expectations regarding all the positive characteristics and skills, such as proactiveness and preciseness, but the strict focus on financial figures received also criticism.[163] Especially the team skills were recognized as essential set of skills in the cross-functional communication and teamwork, although the interaction between the R&D controllers and the program team is not very close. On the contrary, creativity as a characteristic received very extreme attentions, which may be due to the fact that only the controllers themselves are forced to provide the top management with predictions of the future profitability under great uncertainty. More naturally, the need for creativity and innovative skills emerge when the R&D controllers are developing their own accounting processes. In brief, taking advantage of the complete set of R&D controllers' personal competencies and abilities was widely emphasized.

> *"It may sound unbelievable [laugh], but creativity is a pretty good characteristic […] Often you face new situations where quick response is required […] standardized models can seldom be used because of the tight schedules."* (R&D center controller)
>
> *"There are no limits with the creativity when it comes down to the PLP [product lifecycle profitability] calculations […] and the cost allocations. It is nothing but creativity. […] Nothing is as creative as accounting, if you have the knowledge and skills."* (R&D program controller)
>
> *"It is a disadvantage that the people in finance and control keep staring at the financial figures. They cannot see, what it actually means. In some programs you just need to spend more money in something to receive returns later. […] I think that they don't need to be creative. They have*

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[163] Järvenpää (1998, 132) reports the relationship between the management accounting and R&D function in the Nokia Telecommunications (NTC; thereafter Nokia Networks, NN) with a comment from a business controller. "It is our challenge to begin to understand the situation where our Gyro Gearlooses start to think about something new […] to get a kind of a control mode […] Where it leads, how much costs would derive from a product concept and which products may some day be created. We have started a method in which there is one person who is assigned to take care of the R&D activities and participate in the meetings, try to understand what they are thinking […] and then bringing the information from there to be considered in the sales function." (Translated by Taipaleenmäki). According to Järvenpää (1998) management accounting in NTC was expected to be able to support from the financial point of view the product decisions including the financial implications of the various events and risks considering at the same time e.g. timing and the needs of the marketing function. He suggests (1998, 164) that the management accountants were expected to participate more with their core competence in the product process, NPD projects in particular. Thus, the anticipated revenues and costs, timing, and enhancing the market-orientation were seen to be in the focus.

> *the top-down guidelines which they try to bring down… that's what their creativity is all about [laugh]"* (Product program manager)

It was widely recognized that the most important role of R&D controllers is to increase the business-orientation in the NPD through taking financial perspective and communicating financial figures and challenging the NPD teams. The importance of management accounting information was experienced to be very high, which is also the underlying factor with the role of management accountants. On the local level of control, facilitating and ensuring the dissemination of financial information was highlighted, whereas naturally, on the global level, the role in coordination and development, and even the role of a change agent and a trainer surfaced. The multi-dimensionality of the organization has set its requirements also to the role of management accounting. Reporting accounting information from the product development processes is at the same time reporting accounting information from various functions. Both the local and global R&D controllers found, thus, integrating elements in their role. Moreover, it was mentioned that R&D controllers develop the integrating control systems, which include also information systems. The integrating role of R&D controllers, was however denied by the NPD staff, since the only interaction appeared to be between the program manager and the local R&D controller. However, at the same time it was admitted that the R&D controllers' role towards the non-accounting leaders depends on the leaders themselves – their competencies and interests.

> *"It is about bringing the financial approach to the ideology of the actual decision-makers."* (R&D controller)
> *"The global R&D controllers coordinate the system and develop the processes globally."* (R&D program controller)
> *"We are under continuous change and the change resistance needs to be minimized. Actually, we are even supporting the change, rather than resisting it."* (R&D controller)

It should be noted further that although the importance of management accounting information was acknowledged, there was to some extent a suspicion that NPD staff in the programs might not always be aware of the total costs of the program. Especially, on the local level of R&D control, it was obviously observed that there are individuals who have different approaches to management accounting information and basically to the importance of financial aspects in NPD. An additional interesting finding was that the program participants focus in resources in their discussions, and when they do so, they are referring only to the human resources, e.g. software specialists or engineering experts.

> *"I could imagine from the PPM's point of view that he doesn't know himself, how much the program cost. He knows that 60 persons are working in the program, but I wonder how many program managers know what it means financially."* (R&D program controller)
> *"There are totally different of them [PPMs]. I think there are more of those who understand the importance of the financial aspects. […] in small details the program manager may transform into a tiny horned monster."* (R&D center controller)

One fundamental factor with respect to NPD investments and thus with the role of management accounting in the new product development is how well the company is doing financially. The representatives of the R&D controller organization were aware of the fact that when the company is as profitable as Nokia during the last few years, the importance of management accounting information has declined even though the company aims at being profit driven. It was further emphasized that many values such as quality, and image, are difficult or even impossible to measure financially. However, it was comprehended that the cumulative profitability is critical with regard to the existence of a company. In brief, it may be argued that although there is a need to invest large amounts of money in NPD in order to remain profitable in the fierce competition, the cash flows have to be controlled and thus the accounting information cannot lose its importance either during the profitable years. From the decision-making perspective, actually two kinds of decisions seemed to emerge, namely purely business decisions and strategic decisions.

> *"They do say all the time that if Nokia or especially NMP wants to remain number one, as a market leader, in practice the money has to be spend right here, and that's for sure. […] Naturally, a company makes its living from the profitable products or dies together with them. In the long run we cannot introduce products that only make losses […]"*(R&D program controller)
> *"There are only two kinds of decisions […] they are made either on the basis of business reasons or on other strategic reasons that have their business consequences in the distant future."* (R&D controller)
> *"Their [financial aspects'] importance is far too low. […] probably it is our business, which has its effect on this. The fact that the company is doing financially well may create an atmosphere where only big things matter. […] Another aspect is the one of gaining more market share or introducing totally new products. It makes no difference, what it costs, if the post-projects skim off the cream. New technology always requires substantial investment […] and the decisions cannot be made on the basis of the financial facts.* (R&D center controller)

Moving from the role of management accounting and MA information itself to the roles of management accountants, it was discovered that the traditional role of controllers as corporate watchdogs was surprisingly important especially in the local level of control, in NPD teams. In the final analysis, the reason for this appears to be simply the focus in the technical development among the NPD team. For example, it is extremely unusual that the R&D controllers are present in the milestone meetings, where the focus is definitely on the technical issues. It can be argued that the importance of the technical issues derives partly from the very tight schedules as well as the organizational culture. In the business reporting chain, the accounting information is passed from the program manager to the global R&D controllers via the local R&D controller. This has also affected the role of controllers. It was agreed that challenging the accounting information from the programs is important, which included both questioning the correctness of accounting information and analyzing and demanding for explanations beyond the figures as well as pushing the program towards more profitable results. Some non-accounting leaders suggested that the smaller is the profit margin of the product under development, the more significant is the role of the R&D controller in the program.

> *"Someone needs to be there to watch that the programs don't fool around. Always, there is the possibility that a lunatic program manager could spend substantial amounts of money. Someone has to challenge that all the things that are done are rational, financially. This challenging comes from many directions. […] It is the role of a big brother."* (Product program manager)
>
> *"[A]s the job title indicates, it is to control their cash flows. The role is to integrate, but also to watch. Fifty-fifty. […] Before we do anything, there is a check done by the center controller […] actually it is she who takes the watchdog role."* (R&D program controller)
>
> *"Their job is to control the operations – it's in their job titles. But in my opinion, it is about supporting, too."* (R&D project leader)

However, the role of advisor or information providers was even more emphasized among both the R&D controllers and the program team members.

> *"We are the advisors, there. […] We do control that all relevant is taken into account."* (R&D controller)

R&D controllers themselves noticed the effect of organizational values (e.g. respecting individuals and continuous learning), organizational culture and management practices, to their role and work in new product development.

> *"What the top management emphasizes, it does have its effects throughout the organization."* (R&D center controller)

Recently, the R&D controllers have extended their role from the routine accounting to include calculating and analyzing profitability, following the process performance measures, and planning the future together with the NPD staff from other functions– the tasks that will be discussed later in more detail. In the future, the development path of the R&D controllers' role may lead to a situation where the controllers mainly support the cost control and operational planning done by the NPD staff, i.e. the controllers may carry a more supportive role both to the operational planning in NPD projects and to the higher-level decision-making. In the R&D controller organization, there was quite a strong belief that the process-orientation will be highlighted also in the more and more specific roles of management accountants. The program manager, however, suggested a shift towards a role with more routine tasks.

> *"[W]hile the organization has been in a rapid growth, the controllers role has changed […] In the past, you knew a little about a lot and now you know a lot about a little. [laugh]."* (R&D controller)
> *"I don't think their role will remain similar. Of course, they could take more of this stupid daily number crunching to their own hands, but it doesn't make a difference."* (Product program manager)

In sum, the development trend of the R&D controllers' role in NMP parallels the role expansion path of the business controllers and can be argued to capture wide variety of roles from a historian to that of a change agent and process developer. The case findings indicate that there are no major differences between the characteristics the R&D controllers are expected to have by the non-accounting leaders and the existing characteristics that R&D controllers themselves emphasized. The only exception here arise in the fact that the R&D controllers highlighted more the understanding of both the R&D and accounting or control processes and creativity as a prerequisite in their work. In spite of the wide great number of characteristics, e.g. creativity and analytical skills, no trade-offing or completely mutually exclusive characteristics surfaced.

3.2.3. The Tasks of Management Accountants in NPD

3.2.3.1. Cost (Profit) management

In the new product development of NMP, the trade-offing in R&D targets (e.g. time, costs, product properties) was heavily emphasized. In other words, costs

are not the most significant single target, but only one among the various targets that should be balanced with e.g. the development speed and product properties. However, a low-cost or a cost leadership strategy can also be important if the firm is following a differentiation strategy in the sense that lower costs will allow the firm more flexibility in pursuing a broader array of products (cf. Gopalakrishnan *et al.*, 1999; see also Liao & Greenfield, 2000) and some elements of cost management can be considered to be relevant in almost any company. This can also be reflected back to having various product strategies where one of the targets dominates with regard to the specific product in question. For example, Miller and Roth (1994) identify price, time-to-market[164], and customer focus as different product strategies. In his study, Dávila (2000) adds in the technology-focused product strategy, and suggests even that these product strategies will be related to the management control systems' design in product development. Similarly, one of the trade-offing targets, e.g. costs can be highlighted in a particular NPD project in NMP.

Although the role of R&D controllers includes cost control activities and cost efficiency is to certain extent recognized as one element in the corporate strategy, profitability contribution has replaced all other concepts in managing the NPD financial performance with regard to single new products. All this considered, it can be argued that cost management as a particular management philosophy or concept is not purely or explicitly adopted. However, the general profit-driveness in the company seems to include the features of cost management and in this sense the elements of cost management thinking can be found implicitly in the case company.

Globally, there are hundreds of product programs and approximately 100-200 cost centers in the functional organization of NMP, which provides the programs with resources. Due to the matrix-organization the very same costs may be analyzed, controlled and managed from various perspectives.

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[164] Cannibalization product strategy can be considered as one special case of time-to-market strategy. McGrath (2001, 257) writes that "cannibalization is perhaps the most misunderstood or most overlooked product strategy in high technology companies, although it is a recurring issue. Emerging technology drives companies to continuously upgrade and replace existing products; cannibalization occurs when a new product replaces an existing product. There's good cannibalization and bad cannibalization, however. The latter takes place when companies inadvertently consume their own profits." However, deliberate cannibalization can be a key element of product strategy. Offensive cannibalization can occur e.g. when cannibalizing an existing market by attacking an entrenched market leader or introducing new technology first. A market leader can use defensive cannibalization strategy e.g. by cannibalizing itself before competitors do it and managing the rate of cannibalization through optimal pricing. Even though this issue, which is of strategic nature is not discussed in the light of empirical evidence, it is worth mentioning that the case product 8850 was second release in one of NMP's product lines and hence cannibalization issues have probably been considered before launch.

> *"It is very different thing to talk about R&D costs […] the scope expands tremendously, when the profitability is taken into the picture. […] PC process itself doesn't have an output. When we look at the profitability dimension, it means that we combine all the R&D processes."* (R&D program controller)

Interorganizational cost management

Interorganizational cost management is almost unknown concept among the R&D controllers. The issue of mutual trust was seen very problematic in this highly competed industry. However, the controllers in the sourcing function are actively involved in the discussions with the subcontractors. Actually, it emerged that the sourcing function, where the local R&D controller has been working previously, is in serious need of support from R&D function. This emphasizes also the importance of job rotation as well as cross-functional communication and interaction.

> *"I think we share a little if any cost information. Many of the subcontractors we are using are also Ericsson's subcontractors. […] Naturally the cost consciousness starts there."* (R&D program controller)
> *"[T]he sourcing in Vaasa would like to have strong participation from R&D together with a proper competence from the subcontractor, in order to develop things at that stage. […] The chief buyers are regularly disappointed, because R&D doesn't provide them with adequate support towards the subcontractors."* (R&D center controller)
> *"I think it [interorganizational cost management] is very limited. There should be more, because there is this hot topic end-to-end integration... the subcontractors and customers as fundamental elements in our processes. The information should be shared… why not the financials?"* (Logistics project leader)

Product lifecycle calculation and profitability

The product lifecycle is the most important concept in controlling the new product development activities. In a way, the interviewees described the product lifecycle profitability calculation as both product and process accounting tool.[165] In other words, the product lifecycle is considered to pass through all the processes. The attention is paid to both the resources needed and the revenues and costs that are incurred during the whole lifecycle. With these lifecycle calculations, somewhat radical decisions are also made on e.g. what markets the company is operating in and with which products. These calculations affect the go/no-go decisions at each milestone review, where the product program manager

[165] In addition, there is another cost object in R&D, namely the previously (Ch. 3.1.2.) mentioned profit responsible business unit level in the organization.

from the program team introduces the current state of the NPD program but where the vice president of the product program from the steering team has the authority. Lifecycle calculations and reports with the profitability dimension are the most effective tools of control and support for decision-making.

> *"Everything culminates in the lifecycle calculations."* (R&D controller)
> *"We have this target profit calculation. […] In addition, we have sales margin targets on the NMP level, and of course, some products fall below them and some exceed them […] we do not set strict targets to single products."* (R&D program controller)
> *"We talk about the product contribution, not about the operating profit."* (R&D program controller)
> *"Above all, the lifecycle calculation is what matters. […] it includes all costs, estimated sales price and volume […] and the profits are estimated […] it is a very important tool […] The most important R&D controllers' task is to force the program to reconsider and update the profitability calculations so that the latest knowledge is included."* (Product program manager)

Product lifecycle profitability (PLP) means that a product program is translated into financial terms. It includes all costs and revenues for a product during its total lifecycle (milestones E0-E8). Some overheads of the company are allocated to all products and only some fixed costs such as corporate financial costs are excluded from the PLP calculation, which can be considered as full costing. There are several reasons for this very important accounting process. Firstly, PLP refers to NMP vision and strategy, i.e. profitable growth and product lifecycle. Secondly, NPD involves strategic decisions, e.g. in what businesses NMP desires to be involved – and limited resources can be allocated only for profitable programs. In other words, more systems, products, and variants as well as several markets describe the operating environment. Thirdly, knowing the profit or loss for the decision-making purposes requires a reliable analysis, since the margins are becoming thinner and thinner. This is seen as a way to support the go/no-go decisions. Fourthly, in NMP, the fact that some 80% of the product costs are committed in the very early phase of a program is recognized. The financial impacts of various alternatives should, thus, be available very early. The Figure 19 illustrates the cash flows of a product program in NMP. Fifthly, PLP calculations should facilitate the comparison between single programs in financial terms, as well as the estimation of the NMP total profitability in the future. Moreover, it should be noted that the internal customers of PLP calculations are various: NMP R&D management, product line management, NMP management board, region management, finance and control, and program manager and leaders in a program.

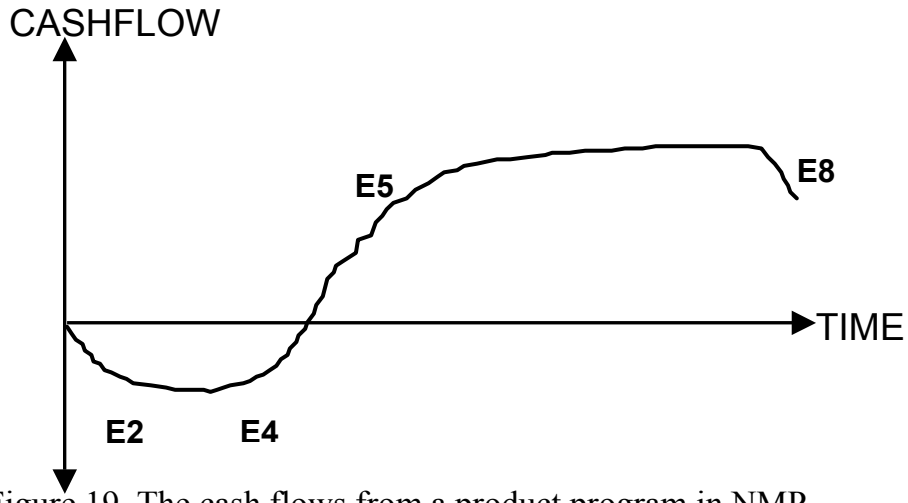

Figure 19. The cash flows from a product program in NMP

Initial examinations and benchmarking are made at a very early stage of the product development project. First drafts are prepared at the milestone E0. Thereafter, the calculations are updated on a regular basis with the "best knowledge available", and this knowledge has its origins in all the processes involved in NPD. The updating takes place at least quarterly and for each milestone, at which the calculations have to be approved.[166] Program managers are responsible for the lifecycle profitability calculations and updating process. Frequently, they also collect the data for those calculations. The global R&D controller combines the PLP calculations from various programs. The R&D center controller may assist in single program PLP calculations by filling in spreadsheets and helping in the collection and control of the data concerning the parameters, i.e. collecting spreadsheet files from R&D centers. They are not responsible for the contents of the calculations. Only if agreed locally, the R&D center controllers update PLP calculations. Table 2 shows the PLP calculation structure.

Information source:	
Regions, sales and marketing	Sales revenues
Factories, Product program	- Variable product costs
	= *Sales margin*
Factories, Product program	- Fixed product costs
	= *Gross margin*
Product program	- Development costs
Marketing function	- Marketing costs
Administration	- Other costs
	= Product contribution

Table 2. PLP calculation structure and related information sources

[166] There are pressures to use the profitability analysis even earlier. This fact will be discussed in more detail with the latest estimate process.

Table 3 includes the functions and persons involved in the data collection for the calculations. On the basis of these two tables it can easily be argued that PLP calculation is the most challenging accounting process with regard to cross-functional co-operation.

Data	**Information Source**	**Spreadsheet Model**
Sales prices and volumes	Product marketing project leader (Regional marketing manager)	PRI&VOL
Material Cost	Sourcing leader	MATERIALS
Plant Overheads	Cost Roadmap for driver values ➔ Plant controller Overheads per product ➔ Operations leader calculates	FACTORY
Direct labor time	Operations leader	OPER-leader
All resources in program	Leaders in program (R/3)	LEADERsheet
Expenses in program	Leaders in program (R/3)	LEADERsheet
Field failure rate	After Sales leader in a program	AS-leader
Tooling cost Project materials Non-reoccurred costs	Sourcing leader	Materials project leader
Cost of manmonth	Controller	Input sheets
Cost of labor hour % for scrap, % for auxiliary mat., % for duties, % for freights	Controllers (Factories)	FACTORY
Marketing costs (checked from NMP actuals)	Controller	MARKETING
Administration costs	Controller	CALCULATION

Table 3. The data and information sources included in PLP calculation

Furthermore it should be mentioned that although the product program manager is responsible for organizing the PLP process, one nominated person enters the figures into the information systems. PPM is ultimately responsible for providing up-to-date business calculation during the whole lifecycle of a product. Preparing a PLP calculation is a continuous process and thus an essential part of a product program. It is required that effects of all changes in a product or in logistics should be checked from the profitability point of view. The process overview is illustrated in the Appendix 7.

Whereas a PLP calculation covers one NPD program as a whole for a bulk product, there are also some calculations to meet the requirements deriving

from the modular and variant design decisions. The variant profitability calculation (VPC) process is carried out to assist some single choices in a product program. For example, a German operator might want only 5000 pieces of a tailored mobile phone with e.g. a company logo, an alternative memory module and varied software settings. As the variant product is designed by making changes to the original product, the PLP calculation is similarly used as background information in VPC process. Further, this means for example that the logistics program leader prepares more detailed VPC simulations of e.g. some alternative memory modules, in order to make decisions as optimal as possible. Thus, the sensitivity of the logistics costs, i.e. additional reception control and inventory costs etc., can be determined with regard to e.g. the module volumes and module size alternatives.

> *"When the variants are designed, only small changes are made. The PLP is not for tracking the effects of the changes. It calls for new modeling."* (R&D program controller)

NMP cost accounting tools vs. textbook target costing and activity based costing

After discussing the company specific accounting processes and models in NMP, it is worth reflecting and comparing them to textbook management accounting tools and their characteristics. In Finland, there have been a few surveys related to the cost accounting practices during the 1990s (e.g. Hyvönen, 2000 and Lukka & Granlund 1996, see also 1993). Hyvönen (2000) reports that target costing (TC) was applied in 8% and lifecycle costing (LCC) in 5% of the companies. According to Lukka and Granlund (1996), in the beginning of the 1990s, none of the companies applied those accounting tools, but in 1% of the companies, target costing was under implementation (6% under consideration) and in 1% of the companies, lifecycle costing was under implementation (2% under consideration).[167] The recent empirical findings indicate that the use of TC and LCC has increased moderately over the past decade, but these management accounting tools have received no greater success in the Finnish companies. However, as Hyvönen (2000) reports that 24% of the companies use ABC and argues further that this trend has been rising towards the new millennium.[168] It should be noted that there are some

[167] With regard to activity-based costing (ABC), Lukka and Granlund (1996) report also that none of the companies applied ABC, but in 5% it was under implementation (25% under consideration).

[168] Hyvönen (2000) writes also that 59% of the companies that applied ABC faced only minor or no problems related to the R&D costs whereas in 61% of the companies that did not apply ABC faced moderate or major problems related to the R&D costs. This result indicates that ABC has some potential in R&D accounting.

limitations to interpretations from these results due to e.g. concept definitions, data gathering and statistical analysis applied in the survey methodology.

The product lifecycle profitability calculation in NMP cannot be regarded as a typical textbook *target costing* process. Although target costing can take many company-specific forms, there is a general understanding of some technical features that characterize target costing. These features include especially the following: (1) TC is performed early in the product lifecycle; (2) market-orientation, i.e. TC is driven by market price and focuses the design team on the ultimate customer; (3) cost reduction as an ultimate goal and the cardinal rule that target costs cannot be exceeded, i.e. TC is a rigorous cost management technique (cf. e.g. Bromwich & Bhimani, 1994; Cooper & Chew, 1996; Shank & Fisher, 1999)

In NMP, the costs are not a single target, but only one target that should be balanced with e.g. the development speed and product properties. The R&D business controller described the targets as approved guidelines to carry out the NPD programs. This description indicates that although the targeted levels are typically set on a very strict level, they still leave space for the creativity, which is a prerequisite in the R&D, especially in the immature industry NMP operates in, as they are the leading creators of the future technology. The cost pressure together with other objectives is communicated to the designers through a comprehensive performance measurement system, not with the help of single cost accounting method. The case findings indicate even that the cost target loses some of its importance after the beginning of the development cycle, at the E0-E1 milestones of the concurrent engineering process, where the business case of the new product is approved in the board meeting. Very similarly Dávila (2000, 399) concludes that "the financial attractiveness of a project is studied before the actual development starts; once the development effort is under way, financial performance is expected to follow from sound non-financial performance".

The costs of a new product are usually easily anticipated, but the market components, i.e. sales price and volume, are more difficult to forecast, and on the other hand the immature industry only highlights the importance of these market components. When the strategic product roadmaps (cf. Tabrizi & Walleigh, 1999) are determined, the roadmappers benchmark NMP with its competitors with regard to the product categories that will be invested in. The price formation process, which produces forecasted input information for the PLP calculation, is carried out by the regional organization.

Furthermore, the profit contribution of a new product is more significant in NMP than the underlying costs. What is more important to note, is the fact that in NMP, the entirety, i.e. the corporate profits is under optimization, not necessarily the costs or profitability of a single product. It has to be mentioned that some authors do explicitly recognize that target costing is also driven by the desired profits and deals also with time and quality issues (cf. e.g. Bhimani & Neike, 1999; Shank & Fisher, 1999). It is, however, somewhat surprising, however, that the NMP cost accounting tools in R&D do not capture all of the characteristics of textbook target costing methods.

> *"When the board approves the business case, the PPM's job is only to execute the process with those features and specifications and to keep the schedule. […] It is always case-by-case, a part of the wholeness. The board might even decide to continue the development of a product with a negative contribution. We have no general sales margin targets [to be applied to all product business cases]."* (R&D program controller)
>
> *"I think our targets and the outcome are two different things. We have this E1 milestone when the board accepts that the development is continued with the proposed setup. The business case [of the product under development] is evaluated at each milestone and if it seems that the targets won't be met, the board decides what to do."* (R&D business controller)

It is obvious that the (1: +) PLP process is initially carried out during the early phases of the product lifecycle (2: +/-) and it is to certain extent market-oriented with regard to the sales price and volume, but the cost target of the future products is not necessarily determined in line with the immature markets, (3: -) nor there is a rigorous analysis to especially reduce the costs. It should be mentioned that the multiple trade-offing targets, costs included, do not necessarily indicate the absence of target costing methods (cf. Cooper, 1994), as the ultimate goal is long-term profitability. However, this emerged as the major argument by all the interviewed R&D controllers who suggested that the PLP process is "light-years from the target costing system". The description above indicates thus that all the basic characteristics of the target costing do not become manifested in the case company fully or at least explicitly but many elements of it can be argued to exist implicitly in NMP.

The findings of this study are not contradictory to the empirical findings from Nokia Telecommunications by Järvenpää (1998) who concludes that in NTC (at present Nokia Networks division) some elements of target costing were applied context-bound, and implicitly even though a complete target costing system did not exist. Järvenpää lists also the characteristics of the Japanese

target cost management (strategic thinking, market-orientation, cross-functionality, long time perspective, systematic nature, commitment etc.) and finally questions the existence of the Western TCM – the argument, which receives support from this case study evidence.[169]

The use of *activity based costing* in R&D operations has been only marginal in NMP. Despite the fact that the management accounting information is usually based on financial accounting with estimations for the future there is some ABC on the local plant level. The potential of ABC is seen in providing the background information in the process-oriented profitability calculations. For example, some of the PLP figures provided by the sourcing function are to some extent based on ABC. Especially, the variant profitability calculations for the product variants might call for a more accurate cost assignment.

> *"[W]e see the company and its processes through a pipe [...] we have these cones to look through. On the draft level there is a lot of ABC, in PLP calculations. These are so future-oriented that it sets limits on how detailed activities we have."* (R&D program controller)
> *"When we make more detailed decisions on a lower level of the organization, understanding activity-based-costing is quite necessary."* (Logistics project leader)

Whereas the textbook activity-based costing suggests that costs are assigned – more accurately – from resources through activities to cost objects, no such two-stage cost accounting model is in use in the NPD of the case company. The strong future-orientation in the actual PLP calculations is considered as the major obstacle for taking advantage of the activity-based costing. On the other hand, the easily anticipated cost structure creates an atmosphere where a more detailed cost accounting is not a necessity. However, it was emphasized that as the human resources are the most significant element within the R&D, where the headcount is the major cost driver.

NMP practices vs. cost tables, and other philosophies & techniques

Cost tables as a cost management tool were almost unrecognized concept among the R&D controllers. Some cost tables has however been piloted during the past years, but these techniques have not been in use ever since. The potential in cost tables is most likely very limited in the mobile telephone industry where the product development takes place in complex hi-tech

[169] Järvenpää (1998) suggests also that target cost management would be suitable in the context where the company is customer-oriented and operates cross-functionally in the industry which is characterized by price erosion, fast technological development.

environment. Only some simplest alternative solutions, such as colors or batteries could be analyzed with the help of cost tables. Further, it should be noted that the manufacture of the simplest elements of the mobile phones, such as plastic parts is typically outsourced.

> *"Someday we have attempted the construction of cost tables. I wonder if they are suitable for this industry. There are certain things, the use of which can easily be identified to some extent, for example the color of the mobile phone and some details such as the battery."* (R&D controller)

The technical philosophies and techniques that were introduced in the chapter 2.2.3.1. are totally unrecognized among the R&D controller organization. Even the product program manager and the leaders in the team are unfamiliar with e.g. QFD, FAST, DFMA as well as value engineering and analysis. However, the quality as a significant management concept was identified in this respect. Virtually, some of these philosophies and techniques may be relevant at the very initial R&D process, but not during the concurrent engineering.

> *"The quality concept emerges everywhere […] not moneywise but it is related to the brand image […] it is more engineering stuff, here."* (R&D program controller)

3.2.3.2. Financial Planning and Control

Budgeting (Short-Term and Long-Range Planning)

As mentioned, the rolling forecasting of the single product programs is based on the product lifecycle calculations. The global rolling short-term planning (STP), which replaces the traditional budgeting procedure, is an official verified plan consisting of annual and action plan as well as the financials. The global R&D actuals from 1998 account for 7% of the net sales, and there is always a recommended budget pipeline, with avoidance of either too large negative or positive deviations. Nokia as a Group has abandoned the traditional annual budgeting in 2000. STPs are to be done for 13 months, the rolled plans will be verified and frozen for six months ahead and after that the STP figures are revised. In STP, the local R&D controller focuses in the R&D center budget, whereas the global R&D controller is in charge of the global PC process. In practice, this means that the global R&D controllers develop the global budgeting process, write the budget manuals and control the freezing and closing of global figures. The local R&D center controllers basically are the critical link between the global R&D control and the program managers in projects and the representatives of the functional organization. The persons responsible for cost centers in the functional organization enter the plans for the headcount, costs and investment of each cost center, and the program

managers enter the planned project resources and costs into the information system. In other words, this means that capital budgeting (investment planning) and capacity planning belong to the cost centers that provide the competencies and infrastructure for the approved NPD programs, which in turn focus on the resources and cost planning. Functional project leaders (sourcing and operations) are responsible of the function part of project.[170]

The STP process includes various informal cross-functional meetings and training sessions where the R&D center controller is the key person. The focus of the local R&D controller may be very strict with regard to the R&D center. For example, some of the product programs may take place in two R&D centers (e.g. Salo and Copenhagen), and that being the case, only one part of the program may be included in the calculations and budgets of the R&D center in question. On the other hand, the R&D center borders may be organizational and not physical (e.g. part of the Tampere R&D center belongs to the Salo R&D center).

It should be noted that the Product Lifecycle Profitability processes are tightly connected with both Long-Range Planning (LRP) process (3-5 years) based on various roadmaps and STP process (1-1,5 years), as well as Demand supply balancing process (DSB; the sales volumes). In Figure 20, the relationship between budgeting period and PLP calculation is shown together with the time perspective, and it illustrates the difficulty of traditional budgeting in the environment with multiple ongoing NPD projects at various stages. In practice, the latest PLP estimates should be in line with the budgeted figures. Currently, there are programs at very initial stage without program managers. These programs are included in the R&D center budgets as well as the global PC process budgets, but there are no PLP calculations. If the first PLP estimations would be done even earlier, this could also be taken into account in the local and global budgeting. To balance the financial aspects from the many dimensions, the local R&D center controller introduced a new monthly meeting with representatives from functional organization, product line organization and product programs in the center.

> *"The budgeting is rolling and traditional [laugh] […] the programs are not bound to a calendar year – that is why the strictly traditional way of budgeting is not relevant."* (R&D controller)
> *"The budgeting process usually begins in August, and the figures are ready in November […] next August, it may be said 'what budget', no-one believes it then."* (R&D program controller)

[170] Handling the subcontracting in the STP process is somewhat problematic, because the programs may directly use outsourced resources. This means that the planned "internal purchases" from the cost centers will not be realized. In addition, an interesting detail in budgeting the R&D center figures emerges with the so-called copy programs, which are much more straightforward compared to the original product programs they take advantage of.

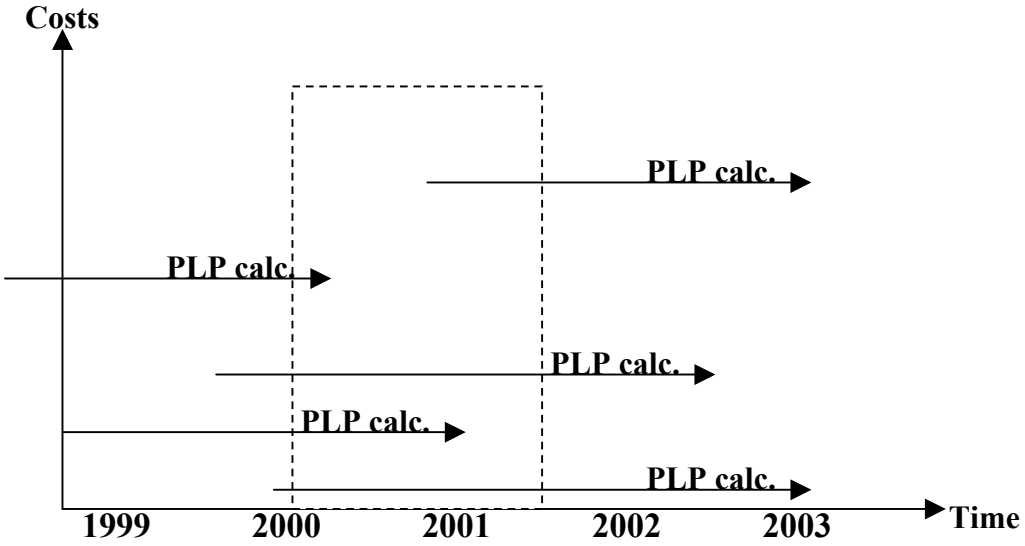

Figure 20. Budgeting and PLP calculation processes

However, the PLP calculations are even more connected to the Latest Estimate (LE) process, which takes place at least quarterly and at each milestone of a product program. These rolling estimates are seen a very effective tool of financial control, which requires very creative approach from the R&D controllers. This development towards LEs has had at least two kinds of implications. The traditional annual budgeting is losing its importance, whereas only the LE process, which was changing to short-term planning (STP), is often referred to as budgeting. The industry NMP is operating in, with its strong time-to-market pressures has strong negative implications in the relevance of the traditional budgets. Moreover the future-orientation is increasing, and there are pressures to make even earlier latest estimates with the product lifecycle profitability calculations maybe at the stage where the product platforms are produced. At least, the cost components could be available before the concurrent engineering process.

> *"In the future, we may totally abandon the traditional budgeting. Not just with the new product development but with the business as a whole. This kind of budgeting is of no use in the consumer electronics business."* (R&D program controller) [NOTE: NMP abandoned traditional budgeting in 2000.]
> *"We have the need to pull the gear shift lever backwards […] not to the basic research stage but to the stage thereafter, where they start […] these big concept projects that are being used in many product programs."* (R&D program controller)
> *"The process cycle is getting shorter and shorter. We need to have really good estimates of what is coming from the AD [advanced development] when the normal CE [concurrent engineering] process begins. I think they should deliver us the price for the motor."* (R&D project leader)

Currently, despite the product platform approach applied, no specific accounting tools or processes whatsoever – either cost accounting or

budgeting – have yet been developed for modular design in NMP, even if it might be possible. The joint costs from the earlier advanced development phase are allocated to the concurrent engineering projects with the resource usage in the CE program as the cost driver. In practice, this means that the ongoing AD operations are financed with current products. Costs deriving from the joint modules developed in the CE phase for another future product are not charged from the original project to the copy project.

Bayou (1999) recognized the same problem and suggests that accounting for the modular approach requires new costing and pricing concepts since the focus is no longer on the finished product, which is assembled from large number of individual parts, but rather on building very few platforms, subsystems, modules, and interfaces from which unlimited number of product derivatives can be designed and assembled.[171] Being aware of the logic of ABC, it can be argued that activity-based-costing may provide support in assigning costs to product platforms and modules. So far, not even anecdotal evidence exists on this.

Performance measurement and incentive systems

Performance measurement is becoming more and more important as a control mechanism in the new product development in NMP. The reasons are quite evident: There is a need for both financial and non-financial indicators in the environment were the relationship between the input and the output of the process is extremely complex.[172] The R&D center controller was working on the metrics related to the Advanced Development (AD) process during the empirical part of this study. However, the global R&D controllers are in charge of the performance measurement of the product creation (PC) process as a whole. To be more specific, the global R&D program controller maintains the financial measurement process, while the global R&D controller maintains the non-financial measurement process.

The single measures, which derive from the strategic roadmaps, are from various dimensions, with the strictly (1) financial measures being the consequence indicators and (2) customer, (3) process, and (4) people, learning, and knowledge measures being the cause indicators, among which there may

[171] Bayou (1999) concludes that the module commonality for cost control and simplicity can run into conflict with standardization for product quality purposes, and that modules can be used as a basic measure of output, in addition to the customary, yet complex, measure of assembly.

[172] A good example of this is the evaluation of the R&D centers and their performance. Profitability cannot be a criterion of evaluation, because some R&D centers might receive a NPD project with a negative profitability contribution to be carried out, due to e.g. human resource reasons.

be even significant overlap. Table 4 illustrates the issues that are considered together with the bolded financial measures that are used for the PC process. Some of the financial measures and issues are reflected in more detail in Appendix 8. The R&D measures are evaluated four times a year.

Dimension	Issues regarding the Product Creation (PC) financial measures
Financial	R&D costs, **R&D costs / net sales (%)**, Profitability, Licensing, litigations, savings
Customer	**New product revenue**, **Warranty costs / sales (%)**, Customer satisfaction, Market strength, Attractive product portfolio, Standards, Alliances
Process	Time accuracy & speed, **Direct costs**, Process quality, Market orientation & product quality tools, Innovation
People, learning, and knowledge	Process quality tools, Managing resources, Technology tools and methods, Technology strategies update, Employee satisfaction, recruiting & retention, Development, learning

Table 4. PC financial indicators and the issues related to the measurement

> *"The indicators are not necessarily financial […] the financials are only symptoms, the reasons are of technical nature."* (R&D controller)

In NMP, there is a management tool for single NPD projects, which strongly resembles the balanced scorecard approach and at least captures the ideas of combining both financial and non-financial measures. In the performance matrix, which can be seen in the Appendix 9, *the development speed target*[173] consists of two columns in the matrix, (1) target date for next milestone and (2) target date for sales launch. *The product performance target* consists of three columns, (3) product reliability parameter, (4) production quality parameter, and (5) product performance parameter. *The product cost target* is indicated in the product cost-driver sub-matrix. *The resource target* in the trade-off is taken into account when the team – knowing the resources given – makes its plan.

The matrix is reviewed at each milestone. Rows from 0-10 indicate possible dates for the completion of each subtask in the process; 5 is the budgeted level (or speed of completion). If the team is able to complete the task earlier, it receives more bonus.[174] However, the team is not given all of the bonuses immediately. A part is reserved until the end of project in order to guarantee

[173] Slippage measurement is practiced to indicate difference between the targeted and actual development speed of various NPD programs.

[174] The bonus calculation process, roughly described, has the following stages: (1) Information of the milestone is sent to the bonus calculation unit, (2) Budgeted and actual hours and %'s are collected from the Hours-Follow-Up-system (HFU), (3) List of persons, hours, and %'s is sent to the PPM, who adds the possible corrections and bonus-%'s, and sends these back, (4) Salaries (and other information) are requested from the local salary office, (5) Bonus is calculated, (6) PPM approves the bonus, (7) Senior Vice President CE / VP Advanced Development (or even SVP PC or president of NMP) approves the bonus, (8) The approved bonus information is sent to the local salary office.

the team's continuous motivation. Some leaders claimed that typically an educated guess could be made over the forthcoming values of the performance indicators, because the line between the average and good performance is not a fine one. This might be due to the serious time-to-market pressures. Frequently, the CE process was compared to 110 meters hurdles.

> *"We do not report them outside […] we keep the scorecards within the R&D. The targets are set with the help of the scorecards and they are applied to control. Also the targets and rewards for single programs are defined on the basis of these scorecards."* (R&D controller)

Many of the targets used in the reward system, especially the non-financials, derive from the strategic roadmaps. It is especially important to note that, with the help of the matrix, the concepts of process management and cross-functional teams are implemented in a traditionally very project-oriented product development environment. It should also be noted that the incentive system is constructed to support and motivate also the product development teams that might have negative profit contribution target set by the steering team. Some non-accounting leaders, however, questioned the motivational effects of the incentive system.

> *"Let's take for example Nokia 8850, which was supposed to be at E2 milestone review last November. It was postponed, but my sub-review was completed 5th December. The review took place in March-April this year and it was about half a year late. I didn't get any bonus for being in time."* (Aftermarket service leader)

NMP financial planning and control tools vs. textbook practices

In NMP, the performance measurement system resembles to great extent the balanced scorecard approach (see e.g. Kaplan & Norton, 1992, 1993, 1996a, 1996b, and 1997), where the major idea is to balance various dimensions, such as internal and external orientation, time orientation between past, present and future, current situation and on-going change, as well as the use of financial and non-financial (cf. Eccles & Pyburn, 1992 and Fisher 1992) performance indicators. The balanced approach is adopted especially on the global level of controlling the product creation process, whereas the single new product programs are managed with a specific performance matrix. Further, the measurement dimensions and individual indicators include to great extent the typical innovation measures in both accounting and R&D literature. In addition, the case findings indicate that the current practice in NMP parallels the textbook performance measurement in the sense that the indicators derive with causal relationships from strategic roadmaps, i.e. the visions, strategies

and critical success factors[175] that are the prerequisite of the future success in the NPD in high technology.

Since the global R&D measures in NMP are dealt only at the global level of control and the non-accounting leaders are not aware of the underlying factors of the local measurement systems, it can be argued that the aspect of communicating strategy into action has been of little importance. This thing will be discussed later in more detail. Commenting the potential of strategic learning, i.e. the feedback from the performance measurement system to the strategy in the case company is out of the scope of this study. Furthermore, it should be noted that some of the characteristics of management by objectives related to the performance measurement can be found in the case company (cf. Malmi, 2000): (1) Target values are set to the measures; (2) Managers and leaders are held responsible for meeting the targets, and (3) The incentive systems are linked to the performance measurement system. However, it can be argued that the targets in the performance matrix of a NPD program are not very strict in the final analysis. For example, the R&D business controller compared them to "guidelines" necessary in the milestone management.

When it comes down to the budgeting, the case findings indicate that the traditional annual budget has lost its importance in the fast changing future-oriented R&D environment with multiple ongoing NPD projects. Hence, the case company has abandoned the annual budgeting in R&D (cf. Wallander 1995 and 1999; see also Hope & Fraser, 1997 and 1999) and shifted towards latest estimates in the short-term planning (cf. rolling forecasts). Another company specific budgeting practice emerges in the global R&D control in the form of R&D budget pipeline, which means certain avoidance of either positive or negative deviations from the budgeted figures.

3.2.3.3. Other tasks

In addition to the tasks related to cost management, financial planning and control, there are various tasks belonging to the R&D controllers' work, which will be discussed on both local and global levels of R&D controller function. Examples of the official job descriptions for local and global R&D controllers can be seen in Appendices 10 and 11. Further, it should be mentioned that the job of the R&D business controller, who has 5 direct and 5 dotted-line subordinates in the matrix organization, consists of managerial tasks, especially planning and managing the R&D control processes. Naturally, the

[175] The corporate strategies, critical success factors or strategic product roadmaps of NMP cannot be discussed in more detail due to the business secrecy.

job of the R&D controllers includes a great number of ad hoc tasks, when e.g. quantitative information is request from the R&D function. However, in addition to the evident *reporting*, two tasks, namely training and process development, arise in the job of both the global and local R&D controllers. These tasks will be discussed first in more detail.

Training

One of the accountabilities of the R&D center controller is the training of the non-financial managers. More precisely, the global R&D controllers are in charge of the global training of financial issues in the new product development. Two or three times a year they train also the local R&D controllers, who on their behalf train the non-financial managers in the local R&D centers. In addition, there are many training sessions of informal nature.

Firstly, the training includes business-oriented thinking. The product lifecycle profitability calculations are involved in the training, as well as the basic cost items, underlying cost drivers and facts that make the consumers desire NMP's products. Secondly, the focus is on the issues related to processes, systems and software.

> *"The more there are controllers, the more we can train the people that actually are making the profits. […] we tell the financial rules of the game […] it is the R&D controllers' task. […] There are two types of training […] either it is purely about business-oriented and financial way of thinking […] or about learning the technical side, how to use these systems."* (R&D controller)
>
> *"We are the training team, we coach people about the processes etc. […] the center controller is responsible for the financial training and the creating business-oriented atmosphere in the program."* (R&D program controller)

This finding of substantial cross-training by R&D controllers is similar to the argument by Siegel (2000) who reports that the management accountants spent a great deal of time in organizational education of the non-accountants.

Process development

Both the local and global R&D controllers are strongly involved in the process development work. The process development from the R&D controllers' point of view means constructing relevant indicators related to the process output. With the help of these indicators, the development of the process output can be controlled.

> *"The process is about certain output. Developing a process is about improving the output.* (R&D program controller)
> *"[W]e are currently updating the LEs and we are going to introduce a completely new process. We invite all the people responsible for the technology areas in a detailed interview by our center manager. The interview will be about how they see their current resource position and how well they are able to commit themselves in the resource demands, e.g. on software experts, of the programs and on what schedule […] or what are the other alternatives."* (R&D center controller)

Other tasks of the local R&D controller

The job of R&D center controller does not include many tasks belonging to the field of financial accounting. Only some depreciation calculations related to fixed assets may be considered financial accounting. Thus, the cost management and challenging cost is the R&D center controller's major accountability.
Another significant task of the local R&D controller is the resource planning which takes place on three levels: (1) task and role level planning for approved projects, (2) projects and person level planning for approved projects, and (3) project roadmap and technology area level planning for future projects. Basically the resource planning means planning for the human resources. Frequently, there is fierce competition between ongoing programs for the resources. Many of the interviewed leaders did not know that the R&D controllers were involved in the resource planning.

> *"The resource planning is very time consuming. [...] I think I spend half of my working time in it."* (R&D center controller)
> *"There are these continuous resource control calculations […] it should be controlled that the resources we have requested for are employed all the time, nobody else has stolen them […]"*(Product program manager)

The iterative project resource planning process, roughly described has the following stages for the approved projects: (1) Planning task hierarchy with schedules based on project targets, (2) Defining the Work Breakdown Structure (WBS), (3) Mapping the roles to tasks. Calculating and aligning the needed manmonths for each role per month, (4) Mapping persons to tasks and finalizing the WBS according to the allocated resources, (5) Collecting the actual resource usage status and analyzing it against planned figures and reporting the status, (6) Making and updating project requests on technology group level, and (7) Making allocations on person level.

The product and project roadmaps provide the guidelines for the future resource needs through the requests of the future projects and the identified resource gaps. After identifying it, the resource gap is reflected against the capacity target, and activities are planned to minimize the gap. This information is used in the recruiting and subcontracting decisions.

Other tasks of the global R&D controller

The global reporting tasks are emphasized in the accountabilities of the global R&D controllers. Reporting includes both profitability information (PLP calculations) and control information (performance measures). In addition, there have been some benchmarking activities.

Moreover, the global R&D program controller is responsible for the project accounting in the field of financial accounting. The tasks include also capitalizing items into the group balance sheet. In this respect, it should be noted that the R&D controllers are working in a globally quoted public company, with extremely demanding investors and analysts. This task involves also discussions with group auditors. The time pressure from the markets is significant also in the financial accounting. This may be illustrated with Table 5.

	Friday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
12.00 a.m.			NMP's reporting units ready	Reporting to Region (NMP Europe)	Europe reports to NMP Group level	NMP Group to Nokia Office
2.00 p.m.			Reconciliation (bookkeeping) = reporting			After 2-4 hours whole Nokia Group results to CEO
4.00 p.m.	Cut off day	Autom. Transfer R/3 -> Hyperion	Cost center reports to network			

Table 5. Reporting timetable after the Cut off day

To sum up, the work of the R&D controllers include various financial planning and control tasks. Cost accounting is expanded into the product lifecycle profitability dimension, which undoubtedly is the most important accounting tool in the NMP's process-oriented new product development. Moreover, human resource planning, training, and process development play a significant role among the tasks of R&D controllers.

The hi-tech industry with its R&D-intensity and fast product lifecycles has its effect both in the role and in the daily routines of R&D controllers. Time pressure is sometimes enormous with respect to producing accounting information. It was even claimed that the R&D controllers in other industries are likely to have more time to develop new systems and practices. The R&D business controller suggested even that the demarcation criterion is the fast lifecycle, considering the features of R&D control in various industries. The program manager, however, stated that the time pressure in producing accounting information is not emphasized in this industry, maybe because he was not aware of R&D controllers' daily work compared to R&D control in other industries and reminded that the R&D controllers do not have to be aware of the technical details, and in that respect, the management accounting might be similar in any field of business. The process-orientation in NMP, on its behalf, has lead to a wholly new internal environment, which has had its effect in the current accounting practices as well as the R&D controllers' way of thinking.

> *"There is a terrible chaos all the time [laugh]. The speed, dynamism, fast moves and constant change, things like that, are industry-specific, to a great extent. Naturally the strategies have their impact, too."* (R&D center controller)
>
> *"This cannot be imagined in any other industry. There is no other business that would tolerate these investments in R&D."* (R&D controller)

3.3. The Profit Consciousness (Knowledge) Creation Process in NPD

> *"First off, we should understand how the profit and cost consciousness help us to make better decisions [...] usually the product performance or time-to-market targets run over the cost targets. If we had the tools how to increase it, how to add cost consciousness to decision-making, we would most probably use that kind of knowledge."* (Logistics project leader)

One of the points of interest considering this research project is the comment by Järvenpää (1998, 231): "The ability to bring the financial aspects understandably to the business context to be used managers in decision-making is […] becoming a critical characteristic of management accountants. They should, thus, be able to both produce and explain and interpret this information. […] Furthermore, they should be able to interpret and explain the information from other managers with their own knowledge, and participate proactively in the decision-making process e.g. as a team member." (Translated by Taipaleenmäki). In this comment, the fundamental aspects of

the role of management accountants, knowledge creation and the cross-functional co-operation applied in this study are integrated comprehensively.

It is easy to give an impossible combination of targets to R&D, e.g.: to be the best in the world, with the cheapest product created in a very short time. But taking into account the resources available and the fact that the targets partly exclude each other, the challenge is to find a balance.[176] That is the very task of the cross-functional team: strike the right balance between the targets in order to get the best possible business result. According to this aim, the composition of the NPD teams in NMP as well as the way it works have been defined. The following conceptual model (see figure 21) of the trade-offing targets in NPD at NMP is developed by Laaksonen *et al.* (1998).

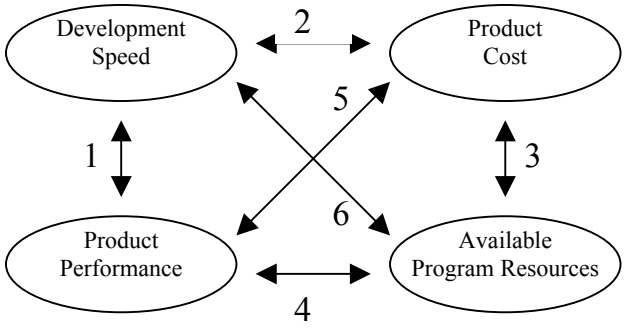

Figure 21. The six "trade-offs" between NPD objectives in NMP

> *"It [the role of R&D controllers] is actually to balance these arrows…* [the trade-offing targets] *you know natural sciences, how big these forces are… to make the best trade-off. […] They can provide us information to make these more balanced, so we can get this overall picture."* (Product marketing project leader)

The balance of the targets is described, quantified and prioritized (using weight factors) by the team. The proposal of the team is then approved by management and transferred to a performance matrix. The team is managed by this "deal". The deal clearly defines the roles and responsibilities of each party and is based on cross-functional results, thereby making a change compared to more traditional performance measurement (Laaksonen *et al.*, 1998). The behavioral aspects of the performance measurement in NMP are thus very carefully considered.

[176] This idea is presented widely in both professional and academic sources. See e.g., Herrmann, 1999. A somewhat more typical concept is this respect is the R&D sweet spot, which means determining the optimal spot of human resources in person-years used in product development with regarding the desired development time (e.g. Iansiti, 1999).

> *"A change in one becomes reflected everywhere else. […] When a customer desires a product R&D meets the need. Our aim is to produce attractive mobile phones quickly. […] It is the same question as with the egg and the hen, which one was first. We have to invest [in R&D] for future profits. The [human] resources are always limited."* (R&D program controller)

The costs, however, are just one dimension in the complex set of trade-offs that is experienced in the NPD projects in NMP as was discussed earlier with cost management issues. The same goes with time targets. Although time is one of the most important criteria in NPD success, the NPD processes cannot be considered as run with TBM practices, although some of its features can be observed (cf. milestone management). It can be argued that in the final analysis, it all comes down to profitability: managing all four dimensions well means profitable new products and success of the company. In other words, that is one of the main reasons why the traditional pure cost management thinking or pure time-based management on the management philosophy level is somewhat discarded in NMP and the key concept to increase profit consciousness and business-orientation among the NPD team members is product lifecycle profitability. However, it should be noted here that one specific criterion, e.g. time or cost can be stressed on the single product program level depending on the situation or product (line) strategy. The creating of profit consciousness is analyzed here with the help of the organizational knowledge creation theory (Nonaka & Takeuchi, 1995).

Similarly, Vaivio (2000), who is among the first ones to discuss management accounting together with organizational knowledge creation, argues for a ”provocative” management accounting, which first mobilizes non-financial measures in the exploration of ”new” knowledge. According to Vaivio, as significant ”new” knowledge becomes exposed, the ”provocative” management accounting also directs the following organizational initiative into financially sound alleys (Vaivio, 2000). Thus, also the understanding of the non-financial drivers for financial success of a company can be considered as tacit knowledge possessed by controllers who are able to explicate and analyze the management accounting information.

Since cost consciousness was defined as comprehensive understanding of costs of various cost objects (e.g. products, organizational units, customers, processes etc.) and the underlying cost drivers, it can be argued that the concept of profit consciousness together with business-orientation only take a

more wider perspective with both revenues and costs, their interrelationships and underlying drivers for profit.

Socialization (from tacit to tacit):
Sharing tacit knowledge in the cross-functional knowledge creation interface

In order to increase knowledge creation the process should be started with proper socialization, especially between the R&D controllers and program leaders. Issues related to e.g. organization, culture, training, and meetings are discussed in more detail regarding the cross-functional co-operation, which according to the theoretical discussion emerged to be the most significant topic.

Inter-team learning is currently facilitated through appropriate team forming. People (Product Program managers and leaders) are shifted to another NPD programs after one is finished and thus experiences are passed to other programs. However, at present, the program leaders or even the program managers are typically quite inexperienced due to the rapid career development possibilities in the case company. The local R&D controllers, who have been and are simultaneously working with multiple programs, may also contribute to the inter-team learning and pass their management accounting expertise and experiences to various programs. One potential way of facilitating cross-functional learning would be the job rotation among the local R&D controllers. It was more or less a fortunate co-incident that the local R&D controller in Salo R&D center had worked in the sourcing function and one global R&D controller had worked in the operations. It should be noted that the leader teams of product development program are frequently located mostly in one place, which is also a very effective way of changing the traditional functional mindset. As it was mentioned earlier, the R&D controllers in NMP are not included in the NPD leader team.

> *"It [the cross-functional interaction] should be much more frequent. […] In addition, the gap between our two main processes, product creation and product delivery is a little too wide".* (R&D program controller)
> *"Although, officially we have this process organization, the borders between functions are actually incredible high. There should be two-way information and knowledge flow […] the product development should be more in contact with us in the controller organization. They should disseminate the knowledge and understanding as well as make us aware of their thoughts."* (R&D center controller)
> *"They [the local R&D center controllers] should be more involved if we really want to be more cost-driven. They are far away from the program*

> *in my eyes. In one way it gives us more flexibility and freedom…"* (Product marketing project leader)
> *"It seems that we are not having tough times… there is the need for R&D controller who is more involved in the NPD projects."* (Operations project leader)

The mutual understanding between different functions has evidently increased during the past few years. This is the fact also between R&D controllers and the multi-functional program teams. Obviously, this understanding is dependent upon the persons involved in the interaction, but with regard to R&D controllers also on the attitudes of the management of other functions towards management accounting. As it could be expected, the cross-functional co-operation may also emphasize the potential integrating role of the R&D controllers.

> *"The understanding increases, but on the other hand it may argued that it is insufficient."* (R&D center controller)
> *"I think we have practiced it [the cross-functionality] for so long that it has become a way of life."* (Logistics project leader)
> *"Personally, I have had no problems whatsoever. The engineers do not think in the way accountants do […] marketing people think differently. Controller's job is to combine these thoughts and dress them in numbers."* (R&D controller)

The cultural factors affecting knowledge creation in the profitability consciousness sense are obvious. The engineering-oriented culture prevents this kind of learning to some extent whereas the focus on informal information dissemination and encouraged knowledge transfer act as facilitating factors. In NMP, both the R&D controllers and NPD team members recognize to some extent the cultural lag as well as the knowledge gap (cf. Ratnatunga *et al.*, 1989) between the R&D controllers and non-accounting leaders. However, there have been only minor disputes or conflicts, but no major tension whatsoever between the NPD staff and R&D controllers. Frequently, the non-accounting leaders even expressed their satisfaction with the R&D controllers' ad hoc service. On these points, however, it should be highlighted that there are strong differences between the individuals involved.

> *"The cross-functional co-operation works quite well […] Traditionally the only disputes arise from the programs' travelling budgets."* (Product program manager)
> *"When you challenge things […] whether or not you need this and that […] it may seem that our main job is to focus in the travelling budget […] When you question these things we are scary monsters, because we*

> *don't allow business class travelling every day […] not a single travel has been forbidden."* (R&D center controller)
> *"The only cultural differences arise in the interface between R&D and operations, which has a more traditional and hierarchic organization."* (R&D project leader)

The most peculiar detail here is the fact that in NMP in general, there is typically no direct cross-functional interaction between people, mostly because of the multidimensional global organization. Substantial amount of information is disseminated in the information systems. The finance and control organization in particular, are – if not in complete isolation – at least heavily depending in software and hardware in communication with other organizational functions. The shared use of OLAP (On-line analytical processing) database is very common in the PLP process. The R&D center controller reports on the product programs that belong to the center and makes summaries of the center's programs as well as provides the users of the database with the newest basic information. On the other hand, the global R&D controller has the database ownership and makes NMP level summaries (all programs, protocols, regions, and functions). The communication equipment, both the software and hardware are extremely sophisticated. However, access issues should be reconsidered: e.g. the local R&D controller might benefit from wider access to accounting information of other product programs. The implementation of the cost planning functionalities in the ERP-system provides better possibilities here.

However, it can be argued that the knowledge creation may be limited without the direct interaction between people. Even though they encourage people to discuss the financial information, many of the R&D controllers emphasized the importance of the electronic communication. Consequently, it can be argued with the concepts by Nonaka and Konno (1998) that the cyber ba for combination has been well-constructed, but at the same time at least the interacting ba for externalization and especially the originating ba for socialization have suffered enormously. Some leaders suggested even a more close physical location with the R&D center controllers or a local R&D project controller, whose only responsibility would be a more close contact with the members in the NPD programs. It was further widely agreed that there is no need to have one R&D controller for each product program.

> *"The multi-user system takes care of the communication"* (R&D controller)

In their study, Amelingmeyer and Kalvelage (1999) argue that since knowledge per se is not material it requires a physical carrier. Knowledge is thus stored in material knowledge carriers, such as print-related, computer-related, and product-related knowledge carriers. In addition there are direct knowledge carriers such as people and collective knowledge carriers, such as teams. Furthermore they identify three different knowledge domains in NPD (the individual domain, the intra-project domain, the inter-project domain) and three classes of vehicles of knowledge (people, reports and databases, organizational and technical elements). Their explorative case study is interesting with regard to this study, because it is conducted in the NPD environment in telecommunications industry (Ericsson Finland and Italy). Amelingmeyer & Kalvelage (1999) suggest that in the inter-project learning the members of Finnish culture prefer tacit knowledge transfer with people as vehicles, while reports, databanks, and organizational elements play hardly any role.[177] The reported result of the knowledge transfer is strongly contradictory to the empirical findings of this study, although the focus of this study lies in cross-functional knowledge creation, instead of the inter-project knowledge transfer and its cultural origins. One potential explanation to the remarkable difference in the results may be the fact that despite the national, professional and industry-related cultural variables seem to derive from very similar cultural platforms in both the studies, the Finnish interviewees of this study may represent more the global corporate culture of Nokia than their national background, especially with regard to work-related knowledge transfer preferences.

As it was mentioned, only the program managers, but typically not the leaders, discuss directly with local R&D controller. No doubt, better interaction between the R&D center controller and the leader team would result in increased profitability consciousness. Especially, the local R&D controller could be present in some of the milestone meetings, where the product profitability issues are controlled with the help of updated latest estimates and something requires more detailed financial analysis and in-depth understanding. The interaction between the local and global R&D controllers is currently very efficient. Similarly, the inter-team learning is facilitated with the regular meetings of the product program managers (Program management board), where also the

[177] In addition, Amelingmeyer and Kalvelage (1999) report that in the multi-active Italian culture, the preferred mode of learning is explicit and group-oriented. As the Finnish new product developers preferred personal individual conversations even with their superiors, they argue that this conforms to the low power distance typical of the Finnish culture and its classification as a people-oriented listening culture. In addition, it was recognized that the Finnish interviewees preferred also the intranet web pages. However, the German interviewees preferred more strongly the computer-related knowledge carriers.

financial issues are on the agenda six times a year. However, considering one of the stunning facts, it would obviously facilitate communication, if the global R&D controllers were more often present in these gatherings.

The cross-training chain in NMP is quite efficient. The global R&D controllers train the local R&D controllers, who, in turn, are mainly responsible for the training of the NPD team. The R&D controllers receive some training themselves. Controllers, who have two years of working experience with the company, are provided with a group level finance and control training program called Abacus. The R&D controllers are not subject to the training of the mobile phones' technical details. However, e.g. some leadership training programs are available for them. The program manager training and the intro-training for the leaders, on the other hand, naturally include basic financial issues with certain business games. In addition there is training program for PPMs and program leaders, called Compass, which includes only some financial issues, and the functional organization may provide the leaders with more training. Despite all this, the PPM and some leaders questioned the positive effects of the financial training, which should be more tailored to the specific environment.

> *"In a way you grow to understand the figures […] you will have in-built rules of thumb for understanding the costs. […] In fact, there cannot be training for this […] the experiences bring the understanding."* (Product program manager)
> *"If you take a traditional career path from head designer upwards, it will bring you the [financial] knowledge you need. As I said, you don't need to know much. […] For those interested, there could be more in-depth training available."* (R&D project leader)

The most powerful restrictions to the socialization derive from the time-to-market pressures and limited human resources. The R&D controller organization, which may occasionally be considered as an under-resourced support function, frequently suffers from lack of time, when it comes down to interaction between people and learning-related issues. The role of local R&D center controllers is of paramount importance in increasing the profitability consciousness and business-orientation among the NPD team members.

Externalization (from tacit to explicit):
Using the concepts Product lifecycle profitability and critical success factors

The concept of product lifecycle profitability (PLP) has been introduced in the company. The concept is very simple and conceivable. It includes the idea of

satisfying customers' needs and increasing investor's profits during the lifecycle of profitable new products. Although there are some other externalized concepts in the form of performance matrix targets, PLP is definitely the key concept of increasing profitability consciousness and business-orientation.

Also the only disadvantage in this concept is its holistic nature. Although profitability captures both the revenues and the costs, there is this possibility that the cost dimension is not completely understood by the leaders in the NPD team, who focus on the profitability and analyze only the human resource costs in more detail. Only those leaders, who themselves provide analyzed cost information for the PLP calculations, seemed to understand some of the cost drivers for the "big picture".[178] The leader team members' unawareness of the product cost structure might easily lead to unprofitable products if the costs in latest estimates are not analyzed and understood. On the other hand, it was claimed that more detailed knowledge of the costs is of no use in the everyday work of the leaders.

Moreover, the product lifecycle profitability concept might be linked to the ideas and concepts of value chain analysis e.g. in the training sessions (cf. Clinton & Graves, 1999). Value chain thinking could promote a more holistic view of the business, and the process-orientation in NMP only supports this. Similar to the PLP concept, the previously presented conceptual model of six trade-offs in the NPD would probably increase business orientation among the NPD team members. Even though the model, on which the targets in the incentive system are set, was extracted from internal documents, most leaders had never seen it. Some of the leaders would like to know the background factors in the performance matrix targets as well as the relationship between the NPD measures and corporate objectives. Actually, this could be done easily through including corporate strategy and the related critical success factors in the financial training. This, in turn, would mean firstly clarifying the cost and profit drivers for the non-accounting leaders. Secondly, the program team should be made aware of the overall cause-and-effect relationship – network affecting the performance matrix, i.e. moving beyond the plain performance report towards the very drivers for success (cf. Sandström &

[178] Similarly, Sandström (1999a, 6) suggests that there are differences among the group members and in their practices of understanding and communicating cost information. She describes that "Engineering oriented persons like to model and quantify the problem from its technical point of view. Purchasing personnel see the possible suppliers to deliver the needed parts and they consider the costs of individual sub-sourced parts. Marketing people see the markets and price levels of the future product, and manufacturing personnel think of the optimal production volume and manufacturing costs."

Toivanen, 2000). Actually, the program team might even reverse the construction of the performance matrix by decomposing the measures into the underlying critical success factors, or even strategies and visions. [179]

> *"It [how the bonuses are determined] is a kind of vague to me. Naturally, we do take a look on it [the performance matrix] and try to identify the underlying factors, and then push for good performance – but if you really understand why the measures are there, from the viewpoint of the company as a whole, it would motivate us even more […] If you understood it, you would be much wiser and more motivated."* (Logistics project leader)
>
> *"Somehow it would be good to sometime get the background story about those [PLP] numbers […] Every two weeks we have program meetings with the leader team. Maybe the controller could join us to explain how the cost and profitability picture is developing during this development cycle."* (Product marketing project leader)
>
> *"The people who read those [PLP] figures should understand, what is the underlying logic."* (R&D program controller)

Thus, especially the strategic management accounting might crystallize the corporate values and strategy among the people who work in one of the most important processes of this enormously grown and complicated global company.

Combination (from explicit to explicit):
Participating in the data gathering and calculations in the PLP process

The product program manager typically collects the data for the initial product lifecycle profitability calculations and the latest estimates thereafter based on them. However it should be noted that some of the PPMs might use an assistant in the data collection. Moreover, usually there is a slight contribution to the data input by the local R&D controller and the sourcing leader.

> *"I desire to prepare the PLP calculations myself, because that is how you know a lot better what's going on. In some programs the assistants are*

[179] The R&D business controller referred implicitly also to different types of tacit and explicit knowledge. She suggested that the R&D controllers have their own *"rules of thumb"* when challenging and analyzing the R&D cost information provided by the cross-functional program team. In addition she argued that in training the non-accounting engineers it would be useful to illustrate the accounting concepts they are not familiar with, such as working capital, with some *"simple analogies"* that are close to their personal life.

> *preparing the calculations, I think it is not the right way."* (Product program manager)
> *"[W]e develop the processes […] when they [the PPMs] enter the figures [into the systems], they become committed, and the probability to succeed increases. The responsible is the one who performs."* (R&D controller)

This actual participation in the major management accounting process, which basically means participative rolling budgeting both in the PLP and potentially in the STP processes can be seen as a facilitating factor in the knowledge creation process. However, an even more close involvement by the members of the leader team would inevitably raise the level of understanding the own contribution to the company's performance, and hence increase further motivation and commitment as well as the profit consciousness of the participating individuals.[180] This would most likely be the case also with the program target setting and bonus calculations. When it comes down to the NPD staff who are the subordinates of the cross-functional leader team, mainly from the R&D function, promoting business-orientation is inevitably much more difficult. Appropriate performance measurement, together with the incentives, are the major elements in the R&D control system to direct the behavior of the NPD staff towards the corporate goals. In the telecommunications and consumer electronics industry, it is easier for the designers to understand the business than e.g. in business-to-business trade.

Considering the R&D controllers in the data collection for the PLP process, it was suggested that they are the knots in the multidimensional reporting network disseminating financial information and knowledge in the organization.

> *"There is the problem of collecting information we have in the organization […] it is everywhere in the regions etc. It is problematic or at least time consuming."* (R&D program controller)

Internalization (from explicit to tacit):
Embracing lessons learned from the PLP cases

Compared to Huber's (1999) practices of contributing to team learning, in NMP, the practice of sharing and explicating evolving knowledge within the team is very informal. It can be argued that this practice has become institutionalized through creating an organizational culture where free and full

[180] On the other hand, it is obvious that even the non-accounting people can participate in the accounting, especially in the data collection, they cannot take the role of R&D control themselves.

knowledge transfer is actively pursued (cf. Huber, 1999). The accounting information is typically analyzed critically by the local R&D controller, and the information is used in the future decisions.

> *"In a local R&D center, […] [the PLP calculations] support the decision-making. It is about receiving and sharing information […] If the results of a calculation show that this product line has performed like this we may find a reason for it […] and in the plant, the reaction times may be shorter in the future […]."* (R&D center controller)

Furthermore, it can easily be seen that the findings of lessons learned in NMP are very consistent with the ideas of Huber (1999) and Jönsson *et al.* (1998). One critical link is missing, however: There are no documented lessons learned in the area of management accounting.[181] This, in turn, means that the experiences in the form of management accounting information are not passed to future programs and the accounting system is not acting as a learning device (cf. the machine analogy in accounting, e.g. Burchell *et al.*, 1980). If the NPD staff in NMP would have more time they could adopt the idea of reversed engineering (e.g. Daniele, 1998). In this practice, some finished product development projects are discussed in reversed chronological order, step-by-step and decision-by-decision, and all information available, technical and accounting information included may be taken into consideration. The program manager, however, questioned the use of past PLP cases in learning purposes due to limited time resources.[182] There is an aim to mutual learning from the accounting information of the ongoing programs in the program management board. It can be argued that the trend towards modular design and using technology platforms will only increase the importance of the inter-team learning (cf. Boer *et al.*, 1999).

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[181] Cf. Lam (1997, 986-987) : "Tacit knowledge, as far as possible, will have to be codified and made explicit so that in can be easily understood and accessed by those who do not share a common experience or background. In other words, relevant knowledge is extracted from the individuals and groups and stored within the organization in written procedures and documents."

[182] As Roth *et al.* (1999) report the findings from their field study, they emphasize the fact that all respondents felt that the major barrier for knowledge creation in NPD is lack of time, which in turn renders a lack of space in the agenda to discuss important and often ad hoc issues. They found also that the sharing of experiences and knowledge gained in a late phase of a project frequently is carried out through personal contacts network and rumors. Hoopes and Postrel (1999), in turn, have studied the effects of the gaps in the shared knowledge in NPD and suggest that in addition to the attributable hours of extra product development work there are substantial indirect costs arising from e.g. incorrect features or later launch of the product. Boer *et al.* (1999) however argue that the organizational, space and time barriers that emerge in the knowledge transfer in NPD are overcome by managerial and cultural awareness of knowledge transfer and integration.

> *"The role of the past… it is to learn something from the history […] learn from the mistakes"* (R&D controller)
>
> *"[…] whether or not something is worth doing […] are we able to learn from something in the past […] can we find some good projects […] I just had a few words with a program manager about the fact that we should find a case program and take a look of its actual costs for example at some stage of pilot production, how much the cost have been versus the actual costs at the mass production stage […] the costs at the product development stage versus the final costs […] We could find different projects that have been completed in a totally different way. Then a PPM probably would find the PPM from another program and discuss of how they have done the things differently. These are creative calculations."* (R&D center controller)
>
> *"Actually, I have enough to do with my own figures. I hardly had time to take interest in [the figures of other programs] […] Naturally we benchmark the figures of the current programs because we have constantly limited resources. We challenge other ongoing programs. […] [At the program manager board] we discuss the business cases, and PLP calculations and try to learn from each other's mistakes and successes."* (Product program manager)
>
> *"One good example [of using PLP calculations in inter-team learning] could be the fact that the FFR [field failure rate] might be underestimated in these calculations. […] We have PPM boards and sessions for functional leaders where we transfer the knowledge and discuss our problems on program-level and naturally our designers and technology groups have meetings, too. There is the latest technical knowledge, but the best space for knowledge transfer is our coffee table."* (R&D project leader)

There are at least two possible ways of internalizing the knowledge in the field of NPD management accounting. First is the above-mentioned documentation of accounting lessons learned from all programs and the second is drawing special programs as cases to training and in-house workshops as well as the program managers' database. The quantitative information available could be at least the initial PLP calculations, updates at each milestone and quarter and the actual figures over the product's lifecycle. The qualitative information might include e.g. the role of accounting information in the decision-making of these case programs together with detailed analyzes as well as the description of the successful and less successful decisions and the implications. It should be noted here, however, that it is extremely rare that the programs at the concurrent engineering stage receive a no-go decision.

The second alternative, i.e. the above-mentioned training, in turn, would meet the demand for more tailored financial training. The access issues are very critical here. It was suggested that the lessons learned from the management accounting as well as the financial information of the case programs should be available only to R&D controllers, program managers and leaders. Moreover, if these success and failure stories were combined with the information of their target setting and actual measure values from the past as well as the possible bonus calculations, this would most likely enhance the learning towards a more holistic understanding of the financial issues together with the decision-making in the NPD projects, and thus result in increased business-orientation and profitability consciousness among people involved in the future programs.

In this chapter, some examples of profit consciousness creation process in the product development of the case company were discussed. Although the above examples from knowledge creation were presented each to describe a single phase in the organizational knowledge creation process, it should be noted that in fact, every single one of them can contain all of the phases of knowledge creation, i.e. both creating and using cross-functional interface, new concepts, accounting information from new calculation, and lessons learned (tacit – tacit – explicit – explicit and back to tacit knowledge). However, here the examples linked together illustrated a complete knowledge creation process, where after the occurred socialization in cross-functional co-operation (T-T), some new accounting and business concepts became externalized (T-E), and accounting information was gathered and combined to prepare e.g. product lifecycle profitability calculations (E-E), which can be collected into the lessons learned documents to be further embraced and thus internalized (E-T) in order to increase profitability consciousness and business orientation in NPD.

3.4. Empirical summary and NPD Accounting Framework

This discussion outlines and summarizes the key issues from the case findings of the study in the form of a NPD accounting framework, which was developed in order to conceptualize and organize the discussed topics, and to be further used in supporting the gathering of the empirical data (cf. Figure 12). No strict causal relationships are to be captured in this framework. The role of accountants is excluded from this framework due to reporting purposes.

In Figure 22, the case company NMP is presented with all its interest groups that are relevant to the NPD operations. Thereafter, the partly mutually exclusive NPD objectives are introduced. From case evidence, the need to control the limited human resources was considered to be strategically critical.

The ongoing product programs were challenged even to compete internally from the available resources. The various objectives of the NPD also raise the issue of different forms of competition and competitive strategies at corporate level. These generic strategies can be reflected from corporate level to product level. The various product strategies emerged from the case evidence. It is typical that one or two of the mutually trade-offing targets become emphasized in the product strategy.

Figure is further elaborated with certain critical issues related to costs, time, technology, NPD staff and NPD organization. In NMP, the typical practices in NPD, such as concurrent engineering, milestone management, and platform-based development were all explicitly applied. Regardless of the enormous time-to-market and cost pressures, time-based management or cost management were not explicitly applied as management philosophies, although some implicit elements of them could be observed. The cross-functional NPD teams are the social platforms that form the organizational knowledge creation interface in NMP. The knowledge creation processes seem to be typical in NMP, except for the fact that from the management accounting perspective heavily highlighted aim is to increase profit (not just cost) consciousness in NPD.

The framework will be completed with regard to the job of accountants (dotted-line ovals), which include current management accounting practices. It was observed that benchmarking activities were very limited and moreover currently there is only marginal need for inter-organizational cost management. The case evidence indicates that in NMP there are no traditional or text-book strategic management accounting tools applied explicitly but the R&D control tools, such as product lifecycle profitability (PLP), performance matrix (PM) for single product programs, and 13 months rolling forecasting as short-term planning (STP), are very company-specific in nature. It should be mentioned that in STP, NMP has abandoned traditional annual budgeting, PM and other performance measurement resembles strongly balanced scorecard approach, but PLP calculations include only some implicit elements of target costing. Finally, some other important tasks, e.g. training and developing finance and control processes belong to the typical activities of both local and global R&D controllers in NMP.

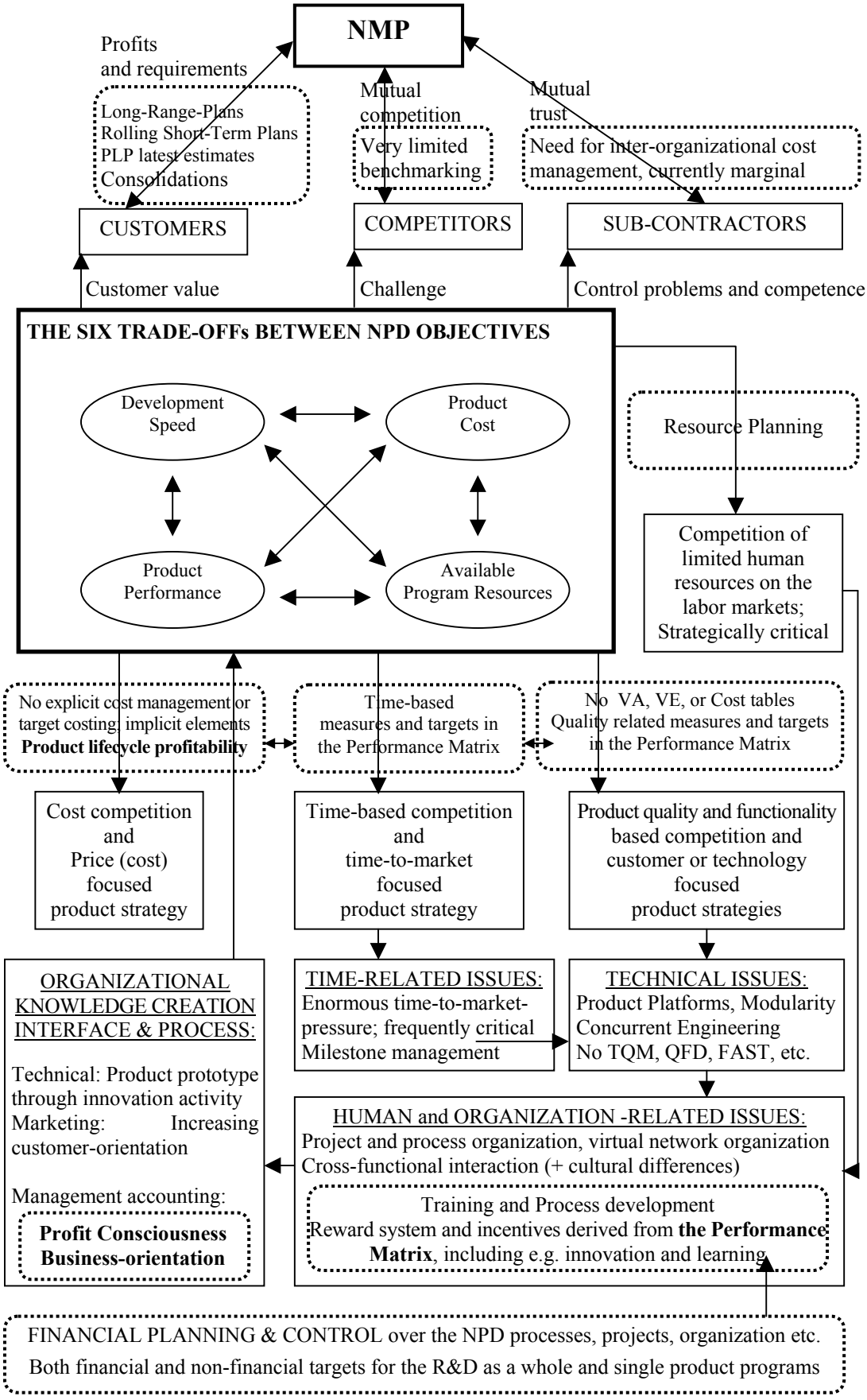

Figure 22. The NPD Accounting Framework and case Nokia Mobile Phones

4. RESULTS

4.1. Brief description of the research setting

This study is an in-depth case study, which is mainly descriptive and illustrative but has also slightly interpretative (cf. Scapens, 1990) and slightly prescriptive features. When describing and analyzing e.g. the management accountants' task and current accounting practices in NPD, the researcher has minimized the intervention and to certain extent used theories and previous findings as tools in interpretations. These parts of the study are characterized to some extent by explorativeness. In addition, those parts of the study, which deal with analyzing and describing the role of the management accountants are also conducted with similar approach, i.e. the intervention is minimized as well, but the focus is more on existing research findings and how they are applicable to the specific situation. In this case, it is illustrated how the current business controller role trends are applicable in the situation of the R&D controllers, so the question is actually of refining previous findings. Furthermore, there is part of the study, namely the knowledge creation section of the empirical case study, where the researcher finally identifies development potential with the help of organizational knowledge creation theory and suggests some measures be taken to promote profit consciousness and business orientation in the cross-functional NPD teams. This part of the study has thus to some extent minor features of action research, i.e. this implies features of minor intervention where both theory and practical solutions development are on demand. This brief description shows that according to the new classification of case and field studies in accounting proposed by Lukka (1999), the study can be regarded as an illustrative case study. As qualitative methods have been used to study accounting practices and their background factors, the approach has also minor features of ethnography (ibid.).

The contribution of the findings of this case study emerges in the in-depth understanding of management accounting in process-oriented new product development. The case study is conducted in a globally operating MNC, Nokia plc., in the mobile phones division NMP. The organization, role and tasks of the management accountants as well as the management accounting practices and the organizational knowledge creation interface in increasing the profit consciousness in NMP's NPD are analyzed and reflected against the current academic literature wherever comparison is applicable and feasible.

NMP faces enormous time-to-market pressures in the NPD, due to the operations in the extensively competitive industry. It can be argued that there are features of many generic strategies (cf. Porter, 1980 and 1985) and the confrontation strategy (Cooper, 1995) in NMP's business strategy, which becomes crystallized in certain trade-offs (speed, cost, resources, product performance) in the NPD. These generic strategies can be reflected from the corporate level to the product level. The case findings indicate that NMP balances the above-mentioned trade-offing targets with regard to every single new product under development, and thus time-to-market, price (cost), customer and technology focused product strategies were adopted (cf. e.g. Dávila, 2000 and Miller & Roth, 1994). Thus, although the management philosophy in Nokia and its R&D is not purely focused in time-based management or cost management, some features of the features of those were clearly observed (cf. targets that are controlled with milestone management). What is important to note is the fact that the emphasis on one or the other criteria can be stressed on a product-level, depending on the product (line) strategy.

The fierce time-based competition and size of the company have lead to the use of concurrent engineering practices and milestone management (cf. Hertenstein & Platt, 1998; Lindkvist *et al.*, 1998) in the process-oriented NPD environment of this multidimensional company. NMP takes also advantage of the product platforms, which is very typical to NPD in the consumer electronics business. One product program manager is in charge of the cross-functional leader team and some 60 persons in the NPD project, which is at the concurrent engineering stage.

4.2. Understanding the current management accounting practices in NPD

The first research objective was to understand the current management accounting practices in NPD. Here, the case study evidence of the issues related to the organization, role and tasks of management accountants in the NPD is summarized and partly reflected to the previously discussed existing literature.

Organizing management accountants to support NPD

The increasing decentralization has had its effect in the case company and this has resulted in the form of local R&D center controllers. Although this finding supports the decentralization arguments (e.g. Granlund & Lukka, 1997a and 1998b), the local R&D controllers are not assigned as far as members of the leader teams product programs (cf. Hertenstein and Platt, 1998), but instead,

they are controlling multiple NPD projects in the local R&D center. The reason for this is simply the fact that there seems to be no need for a R&D controller assigned directly to a single NPD team. The costs would most likely exceed the potential benefits. A specific feature of a globally operating multi-national company arises with the global R&D controllers who take more holistic perspective in controlling the NPD processes and R&D centers. It should be further noted that in addition to the R&D controller organization, there are also controllers in the product line, regional, and functional organizations, and in some NMP's R&D centers, the organization may vary.

The role of management accountants in NPD

In addition to the core competence in management accounting, the R&D controllers in NMP face certain role-related expectations with relation to NPD. Although there is evidently no need to understand the details of technology or manufacturing techniques, understanding the processes and IT (cf. Caglio, 1999; Hrisak, 1996; and Scapens *et al.*, 1998) were experienced as significant requirements. A somewhat surprising finding was the very strong need to be creative in the forecasting activities under uncertainty (cf. e.g. Bromwich, 1990 and Pihlanto, 1988). The findings give strong support to the contingency theory analysis by Järvenpää (1998), who argues that the complex organizational structure, engineer-oriented culture and the elements in the operating environment have their impact on accounting and accountants, upon whom is placed various challenges, limitations and change pressures. Also, strong support is given to the interpretation by Granlund and Lukka (1998b; see also 1997a and 1997b), who state that the role of management accountants, has been affected by the characteristic business trends, such as customer orientation, process-orientation and the time focus towards the present and the future (see also, Nixon, 1998a). Similarly as Granlund and Lukka (1998b), Järvenpää (1998) argues that management accountants should be convincing performers with deep knowledge and holistic view of the company's business, and they should be able to see the big picture beyond the number crunching. In addition, the inter-personal skills set is typically welcomed (cf. Lebas, 1994). Hopper (1980) mentions that the role behavior of a management accountant is a result from his or her own desires and orientations, requirements set by other people and the current and potential techniques or methods. This can be said to be very true also in the cross-functional R&D control environment.

The case findings indicate that there are no major differences between the characteristics the R&D controllers are expected to have by the non-

accounting leaders and the existing characteristics that R&D controllers themselves emphasized. The only exception that indicates the expectation gap arises in the fact that the R&D controllers highlighted more than the non-accounting leaders the understanding of both the R&D and accounting or control processes and creativity as a prerequisite in their work. Notwithstanding the great number of characteristics, e.g. creativity and analytical skills, no trade-offing or completely mutually exclusive characteristics surfaced. The expected characteristics from the case findings are presented in Table 6 together with references and the explaining background factors that answer to the why-question in the second research problem.

The resulting expected characteristic	**The background factors (case)**
Creativity (e.g. in updating the latest estimates of the programs and rolling short-term planning) [cf. Bromwich, 1990; Granlund & Lukka, 1997a, 1998a, 1998b; Hertenstein & Platt, 1998; Pihlanto, 1988]	Time-to-market pressure and future-orientation
Understanding of the processes involved [cf. Granlund & Lukka, 1997a, 1998a, 1998b; Nixon, 1998a]	Process-orientation
In-depth understanding of the business [cf. Granlund & Lukka, 1997a, 1998a, 1998; Järvenpää, 1998]	Business-orientation
Preciseness (need to match the figures in many organizational dimensions), Understanding the complexity Analytical characteristics [cf. Granlund & Lukka, 1998b; Järvenpää, 1998]	Multi-dimensional organization
Team skills, communication skills [cf. Granlund & Lukka, 1998b; Lebas, 1994]	Cross-functional co-operation
IT understanding [cf. Banerjee & Lloyd, 1995; Banerjee & Kane, 1996Caglio, 1999; Granlund & Malmi, 2000; Hrisak, 1996; Maccarone, 2000; Scapens *et al.*, 1998]	Enterprise resource planning system and other information systems

Table 6. The expected characteristics of the R&D controllers in NMP

Considering the role of the R&D controllers in NMP, it should be first mentioned that the decision-making is taken out from the product program. In the final analysis, this means that the management accounting information,

which without the estimated figures is largely based on the financial accounting system, has a different role compared to the role of R&D controllers. It can be argued that the R&D controllers themselves have mostly an operational role whereas the accounting information is seen to have strategic relevance. Compared to the discussion of traditional bean-counter archetype vs. new business controllers (e.g. Granlund & Lukka, 1997a and 1998; cf. also, Lyne & Friedman, 1996 and Friedman & Lyne, 1997), the R&D controllers in NMP have extremely heavy temporal emphasis towards the future and the understanding of the business logic is highly expected. The cross-functional appreciation is also very high. However, the primary aim of the communication and the felt scope of responsibility lie between the fulfilling of formal information requirements with timely and correct accounting reports and active role in the business decision support by analyzing the accounting information. Although the tasks include also "bean-counting", the tasks such as training and process development represent the other end of the continuum. Considering these facts, the results indicate that the typical tasks and characteristics of both the global and local R&D controllers in NMP place them closer to the new business controller category.

The expansion path of the management accountant's job description by Granlund and Lukka (1997a and 1998b) suggests that the accountant's role can vary between that of a historian, a watchdog, an advisor or a consultant and a member of management team or a change agent. Both the global and local R&D controllers in NMP have various traditional accounting and cost controlling tasks, which means the first two stages in the path are obvious here. The R&D controllers have taken also the role of advisor and trainer and there can be seen some elements of the change agent role. Only the participation in the decision-making is missing from their role, which does not include the management team member dimension. Hence, the role of R&D controllers in NMP captures a wide variety of roles, which vary between a historian, a cost challenger, an advisor or a trainer, and a process developer or a change agent. The development trend of the R&D controllers' role in NMP thus parallels the role expansion path of the business controllers identified in the management accounting literature. The future of the R&D controllers' role may be even more process-oriented (i.e. controlling with more process-oriented techniques and perspectives) but the role has likely reached its highest levels in the expansion path. The roles in the continuum are presented in Table 7 together with the explaining background factors that answer to the why-question in the second research problem.

The resulting role in the continuum	The background factors (case)
Not a member of management team; to some extent, however, change agent and process developer	Decision-making is taken out of the NPD programs; lack of time; engineering-oriented culture
Advisor and Trainer	Increasing importance of the accounting information systems; core competence in financial issues; The facts that the role of the management accounting information is considered strategic and that the mass products have small profit margins were seen to lead to a more significant role of the support by the R&D controllers.
Cost challenger	Increasing importance of the limited human resources; mutually competing product programs; uncertainty in the R&D investments and returns
Historian	Management accounting information is based on the master data from the financial accounting information

Table 7. The roles of the R&D controllers in NMP

Järvenpää (1998) argues that management accounting is surrounded by an uncertainty over the core of its role, whether it lies in supporting decision-making with accounting information or acting as tool of management control (see also, Caplan, 1971; Hopwood, 1974; McKenna 1978). He identifies the human expansion (i.e. increasing the active participating instead of the passive scorekeeping and control role) and the technical expansion (i.e. transfer from the traditional operative accounting towards the strategic management accounting methods). Consequently, in the light of this demarcation, strategic management accounting with its future- and outward-orientation is one of the underlying factors in the changing role of management accountants (Bhimani and Keshtvarz, 1999). Hrisak (1996), in turn, argues that by using technology innovations, controllers are turning data into knowledge for decision-making and their role towards a business strategist. On the basis of this study, this thinking can be expanded to include the whole data-information-knowledge-continuum. It can be argued that data, together with analysis and decision context, can be turned into information. The true business controllership

becomes fulfilled when the information is combined with reasoning including tacit knowledge in order to create new knowledge.

It was widely agreed that the ultimate purpose for the existence of the R&D controller organization is to increase business-orientation in NPD through taking financial perspective and communicating financial figures and challenging the NPD teams.

Finally, with regard to R&D controllers' role, the question of degree of involvement in NPD can be raised. Whereas there is a great deal of variation in the workload of other functions in NPD, it was observed that in NMP the workload and also the degree of involvement of both local and global R&D controllers is pretty much the same at all stages of a new product's lifecycle. The only fluctuations can be seen in the importance of management accounting information, which is naturally higher at every milestone review, where both the product profitability and general performance indicators are controlled. Figure 23, adapted from Tabrizi and Walleigh (1999) illustrates roughly the typical cycle mismatch and R&D controllers' workload in NPD (see also Bailey, 1991).

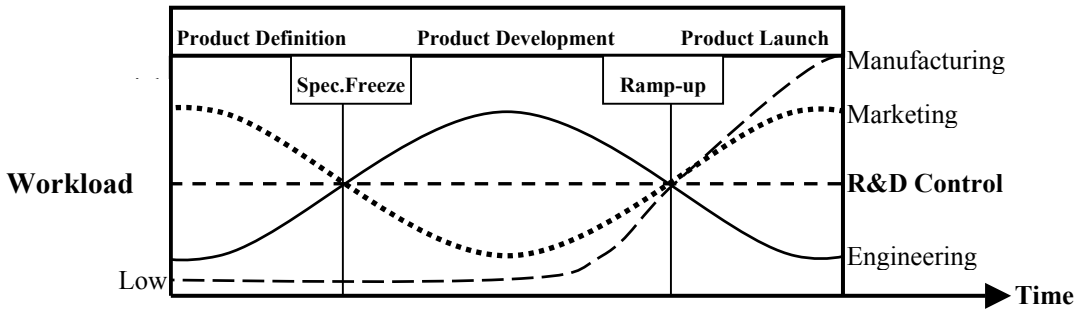

Figure 23. The Cyclical Workload Mismatch and R&D Controller's Involvement

The tasks of management accountants and the current accounting practices in NPD

The accounting practices related to NPD in NMP include some traditional and strategic management accounting techniques in cost accounting as well as in financial planning and control. Cost management is not explicitly adopted as a management philosophy, but some of its implicit elements could be observed in NMP and a need for the inter-organizational cost management with the subcontractors emerged to some extent. The same observation applies also to time targets. Although time is one of the most important criteria in NPD success, the NPD processes cannot be considered as run with TBM practices, although some of its features can be observed (cf. milestone management).

The product lifecycle profitability calculations with latest estimates to be updated quarterly and at each milestone are considered as the most effective

tools in controlling single NPD projects, and a pressure towards even earlier initial PLP estimates existed. Quite surprisingly, the PLP calculation in NMP cannot be regarded as a typical textbook target costing process. Although target costing can take many company-specific forms, there is a general understanding of certain features, (e.g. early phase at the product lifecycle, market-orientation, cost reduction as the ultimate goal) which characterize target costing. In NMP, the costs are not a single target, but only one target that should be balanced with e.g. the development speed and product properties. The case findings indicate further that the costs of a new product are usually easily anticipated, but the market components, i.e. sales price and volume, are more difficult to forecast. Moreover, the findings suggest that the profit contribution of a new product is more significant in NMP than the underlying cost target, which loses some of its importance after the beginning of the development cycle, at the E0-E1 milestones of the concurrent engineering process, where the business case of the new product is approved in the board meeting (cf. the evidence by Dávila, 2000). Thus, according to the case evidence, it is obvious that the PLP process is initially carried out during the early phases of the product lifecycle and it is to certain extent market-oriented with regard to the sales price and volume, but the cost target of the future products is not necessarily determined in line with the immature markets, nor there is a rigorous analysis to especially reduce the costs. The description above indicates thus that all the basic characteristics of the target costing do not become manifested in the case company fully or at least explicitly but many elements of it can be argued to exist implicitly in NMP. Hence, the findings of this study are not contradictory to the findings from Nokia Telecommunications (at present Nokia Networks) by Järvenpää (1998) who identified some, although implicit elements of target costing. However, Järvenpää argued that target cost management would be suitable in the industry where the technological development is very fast. At least on the basis of this case study it can be observed that if the industry is under serious growth, the costs and their reduction may receive only limited attention. Järvenpää (ibid.) finally questions the existence of the Western TCM. This suggestion receives support from this case study evidence.

In addition, the use of activity based costing in R&D operations has been only marginal in NMP. The potential of ABC can be seen in providing the background information in the process-oriented profitability calculations and especially the more detailed variant profitability calculations for the tailored products. Whereas the textbook activity-based costing suggests that the costs are assigned – more accurately – from resources through the activities to the cost objects, no such two-stage cost accounting model is in use in the NPD of the case company. The strong future-orientation in the actual PLP calculations is

considered as the major obstacle for taking advantage of the activity-based costing. On the other hand, the easily anticipated cost structure creates an atmosphere where a more detailed cost accounting is not a necessity. However, it was emphasized that as the human resources are the most significant element within the R&D, where the headcount is the major cost driver.

In NMP, the performance measurement system resembles to great extent the balanced scorecard approach (cf. Kaplan & Norton, 1992, 1993, 1996a, 1996b, and 1997). The balanced approach is adopted especially on the global level of controlling the product creation process, whereas the single new product programs are managed with a specific performance matrix. Further, the performance measurement system in NMP includes the typical BSC dimensions as well as a great number of innovation measures that arise frequently in both accounting and R&D literature. In addition, the case findings indicate that the current practice in NMP parallels the textbook performance measurement in the sense that the indicators derive with causal relationships from strategic roadmaps, i.e. the visions, strategies and critical success factors that are the prerequisite of the future success in the NPD in high technology.

When it comes down to budgeting, the case findings indicate that the traditional annual budget has lost its importance in the fast changing future-oriented R&D environment with multiple ongoing NPD projects. Hence, the case company has completely abandoned the annual budgeting in R&D (cf. Wallander 1995 and 1999) and also in the Group in general, and shifted towards latest estimates in the short-term planning (cf. rolling forecasts; see also Ekholm & Wallin, 2001). Another company specific budgeting practice emerges in the global R&D control in the form of R&D budget pipeline, which means certain avoidance of either positive or negative deviations from the budgeted figures.

The other tasks of the R&D controllers in NMP include e.g. training and process development. In addition to the short- and long-term financial planning and control, the tasks include also human resource planning especially at the local level of control. The case findings thus highlight the current discussion of the roles and mutual relationship between financial and personnel control in R&D, according which the two apparently contradictory aims – encouraging a climate of innovation in NPD and simultaneously exercising enough financial control in order to meet stakeholder objectives – are extremely challenging to combine (cf. Gleadle, 1999). The relevance of even the most modern management accounting techniques can always be questioned in the field of controlling the human resources in R&D operations. In the final analysis, the focus of the tasks was somewhat different on the local and global levels of the R&D control due

to the distinctions in control perspective, despite the fact that the R&D controllers' role in the organization was quite similar.

According to Nonaka *et al.* (1998), western companies mainly focus on explicit knowledge and attempt to achieve breakthrough insights by compiling and analyzing existing knowledge. Reflecting this suggestion, it can be argued that the utilization of existing knowledge should be self-evident, and creating new knowledge through knowledge creation processes is also critical. Considering accounting information in NMP, it may be argued further that the existing accounting information is used rather effectively in the NPD processes, although the information dimensions are very complicated, and a plethora of needless information is evidently produced. To be more critical, there may be many pieces of useful accounting information, which are currently omitted from the decision-making and analyzing processes. What is more important, in the NPD of NMP, the focus is to a surprisingly great extent on the existing information. Naturally the actualized financial figures are compared to the estimates, which tend to be based on previous actuals in any organization, but even though the analyzing of accounting information is organized and routinized in the local and global level, increasing the tacit knowledge both on the individual and organizational levels through knowledge creation and learning processes related to NPD accounting information and knowledge appears to be only marginal and carried out more or less on a coincidental basis. This leads us directly to the second research objective.

4.3. Understanding the cross-functional knowledge creation interface in NPD

The second research objective was to understand the interface between management accounting and company's other functions in the NPD and especially organizational knowledge creation in this interface. The theoretical discussion revealed that promoting business orientation by increasing cost consciousness among the cross-functional team members of an NPD project is a critical knowledge creation task of a management accountant. In other words, cost consciousness and the relationship between cost and profit drivers, cost structure and the business as a whole can be seen as the major element in the tacit knowledge possessed by the management accountants supporting NPD. In the following figures, the results of the knowledge creation process which aims at increasing profitability consciousness, not just cost consciousness, and business-orientation in NMP, especially through product lifecycle profitability (PLP) calculation process are summarized and categorized in accelerating (Figure 24) and decelerating (Figure 25) factors and the

development potential (Figure 26), by using the theoretical framework of organizational knowledge creation provided by Nonaka and Takeuchi (1995).

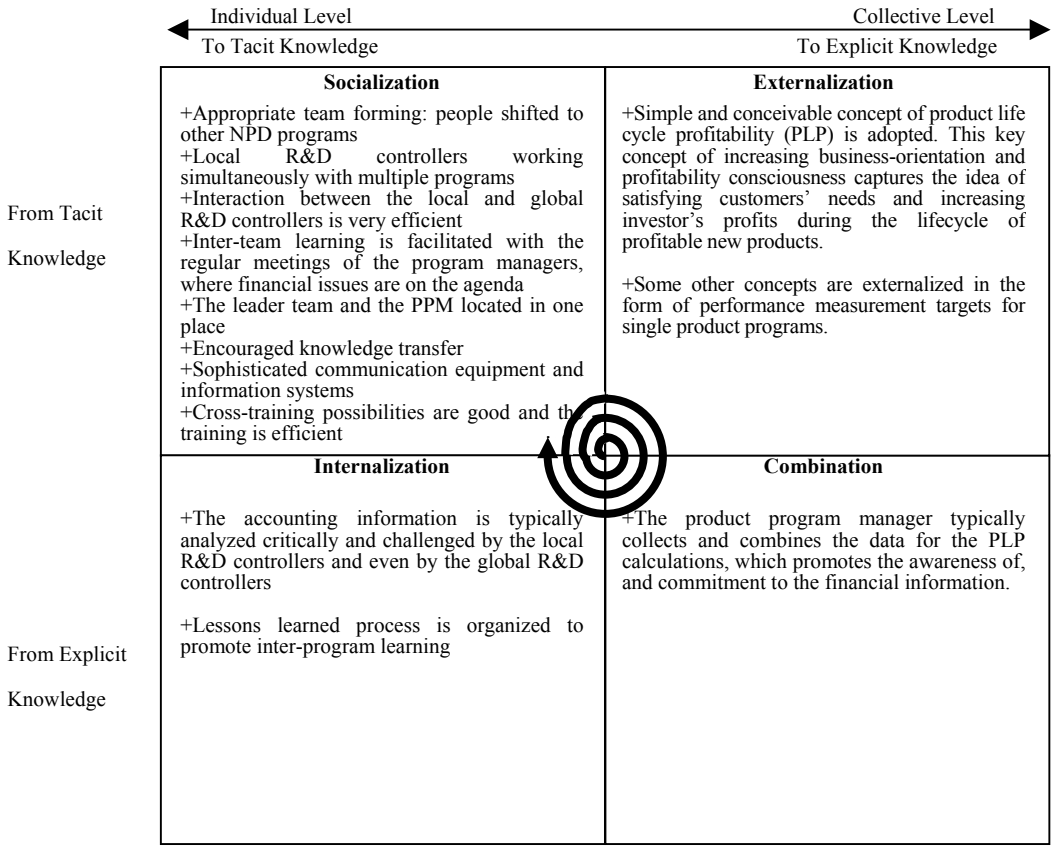

Figure 24. The Knowledge Spiral in Increasing Profit Consciousness in NMP's R&D organization: the factors accelerating knowledge creation

The focus of the case was on the local profit consciousness and business-orientation among the program manager and the leader team of the selected product program. The results indicate that the program managers who are in charge of the product lifecycle profitability calculations are more profit and especially cost conscious than the program leaders from various organizational functions. It may be argued that program managers as well as the R&D controllers, thus, represent a more balanced perspective of managing the NPD costs and understand how the cost structure relates to the NPD targets such as time and product performance. On the other hand, the leaders typically understand the total lifecycle profitability of the product to some extent, but they comprehend only some line items among the PLP costs (cf. Shields & Young, 1994). However, significant individual differences exist in the approach to accounting information. Further, the results indicate that the cross-functional co-operation works quite well, and the inter-team learning from the financial issues is quite efficient on the local level. The only fact, which prevents this, arises in the extremely limited involvement of the local R&D

controllers in the daily routines of the program team. More tailored financial training was also desired among the members of the leader team.

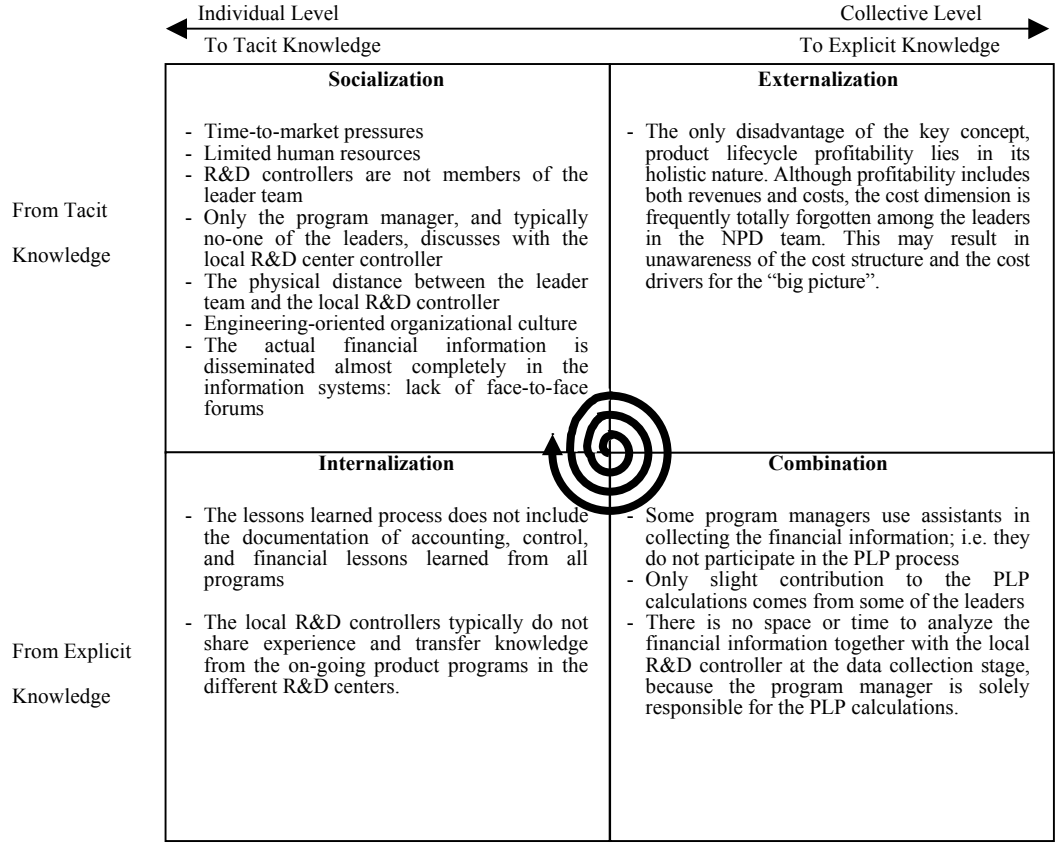

Figure 25. The Knowledge Spiral in Increasing Profit Consciousness in NMP's R&D organization: the factors decelerating knowledge creation

When it comes down to a more global level of profit consciousness among the NPD professionals, it can be argued that the inter-team learning (cf. Amelingmeyer & Kalvelage, 1999; Olivari *et al.*, 1998; and Roth *et al.*, 1999) from the financial issues is not very efficient. Although the profitability calculations are involved in the program manager board of the on-going product programs, the profitability information from the finished programs is not documented in the otherwise well-organized lessons learned process. Furthermore, special case programs with profitability and performance indicator information could be available in the training and databases and the knowledge transfer between the local R&D center controllers could be more frequent. At the end of this research project, the global R&D controllers in the case company indicated unanimously a strong willingness to make the decision to implement these ideas of development potential suggested by the researcher.

This example of facilitating the internalization process illustrates the argument that learning on the organizational level takes place only when the newly created knowledge changes collective behavior (cf. e.g. Argyris, 1976; Nonaka

& Takeuchi, 1995), here through potentially increased profit consciousness and business-orientation among the NPD professionals.

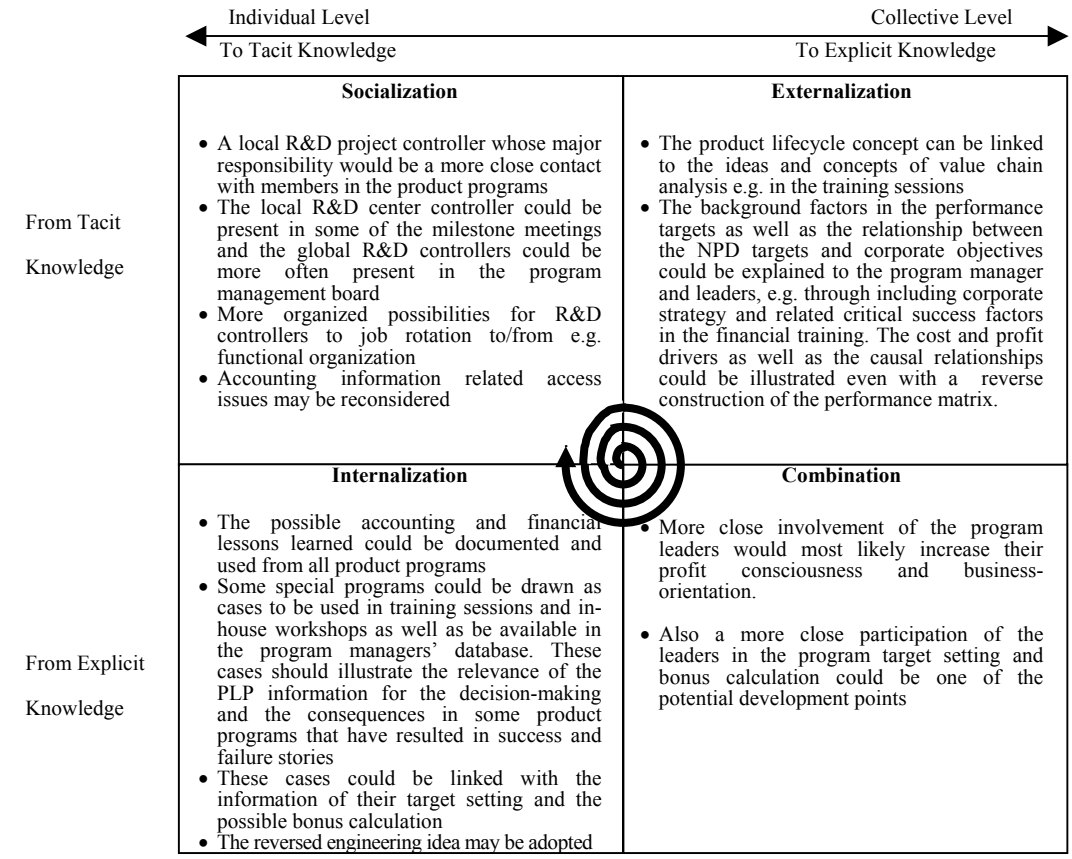

Figure 26. The Knowledge Spiral in Increasing Profit Consciousness in NMP's R&D organization: The development potential

To sum up, the management accounting practices related to NPD in NMP include most traditional and some SMA techniques The local and global R&D controllers in NMP are currently working in an environment, where the necessary facilitators, i.e. the cultural and organizational platform for knowledge creation and transfer do exist, but where some obstacles for intra- and inter-team learning, e.g. the lack of time and the use of mainly electronic communication only limit the possibilities of creating profit consciousness and business-orientation among the cross-functional leaderteam of a NPD program.

Previously it was discussed how *data*, together with *proper analysis and decision context* can be turned into *information*. If it is further presumed that the true business controllership role becomes fulfilled when the management accounting information is combined with *sound reasoning* by an R&D controller in order to create *knowledge*, it can be argued that the previously mentioned facts may prevent knowledge creation and hence threat the true controllership beyond the

role of a cost challenger in the case company. This challenge of knowledge creation and controllership is illustrated in the Figure 27.

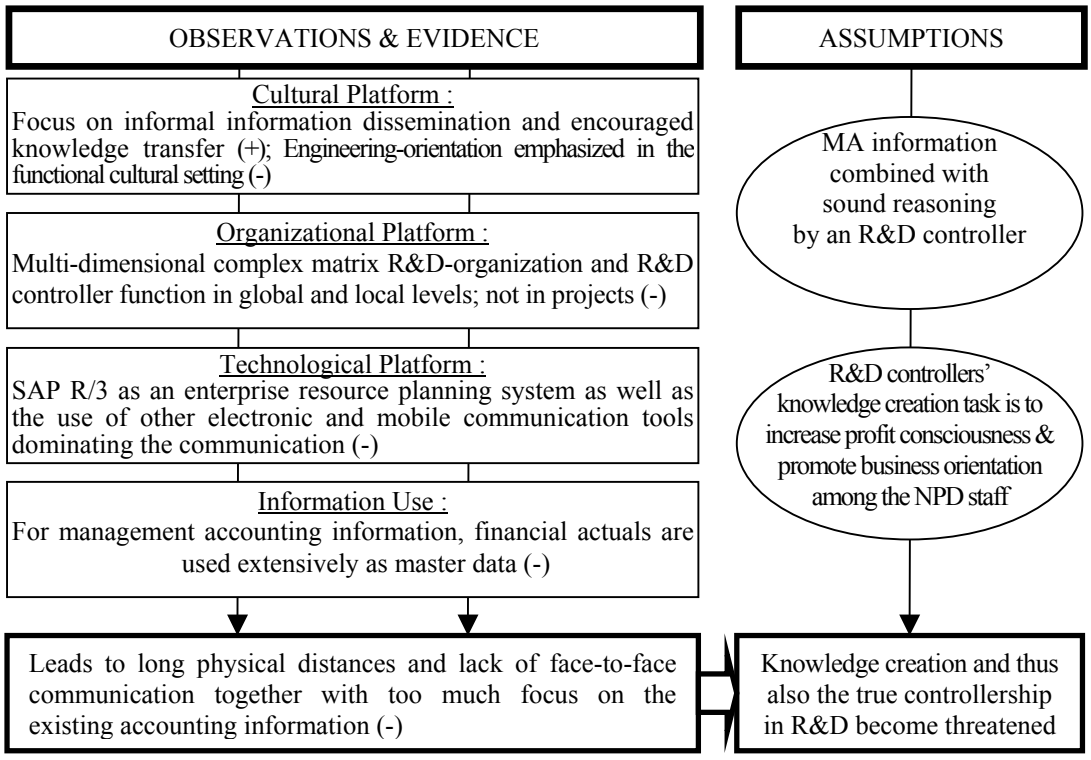

Figure 27. The Challenge of Knowledge Creation and R&D Controllership in NMP

Figure 28 in turn summarizes the issues related to cross-functional knowledge creation tasks in NPD. In the focus, in knowledge creation interface is the business case of a new product with multiple trade-offing targets (Laaksonen *et al.*, 1998). On the basis of theoretical discussion (see also Appendix 2d) and empirical evidence, people and the explicit data and information from various functions, R&D control included, are added in the picture. It is suggested that the knowledge creation tasks of these people is to innovate a new product and increase either technology-, market- and customer-, or business-orientation. As it is previously reasoned, it is in the hands of R&D controllers to promote the profit consciousness, because they typically possess the ability to "see behind the figures", which derives from the tacit knowledge regarding e.g. the cost and profit drivers, especially the non-financial ones during the entire lifecycle of a product. Everyone has also to some extent understanding of the NPD processes. As the initial theoretical discussion indicated, NPD includes complex managerial issues and hence problems with anticipated decision consequences especially in the long term. According to the case evidence, the most significant R&D control tools are product lifecycle profitability calculations, which includes long-term thinking, and performance matrix of balanced nature, which captures also the trade-offing targets and profit drivers. These tools can be argued to facilitate R&D controllers' knowledge creation task.

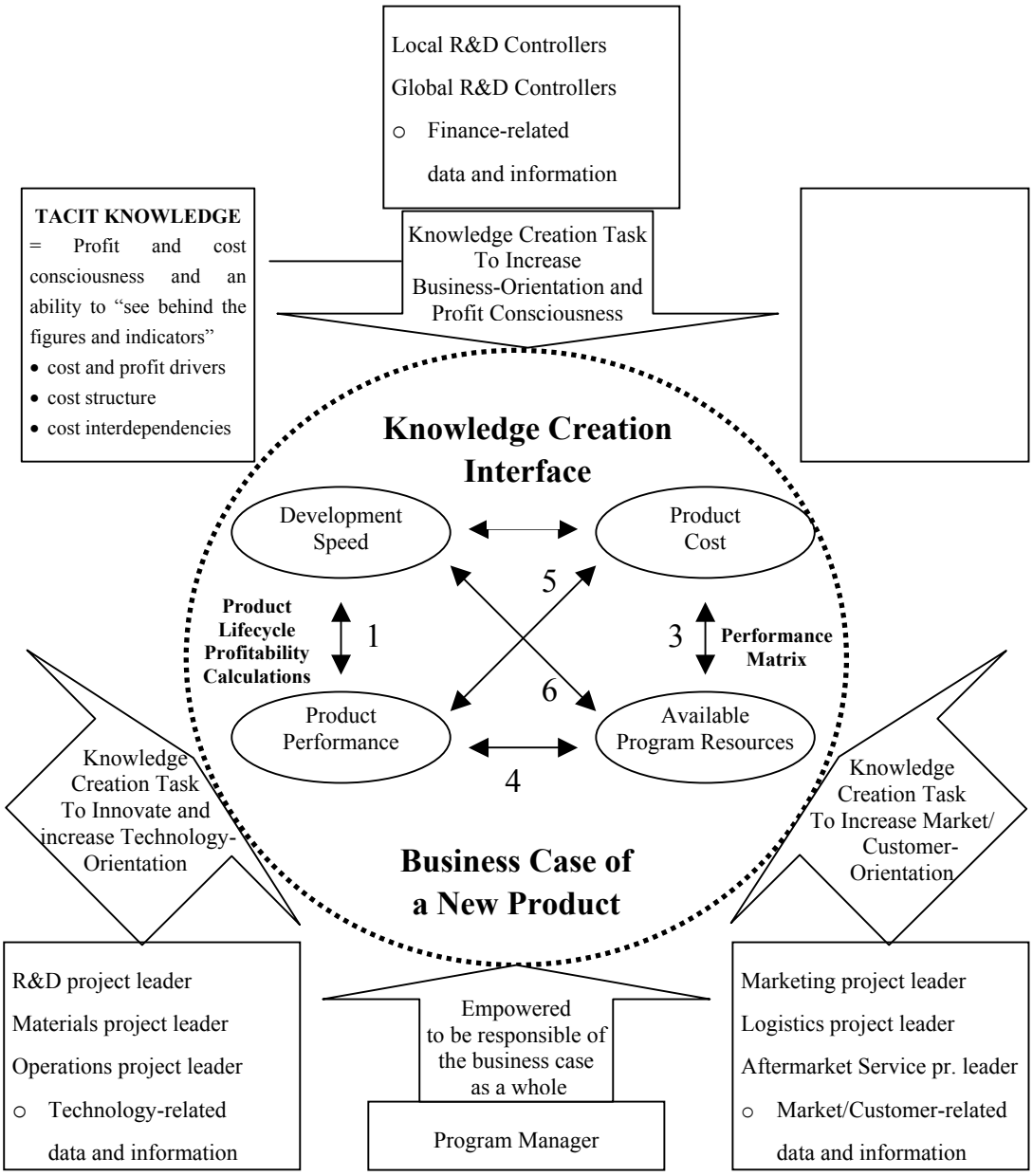

Figure 28. Knowledge Creation Tasks and the Business Case of a New Product

Finally, it should be stressed that in typical R&D environment, there is simultaneously (1) a need to align R&D strategy with competitive, product, manufacturing, financial, marketing, and corporate strategy (cf. Nixon *et al.*, 2000), (2) a need to balance the mutually trade-offing targets (development time, costs, product performance and resources) with regard to a single product strategy (focus in price, time-to-market, customer or technology) (cf. Dávila, 2000), and (3) a need to avoid situation where the various functions involved in R&D strictly focus only on a small amount of costs (cf. e.g. da Silva *et al.*, 1999). This results in the fact that R&D environment is an extremely complex context to practice control in. In addition, another consequence can be argued to be the above-discussed case findings, which indicated that there is rather a need to especially promote business-orientation and increase profit-consciousness rather than cost consciousness among the non-accounting R&D personnel.

4.4. Emerging issues from the case evidence

Here the key points of results are emphasized. Table 8 summarizes the topics of the study and outlines the key findings that emerged from the study discussed above.

Emerging issues from the case evidence (in general)	
Topics of the study	**Case findings**
Organizing management accountants to support NPD	• Both global and local needs for R&D control • R&D controllers are not directly assigned as NPD team members • Emphasis on process-orientation both in R&D control and NPD operations
The role of management accountants in NPD	• Support to some extent the previous findings of the business controller's role expansion trend • Support to great extent the previous findings of the expected characteristics of a business controller
The tasks of management accountants in NPD	• The R&D controller's tasks include also training and process development. • Current management accounting practices in NPD in the case company include some traditional and SMA (textbook) techniques, but especially company specific accounting tools and models. • The product lifecycle profitability calculation is the most significant R&D control technique, whereas the textbook cost accounting methods such as target costing, activity-based costing and cost tables are not explicitly applied in the company, although some elements of target costing can be observed. • In financial planning, NMP applies rolling forecasting while the traditional annual budgeting has been abandoned due to its lost importance. Performance measurement indicators include financial and non-financial measures in the spirit of the balanced scorecard approach on both global and project levels of the R&D control. • Despite the product platform approach applied, no specific accounting tools or processes have yet been developed for modular design, even if it might be possible at present.
The profit consciousness (knowledge) creation process in NPD	• The knowledge creation in order to increase profit consciousness and promote business orientation among the NPD staff – and thus the true controllership – become threatened especially because of the lack of face-to-face communication and too heavy an emphasis on the existing accounting information.

Table 8. Emerging issues from the case evidence (in general)

Emerging issues from case evidence : process-orientation and high technology

The aim of the following discussion considering process-orientation and high technology is to draw some conclusions from the case findings as well as their theoretical reflections. Tables 9 and 10 outline some of the more detailed emerging findings that can be explained by the above-mentioned issues, which may even be considered as contingency factors (cf. e.g. Dent & Ezzamel, 1987; and Otley, 1980). They show how especially process-orientation and high technology related R&D environment have influenced the major topics of the study. The high technology environment is an obvious external contingency factor to affect corporate R&D control, because the industry has so far been very immature and under fast growth. On the other hand, process-orientation can be considered as a contingency factor of partly internal nature. In the final analysis, it can be argued that the process-orientation has diffused into the organization through institutional isomorphism, especially through mimetic processes from the context external to the organization (cf. DiMaggio & Powell, 1983 and 1991, see also Granlund, 1998).

Emerging issues from the process-orientation (more detailed case evidence)	
Topics of the study	**Case findings**
Organizing management accountants to support NPD	• R&D controllers are organized to control the global product creation process. In the matrix organization there are also functional controllers.
The role of management accountants in NPD	• Understanding the business and especially R&D processes were heavily emphasized among the expected characteristics of the R&D controllers.
The tasks of management accountants in NPD	• R&D accounting operations organized as true processes; e.g. product lifecycle profitability calculation process and performance measurement processes • Responsibilities may include accounting and control process ownership. • Role is significant in developing the accounting and control processes.
Cross-functional interface between Finance & Control and other organizational functions	• Cross-functional integration, here especially between R&D control and other functions is managed through formalized processes typical to large companies. This finding supports strongly results by Haake *et al.,* 1999.
Management accounting in NPD in the future	• Process-orientation is anticipated to increase in the R&D control in all the above-mentioned three dimensions – organization, role, and tasks and practices.

Table 9. Emerging issues from the case evidence : process-orientation

The process-orientation becomes only more significant when considering the accounting and control practices in R&D and especially the challenges in the performance measurement of new product development – the difficulties that rise

from the vague relationship between the inputs and outputs. Traditionally, R&D professionals have been managed to achieve technical outcomes. It can be suggested that it is the customer-oriented process outcomes rather than the internally oriented technical outcomes that drive future business performance (Cocoran, 1994; Cooper, 1994 and Hammer & Champy, 1993; Iansati, 1993, see also Brown & Svenson, 1988). The empirical results by Martinez-Ros (2000) indicate further that while product innovations are more likely to be oriented towards product differentiation, process innovations will be cost reduction driven. The evidence indicates also that firms producing and selling standardized products have a higher probability to innovate in product, which gives the opportunity to differentiate in products and a lower probability to innovate in process.

Cordero (1999) makes four propositions that, when combined, suggest a framework that provides a process-oriented approach to managing R&D professionals. He argues that process-oriented management practices (leadership, performance appraisal, reward structure, information sharing, etc.), process-oriented culture, R&D professionals taking advantage of process-oriented career opportunities, and R&D professionals working in cross-functional teams and possessing process knowledge and skills lead to the previously mentioned process outcomes. These propositions are however left unexamined with empirical evidence. The major linkage between this study and propositions by Cordero relates to the reward systems. As the theoretical discussion of this study suggests that the performance measurement in NPD necessitates both financial and non-financial indicators, similarly Cordero (1999) suggests that the process outcomes in NPD can be operationalized by using such indirect measures as customer satisfaction, product quality, time required to develop new products, product development costs, and percentage of sales generated by new products.

It is of paramount importance to note that the process knowledge or process understanding, which according to the findings of this study is on requirement from both the R&D professionals and R&D controllers in the case company, and which may lead to the discussed process outcomes, can be argued to be at least to certain extent tacit of nature (cf. also Gopalakrishnan *et al.*, 1999). The process knowledge may include tacit elements in the sense that even if processes are collections of functional activities that are supposed to add value to the customer, process-orientation adds in a very abstract but holistic organizational dimension where especially many management-related concepts and phenomena on both strategic and operational level are difficult to understand as well as express and define in exact and explicit terms (cf. also da Silva & Rozenfeld, 1999). Since the input-output measurement is difficult in R&D environment, the last resort may be to measure the process outcomes, where the causal relationships cannot be easily determined and thus, frequently, have to be left somewhat inexplicable. This is where the tacit elements of

process knowledge possessed by the R&D controllers become invaluable (cf. also Vaivio, 2000). Moreover, the results of this single case study support the finding by Dávila *et al.* (2001), who report that companies that interpret innovation as a process tend to give more importance to a balanced view of the NPD performance measurement. Thus, process-orientation has its implications also in management control and performance measurement of R&D operations.

Emerging issues from the high technology (more detailed case evidence)	
Topics of the study	**Case findings**
Organizing management accountants to support NPD	• No direct association, although high technology may play a role in the global R&D operations due to the severe competition in labor markets and thus contribute to the R&D control needs in global level • Also the absence of R&D controllers from the cross-functional NPD leader team may also partly derive from the NPD of hi-tech nature of the business in the sense that technical and engineering related issues can be argued to dominate the business issues during the development.
The role of management accountants in NPD	• Emphasis on the future in the time-orientation of the R&D controllers' work due to the leading edge hi-tech. • Understanding the technical issues is not among the most expected characteristics of the R&D controllers
The tasks of management accountants in NPD	• The trade-offs between the NPD objectives should be balanced with regard to single NPD projects and hence various product strategies and combinations may be applied. Thus costs may typically receive only limited attention, whereas the emphasis is on the market components, sales price and volume. It can be argued that this might have lead to the following two points: 1. Neither target costing, nor cost management (nor time-based mgt) philosophy has been explicitly adopted. 2. Even though the characteristics of management-by-objectives philosophy exist, the targets act as guidelines in performance measurement, to promote also creativity and innovation required in hi-tech business operations. • The potential of using cost tables was seen minimal • Multiple ongoing product programs with short lifecycles typical to high technology environment have probably been one driver to the complete abandonment of the traditional annual budgeting and apply rolling forecasting, especially in R&D. • Irrespective of the fact that the corporate culture includes elements of continuous change and improvement, the R&D controllers have rather little time to develop the accounting and control processes, because of the serious time-to-market pressures that have their implications also in the daily control routines.

Table 10. Emerging issues from the case evidence : high technology

The most important point from the high technology R&D control environment emerges in the form of the industry maturity in the sense that the telecommunications industry can be regarded as a fast developing, immature industry under serious growth despite the fierce ever-increasing competition. As a consequence, Nokia is facing a situation where the global performance and profitability should be optimized. This, in turn, means locally that the mutually trade-offing NPD objectives should be balanced with regard to single NPD projects and hence various product strategies and combinations may be applied. The above-mentioned facts have influenced the strategic field of the high technology NMP operates in and resulted in the fact that unlike in a more mature industry, the costs typically receive only limited attention, whereas the emphasis is on the market components, sales price and volume.

Especially, it is easily identified how the investors focus on market share and growth figures in the new economy companies, whose market value is heavily based on the expectations of the future success whereas only little attention is paid to the current profits. Furthermore, it can be argued that in the immature high technology industry, the other NPD objectives, e.g. product quality and properties and development speed clearly dominate during the early development phases of the lifecycle of a hi-tech product. The limited attention costs receive has its implications in the current R&D control and especially the cost accounting practices in NPD. The case findings indicate even that the cost target loses some of its importance after the beginning of the development cycle, at the E0-E1 milestones of the concurrent engineering process, where the business case of a new product is approved in the board meeting; the fact which has been previously discussed in more detail (cf. Dávila, 2000).

Finally, it is worth mentioning that the findings of this study give support to discussion by Granlund and Taipaleenmäki (2001) on the significance of the operating environment to the role of management accountants. NMP is a quite typical new economy firm (NEF), which is characterized by high technology, R&D and knowledge intensity, and fast pace of growth (see also Lukka & Granlund, 2001). The authors suggest that among the highly preferred tasks of controllers in NEFs are budgeting and related various financial analyses. In NMP this is very true, although the budgeting is rolling short-term planning, an even more typical form of budgeting in dynamic operating environment. It is evident that NMP has passed the initial stages of the lifecycle of a NEF and hence the product lifecycle profitability analyses and even performance measurement are more in focus than in smaller NEFs. Strong support is also given naturally to the importance of R&D project control and the fact that R&D controllers in NMP actively develop finance and control processes and information systems, especially if they have time to commit to these kinds of critical tasks (Granlund & Taipaleenmäki, 2001).

5. CONCLUDING DISCUSSION

In this concluding discussion chapter, the study is evaluated against the commonly accepted criteria of good scientific research. In addition, the limitations of the study are reflected to the methodological considerations. Generalizability of the case findings and interpretations are discussed together with the contribution of the study. Furthermore, some suggestions for the future research potential are made and they are reflected back to the research design decisions of this study. Finally, some concluding comments and remarks are made.

5.1. The evaluation of the study and the criteria of good research

It can be argued that the commonly accepted criteria of good scientific research include at least dependability, validity including generalizability or transferability, reliability and conformability, credibility, and contribution.

The study can be considered to at least a some extent as a longitudinal one, because the empirical data has been gathered during a period that lasted for well over a year. Thus, it can be argued that the interpretations that identify even some trends of change simultaneously recast the state of its organization studied (i.e. stability) and the process by which the organization is changing (i.e. dynamics) *(dependability)*.

When it comes down to the validity regarding the philosophy of science and the methods, the previous discussions concerning the methodological approach and the chosen methods in relation to the purposes of the study can be referred to. The theoretical underpinnings of the study consisted of the relevant academic literature related to the topics of the study. One specific theory, namely the organizational knowledge creation theory by Nonaka and Takeuchi (1995) was applied. The constructive critique by Tuomi (1999) on the knowledge creation model is discussed together with the fundamentals of the theory (see chapter 1.4.). It should be stressed, however, that the theory was only a tool of outlining and analyzing the empirical findings of the cross-functional interface in the NPD. In that sense the theory proved its usefulness *(methodological validity and theory critique)*.

The issue of validity can be demonstrated with the question, whether the researcher is really studying the phenomenon she or he purposes to be studying (McKinnon, 1988). Typically, the concept of validity is divided to internal and external validity. Whereas the former indicates the true existence of the observed relationships between the independent and dependent variables, the latter is related to the issue of generalizability of the results. In this study, the measures that have been taken in order to improve the internal validity include e.g. the cross-functional interviews, careful and rigorous planning of the research setting and the interviews, as well as their implementation. In addition, the access to all the confidential material in the case company can be considered very satisfactory regardless of the sensitive business secrets related to NPD. Naturally everything cannot be reported here *(internal validity)*.

The external validity in applying the case strategy can be considered problematic, because whereas something is gained in how the real-world phenomena can be captured through the chosen research setting (case or field studies), something is lost with regard to the conditions of a more controlled experiment (surveys, lab experiments) *(external validity)*. This raises the issue of generalizability of the results. It is self-evident that the findings and interpretations of this study are case-specific. There is some potential of generalizing the results on the theoretical level, since the case findings are reflected back to the current management accounting literature and their previous empirical findings (cf. Lukka & Kasanen, 1995, see also Scapens, 1990 and Spicer, 1992). However, a wider theoretical generalization necessitates more case studies on the field. In addition, it can be argued that while conducting a study using the case strategy, the results may be generalizable to another similar context. That might be the case also with some results of this study. Especially some features of the context have been emphasized in this study, namely the high technology industry in business operations and process-orientation in the business, R&D as well as accounting and control operations. Thus, in this study, the elements of contextual generalization rhetoric, which in turn is closely related to the efficient triangulation of the data elements, thorough in-depth understanding in the main case analysis and credible reporting, are applied (ibid.). In practice, this means that the purpose is to have an ability of the interpretations of one organizational context to be transferred to another *(generalizability and transferability)*.

The credible reporting requires explicitly expressed case evidence. In the empirical part of the study, an extensive amount of information including a great number of citation extracts from the interviews is provided, so that the reader can also evaluate both the generalizability and credibility of the study.

Furthermore, the credibility can be defined as believability of the observations and interpretations to both the academic community and participants of the study. Thus it has also its underpinnings in sound triangulation, and further in the saturation that has risen from the empirical data in order to prove the equivalence of the theoretical arguments and interpretations with the real-world phenomena under investigation *(credibility)*.

Due to the methodological choices, it is natural that the unique interviews, atmosphere and observations cannot be directly corroborated as such by another investigator or another method *(conformability)*. Reliability, which is closely related to validity, concerns the fact how reliable the measurement is, the question, which is considered problematic with the case study method because of the above-mentioned facts. When obtaining the empirical data through case strategy the researcher analyzes and interprets the subjective views of the interviewees according to the mental models and previous experiences of his or her own. As McKinnon (1988) has suggested, the observer bias, i.e. the distorted effects of the researcher's selective perception and interpretation are a natural – though not positive – part of research practice. In consequence, to overcome this bias its risk has to be accepted and the actions should be directed towards the protection of collection and analysis of data from the potential distortion. Here, the reliability of the observations is improved with the help of triangulation, i.e. taking advantage of multiple research methods. Furthermore the researcher has analyzed data from both the interviews and the potential probing questions thoroughly and rigorously. The major method applied in this study has been semi-structured interview. All the conducted interviews have been tape-recorded and transcribed by the researcher. Achieving the advantages of triangulation, which support the validity and reliability of this study, (see also Yin, 1991) has been done through direct observation, the saturation effect from the semi-structured and some open interviews as well as reviewing internal documents. The saturation effect emerged from the rigorous analysis of the empirical data. Especially the paralleling extracts from interviews serve here as pieces of evidence. Both formal and informal discussions (face-to-face, telephone, email) with the R&D controllers provided the researcher with a more natural way of obtaining data. Final gathering and updating of empirical data took place in a corroborative and integrative group interview in 2000 *(reliability)*.

Finally, the question of the contribution can be raised. In the final analysis, the question whether or not the results are new and interesting to both the academic community and the participants in the study should not be answered by the researcher. Some facts, however, can however be presented here. Firstly, the

theoretical discussion integrated two categories of literature, namely accounting and R&D literature, which were brought to interaction with the comprehensive empirical data rich in experiences. Secondly, the investigated topics, management accounting and control are studied in the context of NPD that itself has obvious relevance in the business operations. Thirdly, the empirical findings provide some new perspectives as well as an access to the current management accounting practices in a context, where they are typically left almost completely undiscovered – at least compared to the extent and intensity of this study in investigating the concepts and phenomena that are related to the discussed topics. In addition, some of the findings can be considered to have even surprising elements. Lastly, considering the practical relevance of the study, it should be mentioned that at the final stages of the research project, the global R&D controllers in the case company indicated unanimously a strong willingness to make the decision to implement some of the ideas of development potential related to the knowledge creation suggested by the researcher. Although the implementation of these ideas is not included in the scope of the study, this indicates also minor practical relevance typical to the constructive approach in great extent (cf. Kasanen *et al.*, 1991 and 1993; Lukka, 1999) *(contribution)*.

When discussing the evaluation of this study, it should also be noted that during the last twelve months of the finishing stage of this study, the researcher became business controller in another Finnish IT company under initial public offering process, specializing in software development in the information security. The researcher had a unique invaluable opportunity to be the sole developer of all management accounting systems, practices, and processes from the scratch and simultaneously conduct "a relevance and reality check" for most of the discussions, analyzed empirical findings, results of this study, in another context that was also characterized by high technology and R&D intensity.

5.2. The research design decisions and the future research potential

Here the purpose is to suggest the identified points of the future research potential and reflect them to the methodological considerations and research design decisions of this study. These points indicate also the directions to which this research project can be extended, because additional theoretical discussion and empirical evidence are required to fully understand the implications of this study.

The first research design decision was to limit the study to the high technology industry. In the future, it might be contributive to create a comparative setting

with R&D environment in a more mature industry (e.g. medical or pharmaceuticals industry) in order to discuss the similarities and distinctions of the patterns in R&D control.

The second research design decision was to select the case on most-likely basis. Another alternative to create a comparative setting could be comparing the most-likely situation with a situation close to least-likely. The described environment could be found in an R&D intensive growth company with a serious need to create or develop R&D control systems possibly due to e.g. venture capital environment. Thus, the company could represent the so-called new economy (dotcom companies operating in electronic and mobile commerce, biotech companies etc.). An interesting alternative might also be to conduct a study with constructive approach (cf. Kasanen *et al.*, 1993 and Lukka, 1999), where the ultimate goal would be to construct R&D control organization and practices in a company with problems in R&D control or even no current support from management accounting to product development.

The third research design decision was to focus on the concurrent engineering phase in the NPD. The scope might be extended by investigating the management accounting and R&D control earlier in a product's lifecycle. On one hand, the basic research oriented R&D could be analyzed, or on the other hand the focus might be directed to the advanced development, which is more close to the new product development. Especially, the question of product platform might be emphasized and the attention could be directed towards the modular design and how the traditional and modern management accounting tools can meet the R&D control requirements and challenges there.

The fourth research design decision was to specify the scope of study geographically. For research economy reasons it was decided to conduct the empirical case study in a single research center locating in Finland. Despite the decision made, the R&D control was captured on both local and global levels to its top, since the global R&D control of the case company is located in Finland. Unfortunately enough, most of the issues concerning multiple national cultures in R&D control were lost due to the chosen research design, but this might be also one path in the future research potential.

The fifth research design decision related to the hierarchical level of the R&D inside the case company. In addition to the R&D controllers, it was decided to interview all the non-accounting key persons from the cross-functional leaderteam, who thus represent all the functions involved in the NPD. However, due to the decision made, e.g. the cost consciousness and business-

orientation of the R&D engineers working in the functional sub-organizations, which are most directly involved in the innovation and design work, are left almost completely unexamined. The future studies might be concerned with the R&D control by interviewing non-accounting people working at the grass-root level of the product development.

The sixth research design decision was to analyze a single new product (concurrent engineering) program in the case company. This choice limited the interviewed R&D personnel to a very typical cross-functional team. The case product, Nokia 8850 mobile phone is a typical new product in the product mix of NMP. In one sense it was launched as a new model, which is taking advantage of the technology and experiences from an existing product, in this case Nokia 8810, to an existing product family. On the other hand it includes totally new features and thus cannot be regarded as a copy project. The issues related directly to the product in question (e.g. meeting the milestones, lifecycle costs, and success in the markets) are not reported here due to the business secrets. Because of the research design decision, the differences arising from the various product strategies (cf. Dávila, 2000) cannot be analyzed here. However, considering the purposes and specific research questions of the study, no shadow of a doubt whatsoever can be laid on the empirical evidence, especially because the various targets were all seen significant in all the new product programs, although with different weighing.

The seventh and thus the last research design decision related to the time-span of the study and timing it in relation to the lifecycle of the case product (cf. also the 3rd decision). The decision to study an ongoing NPD project to be finished during the gathering of the empirical data was made to gain a comprehensive picture of the CE program in question. The only way to improve this is to make a future study an even more longitudinal one to cover a whole lifecycle of a new product.

5.3. Concluding remarks

To sum up, a good research can be regarded as a combination of new ideas, rigorous analysis, good rhetoric, convincing arguments and logical flow of thoughts. In addition, the study should be reliable, reproducible and relevant. All these criteria of a good research have been considered and all the problems faced have been addressed with the best available measures, while practicing all the characteristics of a good scientific research during the whole time-span of this study. The study aimed at understanding the current management

accounting practices and the cross-functional interface between management accounting and company's other functions in the NPD and especially organizational knowledge creation in this interface. It can be argued that the study met its objectives by firstly discussing the topics through providing an extensive literature review of especially previous research findings and finally reporting the empirical findings from the conducted case study. The relevance and the contribution of the empirical results were proved by reflecting the case findings back to the theoretical discussion. Furthermore, the practical relevance of some of the case findings was identified and reported. The management accounting practices were presented also with the help of the NPD accounting framework (Figure 28), which has been tailored by the researcher to the context of the case company NMP. It should be noted that some of the findings should be interpreted with care. The reader should bear in mind especially the fact that the case company was selected on most-likely basis, which inevitably leads to study the most advanced R&D control and accounting practices.

One purpose of this study was to serve as a basis for a Ph.D. dissertation. At the next stage of the research project it is likely that a great number of previously discussed and even new issues will be raised. It would be more than fascinating to create a comparative setting with a more mature industry such as pharmaceuticals in analyzing management accounting and R&D control. Furthermore, it can be argued that academic research literature focusing on the management accounting support and control in process-oriented and high technology environments is currently very scarce and should be increased especially with regard to R&D and new product development, and on a more general level, as well.

Although the case company, Nokia Mobile Phones, is currently doing financially well, it can be argued that the R&D controllers will play a very significant role in the company's future success if Nokia will remain in strong position to lead the development toward the third and successive generations of mobile communications and new wireless data applications.

The shareholders in the modern stock markets are no longer willing to invest their money on a long run against a steady but moderate dividend payment. Something else is under requirement. The emphasis has shifted towards the concept of the shareholder value, which includes both the dividend cashflow and the increase in the share price. As the short term has been stressed, the expectations have accounted more and more of the company's market value. In that sense, the measures aiming at cost reduction can be considered to be limited with regard to certain time perspective, whereas the expectations of the future sales growth might have no limits. As the investors allocate their capital in the best potential target available to their knowledge, for a plethora of the new economy firms, e.g. the information technology companies, "the world is

not enough" to meet the expected future cashflows. The expectations also legitimate and drive the immense investments in research and development.

Consequently, one of the most significant ways of businesses to increase sales in the short run is typically the continuous, but also fast-phased R&D. Especially in the new product development the competence and knowledge capital of the staff, which is possessed by the staff and hence embedded in the individual actors in an organization, become highlighted. This human capital can be regarded as one of the major elements in the intellectual capital, which in turn, has been referred to as the major contributor to the future expectations, and hence to the observed difference between market and book values of the listed companies.

Over the last two decades, R&D organizations have undergone profound changes. The three latest generations of R&D management are frequently referred to as follows: (3rd) integration of R&D with the company's business, (4th) closer involvement of the external customers in the R&D, and (5th) including also external parties in the supply chain in order to develop knowledge that is of mutual benefit (Kerssens-van Drongelen *et al.*, 2000). Paralleling this development, it can be argued that business-orientation has been increasing in management accounting developing it towards strategic management accounting (process-orientation, customer-orientation, inter-organizational accounting, even competitor-focused accounting). In the academic literature, however, there is lack of evidence how these aspects of strategic management accounting have been applied in the R&D environment, which could however be one of the most natural contexts to consider these issues in a company. The fact is that NPD includes complex managerial issues and problems with anticipated decision consequences especially in the long term, which highlights the importance of fact-based decision-making, management accounting information included.

In addition to the change trends that can be argued to be valid in the future R&D environment (e.g. dramatic technological development) and R&D management (e.g. the R&D operations may be run more and more in global R&D networks and virtual R&D laboratories) there is increased pressure on R&D to be accountable to the business needs and on performance measures to include process-oriented indicators that drive innovation and value creation.

Similarly, as a new product to be launched faces a great number of requirements on both operational and strategic levels, the expectations of various stakeholders are always present in the R&D operations. As it was recognized previously in this study, the two apparently contradictory business aims – encouraging a climate of innovation in NPD and simultaneously exercising enough management and financial control in order to meet stakeholder objectives – exist in R&D. To combine them will be the continuous challenge for most of the companies.

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Appendix 1: Collection of interview data

The initial contacts to the case company were made in November 1997. Both formal and informal discussions (face-to-face, telephone, email) with the R&D controllers provided the researcher with a more natural way of obtaining data. Shorter or preliminary conversations, pilot interviews and meetings (e.g. April and September 1998) are not listed here.

Person (position on the date of interview; abbreviation)	Date	Interview Method	Interview Time
1. Global R&D Controller (RDC)	22 April 1999	semi-structured	1'45"
2. Product Program Manager (PPM)	22 April 1999	semi-structured	1'00"
3. Global R&D Program Controller (RDPC)	22 April 1999	semi-structured	1'30"
4. Local R&D Center Controller (RDCC)	22 April 1999	semi-structured	1'20"
5. Head Office Project Controller (ex R&D Program Controller) (RDPCx)	11 June 1999	semi-structured	1'30"
6. R&D Business Controller (RDBC)	11 June 1999	semi-structured	1'30"
7. Global R&D Controller (RDC)	11 June 1999	open	3'00"
8. Product Marketing Leader (PML)	1 July 1999	semi-structured	1'30"
9. Local R&D Center Controller (RDCC)	1 July 1999	semi-structured	0'45"
10. Logistics Project Leader (LPL)	8 September 1999	semi-structured	1'30"
11. R&D Project Leader (RDL)	8 September 1999	semi-structured	1'30"
12. Local R&D Center Controller (RDCC)	8 September 1999	open	1'30"
13. Aftermarket Service Leader (ASL)	27 September 1999	semi-structured	1'00"
14. Materials Project Leader (MPL)	27 September 1999	semi-structured	1'00"
15. Operations Project Leader (OPL)	27 September 1999	semi-structured	1'00"
16. Global RDBC+RDPC	13 June 2000	theme (group)	1'30"

Interview Method	Open	Theme	Semi-structured	**Total Time**
Interview Time	4'30"	1'30"	16'50"	**22'50"**

Appendix 2: Semi-structured Interview – Themes & Questions

(It should be noted that the more detailed questions marked with dots are of complementary nature, i.e. they are used to support the themes in the semi-structured interviews only if considered necessary.)

1. INTERVIEWEE

What is your current position in this company and for how long have you been in this position? For how long have you been working with this company and especially in the new product development (NPD)? What are the most important working tasks or elements in your job description?

What is your educational background?
What kind of previous working experience you have?

Do you have any other experience (e.g. educational, work-related) regarding accounting and finance?

2. THE ORGANIZATION, ROLE AND TASKS OF MANAGEMENT ACCOUNTANTS IN NEW PRODUCT DEVELOPMENT

The organization and management of new product development

- Projects and processes?
- Cross-functional co-operation?

The Organization of Management Accounting to support NPD

- How it is organized?
- What kind of advantages and drawbacks you see in this? Why?

Why, to your opinion, management accounting has been organized to support NPD in the way it is?

- The need to understand more comprehensively and integrated accounting information and financial issues in NPD?

How would you describe the elements in the roles of management accountants in NPD?

- Integrating role (cf. figure: knowledge creation interface)?
  - Accounting as a language?
- New business controllership?
  - Business orientation?
  - Communicator, advisor or consultant, member of management team, supporting in decision-making etc.?
  - Process and IT understanding, etc.?
- Strategic vs. operational role?
  - Does it change during the NPD project? How?
- Past and present vs. the future role?

Why the role of management accountants includes the elements you have described?

- The importance of accounting information and financial issues in NPD?
- Organizational culture and management practices?
- Any other factors?

What are the characteristics that management accountants are expected to have?

- Creativity, proactiveness, team skills, etc.?
- Analytical characteristics, preciseness, etc.?

How would you describe the most significant purposes regarding the role of management accountants in NPD?

- To bring the financial and business perspectives into the decision-making in NPD?
- To facilitate and ensure the dissemination of financial information in NPD?

What are the working tasks and activities of management accountants in NPD?

- Cost management
  - Lifecycle Costing?
  - Target Costing?
  - Activity Based Costing and/or process costing?
  - Cost tables?
  - Inter-organizational cost management?

- Financial Planning and Control
    - Budgeting?
    - Performance Measurement?
        - Balanced Scorecard?
- Financial Accounting?
- Technical philosophies related to NPD
    - QFD, FAST, VA+VE, DFMA, MADE etc.?

How would you evaluate the effect of the following issues on the organization, role and tasks of management accountants in NPD?

- Corporate Strategy, business strategy?
- The industry this company is operating in?
- Process-orientation?
- The six ”trade-offs” between NPD objectives in NMP?
    - Development speed, product cost, product performance, program resources available

IF NOT A MANAGEMENT ACCOUNTANT:

Describe your role and tasks in the NPD processes

- Especially in relation to management accounting and management accountants?

How would you describe the co-operation between management accountants and the organizational function you represent in a NPD project?

- How does this become manifested? Why?
- Do the needs become mutually understood?
- The level of formality in co-operation?

3. SOME SPECIAL ISSUES AND SPECIFICATIONS

How would you describe the communication in the company and especially in NPD?

- Implicit or explicit elements?
- How does this become manifested and in what kind of situations?

How would you evaluate the effects of integrated Enterprise Resource Planning System (SAP R/3) on the co-operation between the various organizational functions participating in the NPD? Especially considering management accounting?

- The processes and activities are integrated in the same information system
- Online data, information and knowledge is widely available in the organization

What kind of cultural differences you have experienced in the co-operation in NPD?

- Professional cultures (engineers, accountants, marketing people etc.)?
- National cultures?
- Any other cultures?

The training and education of accounting and financial issues to non-accountants?

What kind of practical factors are facilitating or hindering in the interface between management accounting and other functions in NPD? How? Why?

- Communication infrastructure?
- Organizational Structure?
- Job Description?
- Databases and data warehouses, and knowledge bases?

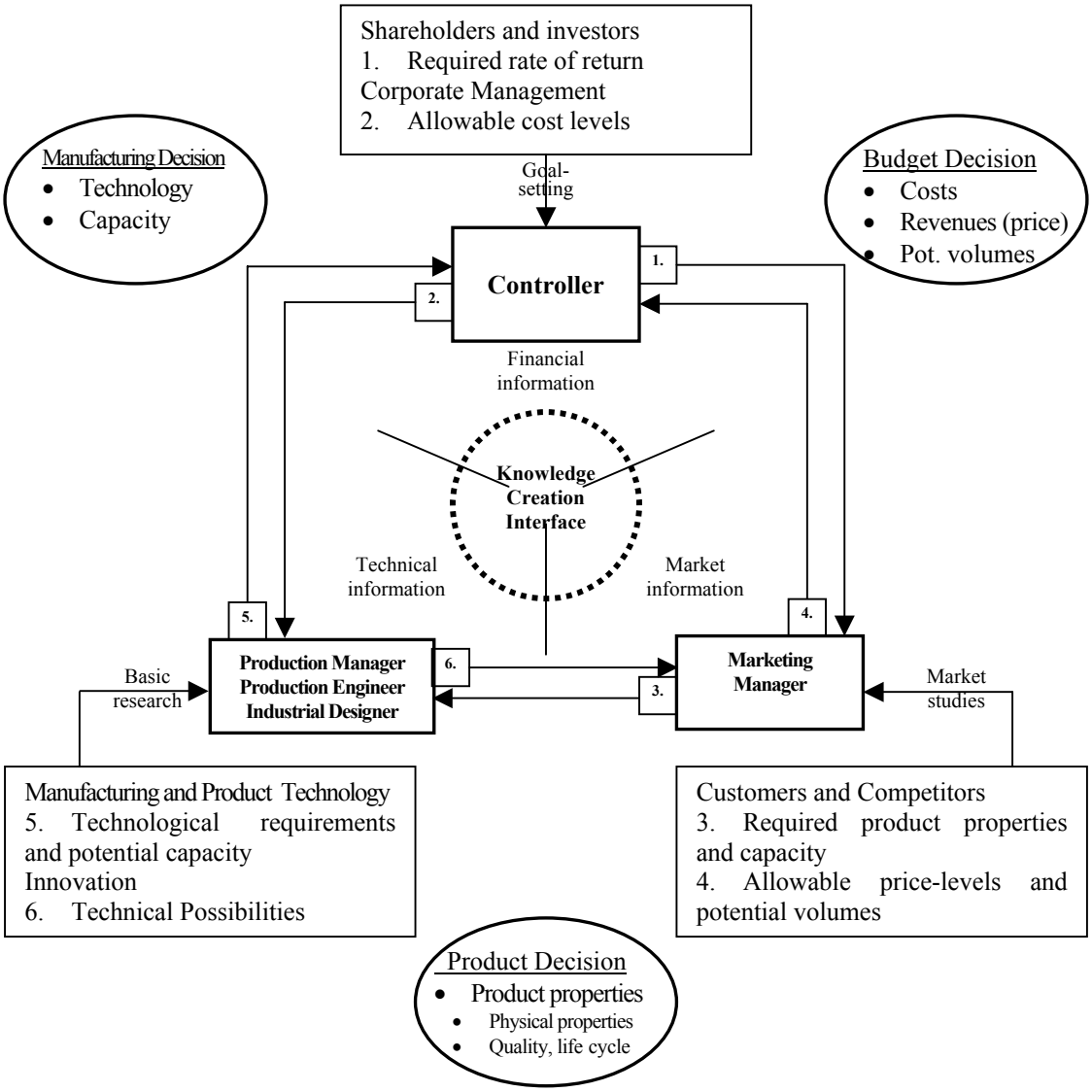
Accounting information and knowledge

- Who collects? What kind of calculations and information?
- Who is responsible for the calculations?
    - Accounting information related to single NPD project or the R&D function as a whole?
- What is your contribution to the accounting information?
- In what kind of situations or decisions the calculations are used?
- Any other comments?

Special concepts (related to management accounting in NPD)?

- Milestones and milestone reviews
- Planning reviews
- Road maps
- Any other concepts?

SIMPLIFIED FRAMEWORK OF THE KNOWLEDGE CREATION INTERFACE IN A NEW PRODUCT DEVELOPMENT PROJECT:



- This simplified framework was developed by the researcher at very early stages of the study to be a facilitating tool in discussions and interviews regarding knowledge creation
- External and internal interest groups provide the allowed levels of certain variables and set requirements (boxes)
- There are certain ways of communicating of this information forward from background (arrows)
- Three major participants (Boxes with thick borders), representatives of different professions in the new product development project disseminate this information (1-6) and bring the knowledge they represent into the knowledge creation interface (dotted circle in the middle)
- Taking a new product in the product-mix requires three major decisions (ellipses)
- Organizational knowledge creation process is iterative in nature
- Product lifecycle is the top-level concept in new product development

4. KNOWLEDGE CREATION (tailored in the case company context)

Knowledge creation, tacit knowledge and explicit knowledge

- Related to the company?
- Related to NPD in general?
- Related to management accounting?
- Related to your function?

KNOWLEDGE CREATION PROCESS and COST CONSCIOUSNESS

- Cost Consciousness
  - Relation to business orientation

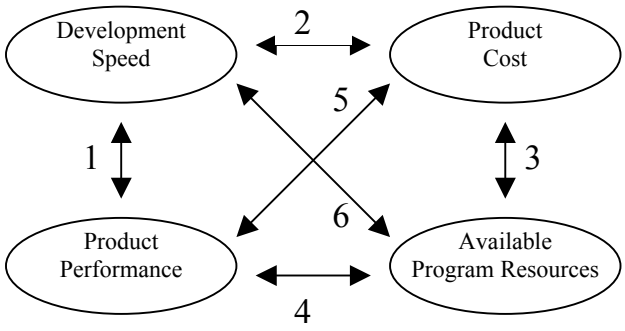
- SOCIALIZATION:
  - Training and education?
  - Via IT-resources?
  - Any other?

- EXTERNALIZATION:
  - Product lifecycle profitability as a concept?
  - Targets and Incentives?
  - Any other?

- COMBINATION:
  - PPM collects the accounting data and finishes the product lifecycle calculations and updates latest estimates?
  - Any other?

- INTERNALIZATION:
  - Learning from calculations and accounting reports: success stories and problem cases from previous projects?
  - Any other?

The six "trade-offs" between product development objectives in NMP



Appendix 3: Nokia 8850 – the Product Info

Nokia introduces a new phase of mobile phone design. It's as much an engineering achievement as it is a craftsman's pride. Timeless, classic, an object of desire, it can only be the Nokia 8850.

Elegant and Ergonomic Design

- Reflecting the next design trend with subtle colors and clean lines
- Compact and sleek, a delight to hold
- Exceptional styling in a class of its own
- Unique combination of materials, including matt alloy casing
- Chrome coated central frame, keys and bezel around the screen
- White illuminated screen for an integrated look
- Internal antenna and battery to give streamlined overall appearance

The Brains Behind the Looks

- Predictive text input lets you write SMS twice as fast
- Infrared for quick wireless transfer of data
- Internal data for fast connection to the Internet
- Intuitive animated menu icons anticipate your next step
- Manages up to 500 names and numbers (250 in phone, 250 in SIM Card)
- Dual band functionality for added convenience when you travel
- Text based internet access allows you quick download of information

Perfect for Your Lifestyle

- Picture messaging puts an added human touch to your messages
- Real time clock that adjusts itself automatically according to where you are
- Profiles and Caller Group settings offer you easy caller selection and identification
- Internal vibrating alert for discreet moments and environment
- Voice dialing to make calling easier when your hands are busy

Accessories Available

- Travel charger
- Desktop stand
- Headset Kit
- Mobile charger
- Plug and play handsfree kit

Some features are network/market dependent.
Please check with your local operator.

Appendix 4: Nokia 8850 – the Specifications

NOKIA 8850

Size

Weight: 91 g (Lithium Battery)
Dimensions: 100 x 44 x 17 mm, 70 cc

Display

Illuminated high-contrast, full-graphics display
Up to 5 lines for text, numbers, graphics

Memory functions

250 names and numbers in phone up to 250 in SIM
Memory for 50 calendar notes

Voice dialing

Memory for 8 numbers

Short Message Services

Predictive text input
- Built-in dictionary database
- Support for over ten major European languages

Picture messaging
- Several default pictures
- All images are replaceable

Smart Messaging
- TTML browser to receive new menu items to your phone making it easy to access services from the operator

Dual-band operation

GSM 900/GSM 1800 Automatic switching between bands
Supports Extended GSM 900 band (EGSM)

Security and cost control

Electronic keyguard
Security code
PIN1, PIN2
Call timers
Call barring
Advice of charge

Optional controls

32 language options available
35 default ringing tones
Space for 5 received ringing tones

Built-in GSM data capability

Built-in infrared link
Internal modem for data connections
Supports data transmission 9.6 kbps
Infrared transfer of names and phone numbers between compatible phones

Operating times and weights

	Talk time	*Standby*	*Standard / fast charging*
Battery cell (BLB-2) 650 mAh, Li-Ion	2 h - 3 h 20 min	50 - 150 h	2 h 25 min / 1 h 40 min

Variation in operation times will occur depending on SIM card, network settings and usage. Talk time is reduced by 5% if Enhanced Full Rate is active, and increased by up to 30% if Half Rate is active. Some of above features are network dependent.

Appendix 5: CE Sub-processes and milestones

PROGRAM DEFINITION (E-1 – E1)

E-1: Feasibility Study Proposal

- Program kick-off

E0: Program Proposal

- Feasibility study complete and targets set

Program Internal e0.5

- Technology/concept selection done, main resource profile agreed

PROGRAM MANAGEMENT and PROGRAM EXECUTION (E1 – E5)

E1: Specification Freeze, Product Development Release

- Product specifications and program plan under change control

E2: Purchase & Pre-Production Release

- Manufacturing process performance, product functionality and materials capacity evaluated

E3: Volume Production Release, Design Freeze

- Ramp-up go-ahead

E4: Sales Release, Production Line Freeze

E5: Termination of the Program

Appendix 6: Program briefs, requirements, plans and specifications

E-1: ***Program Brief*** consists of project brief, product brief, and market brief

- *Project Brief*
  - Program targets, profit estimates / business case (sales price evolution, lifetime volume estimations, basic sales package cost estimations), reuse requirements (how to make), frame resource plan, program schedule plan (proposal for E4), global issues (outside relations / links)
- *Product Brief*
  - Key drivers / features, key parameters (weight, size, talk&stb times etc.), proposed product concept, target for field failure rate (FFR), user interface (UI) style, design brief, colors and materials, variability and variant plan
- *Market Brief*
  - Strategic role of the product / positioning, general market description, user segmentation, USPs, product lifecycle, region specific requirements, customer/sales channel description, advertising/marketing plan

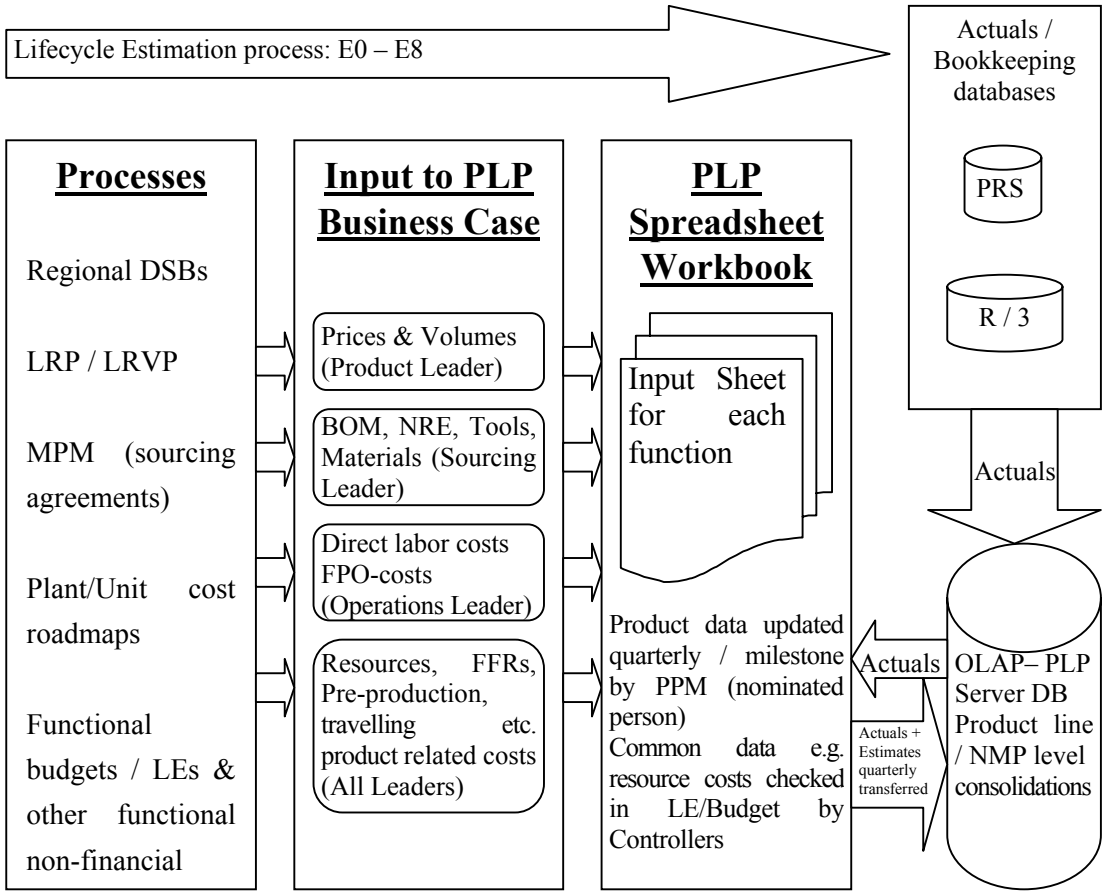
E0: Program Requirements consist of program targets, product and market requirements

- *Program Targets*
  - E0 program plan (scope, targets, milestones etc., subproject targets (marketing project targets: user tests, launch preparation, customer documentation), program management, business case and budget frame)
- *Product Requirements*
  - Product target, basic product performance requirements, mechanical concept, UI requirements, applications, services and features in brief, personalization, interfaces and accessories, additional requirements (operator, benchmarks), design proposals (gray model and 2D surface)
- *Market Requirements*
  - Product mission, product argumentation, initial market description, USPs, user segmentation descriptions, volume and sales prices, initial sales channel description, region specific requirements, list of countries and languages

E1: ***Program Plans & Specifications*** consist of program plans & specifications, and market description

- *Program Plans*
  - Subproject plans: marketing project plan, after sales project plan, mechanical project plan, logistics project plan, etc.
- *Program Specifications*
  - Marketing product specifications: product specification (marketing), feature list, etc; Technical product specifications: software specification, mechanical specification, etc.; approved design mock-up, process & material specifications
- *Market Description*
    - Marketing concept, USPs, volumes and sales prices, marketplace description, competitor analysis, benchmarking, initial definition of service classes, product family matrix / contents of sales package

Appendix 7: Overview of PLP process in NMP (Draft)



BOM	Bill of Materials
DB	Database
DSB	Distributors
E0-E8	Milestones
FFR	Field Failure Rate
FPO	Fixed Production Overheads
LE	Latest Estimate
LRP	Long-Range Planning
LRVP	Long-Range Volume Planning
NRE	Non-Reoccurred Costs
OLAP	On-Line Analytical Processing
PLP	Product Lifecycle Profitability
PPM	Product Program Manager
PRS	Product Report System
R/3	SAP R/3 Enterprise Resource Planning System

Appendix 8: The financial measures of the product creation (PC) process

R&D Costs as a percentage of Net Sales (%)

- Objective of the measure
  - Strategic issue: Efficient Product Creation
  - Provides information on R&D costs. Additional information to the risk management and on productivity is given by reflecting the costs to the net sales
  - Alignment to Center metrics; R&D Center costs (cascade level approx. 80%)
- Indications
  - Are we spending too much/ too little money relative to our net sales.
- Measure by **Product Creation and R&D Centers**
  - Type: Financial / Reactive, but quick-and-dirty indicator of the healthiness of the company
  - Target: No absolute truth. Keep ratio stabile.
  - Math: Financial cascade.
  - Reporting Frequency and databases used: Quarterly. Based on company policy. Database NMPNFS
- Weaknesses / Mathematical sensitivity/ Notes
  - CMT and WD included
  - Capitalization included
  - There is no such thing as right spending on R&D, since R&D costs are investments, which will give return in the long run. Analysis on the investment-output lag is under consideration.

Actual Warranty Costs as a percentage of Net Sales (%)

- Details not to be published

Product Costs: Direct Costs per Sales Package

- Objective of the measure
  - Strategic issues: Best product portfolio, (Fast productization, low cost products)
  - Provides information on how well we design our products and how well we manage the costs of the product. Additional Information on specific low and high cost products
  - Alignment to NMP measures sales margin & operating profit; other supportive measures: component count, R&D costs
- Indications
  - Are we managing our costs & are we able to design less expensive products against lowering prices.
- Measure by **programs**
  - Type: Process & Customer / Reactive
  - Target: Lower product costs per product category
  - Math: financials from components, labor, duty, freight and consumables
  - Reporting Frequency and databases used: Quarterly. Values from PRS.
- Weaknesses / Mathematical sensitivity
  - Excluding DC-costs, warranty costs, (licensing e.g. standards/patents?), does not reflect the value / profit of the product

Renewal: New Product Revenue

- Details not to be published

Appendix 9: The management tool for the teams in NMP CE Process

PERFORMANCE MATRIX

Project: Milestone:
Project No. Date:
Project Manager

Over-all schedule target
Schedule target for next milestone
Product quality target
Product manufacturability target
Product performance target
Product cost-driver sub-matrix

						Measured Result	% Bonus
						10	
						9	
						8	
						7	
						6	
						5	
						4	
						3	
						2	
						1	
						0	

						Performance Weight	
							Weighted Performance

Approval:

President Senior Management Project Manager

Appendix 10: Job Description for an R&D Center Controller

Company/Business Unit		Function/Department Research and Development
Cost Center	Employee Number	Job Title R&D Center Controller
Job Holder		Reporting to R&D center manager

Purpose of the Job	To support and advise R&D program and project managers, line managers and the R&D management team
Responsibility (Budget, Staff Number)	Responsible for 1 assistant

Accountabilities

1. Challenge costs.
2. Assist with planning and highlight the financial implications of actions.
3. Ensure management receive and understand timely reports covering their financial responsibilities.
4. Maintenance of Fixed asset register and depreciation calculations.
5. Provide Financial training to non financial managers
6. Provide financial input and review product lifecycle profitability calculations
7. Liaise with other R&D centers and other functions on the development and integration of common tools within NMP
8. Provide NMP Head office and R&D Business Controller with information as required
9. Ensure both local and global operating procedures are adhered to
10. Preparation of Budgets and Forecasts

Content of the Job

Know how required	Professional financial qualification or qualified by experience
Subordinate activities	
Relationship with other functions	Provision and receipt of data to/from financial accounts, supply data to R&D in Salo and NMP Head Office
Guidance for Decision-making	R&D Business controller for Global R&D issues. NMP Country Financial controller for local compliance, a/c issues and co-ordination with other UK functions. R&D center manager for other issues.
Nature of the Job	

Other relevant Information		Date appointed To Position
Job Holder's Signature		Date
Manager's Signature		Date

Appendix 11: Job Description for an R&D Program Controller

Company/Business Unit		Function/Department: Global R&D
Cost Center: 1600	Employee Number	Job Title: Global Program Controller
Job Holder		Reporting to: R&D Business Controller
Purpose of the Job	To control and report globally profitability and other information from R&D product programs under the orders of R&D Business Controller	
Accountabilities 1. PLP Concept owner: Maintaining and developing the product lifecycle profitability (PLP) process, and training globally the people involved in the process (time: 60%) 2. Project accounting: capitalize items into balance sheet and other tasks related to project accounting. (time: 20%) 3. Reporting tasks: Reporting the NMP R&D performance measures (indicators) to R&D business controller, reporting project costs to product program managers (PPM) and assisting in the monthly NFS reporting (time: 20%)		

Content of the Job

Know how required	Understanding the main processes (PC and PD) as well as the related accounting practices and ability to apply them into practice. Understanding the reporting organization (NFS and PRS) of the NMP Group. Communicating skills in foreign languages. Knowledge in the software tools (Hyperion OLAP, NFS, Lotus Notes, SAP R/3, MS-Office). Master's degree – majoring in accounting
Decision influences	PLP calculations have influence in the NMP board decisions during the product development stage (Go/Non-Go). Capitalizations into the balance sheet have direct influence in the NMP profits. The cost efficiency of NMP R&D is controlled on the basis of reports. PPMs are provided with their relevant costs, e.g. material costs.
Relationship with other functions	Superior + other global R&D controller team, the local R&D center controllers of NMP, controllers in other functions, PPMs.
Job and management responsibilities	The job responsibility includes all the above-mentioned accountabilities. No direct management responsibilities, working under the orders of R&D Business Controller.

Other relevant Information		Date appointed To Position
Job Holder's Signature		Date
Manager's Signature		Date

Appendix 12: List of abbreviations

General abbreviations (Those marked with © are applied also in the case company):

ABC	activity-based costing	
ABM	activity-based management	
BSC	balanced scorecard	
CAD	computer-aided design	
CAE	computer-aided engineering	
CE	concurrent engineering	
CPM	critical parameter management	
CT	cost table	
DB	database	©
DCF	discounted dash flow	
DFMA	design for manufacturing and assembly	
DTC	design to cost	
ERP(S)	enterprise resource planning system	
FA	financial accounting	©
FAST	function analysis system technique	
FPQ	functionality-price-quality –trade-offs	
HIP	human information processing	
IOCM	interorganizational cost management	
IT	information technology	©
JIT	just-in-time	
LCC	lifecycle costing	
MA	management accounting	©
MADE	manufacture and design evaluation	
MNC	multinational company	
NPD	new product development	
OLAP	on-line analytical processing	
OPT	option pricing theory	
PAM	project appraisal method	
QFD	quality function deployment	
R&D	research and development	©
SECI	socialization, externalization, combination, internalization	
SMA	strategic management accounting	
TC	target costing	
TCM	target cost management	
TQM	total quality management	
VA	value analysis	
VE	value engineering	

Abbreviations used in the case company

AD	advanced development (process)	OPL	operations project leader
AMPS	advanced mobile phone service	PIN	personal identification number
AS	aftersales	PC	product creation (process)
ASL	aftermarket service leader	PD	product delivery (process)
BOM	bill of materials	PLP	product lifecycle profitability (calc., accounting process)
Calc.	Calculation	PML	product marketing project leader
CMT	cellular mobile terminals/telephone (gsm etc.)	PPM	product program manager
DB	database	PRI/VOL	price/volume (spreadsheet model for the sales components)
DC	distribution centre costs	PRS	product report system
DCU	digital convergence unit	PS	project systems (a module in R/3)
DSB	distributors	R/3	SAP R/3 (enterprise resource planning system)
E-1 – E8	milestones	RDBC	R&D business controller (global)
EGSM	extended GSM	RDC	R&D controller (global)
FFR	field failure rate	RDCC	R&D center controller (local)
FPO	fixed production overheads	RDL	R&D project leader
FSP	financial systems platform	RDPC	R&D program controller (global)
GL	global logistics (process)	RDPCx	ex- R&D program controller (global)
GSM	global system for mobile communications	RT	research & technology (process)
HFU	hours follow-up	SIM	subscriber identity module
LE	latest estimate	SMS	short message service
Li-Ion	Lithium-Ion battery	STP	short-term planning
LPL	logistics project leader	SVP	senior vice president
LRP	long-range planning	TACS	total access communication system
LRVP	long-range volume planning	TDMA	time division multiple access
MAT	materials	TPM	technology platform management
MPL	materials project leader (sourcing)	TTML	tagged text markup language
NFS	Nokia financial system	UI	user interface
NMP	Nokia Mobile Phones	USP	unique selling proposition
NMT	Nordic mobile telephone	VP	vice president
NN	Nokia Networks	VPC	variant profitability calculation (accounting process)
NRE	non-reoccurred costs	WD	wireless data (e.g. communicator products etc.)
NTC	Nokia Telecommunications (curr: Networks)	WBS	work breakdown structure (a definition: a project in R/3)