Innovation in a holding company: 'from production orientation towards product leadership' a case study of a holding company in the building and construction industry

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Innovation in a holding company:
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A case study of a holding company in the building and construction industry

by
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Preface

This thesis is the final project that serves as my masters thesis for the studies of Innovation Management at the Eindhoven University of Technology. It is the result of a 7-month period of hard work, and is the end of the era of being a student for me. This period may be described as a fun period, maybe later in retrospect I could label it as the most fun period of my life. The period is also one in which I have learned a lot and in which I think I formed a basis on which I can start my working life with.

The period in which this thesis project has been conducted has been a very valuable one. It provided the opportunity to have a look into the different layers of the holding organization CRH Insulation Europe (CIE), with a lot of interesting international contacts. Although currently the economy is going down, the new strategy of CIE may be a good basis for continued and moreover, improved business.

I would like to thank a few people that have supported me a lot during this project. The first one that has helped me the most, may be a surprising one, because her background is totally unrelated to the contents of this thesis: my girlfriend Sanne. Sanne, especially on the emotional side your support has been tremendous, but also regarding the contents. Thank you very much. I am very thankful for your support!
Furthermore, I would like to thank Isabelle Reymen, my university supervisor, for her extensive support during the project, but also in the approach towards this end project. I know that I demanded more time than the average graduation student, so thank you for that a lot.
I would also like to thank Harry Cremers, my company supervisor, for the extensive explanations on unclear issues of the topic and also for the reviewing of my documents. Additionally, I would also like to thank him for giving me the chance to perform my masters thesis at CIE.
Hans van der Bij, my second supervisor, has also provided valuable insights into the field of innovation management, so also for you many thanks.
Furthermore, Wim and Jeannette, my parents, thank you for having provided me with the opportunity to be graduating at this moment! And Elly, Sanne's mother, also deserves thanks for the provision of a place to live for the last couple of weeks of this project.

The report is censored, due to confidentiality reasons of the case company CIE. The body text is censored and the appendices include information that will not be made public, as these include uncensored parts.

I wish the reader a pleasant time reading my thesis!

List of Abbreviations

BPS	Business Problem Solving (project)
BU	Business Unit
CRH	Cement-Roadstone Holdings plc (formerly)
CIE	CRH Insulation Europe (sometimes referred to as *the holding* or *the group*)
EBIT	Earnings Before Interest and Tax
EPS	Expanded polystyrene
KPI	Key Performance Indicator
MD	Managing Director
NPD	New Product Development
Opco	Operating Company
PMC	Product Market Combination (classification system for a business)
PU/PIR	Polyurethane / polyisocyanurate
RMI	Repair (or Renovation or Refurbishment), Maintenance and Improvement
SBG	Strategic Business Group (classification system for a business)
SPICE	Name of the Strategic Program of CIE constituted 2006
XPS	Extruded polystyrene
XPE	Extruded polyethylene

Management Summary

This is a final masters thesis performed as the final project of the studies of Innovation Management at the TU/e, Eindhoven. This project is a case study of a business performance related problem from a holding company in the field of innovation management. Innovation management is becoming increasingly important in business nowadays, with the increasing globalization and increasing customer demands. For multinational businesses, the extent to which synergies can be created in innovation management is the key issue.

This document is structured as follows. At first, the case company, CIE, will be introduced. Subsequently, the problem definition will be discussed, followed by the project approach. This is followed by the analysis of the existing situation. Subsequently, the design that should improve the situation is explained, including a brief change plan. The document is finalized with managerial implications and conclusions and recommendations.

This project is conducted at CRH Insulation Europe (CIE), a division of the Irish holding company CRH. CRH is a holding company in the building and construction industry, employing about 92,000 people world wide in three divisions: (1) primary *materials*, (2) value-added building *products* and (3) specialist building materials *distribution*. CRH is listed at three stock exchanges and has showed continuous and stable growth for approximately 20 % since 1970. It has a twofold strategy for growth, namely autonomous and by means of acquisitions, which both cover approximately 50% of the growth.
CIE is the division of CRH that owns eight business units in Europe. This group consists of nine Operating companies (Opcos) that are all producing foam insulation products. One of them is producing the base materials for the production of the end products and is left out of this project scope due to this difference. CIE covered approximately €500m of sales in 2007. The foam insulation types that are produced by CIE are EPS (covers the largest part of the business), PU/PIR, XPS, and XPE. EPS and PU/PIR are mainly used for thermal insulation in roof, wall and floor applications in residential houses or industrial buildings. XPE is mainly used as sound insulation under parquet or under the screed in residentials. XPS is mainly used in load bearing applications under buildings, also because of its water resistance properties. The main customer groups are the following:

- Builders Merchants
- Specialized Distributors
- Contractors
- DIY (Do-It-Yourself) Chains (e.g. Gamma Retail)

CIE consists of a holding team of eleven individuals. The involvement of CIE within the Opcos was previously only on the appointment of the directors teams, the strategy making and the financial analysis. In 2005, CIE faced a deteriorating performance due to a deteriorated environmental situation. In order to cope with this threatening situation, CIE developed a new strategy in which it was defined that it wanted to break out of this dependent market position by means of a twofold plan:

(1) Improvement of the existing business in terms of deploying a commercial excellence program and an operational excellence program.
(2) Creating product leadership through explorative innovation

As a result from this increased demands of the business, the CIE Director Operational Excellence was installed to put the first part of the plan into practice. The CIE Director Innovation Processes (CIE DIP) was installed in order to improve innovation for the first part of the plan and the second part of the plan. This thesis project was initiated in the product development process area of the CIE DIP.

The problem of the existing situation at CIE that was identified in light of the new strategic plans, was that the current innovation facilities were insufficient to reach the product leadership horizon of the strategic plan. This was due to the fact that no coordination and hardly any cooperation in innovation

within the group was found present, next to the fact that a low extent of explorative innovation was pursued by the Opcos. Therefore, this project was conducted in order to analyze the existing situation and accordingly create a design that would facilitate CIE in reaching the product leadership horizon.

The approach of this project consisted of fifteen distinctive steps, among which the most important were the analysis of the current situation by means of an NPD questionnaire that had been sent out by CIE DIP ahead of this project, together with the strategic documents of the holding and the Opcos, and a literature research. With the aid of these data sources, semi-structured interviews were held. This provided insight into the local innovation processes of the Opcos, the cooperation that is present and the willingness for improvement of the innovation processes from the holding –coordinated level. With the aid of this and more literature insights, a new design was created in order to improve the innovation facilities at CIE, coordinated from the holding level.

Relevant literature provides some key notions and insights. For example, the definition of an innovation is a successful invention, where an invention is defined as a new idea for a new product or process or an improvement of an existing one. Innovations are developed in order to exploit an opportunity, or to overcome a threat. An innovation process is defined "*The combined activities leading to new, marketable products and services and/or new production and delivery systems*". Good innovation management practice involves a structured approach of the innovation process, complemented with a portfolio management system and a project management system. Innovations can be distinguished in exploitative innovations and explorative innovations. "*Exploitative innovations build upon existing knowledge and meet the needs of existing customers*". "*Explorative innovations require new knowledge or departure from existing knowledge and are designed for emerging customers or markets*". Ambidexterity refers to a balance between exploitation and exploration within the organization. This is found important in innovation management practice. "*Portfolio management aims at managing risk in R&D by selecting an appropriate mix of high- and low-risk projects, as well as long- and short-term results.*" Furthermore, a literature review about key success factors in innovation management, e.g. local innovation management, shows that firm culture, experience in innovation, characteristics of the R&D team, strategy towards innovation, project complementarity and management style are generally found important factors in innovation management.
Holding companies are companies owning other businesses and are not producing goods or services by themselves. They can influence the operations of the subsidiaries by choosing the directors team, but also by higher levels of involvement.
Innovation management in multinational companies distinguishes between four types of innovation processes (of which number two and three are called transnational innovation processes):

(1) The local innovation process (within a business unit)
(2) The central innovation process (at the headquarters, in supply of the business units)
(3) The locally leveraged innovation process (transferring local innovations to other business units)
(4) The globally linked innovation process (picking the optimal resources from distinctive subsidiaries in order to develop a centrally coordinated innovation)

Next to the need for good practice in the management of each of these single projects, there is also a need for a management system on top of these parallel existing innovation processes.

The analysis of the existing situation shows that there is no centrally coordinated innovation process present at CIE, only a set of eight local innovation processes. The possibility to create a central, headquartered, innovation process, is low in the holding setting, because each unit is ought to create its own returns, which is not the case with the central innovation department. A centrally coordinated process that utilizes Opco resources and external resources however is a viable option and does not deviate too much from the existing stuation. The transnational innovation processes are potentially applicable to the holding setting. The local innovation processes could be utilized to provide resources for either of the transnational processes. However, the analysis shows that the local innovation processes need some

important improvements. For example, the currently formally allocated resources to innovation within the group is 10.5 FTE on 1400 FTE. Also the structure of the innovation processes needs improvement, with only one formal Stage Gate structure found in the group. With the identified improvements, both the local processes will improve themselves, but also this will enhance the transnational innovation processes as there are more local resources to utilize and also more local innovations to transfer.

The design consists of a system of four elements:

(1) The CIE Innovation Process
(2) A Product and Project classification system
(3) A set of KPI's for measurement of innovation performance
(4) A reward structure

The CIE Innovation Process consists of the addition of a centrally coordinated innovation process, with elements of a central innovation process, but sourced from the Opcos and externally, and transnationally coordinated innovation. With this system, economies of scale and scope may enhace the synergy in innovation within the group.
The product and project classification system is needed to be able to coordinate the processes. The existing system does not support the synergetic utilizations and is therefore replaced with the design of a complete classification for all the existing products and the innovation projects. The first setup has been created.
A new improved set of KPI's is designed, in order to tackle the problems of the old single Vitality Index. The new set consist of two Vitality Indices and three NPD Efficiency Indices, in order to discriminate between exploitative efforts and explorative efforts and to provide insight into the efficiency of the innovation efforts.
A reward structure for personal rewards of the MDs and the NPD representatives is designed. This is done as a backup if the CIE Innovation Process appears unsuccessful. The rewards are progressive over time and also over the intensity of the human resources supply to CIE innovation projects for the MDs. For the NPD representatives, the rewards are directly linked to the CIE innovation projects they are involved with.
The change plan describes that the new set of design elements should best be installed by firstly the exploitation and implementation of the classification system and the set of KPIs, in order to immediately instill an incentive to improve the local innovation processes. Subsequently, the centrally coordinated CIE Innovation process should be exploited and installed.

Although no real test has been conducted, the design appears viable for its purpose, to increase holding innovation projects at CIE, facilitating in more explorative innovation. With this design implemented, CIE has developed a system with which explorative innovations are more logical to be developed.

CIE is recommended to implement this design, according to the described change plan. It will require some adaptation to implement it in practice.

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1 Introduction

Innovation is becoming increasingly important in business nowadays, in order to survive as a company. This is due to the changing environment businesses are operating in. Changes in customer demands, competition and technology have made the environment more global, dynamic and intense (Clark & Wheelwright, 1993). As a result, companies need to ensure that they create a continuous flow of innovations. Both sustaining and advancing current businesses as well as the creation of new businesses are driven by innovation (Chesbrough, 2003). Literature undisputedly acknowledges this need to innovate, as innovative companies grow more quickly and make more profits (Van der Panne *et al.*, 2003). Also in the construction industry, in which the studied company of this thesis is found, the strategic importance of innovation is increasing (Hartman, 2006). Although this trend is seen, not every company innovates. This raises the big question: WHY? It is probably due to the fact that the innovation process is accompanied with high failure rates, due to the risks and uncertainties of the innovation process (Van der Panne *et al.*, 2003).

Innovation depends on several critical organizational capabilities, like technological, human resource management, manufacturing, and marketing and distribution capabilities (Burgelman et al., 2004). Multi-business corporations, like holding companies, also face these challenges, together with an additional critical capability: the ability to identify and exploit synergies (Burgelman et al., 2004). That is the area where this thesis focuses on.

This report is structured as follows. Chapter 2 describes the case company discusses the approach of this project. Chapter 3 presents the problem that will be addressed. Chapter 4 elaborates the approach of the project. Chapter 5 discusses insights from the theoretical field. Chapter 6 presents the analysis of the existing situation. Chapter 7 provides the design. Managerial implications are discussed in Chapter 8 and the total is concluded in Chapter 9.

2 Case study company

This case study project has been executed at CRH Insulation Europe (CIE), the European Insulation division of the CRH plc holding, which is located in Gemert, Netherlands. This chapter will describe both the mother organization and the CIE division[1].

2.1 CRH plc

CRH plc, 'The International Building Materials Group', is headquartered in Dublin, Ireland. CRH plc is a holding organization; a very large group of autonomous companies processing various building materials like concrete, stone, and insulation and it is listed at the Dublin, London and New York stock exchanges. CRH plc employs approximately 92.000 people in over 3500 locations in 34 countries in Europe, America and Asia and is specialized in the three core businesses (1) primary *materials*, (2) value-added building *products* and (3) specialist building materials *distribution*. The organizational division is based on geographic location and core business. The Group CRH plc was formed in 1970, by a merger of Irish Cement Limited (1936) and Roadstone Limited (1949) and has yielded on average 20% per annum shareholder returns since that moment. This growth is twofold: autonomous and by means of acquisitions. CRH plc acquired 78 companies in 2007. 2007 Sales covered over 20 billion euros. With this performance, it is one of the Top-5 players in the sector worldwide. One of the major elements on which it focuses in its growth strategy is by means of a low-risk and balanced approach over its total portfolio of businesses. The balance in the portfolio can be represented by a few indicators. First, the revenues are geographically roughly split 50/50 between Europe and the US. However, it should be noted that CRH plc is increasingly targeting Asia and South America for its expansion. Second, the revenues are roughly 50/50 split between finished building products&distribution and raw materials for construction. Third, a 50/50 split is found between the new construction market, and the renovation/RMI (repair, maintenance and improvement) market. Fourth and last, there is a 33/33/33 split between the residential, the non-residential and the infrastructure sectors.

2.2 CRH Insulation Europe

The focal organization of this project is the CRH (sub-sub) division CRH Insulation Europe (referred to as CIE in the remainder of this text). This subchapter introduces the reader to CIE.

2.2.1 General

CIE is a holding organization with eight subsidiaries reporting to it and CIE itself reports to CRH Building Products Europe. CIE employs about 1600 people within nine business units, referred to as operational companies (further abbreviated as *Opcos*). The common factor within the group is that all Opcos are producing foam insulation materials, with the exception of one Opco that produces base materials for the production of foam insulation. This latter Opco was excluded from this project, due to its distinctive business segment that is a misfit with the focus of the assignment. Therefore from Chapter 3 and further the text and the contents omit that Opco.

The operations of the Opcos are dispersed over eleven European countries, as shown in Figure 2-1. In 2007, sales added up to roughly € 500m.

As being a holding company, CIE develops its business by means of acquisition of formerly autonomous companies and also by means of the autonomous growth of these Opcos. CRH has a policy of acquiring healthy businesses with good performance and growth potential. The existing set of Opcos of CIE were acquired for various different reasons. The amalgamation of the CRH insulation subsidiaries from Europe into a separate CRH division took place in 2003.

[1] The information about the case company is censored due to confidentiality reasons. Therefore, the Opcos are labeled with non-existing names and detailed information is omitted.

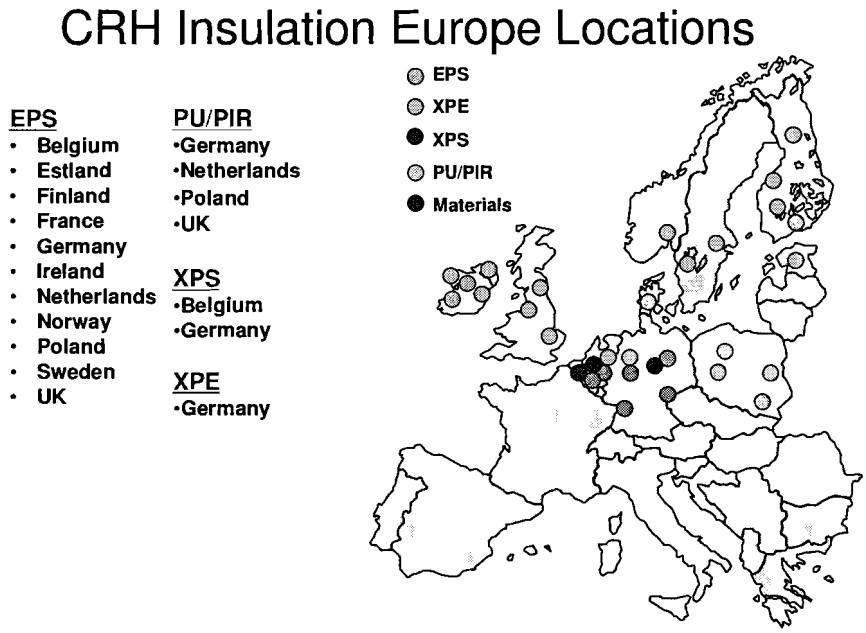

Figure 2-1 CIE locations and product types

2.2.2 Products

The product types that are produced by CIE are EPS, PU/PIR, EPS Beads (raw materials), XPS, and XPE. The countries where this is produced by CIE is shown in Figure 2-1. The product type EPS forms the main part of CIE; CIE is the biggest EPS manufacturer in Europe. The product types are discussed in more detail in this subchapter.

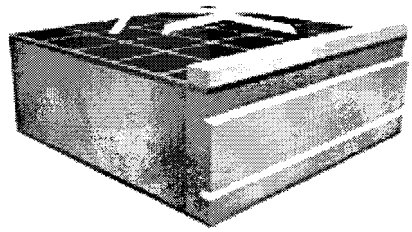

Figure 2-2 EPS Pitched roof sandwich panel

EPS (expanded polystyrene) is used for various sorts of thermal building insulation, like roof, wall or floor insulation, but also in the packaging industry. It is produced in a discontinuous process, in batches and as a single product it is common as the cheaper type of foam insulation within the group. EPS is produced in the majority of the Opcos. An example of an EPS application is the successful pitched-roof sandwich panel, which is a prefab product that simultaneously serves as thermal roof insulation as well as a construction part. An example is shown in Figure 2-2.

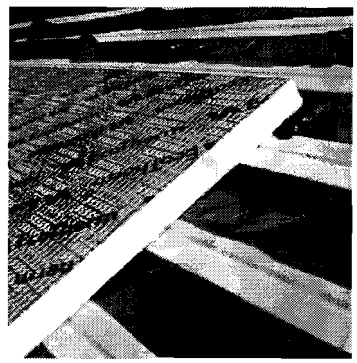

Figure 2-3 PIR Pitched roof application

PUR/PIR (polyurethane / polyisocyanurate) applications are also found in roof, wall and floor insulation. PU/PIR is produced by means of a continuous process, in contrary with EPS. Another difference between the two products is that PUR/PIR has higher insulation performance relative to the thickness of the material, compared with EPS. An example is shown in Figure 2-3.

XPE (extruded polyethylene) is applied as sound impact insulation in for instance floors under parquet, or under the screed. An example is shown in Figure 2-4.

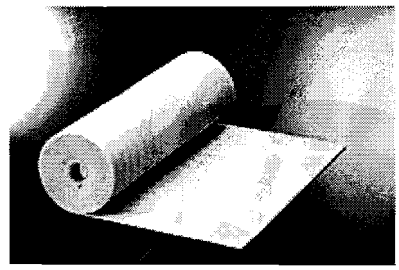

Figure 2-4 XPE Application under parquet

EPS Beads is the raw material to be used for producing EPS insulation material. The beads are little bolls produced from styrene, which is an oil-based substance.

XPS (extruded polystyrene) is used in flat roof and perimeter (underground) applications because of its water resistance and load bearing characteristics.

2.2.3 Customers

The Opcos of CIE are serving a diverse set of customers, mainly in four main categories:

- Builders Merchants
- Specialized Distributors
- Contractors
- DIY (Do-It-Yourself) Chains (e.g. Gamma Retail)

Of these categories, the building merchants and distributors cover most of the sales. It is important to note that only a very small part of the business is done at the end user. So the sales of the CIE Opcos in the current state of business is always dependent upon additional steps in the supply chain. Therefore, the influence of the Opcos on the end user or consumer is limited.

2.2.4 CIE Involvement within the Operating Companies

The major involvement of CIE (or CRH in general) within the Opcos is in the allocation of the directors teams of the Opcos. Next to this, CIE has also been involved in the financial management of the Opcos, in order to ensure CRH stakeholder returns in a risk-avoidant manner. As such, the weekly, monthly and yearly financial results of the Opcos are tracked and are point of discussion for periodic reviews. Budgeting cycles are done periodically, in agreement between the Opco and the holding team. Opco investments in new capital have to follow a so called 'CAPEX' (capital expenditure) procedure, in which the planned expenditure is analyzed by a financial analyst of the holding team. In principle, every year every single Opco is responsible to deliver its own performance.

2.2.5 Strategic change

This level and type of involvement has been changing since 2006, as a result from the new strategy that was formulated then. This new strategy, called the SPICE strategy, was developed as a result from deteriorating performance by the group (see Appendix I and Appendix II for a detailed elaboration). This strategy is based on a principle of improvement of two main pillars: exploitation and exploration. Herein, exploitation refers to the manufacturing and operations and the exploration refers to innovation. The strategic path includes the improvement (and constitution, for as far as it was not present yet) of commercial activity, operational activity and innovation activity. Chapter 3, the Problem definition, describes the background of this strategy change. The improvement plans are communicated by means of a three horizons of growth model. The consecutive levels of growth are communicated by the following different descriptions of the business focus:

1. Operational excellence
2. Product leadership
3. Customer intimacy

This means that at first, CIE want to become very good in terms of the production orientation they are pursuing currently. Then, they want to change business towards product leadership, in which CIE wants to gain market share by means of a product focus, so becoming very good in the products it manufactures.

The third level of business focus is the customer intimacy level, which describes the focus on deep understanding of the customer needs and demands. These three distinctive focuses however do not mean that the phases do not include any practice closely related to the other focuses, but it indicates the main focus of doing business.
So along with this new 'SPICE' strategy, the degree of involvement by the holding is being expanded with strategic coordination of the Opcos and CIE activities on the commercial activity, the operational activity and the innovation activity.

2.2.6 Organization structure

The current organizational structure of the CIE holding team consists of eleven team members as shown in Figure 2-5. It is noted that Opco C and I are managed by the same MD. The holding is located in Gemert, Netherlands. The first constitutions of the CIE team, in 2003, have consisted of the combination of four functions: the Managing Director, the Director Finance & Development, the Director Organisation Development and the Business Development Manager. The analyst and controller functions support these functions. The SPICE strategy has resulted in the constitution of two new functions lately. The CIE Director Operation Excellence was appointed for the development of the commercial activities and the operational activities. In 2008 the CIE Director Innovation Processes (further referred to as CIE DIP) was appointed for the development of the innovation activities.

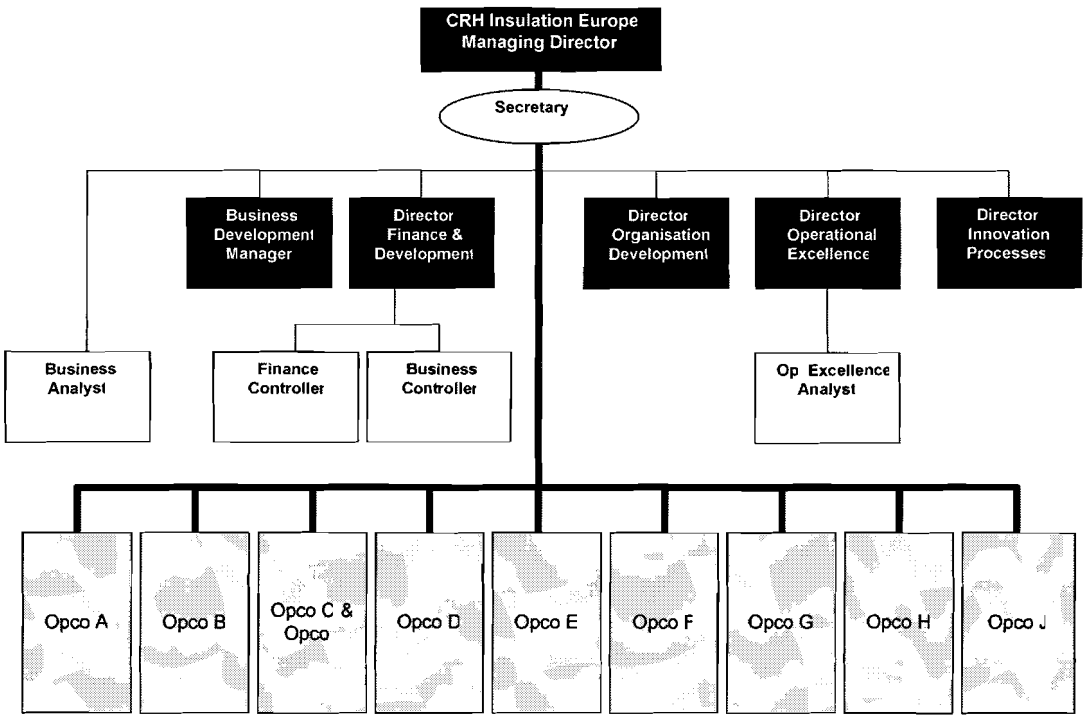

Figure 2-5 Organization chart CIE

2.2.7 Innovation at CIE

The formal allocation and appointment of CIE DIP in the holding team was the first embodiment of the innovation plans of the CIE holding. This means that the innovation facilities of the group now consist of the individual innovation processes of the Opcos and the overarching role of CIE DIP. The role of the DIP is to improve innovation at CIE. The focus of the innovation strategy will be customized to one of the three stages of the three horizons model of the CIE SPICE Strategy (see **Appendix** I). The first step in innovation improvement is focused on commercial and operational excellence, which means that at first the Opcos have to become good in innovation, as a facilitator for operational excellence. Next to that, CIE

DIP is simultaneously working on plans to build an innovation capability in the group that is facilitating the second, product leadership, horizon. The third horizon is not given explicit attention yet within the strategy of CIE.
CIE DIP recognized six different issues as development areas for innovation (see also Figure 10-3 in Appendix III):

- Application development
- Fundamental R&D
- Product development (process)
- Market intelligence
- Sales methods / routes-to-market
- European legislation

Each area is given attention in the development of the innovation capability within the group. The focus of the innovation capability improvement on these six areas will shift as the strategic horizon progresses from operational excellence to product leadership.

3 Problem definition

This chapter describes the problem definition of this project. This problem definition is a performance related business problem, which is to be solved and this project will serve in achieving that. So this problem definition will be a basis on which the rest of the report is grounded. First, the problem background and the problem is described, followed by the assignment that follows from it.

3.1 Problem background

Till 2005, CIE had been organized in a decentralized manner. This was in line with the holding strategy at that moment (the predecessor of the SPICE strategy) which demanded individual performance by the Opcos. Therefore, the innovation activity was also mainly embodied by the individual isolated innovation processes of the individual Opcos facilitating the development of innovations for their own local market needs.
Next to the fact that the old structure demanded *individual* performance, it was also based on *yearly* performance of the Opcos, as the performance of the Opcos is assessed on a yearly profit and loss overview. The freedom the Opcos get from the holding team in the budget making for a new year and also in the investments they plan to make in the new year, depends on their performance in the previous year.
The logical innovations that this old structure therefore mainly generates are innovations that preferably yield optimal returns for the individual Opco that created them instead of that it is focused on a larger scale than this single Opco. On top of that, this old structure also mainly generates logical innovations that yield returns in a one-year time-frame for the Opco, at least preferably the break even time should not exceed this duration too much.

With this old structure running, the operating results showed deteriorating performance due to volatility in the market up to 2005. As a consequence, CIE had set up its new SPICE strategy in order to break out of this bad position. This strategy demands increased centralization in several organizational processes, including the innovation processes, in order to improve the operating results in the short and the long term. The strategy describes the twin imperatives of good exploitation and exploration and both areas are to be supported by means of innovation. For the short-term exploitation part, the need is expressed to build "*product development & innovation enabling CIE to achieve European product leadership*". For the long term, the need is expressed to build a strategy of "*exploration of technology, product (portfolio) innovation, new routes-to-markets, new customers, enabled by sustainable exploitation*" (CIE, 2007). So the demands on innovation performance by the holding changed to more longer-term, explorative innovation, enabled by sustainable exploitation.
These improvements in innovation performance put demands on the structure for innovation within CIE. As such, because the old structure mainly resulted in logical innovations that were more of an exploitative kind, a new structure is necessary that is more supportive for exploration, i.e. the logical innovations that are produced in the new structure should not only be exploitative, but also explorative.

At the start of this project, CIE DIP was just installed into its function and was to start the activities to improve the innovation activity within the group. No structure had been created yet with which these plans had to be but in practice and this had to be developed. The final aim is to have a new system installed in CIE, in which CIE DIP aids in the improvement of both exploitative innovation and explorative innovation and accordingly an increase of the innovation performance by the group should be reached at a level that CIE has attained product leadership in the foam insulation market in Europe around 2015.

As a starting point for this thesis, the problem definition is summarized in the following box:

Problem: *In order to sustain and improve its business, CIE should reach product leadership in its field. This step can only be made if the current innovation facilities within the group are improved.*

3.2 Assignment

The initial question to start the thesis with was provided by CIE DIP and was described as follows: "*How to organize for discontinuous innovation within CIE, taking into account the balance between incremental and radical innovation?*". This formulation of the question fitted with the plans of CIE DIP and with my literature study preceding this project, "Balancing incremental and radical innovation" (Zeeman, 2008). The first preliminary analysis of the situation and the innovation development plans of CIE DIP resulted in a reformulation of the research question: "*How to organize a CIE NPD Process*"? This was due to the fact that this project had been given a focus on the 'Product development (process)' area of the development plans of CIE DIP as provided in Chapter 2.2.7.

The final formulation of the assignment of this project was to analyze in what areas the Opcos are missing out regarding innovation and consequently CIE DIP can add most value. In addition, an added value was to be delivered by this project by aiding in the development of a design with which the innovation activities of the CIE DIP regarding specifically product innovation could be embodied. The type of product innovation on which this design had to focus should be based on the area where the Opcos could be best complemented by CIE DIP in regard of the new SPICE strategy; most probably the exploration part.

4 Project approach

This chapter discusses the approach that has been followed in this project. This project was design-based, and problem-oriented, based on the approach for business problem solving, as proposed by Van Aken *et al.* (2006). The company supervisor of this project was Harry Cremers, the CIE Director Innovation Processes (CIE DIP). One other involved representative from the case company was Erik van Mierlo, CIE Director Organization Development (CIE DOD).

The steps that were followed in the process with which this thesis project has been conducted were the following:

1. *Preceding literature study*

In advance of this thesis, a literature study titled "Balancing incremental and radical innovation" was done. Accordingly, a case was sought to perform a case study in this research area in, which was CIE.

2. *First interviews with CIE DIP accompanied by interviews with CIE DOD*

When the agreement was made about the fact that this thesis project was to be conducted at CIE, some initial interviews were conducted with CIE DIP in order to gain insights into the problem and the accompanying assignment, that are provided in Chapter 3. Additional interviews were held with CIE DOD in order to gain insight into the problem and ensure that the identified problem is agreed upon by other members of the holding team.

3. *Strategy documents of CIE*

The strategy documents of CIE were studied, together with papers that are relevant. The resulting reflection on the CIE strategy is provided in Appendix I and the background of this strategy is provided in Appendix II.

4. *Strategy documents of CIE DIP*

The first plans for the improvement of innovation by CIE DIP were available. These were studied and the overview is provided in Appendix III.

5. *Project proposal development*

After the assignment was formed, a project proposal was written and redefined according to reviews with both the company and TU/e supervisors.

6. *Problem analysis and validation*

The insights into the problem were analyzed more deeply with the use of more interviews with CIE DIP and CIE DOD and also by means of the subsequent steps 7 to 11.

7. *NPD questionnaire*

Beforehand this project was initiated, in February 2008, CIE DIP sent out a questionnaire in order to gain insight into the innovation processes present at the Opcos and their performance. During the first months of this project, the responses were returned and became available for analysis. These were analyzed extensively and areas wee identified that required more questioning, as they were not answered or sometimes not completely answered.

8. *Second literature research*

In order to gain some insights into the specific knowledge in the scientific domain at stake, a second literature research was performed. This knowledge was combined with that from the questionnaire in order to develop semi-structured interviews that were to be held with the individuals that were involved in innovation within CIE

9. Strategy documents

Of seven of the eight Opcos strategy documents were available. These were analyzed extensively in order to find answers to some questions resulting from the NPD questionnaire. If more questions resulted from it, this knowledge was added to the interviews that were to be held.

10. Documentation regarding the innovation processes of the Opcos

Some information was gathered about the specific innovation processes of the Opcos. The analysis of this resulted in some areas that needed further analysis. As such, questions were developed for the interviews

11. Interviews with MDs and NPD representatives

A set of semi-structured interviews was set up for the MDs and the NPD representatives of each Opco. The setup is found in Appendix IV. This was based on the remaining unanswered areas in the NPD questionnaire (which is provided in Appendix V), together with questions about relevant subjects that were identified in the second literature research and with questions that popped up as a result from the strategy documents and the documentation on the innovation processes of the Opcos. A set of seventeen respondents was interviewed. The basic setup of the interviews is provided in Appendix VI and the list of respondents is provided in Appendix VII. The interviews that could be held in the Netherlands were done in personal contact, but all the interviews that were done with respondents from other countries were done mainly by means of video conference. Two respondents were interviewed via the telephone, as no video conference system was available.

12. Analysis and design

The data was analyzed in order to gain insight into the innovation structure of CIE. The reports for each Opco are provided in Appendix VIII till Appendix XVI. This analysis was synthesized into the analysis that will follow in Chapter 6.

13. Innovation Meeting

At Octobre 8th 2008, an Innovation Meeting was organized by CIE DIP and CIE DOD in order to kickoff the improvement plans for innovation by CIE. Approximately all the respondents from the interview rounds were present at this meeting. This meeting was used to present the analysis of this project and also to verify some conclusions about the innovation performance of the local innovation processes of the Opcos. Also the largest part of the design for improvement, as will be discussed in Chapter 7, was presented to the public. Next to this, several plenary sessions were organized to have interactive discussions about the innovation plans with the Opco representatives. This was the last moment that information was gathered in order to improve the design of this project.

14. Final report development

In the final step, this report is been developed. This has been done with reviews from both the company supervisors as well as the university supervisors. These reviews served as a final form of evaluation of the project.

15. Final presentation and examination

The finalization of this project will follow in a final presentation to the company supervisor together with the university supervisors. That will be followed up by an examination to have the complete project assessed.

5 Theoretical field

The focal research area of this thesis, innovation management in multinational holding companies, is discussed in this chapter. It is done to capture the knowledge that is already known on the topic, to be able to relate the findings of this case study to the existing body of knowledge and to create a base of key concepts that are used for the analysis of this thesis. The topics that are discussed are the following:

- Innovation management
- Types of innovation
- Ambidexterity
- Portfolio management
- Cooperation in innovation
- Firm and project success factors in innovation management
- Holding companies
- Innovation in multinational companies

The contents of these chapters serve as a background for the analysis and design chapters.

5.1 Innovation management

The main and general topic of this thesis is innovation, but what actually *is* innovation? The word innovation is used in two ways. At first, it is used for an object that can be labelled 'an innovation'. To explain this case, the formal definition for invention and innovation is adopted from Dahlin and Behrens (2005). An *invention* is defined as a new idea for a new product or process or an improvement of an existing one. On the other hand, an *innovation* is defined as a successful invention, i.e. sufficient monetary returns are generated with the investment in this innovation. Innovations are developed in order to exploit an opportunity, or to overcome a threat (Bartlett *et al.*, 1990).

Secondly, the word innovation is also used in the context of the *innovation process*. For this case, the definition is adopted from Burgelman *et al.* (2004): "*The combined activities leading to new, marketable products and services and/or new production and delivery systems*". This process needs adequate and effective management; accordingly this practice is referred to as *innovation management* (Phillips *et al.*, 2006).

Cooper (1997) explained that an innovation process is one out of three building blocks required for good innovation management:

- Innovation process management system
- Project management
- Portfolio management

Cooper explains that these three cannot go without each other. The innovation process management system ensures that there is a prescription for the activities to be conducted. The project management ensures that a specific project is been executed according to the process. The portfolio management ensures that the strategically right projects are developed.

The project management element is not further elaborated in this thesis, because this topic is on a more detailed level then useful for the more general view demanded in this thesis. The portfolio management element will be described in further detail in Chapter 5.4 and below some elaboration of the innovation management process is given.

The innovation process Cooper refers to is a so called Stage Gate system: "*A stage-gate system is both a conceptual and an operational model for moving a new product from idea to launch. It is a blueprint for managing the new product process to improve effectiveness and efficiency.*" The typical Stage Gate system consists of four to seven stages, from idea to launch. A typical five stages Stage Gate is depicted in Figure 5-1. This system consists of five stages, followed by gates in which the decision is made to proceed the NPD project or not. The five stages of this system are:

1. Preliminary assessment of the idea, assessing strategic fit, general sales potential and feasibility;
2. Detailed business case development, in which the complete plan is elaborated up to launch;

3. Development, in which the product is been given shape up to its full constitution;
4. Testing and validation, in which technical and sales potential are assessed;
5. Full production, in which the upscaling of the production process is executed.

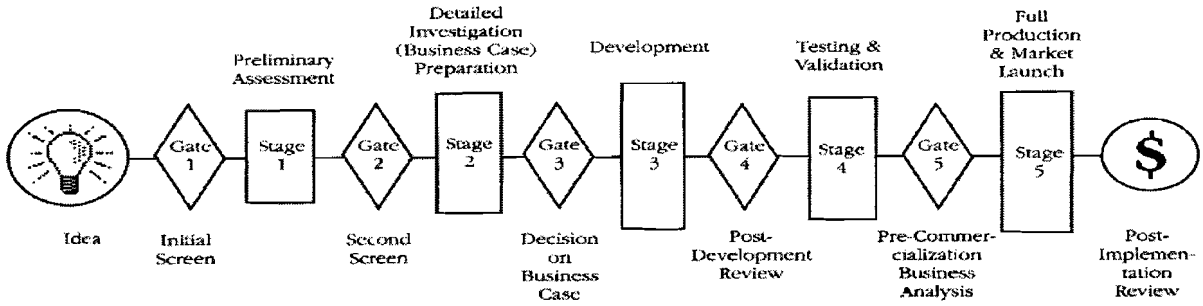

Figure 5-1 A typical five stage Stage-Gate system (adopted from Cooper, 1997)

5.2 Types of innovation

Literature offers a wide range of dichotomous definitions for distinctions in innovations. For this thesis, two are discussed in this subchapter, namely incremental innovation and radical innovation and exploitative innovation and explorative innovation.

The first dichotomy, the one of incremental innovations and radical innovations, is the most common one in both literature and business. A wide range of definitions is used for it. One very common one is based on the technology and the market dimension, as provided by Chandy and Tellis (1998). "*Incremental innovations involve relatively minor changes in technology and provide relatively low incremental customer benefits per dollar*". "*Radical innovations involve substantially new technology and provide substantially greater customer benefits per dollar, relative to existing products*" (Chandy & Tellis, 1998). The incremental and radical dichotomy is also used based on the amount of risk coming with the innovation (where the radical innovation involves higher risk), on the perceived level of newness of the innovation (the radical innovation has a higher perceived level of newness) and on the extent to which both the product and the process are changed (with a radical innovation having both the product and the process renewed) (Damanpour, 1991; Dewar & Dutton, 1986; Edquist, Hommen & McKelvey, 2004; Ettlie & Subramaniam, 2004; Roberts, 2007).

During the interviews that were executed during the project, this distinction was used for discussion on the radicalness of the projects. However, the definition proved to cause ambiguity in understanding of the interviewed people, because of the fact that these definitions included a statement about the customer benefits, of which it is only possible to give factual information after the innovation project has been finished and the product is marketed for a while. Therefore, a second dichotomy that distinguishes on a more fundamental level, namely the knowledge base on which the project is based, is adopted. "*Exploitative innovations build upon existing knowledge and meet the needs of existing customers*". "*Explorative innovations require new knowledge or departure from existing knowledge and are designed for emerging customers or markets*" (Benner & Tushman, 2003). This set of definitions has been used for the operational purposes in the design of this project, as will be discussed in Chapter 7. An andvantage of these definitions is that they can also be used for innovation projects that are in a premature stage, as opposed to the incremental – radical dichotomy.

5.3 Ambidexterity

An organization's innovation activity should consist of both exploitation and exploration, which has been advocated in scientific literature for a number of years now (Gupta *et al.*, 2006; Jansen, 2005; Lubatkin *et al.* 2006). Exploitation refers to exploitation of current products and services and consequently leveraging current competences in order to create stability in the business (Benner & Tushman 2003). Exploration

refers to the exploration of new ideas or the exploration of processes that lead to the development of new products or services for emerging markets, in order to have the firm adapting to environmental changes (Benner & Tushman 2003).
The omission of one of the two types of innovation activity may harm the firm. Jansen (2005) describes this as follows. *"The returns to exploitation are ordinarily more certain, closer in time and closer in space than are the returns to exploration (Levinthal & March, 1993: 106; March, 1991). Furthermore, past exploitation in a knowledge domain makes future exploitation in the same domain even more efficient (Lant & Mezias, 1992; Rosenkopf & Nerkar, 2001). As a result, firms increasingly maintain the status quo, exhibit convergence, and develop highly specialised competences that may become core rigidities (Leonard-Barton, 1992). Although the preponderance for exploitation may enhance short-term performance, it can result in a competence trap (Ahuja & Lampert, 2001; Levinthal & March, 1993) since firms may not be able to respond adequately to environmental changes (Henderson & Clark, 1990; Jansen, Van den Bosch, & Volberda, 2005; Sorenson & Stuart, 2000; Tushman & Anderson, 1986). Focusing on exploration can also have dysfunctional effects. Excessive exploration may enhance a firm's ability to continually renew their knowledge stock, but can trap organizations in an endless cycle of search and failure and unrewarding change (Levinthal & March, 1993: 106). These firms escalate resources and time to exploration and become over sensitive to short-term variations and local errors (Volberda & Lewin, 2003) without gaining benefits from exploitation. Accordingly, too much emphasis on exploration can result in a failure trap (Levinthal & March, 1993)."* (Jansen, 2005).

An interesting issue remains unanswered with the above knowledge, namely *how* the balance should be achieved in the organization. The following subchapter elaborates on the literature findings about the organizational architecture needed to create a balance between exploitative innovation and explorative innovation.

5.3.1 Ambidexterity and punctuated equilibrium

Literature (Brown & Eisenhardt, 1997; Burgelman, 2002; Gupta et al., 2006) provides two fundamental methods with which this balance between exploitation and exploration can be conceptualized. These are ambidexterity and punctuated equilibrium. The ambidexterity approach was introduced by Duncan (1976) and has received a lot of attention in science lately, because it receives strong support in research on business performance (Burgelman, 2002; Gibson & Birkinshaw, 2004; Gupta et al., 2006; He & Wong, 2004; Jansen, Van Den Bosch & Volberda, 2006; Lubatkin et al., 2006; Tushman et al., 2004). An ambidextrous organization consists of differentiated and weakly integrated units (this general notion of ambidexterity is referred to as *structural ambidexterity* in Chapter 5.3.2). So exploration and exploitation are conducted simultaneously in this type of organization. Exploration is conducted by smaller units who are decentralized and simultaneously the exploitation units are larger and centralized with less flexible processes and cultures. The exploration units perform experimentation and hence increase variability and the others reduce variability and are focused on efficiency improvements. These inconsistent organizational architectures are integrated by the ambidextrous manager, at the senior team level (Tushman et al. 2004). The innovation manager managing one of the organizational units reports to this ambidextrous manager and the ambidextrous manager is often found reporting to a meta-manager. The ambidextrous organization should be strategically aligned by means of senior management behavior and strategic framing. Individuals that are assessed for becoming ambidextrous managers should be tested on their ambidextrous capabilities (O'Connor & De Martino, 2006).
The other conceptual approach is that of the punctuated equilibrium, which is defined as "*temporal cycling between long periods of exploitation and short bursts of exploration*" (Gupta et al., 2006, p698). So, as opposed to with ambidexterity, this approach does not allocate one unit of analysis to either exploitation or exploration activities, but lets it shift between the two over time. Brown and Eisenhardt (1997) refer to punctuated equilibrium as an organizational form in which no continuous innovation is promoted, but one that runs on long periods of stable growth and improvement of existing business areas,

every now and then interrupted by brief periods of radical change. According to Gupta et al. (2006) in the case where a single domain is regarded (individual or subsystem), ambidexterity is found not possible, but only punctuated equilibrium. However, regarding multiple loosely connected domains, ambidexterity might be very well suited for balancing exploration and exploitation. This means that ambidexterity at a higher level can co-exist with a punctuated equilibrium pattern on the individual level. Because literature provides strong support in favor of ambidexterity at the organizational level, as opposed to punctuated equilibrium, the remainder of this chapter will elaborate on that.
Beforehand, an important additional aspect to take note from is the balance on network level. Gupta et al. (2006) indicates that long-term survival may also be possible for firms if they pursue either exploitation or exploration. This is so because the balance between them can be created on a higher level, namely that of a broader social system; a network of several companies. The balance is achieved by a market interface, in which either party gets its equal share, weighed against its input. Concluding, specialization is promoted for each company. It is noted that cooperating partners, of which one is performing the exploration and the other is performing the exploitation part, can be acting in a very different market environment, namely a stable environment for the one of the exploitation action and an unstable environment for the one of the exploration.
The research by Tushman et al. (2004) revealed that ambidexterity shows very significant higher performance than alternative organizational designs in terms of the innovation outcomes. The alternative organizational designs in this study were the functional, the cross-functional and the unsupported autonomous organizational designs, which are not specifically designed for the balancing act. An exception on the superior performance of the ambidextrous design was found in the case when the radical innovation can be approached as a product substitute, moreover when the impact on the business process is small (e.g. no disruptive innovation). In the latter case namely, a simple functional architectural design would already be adequate for innovative success.
The factors *senior team integration* and *(limited) structural differentiation* showed both to be important variables for successful ambidextrous innovative performance. The senior team integration comes down to a short, sometimes even direct hierarchical connection between the unit and the senior manager. Limited structural differentiation is embodied by distinct units, the extent to which the units are located physically separate, a distinction in cultures and distinct reward systems for the different units.
A few important additional advantages of ambidexterity are provided. One of these is that also in case when companies process only non-incremental innovations, the ambidextrous designs appeared to be dominant as well. However, according to He and Wong (2004), such an organization could not be labeled to be ambidextrous anymore, but this is just a matter of definition. Another important finding in the Tushman et al. (2004) research is that the ambidextrous organization was the only design that was positively associated with continued performance of the existing products. Most notably, the other designs even yielded decreased performance of the existing products. A facilitating and important finding was that it appeared that over a period of several years, ambidexterity could actually be learned.

5.3.2 Structural ambidexterity and contextual ambidexterity

In addition to the general notion of ambidexterity in the fashion referred to by the authors in the previous subchapter, Gibson and Birkinshaw (2004) introduced another fashion. These authors call the alternative approach contextual ambidexterity, as opposed to the general approach, which they refer to as structural ambidexterity. Structural ambidexterity is defined as consisting of the 'dual structures', in which some units focus on the *alignment* (i.e. exploitation), whereas other units focus on the *adaptation* (i.e. exploration). In contrast, Gibson and Birkinshaw (2004, pp 209) develop and promote contextual ambidexterity, which is defined "*the behavioral capacity to simultaneously demonstrate alignment and adaptability across an entire business unit*". Contextual ambidexterity finds application at the business unit level, so the adaptation and alignment activities are being conducted within the business unit. Moreover, this is not a dual structure, but a complex system in which individuals are encouraged to judge themselves how they divide their time between the two opposing demands. Note that contextual

ambidexterity at the organizational or BU level provides the opportunity to let a punctuated equilibrium pattern arise at the individual level. They indicate that structural ambidexterity has the disadvantage that it creates high coordination costs, because of the strong separation of the units, fractionalized at the organizational level, all configured specifically to the needs of their task environment. As opposed, contextual ambidexterity operationalizes *continuous change* and is found more sustainable, because "*it facilitates the adaptation of an entire business unit, not just the separate units or functions responsible for new business development*" (Gibson & Birkinshaw, 2004, pp 211). Additionally, it manages itself, because it is dynamic and flexible and directs the individuals only by means of clear goals for the unit they are working in, letting these individuals choose their own time spending. So the individuals are trying to deliver value to the existing customers meanwhile they are on the lookout for new opportunities. Note that Cardinal (2001) indicates that goal setting should not be overly specific, because it can lead to an encouragement of risk-averse and imitative actions, therewith emphasizing more incremental innovation and de-emphasizing more radical innovation. This reliance on individuals own responsibilities is also found in Baker and Sinkula (2007, p 330), who promote that all employees should be "*encouraged to be selectively destructive (e.g. to identify and undo the obsolete)*" in light of cannibalization.
Contextual ambidexterity can only be incurred if there's the right *organizational context*, which is defined as the systems, processes and beliefs, that give shape to the individual-level behaviors within an organization. So at first, this context should be in place and subsequently contextual ambidexterity should be given shape. The organizational context is presented to encompass elements of seven key notions:

(1) *Structural context* refers to the relatively tangible administrative organizational mechanisms.
(2) *Organization culture* refers to the underlying belief systems and values of individuals in the organization
(3) *Organizational climate* refers to the environmental characteristics presumed having effect on individual behavior and attitudes.
(4) *Discipline* (voluntarily striving to meet expectations)
(5) *Stretch* (voluntarily striving for more ambitious objectives)
(6) *Support* (assistance to other members)
(7) *Trust* (rely on commitments of others).

Gibson and Birkinshaw (2004) show that contextual ambidexterity was found possible with the support of the right organizational context and did incur increased performance. This was found to be true for a wide variety of businesses and industries. However, it was suggested that for businesses in low dynamic environments it may not incur similarly large advantages, without support. Additionally, it was found that there are different paths to contextual ambidexterity, so the following order in which the adaptability and the alignment capability are built do not matter. Finally, again a very important factor needed for achieving contextual ambidexterity was the role of senior executives. Their efforts in building a system that allows a supportive context to emerge and also their efforts in encouraging and nurturing adaptability were identified as the processes by which these executives played this important role.

Other literature (Gupta et al., 2006; O'Connor & De Martino, 2006), provides opposing thoughts against contextual ambidexterity by their findings that certain individuals are better equipped for less risky, incremental innovation projects, whereas others are better suited for radical innovation projects. This is in line with the work of Amabile et al. (1996) on creativity and motivation, in which individuals who are more prone to exploration are found very different from the people who are more focused on appropriate actions directed towards alignment. This implicates that it can be difficult for individuals to switch between the different types of activities. In this case, structural ambidexterity would fit better because this allows individuals to function within the environment expecting personally better suitable activities.
Another apparently opposing finding in literature comes from Wong (2004) with the notions on local learning and distal learning. Teams were analyzed based on these two types of learning in regard of their innovativeness and efficiency. Local learning is a type of learning that is directed towards (and is found to

improve) efficiency increase within the group (i.e. alignment). Distal learning is learning from abroad or from other teams or other companies and creates an inflow of novel information, thereby fostering group innovativeness (i.e. radical innovation / adaptability). It was indicated that groups could better focus on either local learning or distal learning, because a simultaneous approach impedes both efficiency and innovativeness. Although this research focuses on teams instead of entire business units, the opposing findings about the closely related concepts of local and distal learning with alignment and adaptability is remarkable.

In conclusion about the notion of ambidexterity, companies need to ensure that their innovation output is balanced in terms of exploitative innovation and explorative innovation. Literature provides different approaches to achieve this and it seems that the ambidexterity principle is becoming to dominate the punctuated equilibrium principle. The two types of ambidexterity, the structural ambidexterity and contextual ambidexterity, both have advantages and disadvantages. These factors should be regarded when choosing an organizational setup to achieve ambidexterity in a specific context.
No scientific insights were found on ambidexterity in holding companies, or in multi-business companies. Still, some closely related findings are discussed in Chapter 5.8.6 and Chapter 5.8.7 about managing different types of innovation within a multi-national company.

5.4 Portfolio management

Portfolio management is a practice that is of key importance to adequate product innovation management. It has three major goals: value maximization, strategic alignment and balance in the total business of the company, as identified by Cooper et al. (2001). Portfolio management is the generalized notion that is sometimes referred to in a more specific matter, like *project* portfolio management, *product* portfolio management or *alliance* portfolio management. Portfolio management is defined in a large number of ways in literature. One example that offers a good starting point for the explanation is the definition by the professional literature article of Canez and Garfias (2006, p 46): "*Portfolio management aims at managing risk in R&D by selecting an appropriate mix of high- and low-risk projects, as well as long- and short-term results.*" So it appears that it is about managing risk. This definition is however restricted to only the R&D function of a company, whereas project portfolio management actually covers more disciplines, as projects cross the functional boundaries of R&D and consequently can have involvement from marketing, production, human resources and other organizational functions (Cooper, Edgett & Kleinschmidt, 1998 & 2001). Additionally, this definition is restricted to only two dimensions on which projects can differ, whereas in business as well as in theory, there is a very large number of dimensions on which projects could be assessed in the discipline of portfolio management. Cooper et al. (2001, p 75) mentions several dimensions, among which *strategic fit*, *durability of competitive advantage* and *time to completion*. As Cooper et al. (2001) indicates, portfolio management comprises of a large number of issues, among which project selection, annual budgeting, resource allocation across projects and also on corporate level, prioritizing projects and selecting the best set of projects to meet with strategic needs.
The NPD strategy should be defined based on five important elements, as identified by Cooper et al. (2004). So this NPD strategy is an important antecedent of proper portfolio management. The important elements that should be regarded are discussed in order of importance for NPD performance. At first, this NPD strategy should be in line with the business goals. So the goals that are set for the NPD program have to follow from the business goals. Second, clear *strategic arenas* should be defined towards which the NPD efforts should be directed. These arenas can be based on markets, product areas, industry sectors or technologies. Third, the aforementioned NPD goals should be clearly and explicitly defined in the long term. Fourth, an important aid for the right alignment of the NPD efforts is the use of *strategic buckets*. These are buckets of resources, specified as funds or person-days, which are explicitly allocated to specific project types or arenas. Fifth, another aid can be the use of product- and technology roadmaps, in which the strategic buckets can be allocated over time.

5.5 Cooperation in innovation

The issue of cooperation in innovation is viewed from a knowledge-based perspective in this project. Knowledge in the practice of innovation management can be embodied in two concepts: in *object knowledge* and in *process knowledge*. These conceptual terms are adopted by Van Aken *et al.* (2006) who use them in the context of business problem solving, but a clear parallel can be drawn to the subject at stake here. Van Aken *et al.* (2006) define *object knowledge* as knowledge on the object of problem solving, like organizations, and they define *process knowledge* as knowledge on approaches and methods used for business problem solving projects. A parallel is drawn for the topic of innovation. In this case, *object knowledge* can be described as knowledge on the objects of the innovation processes, so this may involve the product and the accompanying technologies and materials, markets, customers, production methods and other related areas. On the other hand, there is *process knowledge*, which in the case of innovation involves knowledge on the innovation processes. Both these issues will be regarded in the assessment of the extent to which cooperation in innovation at CIE is present (see Chapter 6.2.2).

5.6 Firm and project success factors in innovation management

A large body of empirical and theoretical research reports on findings about success factors and failure factors in innovation. Van der Panne *et al.* (2003) systematically analyzed 43 of these individual research papers about success factors and failure factors in innovation. Based on that, they created an overview of the factors about which scientists have found agreement on and about the factors about which science is either inconsistent or inconclusive. This resulted in four categories of success: (1) firm related factors and (2) project related factors regarding the technological viability and (3) product related factors and (4) market related factors regarding the commercial viability. The two latter types of factors are less of interest for this thesis, as the product and market related factors are too specific and require a unit of analysis on the project or product level, instead of on the process and business unit level, which this thesis project has. So the factors that are specifically relevant for this thesis are:

- Firm related factors
- Project related factors

These factors are shown in Figure 5-2 on the left hand side.

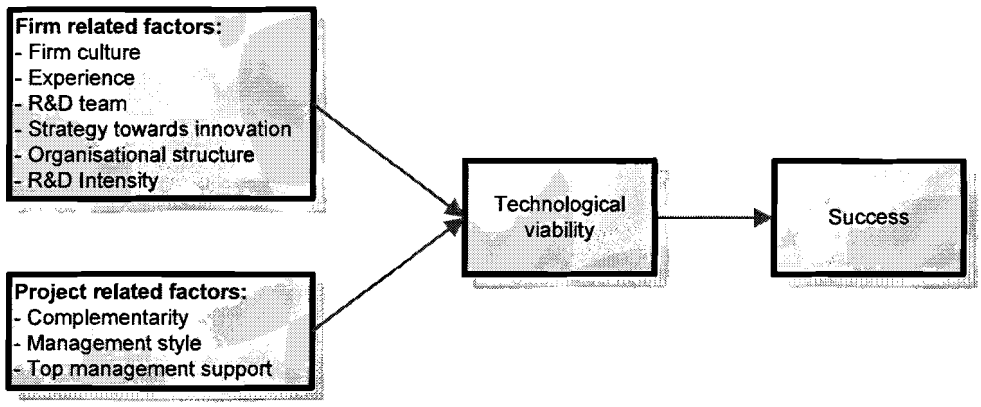

Figure 5-2 Critical firm and project related factors for innovative success (adopted from Van der Panne *et al.* (2003))

The firm related factors that are found to be important by Van der Panne *et al.* (2003) are the following:

- Firm culture
- Experience in innovation
- Characteristics of the R&D team
- Strategy towards innovation

Two firm related factors where no consensus is about are:

- Organizational structure
- R&D intensity

Firm culture refers to a firm-wide recognition that innovation is necessary. Experience in innovation is found key to innovative success, as the organization develops technological and commercial skills, which are on their turn enabling for new innovative engagements. Regarding R&D teams' characteristics, interdisciplinarity and the presence of a product champion is found key. Interdisciplinarity is needed to match the technological developments with the marketing efforts. The presence of an innovation strategy is found key due to several reasons. It aids in giving direction in selecting the skills to develop and the markets to enter; it aids in identification of synergies between projects; and it aids to develop skills in the right areas, as these skills are developed through learning-by doing. Two strategies are identified: re-active and pro-active strategies. Re-active strategies use innovation as a safeguard against competition and pro-active strategies use it to achieve product leadership. One constitution of the pro-active strategies is the portfolio strategy, which involves the simultaneous pursuit of several innovation projects in different stages of development.
The influence of the organizational structure on innovation is under debate in science. There is consensus about the inhibiting result for innovation of a functional structure and consequently the alternative, the organic structure, is unanimously preferred. Differences remain about two types of organic structures: the matrix structure and the venture team structure. The arguments in favor of the venture team structure address its high level of autonomy, facilitating high flexibility and short decision making, all supportive for innovation. The arguments in favor of the matrix structure are the imposed integration of different functionalities and the higher allowance for superior planning techniques.
It is agreed that in general more investments in R&D lead to more innovative output. However, the R&D intensity (R&D investments as a percentage of sales) is subject to debate: there are arguments that this measure is characterized by diminishing returns to scale.

The following two project related factors are found to affect success in innovation:

- Project complementarity
- Management style

And one project related factor is debated in science:

- Top management support

Project complementarity refers to the extent to which a project complements the firm's resources. This means that the projects have high compatibility with the resources of the firm, like skills in management , production, sales, R&D, marketing, distribution, and so on. Additionally, it is often identified that a connection between technological developments and marketing activities is necessary. Theory about organizational learning however provided insights that may indicate not to restrict one's focus in projects on complementarity, when it concerns radical innovation. This is based on the findings of Wong (2004), who found that developing a radical innovation capability also requires *distal learning* (learning from others than the own group), in addition to *local learning* (learning from others within the group) only.
Regarding the factor management style, it is found that adequate management is needed for time, information, costs and decision making. This is mostly done by splitting the project in phases: planning, brainstorming, screening and evaluation, development and market research and introduction. It is

complemented with an identification of and an allocation of team members to tasks and responsibilities. The more the project is executed along this trajectory, the higher the chance for success. This is not only true for incremental innovations, but also for radical innovation projects, because the trajectory reduces uncertainty.
Top management support is a factor under debate. It is found to have high influence on innovative success, but the direction of this influence can be both positive and negative. By having individuals being connected to projects for too long, stiffening can occur. This should be prevented. Conversely, what is needed is long term commitment and a risk tolerance, as learning-by-failing can be advantageous.

5.7 Holding companies

This thesis addresses the CIE Holding, but what actually *is* a holding company and what is the effect of this on the innovation strategy? In order to provide a practical viewpoint that fits business rather than specifically science, a search as been conducted on the internet in non-scientific areas. Some insights about the history of this form of governance were found and several different definitions were provided. Two are filtered out because of their brief comprehensiveness and because they are found a good summary of most definitions. Furthermore some advantages of holding companies are provided.

As the US History Encyclopedia (2006) indicated, the holding has become a popular form of governance since the end of the 19th century, as the economies and businesses were expanding than and accordingly there was a need for new forms of competitive advantage. This advantage was found in risk reduction by grouping together multiple firms by buying their stocks.
According to the Wikipedia website (Wikipedia.org, 2008), a holding company can be explained by the following definition: "*A holding company is a company that owns part, all, or a majority of other companies' outstanding stock. It usually refers to a company which does not produce goods or services itself, rather its only purpose is owning shares of other companies. Holding companies allow the reduction of risk for the owners and can allow the ownership and control of a number of different companies.*"
The Investorwords website (Investorwords.com, 2008) provides an alternative, more brief definition:
"*A company that owns enough voting stock in another firm to control management and operations by influencing or electing its board of directors.*"

So it can be stated that holding companies are owners of other companies. In this sense, holding companies are a specific type of multi-business company. Two important advantages of a holding company are provided by the US History Encyclopedia (2006):

2. The holding organization usually provides the advantage of better access to securities markets than do the operating companies individually, therefore providing better opportunity to secure capital for large scale operations.
3. It offers the option to centralize control for the policies in the different companies, where leaving the control of the operations decentralized.

These definitions and advantages indicate that the span of control of the holding company within the companies it owns is mainly restricted to finance and policy making, although it can affect the operations through these factors.

5.8 Innovation in multinational companies

A literature search was performed in order to find insights into innovation management in holding companies, as CIE is a holding company. No results for this specific topic were found, but a very interesting and closely related body of research was found about innovation management in multinational organizations. These insights are described in this subchapter, together with a reflection on the impact of this knowledge on holding companies.

Scholarly literature has identified innovation as one of the key requirements to ensure continuity of the organization (Bartlett *et al.*, 1990). This is also the case for multinational organizations. Moreover, Bartlett *et al.* (1990, p 216) in their book about managing global firms state that "*scholarly research on international corporations has long identified innovations as the reason d'être of multinationals*". This indicates the importance of good innovation management within a multinational organization.
Innovation management within a multinational company is affected by its state of governance. As stated by Burgelman *et al.* (2004), "*The raison d'être of multi-business firms is based on corporate management's ability to identify and exploit synergies*". As such, the innovation management within a multinational company is also affected by this identification and exploitation of synergies. The implication of this is that it is important to know for the multinational company what business and what innovation related activities are executed where in the organization. Additionally, it is important to be able to make use of this knowledge and accordingly support, accommodate and stimulate cooperation within the organization.

As described by Bartlett et al. (1990), there are four distinctive types of innovation processes that are identifiable in multinational businesses, which can all be important in contributing to the total innovation capacity of the mother organization (also referred to as *concern*). Two of these processes are the more general classical ways of innovation management in multinational companies: *centre-for-global* and *local-to-local*. The other two are hybrid forms in innovation management, described as transnational processes and fall in between the classical types. They are labeled the *locally-leveraged* innovation processes and the *globally-linked* innovation processes. These transnational innovation processes make use of linkages among the units within the organization to leverage resources and capabilities, no matter where they are located, to exploit any idea for an opportunity that is arising in any part of the multinational organization. The four different innovation process types are discussed more elaborate below, together with their pros and cons.

5.8.1 The centre-for-global innovation process

The *centre-for-global* innovation process is the identification of a market opportunity in one home country; using the resources of the parent company for the creation the new product, and exploiting the product worldwide. So this process requires a central R&D- or innovation department. It is a necessary type of innovation process to protect certain core competencies of the mother organization and to achieve economies of both specialization and scale. The centre-for-global innovation process faces the risk of market insensitiveness. This reflects the fact that a centre-for-global innovation process aims to create a product that is generally adaptable to an extent that it can be transferred to as many as possible different local markets that are in the portfolio of the mother organization.

5.8.2 The local-to-local innovation process

The *local-to-local* innovation process is the decentralized process in which the subsidiaries using their own resources in their own innovation processes with which they create innovations in response to the needs within their own environments. This type of innovation process is necessary within a multi-national company because for responsiveness to the local market needs where the subsidiaries operate in. The local-to-local innovation processes face the risk of endless differentiation. Unnecessary differentiation may occur because subsidiaries may want to differentiate themselves to maintain identity and autonomy. It may also increase innovation costs as each single subsidiary is reinventing the wheel in creating solution to problems that are common within the group.

5.8.3 The locally leveraged innovation process

The first transnational innovation process discussed here is the locally leveraged innovation process. This process utilizes locally developed innovations to exploit them world-wide. The advantage of this system

is that the mother company can pick the most creative and valuable resources and innovative developments that have been created locally, in order to let the total company to benefit from them. So in this process, management is able to pick up the responses by certain locations and copy them to lead comparable trends in other locations. This requires an organization wide learning capability of the mother organization. One risk in this process is the so-called not-invented-here syndrome (Katz & Allen, 1983), which refers to the resistance of managers to ideas from others than from their own organization. Another risk is the transfer of ideas that are unsuitable for the environment of the receiving unit. A third impediment is the lack of good mechanisms for coordinating and transfer.

5.8.4 The globally linked innovation process

The globally linked process pools resources and capabilities from different components of the multinational (from both the headquarters level and the subsidiary level) to jointly create and implement the innovation. This approach makes use of unique resources of the subsidiaries to create a collaborative response in response of a globally identified opportunity, by means of flexible linkages between the organizational units with which a combination of their efforts can be made. This can result in synergies that leverage the innovation process of the organization. So this approach is most suited to a situation in which the stimulus for the innovative development is distant from the organization's response capability, or where the capabilities and resources of multiple organizational units may contribute to the development of the most innovative response to an identified opportunity. The limitations of this system are at first a high degree of internal coordination that is potentially expensive and wasteful. Secondly the complexity of the organizational interlinkages may overwhelm an organization because of ambiguity and a very high degree of diffusion of authority.

5.8.5 Three distinctive innovation types in the multinational organization

Bartlett *et al.* (1990) distinguish three distinctive types of innovations based on the distinctive innovation processes: local innovations, central innovations and global innovations. Local innovations are produced by the local-to-local innovation processes, central innovations by the centre-for-global innovation process. Global innovations are produced by the transnational innovation processes, i.e. the locally leveraged innovation process and the globally linked innovation process.

5.8.6 Simultaneously managing the distinctive innovation processes

The management of multinational companies should not focus on one of the four types of innovation processes that are mentioned here, but should distribute attention and resources to manage the four different processes simultaneously, according to Bartlett *et al.* (1990). As such, the roles of the distinctive subsidiaries have to be defined among the set of innovation processes. Bartlett *et al.* (1990) identified three general organizational characteristics that are most helpful in the development of the organizational capability to manage a diverse set of innovation processes, which are:

1. Interdependence of resources and responsibilities among organizational units
2. A set of strong cross-unit integrating devices
3. A pervasive management attitude of strong corporate identification and well-developed world-wide perspectives

The interdependence can be instilled by having each individual subsidiary contribute to the type(s) of innovations it can contribute the most to. So in this way, one subsidiary may play a different role in the total innovation process of the concern than another. The distinctions may be in terms of innovativeness, but also in terms of product type.

The integrating devices that are needed in light of the transnational innovation processes are on the meta-level, so not specifically on the integration within a local-to-local innovation process or the integration of centrally developed innovations to the receiving subsidiaries, but across all the units simultaneously. The

telecommunications company Ericsson served as a case example from which three general pillars for good practice are distilled:

a) *"A clearly defined and tightly controlled set of operating systems,*
b) *A people-linking process employing such devices as temporary assignments and joint teams*
c) *Inter-unit decision forums, particularly decision boards, where views can be exchanged and differences resolved.* " (Bartlett *et al.*, 1990)

The set of operating systems serves to have clarity in responsibilities and expectancies, which supports in delegating different tasks. The people-linking process is done by transferring large numbers of people between the organizational units. The authors mention numbers like 50 – 100 engineers simultaneously transferred for two years. The inter-unit decision forums are facilitated by the national company's board meetings, together with the local boards. In both, divergent interests and objectives of the mother organization and the subsidiaries are exchanged. In this system, also the local board meetings served to coordinate activities, together with channeling the local innovations across divergent national lines.

The last element, the presence of world-wide perspectives, has to be created in order to achieve the right balance between local responsiveness and also global consciousness in the activities. This may be achieved by situating joint teams throughout the organization, as has been successfully done in case examples as with Ericsson.

5.8.7 Managing transnational innovation

The management of the multinational needs to both enhance efficiency and effectiveness of the individual innovation processes, but simultaneously create conditions in which a simultaneous coming about of innovations is allowed through the different processes. This could be done by creating a system in which there is no discrimination between the subsidiaries and accordingly put similar demands on the distinctive subsidiaries. This however may constrain flexibility and imprison the companies to a choice between local or central innovations. More effectiveness may be achieved by the creation of a system in which the unique strengths of the subsidiaries is recognized and leveraged, so a system that is based on differentiation in subsidiary roles, as this system allows for the pursuit of all three innovation types simultaneously without the dilemma to have to choose between them.

Bartlett *et al.* (1990) describe a system to optimally manage these different roles of the subsidiaries. It is based on a multi national organization in which a potentially high degree of centralization and authority by a headquarter is assumed possible, together with the existence of an R&D or innovation department of the headquarters. The system is further based on three required capabilities for the innovation process: sensing, response and implementation. The sensing task is the task of seeking and identifying potentially viable ideas and opportunities for innovations. The sensing task is key in lead markets; markets that are often the front runner from which the environmental characteristics of it are diffused to other markets. The response task is the task of developing the innovation from idea to product. The implementation task is taking up the innovation in the product line and accordingly manufacture and sell the product.

The role subsidiaries can have are addressed based on two dimensions. One dimension is the level of local resources and capabilities and the other is the strategic importance of the local environment. Both dimensions are discussed on a high and a low level in the following section.

In the case when both dimensions are at a high level, the role of the subsidiary is a leading role, in which all three functions are to be conducted as a leader. These leaders may develop many locally leveraged innovations that are diffused among the other subsidiaries. They can also aid centre-for-global innovations in providing insight for the headquarter innovation department on what to do, by exploiting the sensing function.

If such a subsidiary, finding itself in a strategically important environment, has a low level of resources and capabilities, it may mainly serve in the sensing function supporting the global innovation process.

In the case the subsidiary has adequate resources, but finds itself in an environment with a low level of strategic importance, it should be mainly used to supply resources for global tasks instead of local tasks.

In the case of low levels on both dimensions, they should best act as implementers of the innovations developed elsewhere.
It should be noted that these roles should only be applied based on specific product lines, businesses or functions, and especially not on all the activities of the subsidiaries, because in the latter case, the seemingly lower status roles, like the 'implementer role', could have a detrimental effect on motivation of the subsidiaries who have been given this role. Moreover, differentiation is needed in this system, where one subsidiary may play the role of a leader for one product line, but may be an implementer for another product line, and vice versa for other subsidiaries. This creates an optimally leveraged effect on the total assets owned by the organization.

5.8.8 Chapter conclusion

In conclusion about these insights from theory into the management of innovation in multinational companies, it can be said that it involves a unique organizational capability on its own, separate from the innovation management capability of local innovation processes. These insights should be regarded when seeking for an optimal solution in the innovation management in a multinational organization. However, no scientific insights were provided for specifically holding companies. Therefore, in the case of innovation management in holding companies, the restrictions of this specific type of multi-business (or multinational) company should be regarded.

6 Analysis of the existing situation

In order to gain insight into the problem of the suboptimal use of the holding structure regarding innovation, several different data sources were used to gain insight into the innovation performance of the individual Opcos and of cooperative innovation projects. This chapter will first provide insights into the general differences between the Opcos. Secondly, the extent to which holding coordinated innovation, i.e. central innovation and transnational innovation, is present, will be discussed in this chapter. Because these holding innovation processes are hardly present, no real insightful assessment and analysis of it can be provided in this CIE case. Therefore a relatively detailed analysis of the local innovation processes of the Opco's is discussed subsequently, in order to gain insights for the improvement options that are possible in holding innovation. This last subject, the improvement options, will be discussed in the fourth part of this chapter.

6.1 General differences between the Opcos

Although the set of Opcos in CIE shows similarities in terms of product type, there are multiple general differences between them that are discussed in this section, because this affects the potential for synergies that are possible in the group. The following difference categories are discussed:

- Product offering
- Geographical markets
- Size
- Organization structure

The first major difference category is the basic product offering, as discussed in the introduction chapter, on which the portfolio of Opcos include EPS, PUR/PIR, XPS and XPE. The specific knowledge on the base material is fundamentally different, but some similarity is apparent in the potential applications with the products. Therefore, also similarity in the sales methods, marketing and regulations can be present.
The second major difference category are the geographical markets. This results in different specific local market needs the Opcos are dealing with. This inherently includes different building methods, and therefore a difference exists in the applications that are demanded by the markets the Opcos serve. A third major factor of difference in the group is the size of the companies, ranging from 100 to 300 employees. This causes differences in the availability of human resources for all the organizational processes that need to be done, including innovation activities. A final difference category is the organizational structure of the companies. Some Opcos consist of one unit in which every organizational process is included. Other Opcos are consist of multiple business units on their own.
These general differences are taken into account in assessing the options for the organization of innovation from the holding level and the potential synergies for innovation.

6.2 Holding innovation processes

In light of the problem definition, i.e. the suboptimal use of the holding structure in regard of innovation, the existing situation is analyzed as a starting point for potential solutions. The 'existing situation', as it is referred to here, is measured at the beginning of the CIE DIP function, i.e. April - July 2008. It should be noted that the validity of the measurements and findings is limited due to a low intensity of contact with the representatives of the Opcos, however the findings have been presented and discussed at a CIE-Innovation Meeting with the group MD's and NPD-staff and the findings were generally accepted there. The findings therefore are valuable for gaining insight into the current situation and as a basis for a solution.
When the cooperation in product innovation is regarded in general at CIE, this is generally identified as an area where large gains can be made by both the holding team as well as the Opco representatives. Below some insights into the existence and constitution of the potential holding level innovation

6.2.2.3 Opco posture towards transnational innovation

During the interviews with the MD's and the NPD representatives and also during the Innovation Meeting the plans for the development of more synergetic holding coordinated innovation were discussed. During the interviews, mainly the MD's and the NPD representatives showed enthusiasm for improvement in innovation by the CIE holding team. Some indicated that they would like to see fundamental technological issues to be developed by the holding. It was not revealed whether these reportings meant that they would like to see others within the holding do this (e.g. via a central innovation process) or whether they were willing to put a lot of effort in this themselves (e.g. via transnational innovation processes).
However, next to this, there were also two Opco's, namely both the business development manager and the MD of Opco H and the MD of Opco G, who showed some hesitations, next to the fact that they indicated to be enthusiastic towards a more professional approach of innovation by the holding. The reportings from Opco H, considered a front runner in innovation management (see Appendix XVII), were that they had the feeling to be putting more effort into other Opcos' product development processes than they are getting in return. It appeared during the Innovation meeting that the MD of Opco G was not very enthusiastic for putting a lot of effort into holding based innovation, because the demands for resources from its local innovation processes were large, just as the potential gains that could already be generated on that level were also large.
However, in general the mindset of the representatives at the Innovation Meeting was quite good in favor of putting effort in holding coordinated (transnational) innovation projects.

So the conclusion of this subchapter is that there is no existing coordination in transnational innovation. The support by the Opcos for the development of a transnational innovation process is generally positive, however the motivation to deliver resources for these innovation projects is an important element that should be considered when a new innovation processes are developed. Currently there is a basic setup in the field of portfolio management in the form of SBGs, but this system has evolved in a way that the synergetic uses of this system are limited.

6.2.3 CIE uncoordinated transnational innovation

Although there was no formal approach from the holding level to systematic transnational innovation, there are some examples of cooperation present in CIE, which could be considered a form of holding-uncoordinated transnational innovation.
Let's first address the extent to which cooperation and synergy is exploited in terms of *object knowledge* (about projects, products, technology, applications) at CIE. One example is Opco I which is in relatively close reach of the innovative developments processed in Opco H and therefore sometimes adopts some of the innovations that seem to fit its local market needs. Another example is a specific product line from Opco H is transferred to Opco E in the UK.
Furthermore, there are a few examples of Opcos that are involved in projects in cooperation with several CRH subsidiaries from other CRH divisions than CIE. These cooperations are based on end user market similarities; for example Opco A and Opco H are cooperating with some other CRH subsidiaries in their own countries.
Several interviewees indicated that they do have inter-CIE networks with the NPD representatives of other Opcos, which they mainly utilize for knowledge exchange on technical issues. This indicates that there is an informal network, but this cannot be labeled as real cooperative innovation projects, as the involvement is on a low frequency of several times a year and only informally.

Now the coordination and synergy in terms of innovation *process knowledge* is regarded. This refers to the extent to which Opco NPD personnel learns from the innovation practices of other Opcos. This type of learning is not identified to be present, so also in these terms potential improvements can be made.

processes, i.e. the central and the transnational innovation processes, within CIE is provided. Also the extent to which cooperation is present between the Opcos is discussed, followed by the insights into the willngness for improvement.

6.2.1 No central innovation process

CIE has no central innovation process. The central innovation process, as described in Chapter 5.8, is an innovation process where there is an innovation department working on centrally developed innovations in the headquarters, in order to feed the Opcos with these central innovations. The lack of this process however is a logical result of the fact that we are dealing with a holding company as opposed to a more integrated multinational enterprise type where the degree of integration between the different business units is usually historically higher. In such an integrated multinational business, a central innovation department can operate as a distinctive business unit that is funded with the sales returns from other business units. In the CIE holding each business unit (Opco) has historically consisted of operations including production and sales as they were autonomous companies generating their own sales.

6.2.2 No CIE coordinated transnational innovation process

No structural approach for transnational innovation activity was present at the holding level, so no form of a *locally-leveraged* innovation process or a *globally-linked* innovation process. This means that the innovation activities that were deployed till the moment of analysis, were initiated from the Opcos (as will be discussed in Chapter 6.2.3), therefore lacking assessment from the holding strategic scope. Still, the projects were executed under holding accepted budgets or investment plans.

6.2.2.1 Earlier coordination initiatives

Three respondents referred to a preceding initiative, an EPS innovation group, several years ago to improve product development on a group-wide basis. This initiative failed because there was not the right culture and also too much local autonomy. So this should be prevented when designing a solution.

6.2.2.2 Portfolio management

Although innovation was not explicitly coordinated at the moment of the analysis, a basis for a group-wide portfolio overview had been developed at CIE in the latest strategy. It was based on so-called "Strategic Business Groups", or in abbreviation SBGs. SBGs are strategic focus areas of an Opco, expressed in terms of products and routes-to-markets or customer groups. It shows similarities with the commonly known classification in product-market combinations (PMCs), often used in marketing (Mohr *et al.*, 2005). This SBG categorization has two major purposes:

- Strategic analysis and planning
- Financial analysis and budgeting

And it can also serve the following synergetic utilizations:

- Portfolio analysis and improvement
- Channeled information exchange
- Innovation focus areas

For as far as insights were developed in this project, the application of the SBG system can be labeled successful for its main purposes, the strategic analysis and financial analysis, because these are currently done based on this system. However, the SBG system appeared to be not successful for the synergetic purposes, because the formation of SBGs as it is done currently by the Opcos, is too diverse to analyze the overview on a group-level. So regardless of what guidance has been given in the implementation of the SBG system, its final way of use has become too scattered and diverse.

6.2.4 Subchapter conclusion

CIE logically historically lacks a central innovation department, i.e. – process, because the CIE holding setup demands every business unit to generate its own sales. Transnational innovation processes neither do exist in CIE. Still, there are examples of cooperative innovation projects that are coordinated by the Opcos and not by the holding. The posture towards the professionalization, i.e. more sophisticated holding coordinated innovation, is generally positive by the stakeholders from the Opcos, who will have to deliver the resources for these projects. However, the motivation to actually deliver these resources may be a factor that has potential to become a barrier and therefore its presence should be kept in mind when assessing the success of new developments.

6.3 Local product innovation processes

Because there were no holding coordinated innovation processes to be studied for the development of the to-be designed holding innovation process, the local innovation processes of the Opco's were studied. This was done in order to assess the potential for improvement of these individual local Opco innovation processes, but also to gain insights into the areas where any new holding innovation process could add the most value. An extensive analysis was performed on the local innovation processes that provided relatively detailed insights into the individual innovation processes of the Opcos, mainly based on the innovation success factors as provided in literature (see Chapter 5.6). This analysis is provided in Appendix XVII. This subchapter only discusses the main conclusions broadly, in order to report the most important findings.

The first important finding is that the amount of resources that is formally available for innovation is only 10.5 FTE on a total of 1400 FTE, which shows low potential for a well supplied innovation process.

Also all, except for one, Opco MDs reported to be dissatisfied with the innovation performance of their Opcos.

The most important finding is that explorative innovation is only pursued to a low extent by the Opcos. There are some examples of explorative innovation, but mainly the innovation efforts are led by the yearly return-focus, together with the lack of cooperative innovation projects. Therefore mainly exploitative innovations are produced by the Opcos.

The culture of the Opcos is also mainly production oriented as opposed to innovation oriented. All three are indicators of low innovativeness in general.

This may be partly due to a lacking use of the financial performance measures of the innovation processes by the Opcos. Less than half is measuring the investments in innovation and also less than half of the group has a budget defined for innovation. The use of the Vitality Index is done by slightly more than half, but problems are reported with it. This Vitality Index is the percentage of total sales that comes from new products, in which *new* refers to products introduced in the last 3 years. While it was expected to be able to analyze the actual scores on the Vitality Index, it appeared that the Vitality Index was not even used by every Opco. Also, the reliability of the numbers appeared to be questionable, because of unclarity on issues like the question 'what is new' in regard of new products, different methods to report sales, variety in reporting a general Vitality index or a Vitality index for every SBG. Moreover, the current utilization of the Vitality Index needs improvement.

Another important insight was the fact that only one Opco was really applying a formal structure for innovation, i.e. a Stage Gate. Two others are using a structured approach of innovation meetings. This is an indicator of large potential improvements.

The issue of ambidexterity was also assessed. This appeared to be a factor on which the Opcos scored well, as their ambidexterity scores were pretty well balanced. This indicates that the focus of the Opcos on exploitation relative to exploration appears to be balanced.

Finally, the number of patents present at the Opcos was assessed. This revealed a difference between a number of one an thirteen patents that were present in the Opcos.

6.4 Conclusion and improvement options

The overview of the innovation activities within CIE shows that it can mainly be described as an innovation system exclusively consisting of eight individual *local-to-local* innovation management processes, in which mainly the individual Opcos produce new products for their own local market needs. These are mainly exploitative innovations. The performance of the local innovation processes differs between the Opcos, but all the individual Opco innovation processes can be improved. This improvement however is part of a development area captured by CIE DIP that this project is not focusing on, as it has the main focus on the development of holding innovation at CIE. Improvements on the process side of the innovation processes are already planned by means of the use of the best practice method, in which best practices in the local innovation processes are identified and transferred to the other Opcos.
On the part of the holding innovation processes very large improvements may be instilled, because no such processes exist yet. Some insights were gained in the analysis that should be regarded when thinking about improvements, as will be done next. The potential improvement options are the creation of a central innovation process, a transnational innovation process, and on top of that a management system for the total system of the local innovation processes together with the holding innovation processes.

6.4.1 Central innovation process

At first, the extent to which a central innovation process is applicable in CIE is considered. The development of such a process would mean that a new innovation department should be constituted at the headquarters or at another location. The gains of such a system are that more synergy could be created with ideas that are applicable to more than one local market. This would potentially be very supporting in the organization of CIE, also because in that case more explorative innovations could be produced by this new organizational unit. With the aid of this, innovative developments of new technologies and maybe even innovations that are already elaborated up to complete applications could be transferred to the Opcos that serve a local market that may potentially be viable for market success of the new innovation.
Three options are available for the creation of such a central innovation process

1. The reorganization of an existing organizational unit present in CIE;
2. The development of a completely new organizational unit;
3. The utilization of external capacity for central innovation projects

The first option would however be unrealistic, as the current resources for innovation at the local innovation processes are already at such a low grade that they cannot be reorganized into a central innovation department for the total group, because in that case the innovation department of the sourcing Opco would be totally removed.

The second option however may be taken into consideration. The development of such a process can be assessed with the aid of an overview of its advantages and disadvantages, mainly adopted from Van der Panne *et al.* (2003) and also by logical reasoning based on the CIE case. The advantages of such a central innovation department for CIE are:

- Good controllability of the strategic areas where the innovative developments are done in, in order to protect core competencies of the holding;
- Optimal stimulation of creativity, cooperation and knowledge transfer between the individuals working on the central projects, because of their close proximity[2];
- Optimal creation of economies of scale and scope by developing innovations for as many as possible different local markets at once;
- Optimal setup for securing funds for expensive long-term explorative innovation projects.

[2] Allen (1979) theorized in the field of knowledge management that the closer people are working to each other, the better they can cooperate in terms of creativity stimulation. This is due to the fact that they have easy access to each other and therefore have more trust and more knowledge transfer between each other.

The disadvantages of such a central innovation department for CIE are the following:

- The main disadvantage is that such a system demands the largest changes by the total CIE holding in comparison with the existing situation. Moreover, a completely new business unit should be developed, with consequently a need for a complete body of personnel and facilities, together with management and on top of that a need for integration systems with the existing local innovation processes. The development of this organizational unit would therefore require an extreme lot of funding and also time, because the startup process and subsequently the integration process would take a tremendous lot of time;
- This central innovation process deviates from the holding principle currently advocated by CIE; each subsidiary should be self-sustaining, and therefore generate its own sales to perform on a yearly basis. Such a central innovation process could not adhere to this principle as it lacks a production and sales function;
- There is a risk of market insensitiveness, because it aims to create generalizable innovations, which are therefore less customized to local market demands.

The third option for the creation of a central innovation process, the utilization of external resources for central innovation projects, is a more realistic option. This is an option that could firstly be coordinated by CIE DIP only and the resources can be bought in in a customized way. The advantages of this system would be the following:

- Theoretically unlimited resources, as far as they are able to be recognized and found by CIE;
- Funding is only needed on a customized basis, therefore missing out on fixed costs that are extremely high for the development of an own department;
- As more coordination is required from the CIE DIP central innovation role, a low amount of assisting personnel could be hired for this on the holding level.

The disadvantages of such a system are the following:

- Lower extent of learning by CIE, as the tacit knowledge, which is an important element in learning in innovation[3], remains external to the organization
- Lower controllability of the activities, as sometimes the creative processes cannot be explicitly controlled by means of specific assignments with the external party delivering the resources for the innovation activity

Moreover, the creation of a central innovation process for CIE would best be done by hiring external parties for the execution of the fundamental innovation activities in addition to the locally available resources for this. This option would result in more explorative innovation and is the closest to the existing situation.

6.4.2 Transnational innovation processes

The extent to which the creation of a transnational innovation process is viable is considered in this chapter. Recoup from Chapter 5.8 that the different types of transnational innovation processes are the locally leveraged innovation process and the globally linked innovation process.

The locally leveraged innovation process is a very suitable fashion that can be applied to the CIE situation. This process is the utilization of locally developed innovations to exploit them world-wide, coordinated from the holding level. So this means that innovations that are fully developed at one Opco are copied to other Opcos. The one advantage of this system is the following:

- More synergy is created from the existing innovation processes;

[3] Polanyi (1966) and Hansen et al. (1999) indicated that tacit knowledge, the type of knowledge that cannot be made explicit and is therefore very hard to transfer, is very important for developing good practice in innovation

- This process could be installed without an extremely increased demand for more resources for the coordination at the holding level.

As indicated in Chapter 5.8.3, the potential impediments are the following:

- The not-invented-here syndrome could be a barrier to adoption of innovation projects;
- There is a potential for the transfer of ideas that are unsuitable for the receiving environment;
- Lacking mechanisms for the transfer and the coordination.

So when such a process is designed at CIE, these potential impediments should be considered and prevented in the design. When this is done, an increased synergy in the innovation activity in the group will be created without huge investment costs of any new department.

The globally linked innovation process pools resources and capabilities from different Opcos to jointly create and implement the new innovation in as many Opcos as possible. This is another very suitable improvement option, because it is also designable without the creation of a new department. The advantages of such a process are:

- Synergetic use of the dispersed resources available within the different Opcos, without removing them completely (only part time) from the local innovation process they reside in;
- It fits the CIE case, where the stimuli for innovative developments are sometimes in different locations as where the response capability resides;
- It is suitable to create the most innovative responses to identified opportunities, as the most suitable and innovative resources can be pooled together for specific types of projects.

The impediments of this system may be:

- A high degree of internal coordination may be required, which is potentially expensive;
- The complexity of the organizational interlinkages may be overwhelming, because of ambiguity and high degrees of authority

So when a globally linked innovation process is created, the impediments should be prevented in the design. When the system is designed properly and effectively, increased innovativeness and economies of scale and scope may be created in innovation.

6.4.3 Improved coordination

If the above central innovation process and the transnational innovation processes are designed and implemented, they can only work effectively if they are managed properly from the holding level. This may require a series of actions and systems, like for example a system of formal roles and responsibilities for the holding innovation processes, together with a clear and formal meeting and communication structure. At first, an improvement of the suboptimal portfolio overview system, the SBG system, may be required.

6.4.4 Demands on the local innovation processes

In order to facilitate the holding innovation processes, as they are described in the preceding three subchapters, there will be a strong need for strong facilitation of resources by the local innovation processes. In order to make this happen, there is a need to improve these local innovation processes in terms of the lacking resources, the lacking formal structure and the lacking performance measurement.

The lacking resources, i.e. the currently low amount of human resources formally allocated to innovation, can be an impediment when they are demanded by the holding innovation processes. Therefore the Opcos should be stimulated in order to either shift its total body of human resources in tasks from fire fighting and production towards more innovation or attract and employ more personnel for innovation.

The lacking formal structure that is present in the current innovation processes can be an impediment in two ways. At first, it instills the development of local innovations and therefore there are fewer innovations that may be leveraged to other Opcos via the locally leveraged innovation process. Secondly, the lacking structure in the local innovation processes may be impeding for the coordination of specific activities that are needed for either the transnational innovation processes.

The lacking performance measurement in the local innovation processes currently is impeding in the improvement of the local innovation processes, as the improvements are less visible and therefore the need for improvement may be less present. Therefore this is also an instilling factor for the success of any transnational innovation process, as they are interdependent on each other.

6.4.5 Conclusion

The improvement options for both the holding innovation processes and the local innovation processes are needed in order to improve the total innovation performance of CIE. Therefore, the design in the following Chapter will focus on the required improvements that were identified in this chapter.

7 Design

As described in Chapter 6, the existing innovative performance of CIE is unsatisfactory and as part of that problem, CIE is making suboptimal use of the holding structure in regard of innovation. That situation needs to be improved and accordingly the design that should embody this improvement is described in this chapter. The CIE case would actually need an extremely extensive set of large improvements in order to reach the desired situation. This was not possible within the timeframe of this project and it was also not as critical that it had to be finished within one or two years. It was therefore chosen to support CIE with this design in a somewhat broader way, instead of on one area only. The design consists of four parts: A CIE Innovation Process, A Product and Project Classification system,a new set of KPI's and a rewarding system. These parts will be explained in terms of the desired situation and the elements of that larger part that have been constituted in this project.

7.1 Specifications and goal

Before the solution design parts are presented, first the specifications with which they have to comply are presented. By means of these requirements, the solution can be evaluated afterwards. Four types of specifications are discussed, as they are provided by Van Aken *et al.* (2006):

- Functional requirements
  - The realization of the solution should solve the problem
  - The benefits of the solution should outweigh its investment costs
- User requirements
  - The people working in the business system should have the competences to work with the new system
  - The new system should be user friendly
- Boundary conditions
  - The system should comply with legal, health and safety requirements
  - The system should comply with the existing business policies, for as far these are not changed with the design
  - The should fit with the current culture in the company
- Design restrictions
  - The project should take no more than 7 months
  - The level of organizational change constituted with the solution should fit the level of influence of CIE DIP

Together with these specifications, the following goal has been defined for the final design:

> *Goal*: Improving the future product innovation capability of CIE by means of better utilization of the holding structure for innovation and improved local Opco innovation processes.

More specifically, this goal should be achieved by a complete and working system as it will be presented in this solution design.

7.2 Design Part A: The CIE Innovation Process

Part A of this solution design of this project is '**The CIE Innovation Process**'. It can broadly be described by 'a holding coordinated innovation process', which will be explained below. It is a hybrid form of three innovation processes: the *central* innovation process, the *locally-leveraged* innovation process and the *globally-linked* innovation process, as described by Bartlett *et al.*(2006). As described before, the central innovation process exists of a headquartered innovation department, however this is not the case in this design. Morever, the 'central' element of the process means that more external resources could be allocated, coordinated by CIE. The locally leveraged process utilizes locally developed innovations at the Opcos to exploit them group-wide. The globally linked process pools resources and capabilities from different components of CIE to jointly create and implement the innovation. This last approach makes use of unique resources of the subsidiaries to create a collaborative response in response of a globally identified opportunity. The hybrid form of the CIE Innovation Process is based on the *locally-leveraged* system, with coordination from the CIE DIP and with the option to transfer a project to the *globally linked* system and additional allocation of external resources, centrally coordinated. This will be further explained in Chapter 7.2.1.

The definition of an innovation process from Chapter 5.1 is readdressed for additional explanation: "*The combined activities leading to new, marketable products and services and/or new production and delivery systems*". Three remarks should be made for the right interpretation of this definition in the case of the CIE Innovation Process.

First, the formal definition of an innovation process as provided here may be interpreted as *a complete set of* activities needed for the creation of new products, services, production- or delivery systems. In the case of the CIE innovation process, the definition should be seen somewhat less extensive, namely the CIE innovation process may also embody only a part of this total set of activities. That may be the case when the development is stopped at CIE level and the remaining activities are conducted at the Opco level. This will be further explained in Chapter 7.2.2.

Second, the CIE innovation process is a *product* innovation process, which means that the primary aim of this process is to facilitate product development projects. Next to products, it may also result in the development of new technologies that can be utilized for creating products that are fitted to the local market needs of the Opcos. The creation of new services, production systems or new delivery systems is however not excluded by this focus and may be an indirect result of new product developments of the newly created CIE innovation process, because some radically new products may even require totally new ventures to be developed, when they are too distinctive to be adopted within one of the existing ventures. The reason for the focus of the CIE Innovation Process on products and technologies, is the fact that the core business of the Opcos is manufacturing and secondly the generalizability of these to multiple Opcos.

Third, the CIE Innovation Process, in its finished constitution, will make use of a Stage-Gate system in order to ensure that the right activities for projects are outlined. However, the exact formation of these stages is not done in this thesis yet and will have to be done in a later stage of the developments.

7.2.1 Coordination of the distinctive processes

As explained in Chapter 7.2, the CIE Innovation Process is in first instance based on the locally-leveraged system. This will be the case when projects are developed as local projects and afterwards transferred to other Opcos. It could also operate as a globally-linked system if it appears necessary to stimulate an innovation project. This means that in principle, the innovation projects remain to be produced by the individual Opcos, in isolation or in cooperation, like they have been done in the existing system. If an idea, a potential project, appears to have high potential in terms of value for more than one single Opco, and if that Opco (or the cooperative multiple Opcos together) cannot provide the resources on its (their) own, the project may be candidate to be adopted in the CIE innovation process. The project however should also be of strategic importance to the CIE holding to be adopted.

This scattered system of innovation processes requires coordination from the holding level, in order to manage the different innovation processes that are present within CIE. Therefore, at first, three types of innovation projects can be distinguished within the group with the above qualifications: Opco Innovation Projects (within local innovation processes), Multiple Opco Innovation Projects (produced by uncoordinated transnational innovation processes) and CIE Innovation Projects (produced by a coordinated transnational innovation process and a central innovation process). A more formal classification of the three types is provided below with the distinctive characteristics of each project type:

1. Opco Project
    - Primarily of strategic interest to the Opco and its own market
    - Opco has sufficient resources (FTE, budget, time) to deal with the project on its own
2. Multiple Opco Project
    - Of strategic importance to more than one Opco
    - Involved Opcos can provide sufficient resources to deal with the project
3. CIE Project
    - Of strategic importance to CIE
    - The outcome of the project has value for more than one Opco
    - The required resources exceed Opcos capabilities

So there are three factors that distinguish these three project types: the extent to which the project is of strategic importance to CIE; the extent to which the project has value for more than one Opco; and the extent to which the Opco can provide the resources to deal with the project on its own. Accordingly, the classification of the project can be done based on these elements and this is displayed in Figure 7-1. The result of a classification is twofold. It has implications for the source of the funding of the project, i.e. on which specific profit and loss overview the project is ascribed, and it also has implications for the coordination in decision making for the project. But if a project, which is executed by one Opco, is labeled a CIE Project because of its strategic importance, and it is managed in a way that its end product can be applied in a synergetic way throughout the group, CIE DIP will have a minimal involvement. This involvement will in that case be limited to frequent updating of its progress, and transfer it via a locally-leveraged innovation process. In line with this, the project classification does not state anything about the location where the activities are executed, because the locations will almost always be the Opcos themselves.

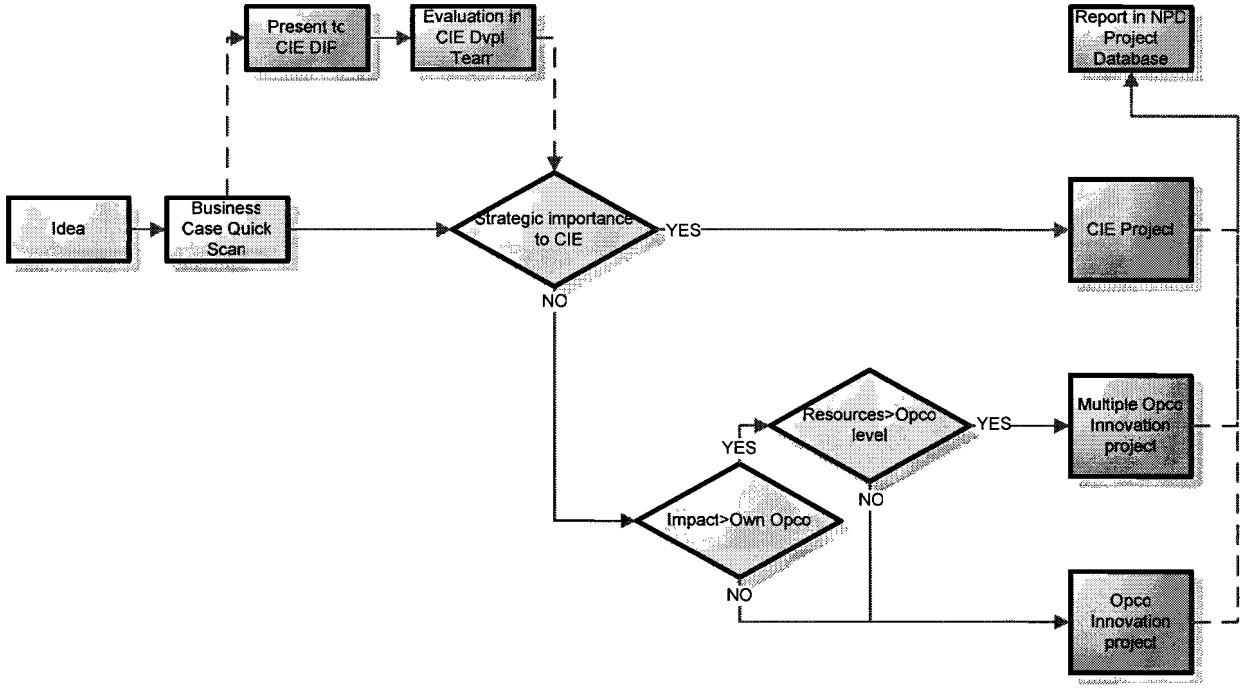

Figure 7-1 Classification scheme for innovation projects at CIE

The classification process as depicted in Figure 7-1 requires some additional explanation. It starts with an idea, which is exposed to a business quick scan where the technological potential and the market potential is assessed, together with the strategic fit with both the Opco and CIE. This strategic assessment is done by a presentation of the idea by its source or the project leader to CIE DIP. CIE DIP evaluates the idea in the CIE Development Team (see Chapter 7.2.4) according to the strategic importance to CIE and in order to build ground in the Opcos where the project can land when the project is adopted in the CIE Innovation Process. This decision is made first, and it is followed by the assessments of the impact size and the extent to which the resources can be provided by the Opco respectively. Based on these three assessments, the classification is made. This order of decision making is applied because the impact of the decision criterion will have respectively smaller consequences for the extent to which any coordination by the holding is required. If a classification is done, it is reported in the group-wide NPD Project Database, that will be described in Chapter 7.3, in order to ensure coordination of the different innovation processes.

7.2.2 Representation of the CIE Innovation Process

This subchapter presents the graphical model in which the new CIE Innovation Process is depicted in relation to the existing innovation processes. The distinctive processes are discussed together with the synergies in innovation projects that are possible in the CIE setting.

The figures in this chapter (see Figure 7-2, Figure 7-3 and Figure 7-4) display the innovation process as a funnel, which is the most common way to depict an innovation process in science currently, based on the work of Wheelwright and Clark (1993). This work describes the innovation process as a composition of a number of stages, followed by gates that filter out the innovation projects that fit the requirements of the company. In this way, the number of projects in each follow-up stage becomes smaller as we move forward in the innovation process, therefore it is displayed in a funnel shape. The output from this innovation process can be thought of in terms of innovation projects, as displayed with the arrows. The current and future (blue boxes in Figure 7-2, Figure 7-3 and Figure 7-4) businesses of the Opco are displayed as several categories of PMC/SBGs in a PMC/SBG Palette, from which returns are made.

PMC/SBG refers to Product Market Combination / Strategic Business Group, which is a combination of two classification systems for the business of a company. The theoretically displayed Opco business consists of five different PMC/SBGs in order to display a clear difference in PMC/SBGs that are supplied with innovation ouput as opposed to the ones who are not. The returns are displayed in terms of money on the right hand side of the picture, over a two-year time horizon. When a specific PMC/SBG is not supplied with any output from the innovation process, this is displayed with declining returns for that PMC/SBG. That is based on commonly used innovation literatures stating that innovation is prerequisite to sustained business and organizational continuity. As such, the monetary returns over time from the PMC/SBGs that are supplied with innovation show continuity. The graphical representation of the monetary returns from a newly created PMC/SBG shows that these returns start off small and rapidly increase, up to large returns in the second year after launch. This shows the big potentials of new business or new markets that are addressed with innovations. The representations that are depicted and described here are theoretical models, hence do not exactly reflect the existing situations.

The first innovation output of an Opco, e.g. Opco A in Figure 7-2, that can be regarded is the innovation output directed to the existing PMC/SBG Palette. This improvement is displayed as the arrow in Figure 7-2, which is innovation output 1, directed towards PMC/SBG A2. The result of this increased innovation activity is displayed as the continued returns in the subsequent years in PMC/SBG A2.
A second distinctive innovation output from the Opco innovation process is the creation of a new PMC/SBG, as displayed in Figure 7-2 with innovation output 2. As shown, the returns that result from this new business start off rather small, but increase as this new product is adopted increasingly in this new and expanding market.

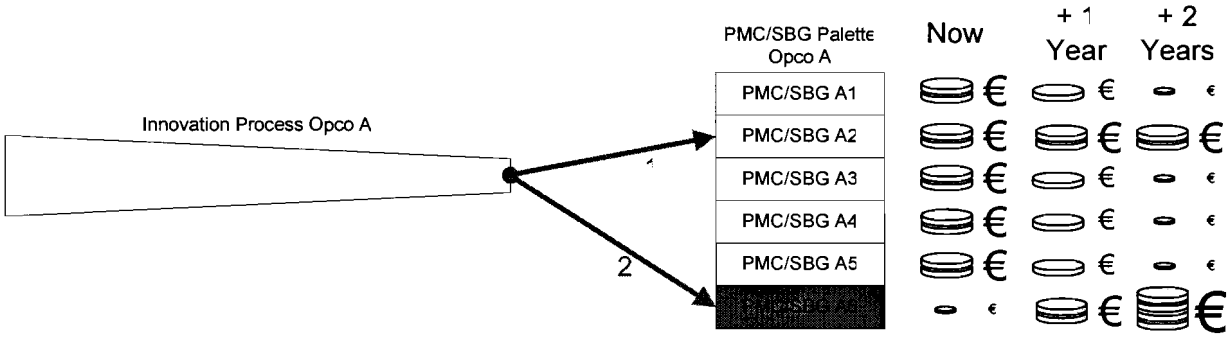

Figure 7-2 Innovation model of a single Opco

The discussed innovation outputs were limited to the perspective of one single Opco on its own. However, the CIE Holding is constituted of multiple Opcos that operate in parallel to each other, which provides an additional set of potential innovation synergies by means of the transnational innovation process. For this synergy, the transnational innovation process is designed for CIE.

One synergy in a multiple Opco setting is the transfer of an existing product from the PMC/SBG of one Opco to the PMC/SBG palette of another Opco, as depicted with innovation output 3 in Figure 7-3. This is the locally leveraged innovation process. This representation does not lead the project through any innovation process, however it can be labeled as innovation, because it will almost certainly involve some finetuning for adaptation to the local legislation and building methods and also because from the perspective of the receiving Opco it is a new product. Although only depicted in a single way, this scenario is possible in two alternatives. The first alternative is the transfer of a product offering from an existing PMC/SBG of an Opco to the existing PMC/SBG of another Opco, as shown. The second

alternative is that this product offering transfer creates a new PMC/SBG in the PMC/SBG palette of the receiving Opco.
The design of this locally leveraged innovation process will have to deal with the potential impediments in the following ways:

- The not-invented-here syndrome should be prevented by promoting the advantages for the receiving Opco;
- Before a project is transferred to another Opco pallette, the suitability should be assessed;
- Enough time and resources should be given, accompanied with explicit goals, in the transfer process of the project.

Another potential innovation synergy possible in the multiple Opco perspective is the cooperation of two Opcos in one innovation project that supplies the PMC/SBG palette of these Opcos (i.e. a globally linked innovation process). This is displayed with innovation output 4 in Figure 7-3. In this case, the project supplies the existing PMC/SBG Palette of Opco A and creates a new market for Opco B, but several other versions can be thought of, like the supply of only the existing PMC/SBG Palettes for both Opcos, or the addition of a third party in this cooperative innovation project.
Innovation output 5 depicts a closely related version of innovation output 4, but is explained explicitly, because its existence is not directly intuitive to one of the cooperating parties. Moreover, this is a cooperative innovation project that led to the supply of only one of the involved parties' PMC/SBG Palette. From the group perspective however, this can lead to increased returns, which indirectly is advantageous for the second involved party that was not directly supplied with the output of this innovation project.
The design of the globally linked innovation process should deal with the potential impediments in the following way:

- Internal coordination should be done by means of a structured and simple meeting structure with the stakeholders of a specific project, keeping the coordination costs as low as possible;
- At forehand, roles and responsibilities for the tasks of the project should be identified and allocated in a structured way in order to keep the ambiguity as low as possible during the project.

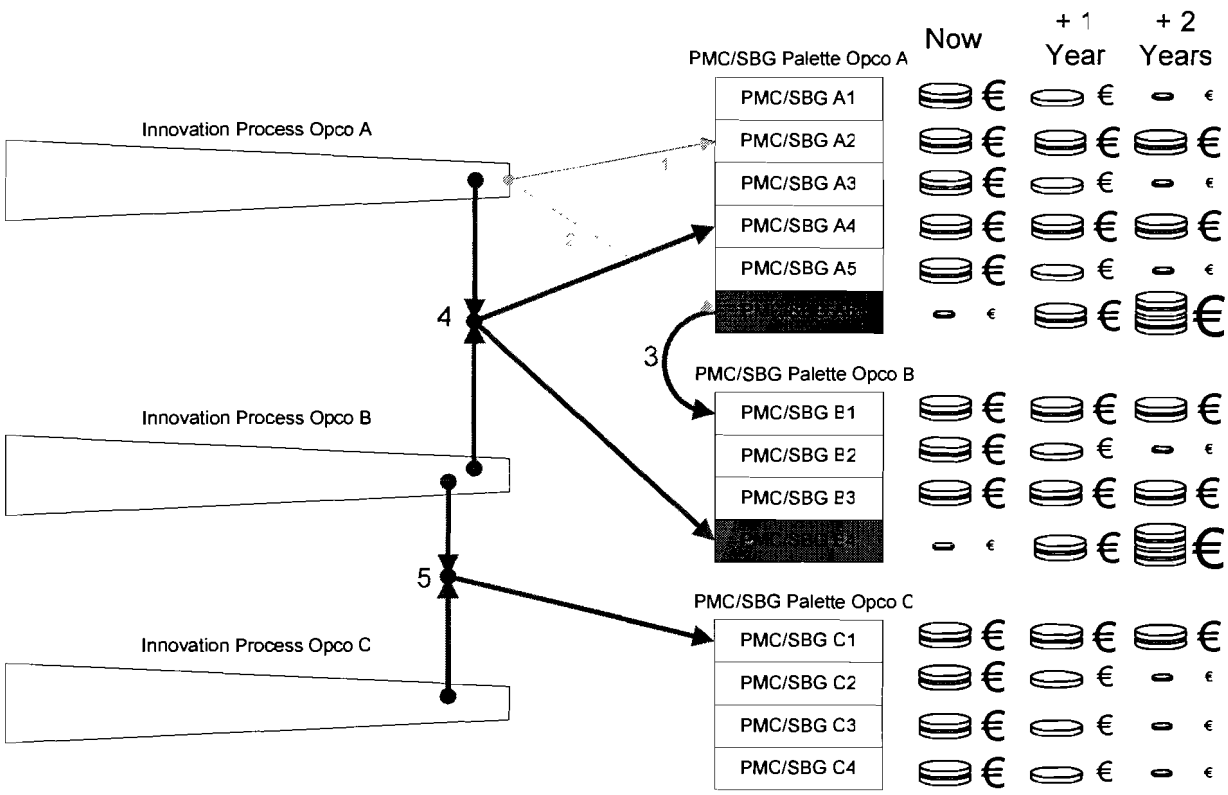

Figure 7-3 Innovation model of multiple Opcos

The final element that is designed here is the more centrally coordinated innovation process labeled 'The CIE Innovation Process'. This process potentially adds far more synergy to the group. One example of a new synergy is the development of a project within the CIE Innovation Process up to a level at which it is not readily adopted yet within the Opcos business, but needs to be fine tuned within this Opcos own innovation process. It is shown with innovation project 6 in Figure 7-4, that could for example be the development of a new technology that is developed up to a level that it can be transferred to the Opcos, where the innovation processes of the Opcos facilitate further development up to a complete product. The two phases of this project could be distinguished as a research phase and a development phase.

Another example of a synergy from the CIE Innovation Process is innovation project 7 in Figure 7-4. This is a similar synergy as in the multiple opco setting, namely the innovation output supplying the existing PMC/SBG Palette of an Opco, which in this case is Opco C. This indicates that CIE innovation projects not necessarily always have to result in the creation of a new PMC/SBG , which probably will be a more common alternative synergy than innovation project 7. This CIE innovation project may supply existing business when the new products appear to fit within this business.

The last discussed alternative is the synergy that will probably be given the highest increased probability of occurrence with the creation of a CIE Innovation Process. That synergy is the innovation project leading to the creation of a new business unit, i.e. a new Opco. This is displayed with innovation project 8 in Figure 7-4. The reason that this type of synergy has been given the highest increase in probability of occurrence, is the fact that a project leading to the creation of a new business apparently deviated so much from the existing business of the Opcos that the CIE Innovation Process was chosen as the development process for the project. The chance to develop such a project that deviates this much from the existing

business of the Opcos, would be very low from within the innovation processes of the Opcos, as it would stand high chance to be filtered out due to strategic misfit, lacking competences, or lacking resources for example. Specifically these barriers are decreased with the addition of the CIE Innovation Process.

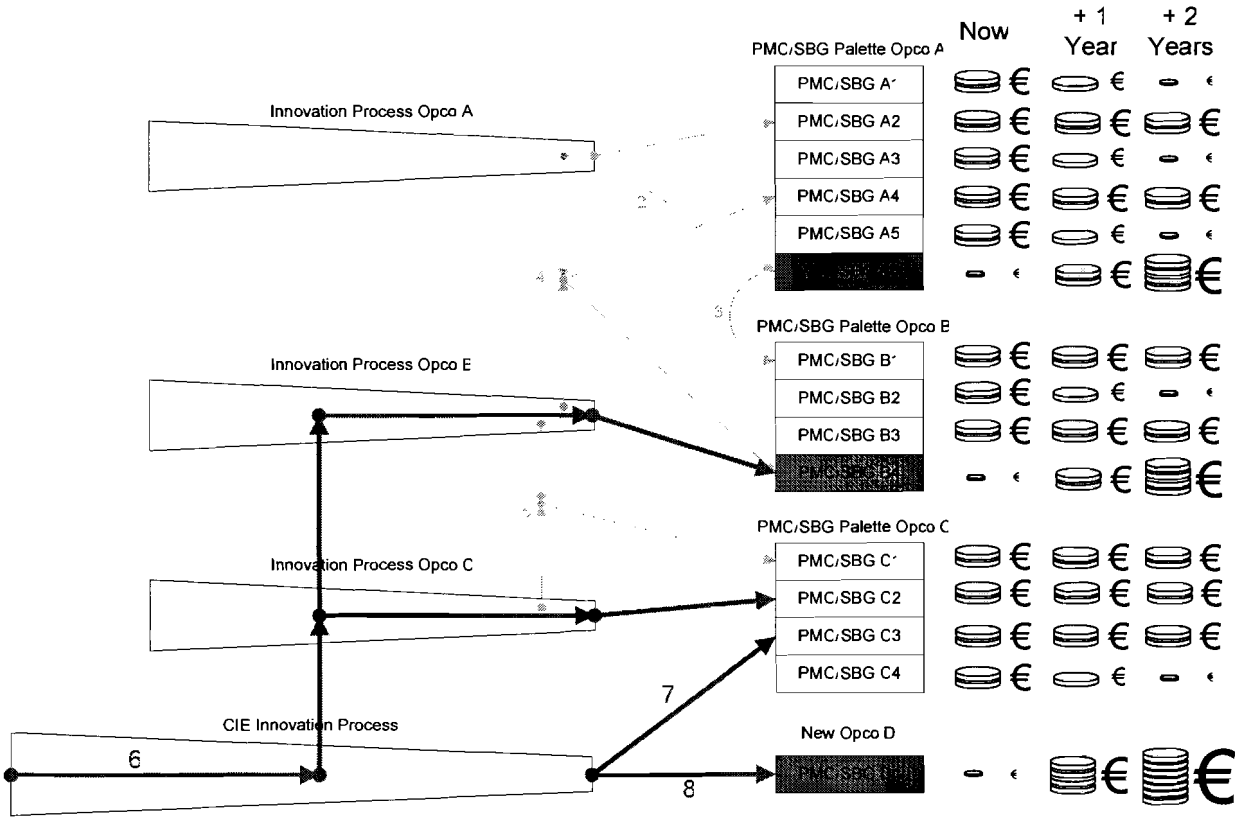

Figure 7-4 Innovation model of the CIE Innovation Process with multiple Opcos innovation processes

7.2.3 CIE project characteristics

CIE innovation projects will be constituted in a customized approach. Still, some general characteristics of these projects are identified and are be described in the list below:

- CIE DIP has the main responsibility of the coordination and success of the project
- CIE Projects will be mostly basic research, and occasionally applied research
- The separate activities of which the total project is comprised will in principle be conducted at the Opcos
- The human resources will be primarily the NPD personnel of the Opcos or alternatively by external support
- The budget will be provided by the CIE holding
- The project leader may be one of the following people, according to the best fit:
    - Idea creator
    - NPD representative
    - CIE DIP
    - External
- The balance between local Opco innovation projects and central or transnational CIE innovation projects should be secured with the Opco MD's responsibility in allocation of the NPD personnel
- The balance between exploitation and exploration, i.e. the ambidexterity, should be considered in allocation of the NPD personnel

7.2.4 CIE Development Team

The CIE Innovation Process should be secured by means of a team of stakeholders from each Opco, in order to maintain the link with the Opcos developments. A CIE Development Team therefore has been constituted and activated at the innovation meeting. The team includes one member of each Opco. This team will gather with CIE DIP in meetings on a regular interval. In these meetings, the developments of the innovation activities at the Opcos are updated. This includes the developments of Opco projects as well as CIE Innovation Projects.

7.2.5 Meeting structure

Three types of meeting structures are included within the system that is created here. First, CIE DIP will have meetings on regular intervals (once every 6 months) with the holding team, in order to update on CIE DIP developments and in order to align the CIE DIP responsibilities with the general CIE strategy.
Second, CIE DIP will have meetings with the CIE Development Team once every 3 months, as described in Chapter 7.2.4. Next to this, CIE DIP will have short contact with all the CIE Development Team members separately in order to update on new ideas and projects. So ideas that are candidate to become a CIE project can be identified in these updates.
Third, for every CIE project that will be done, a meeting structure will be set up by the project leader, for the team members of the project. In this meeting structure, the project management issue will be captured.

7.2.6 Limitations of the design part

It should be noted that the developed CIE Innovation Process is restricted by some limitations:

- The description of the design in this document is only done in a relatively theoretical way, therefore the actual constitution will need to be guided by more detailed elaboration of the process;
- The CIE Innovation process can only fully flourish when enough human resources are available to develop the projects (this is addressed with the design part D);
- This system still lacks any formal integration methods to integrate the output projects in either local innovation processes or Opco PMC/SBG Palettes

7.3 Design Part B: Project and Product Classification system

Another improvement area that was identified in the empirical analysis was the setup of a good portfolio management system at CIE level. This portfolio management system has to be developed in addition to the innovation processes at CIE, because innovation processes without a portfolio management system lack direction and a portfolio management system without an innovation process lacks production of innovations and is therefore static, as described in Chapter 5.1. This thesis project has been involved in the first constitutions of this system: the **Project and Product Classification system.**

7.3.1 Purposes

The Project and Product Classification system will replace the SBG classification system that was not working well, as described in Chapter 6.2.2.2. The system will be used to categorize both the NPD projects as well as the existing products of the Opcos and serve as an interactive database. The Project and Product Classification system will serve the following purposes:

- Information exchange
- Portfolio analysis and improvement
- Strategic planning
- Innovation focus areas
- Clarity of definition

These purposes hold for both CIE as well as the Opcos. The information exchange purpose may serve as a basis for new cooperative Opco innovation projects.

7.3.2 Use

Projects and products will be stored in this database with meta-data based on 'tags' they are given on different dimensions. Grouping and analysis can be done by making cross-cuts based on several tags. In order to make the system useful and applicable for analysis, a comprehensive set of dimensions is chosen that consist of several categories that are unambiguous and mainly mutually exclusive.

7.3.3 Product Classification dimensions

For the classification of the products, the following dimensions were constituted:

- Opco
- Product
    - Base Material
    - Product Class
    - Features
- Application
    - Application classification
    - End use classification A
    - End use classification B
- Main route-to-market

Next to these dimensions, also some general information about the product, like a description, a number, a name and a picture will be included. The first setup of the template is provided in Appendix XVIII.

7.3.4 Project classification dimensions

For the classification of the projects, a similar set of dimensions was developed:

- Opco

- Project
    - Project innovation orientation
- Product
    - Base material
    - Product class
    - Features
- Application
    - Application classification
    - End use classification A
    - End use classification B
- Main route-to-market

The same additional information will be included as with the product classification. The first setup of the template is provided in Appendix XIX.

7.3.5 Accessibility

The system is under development to be accessible via SharePoint, which is the internal CIE-wide knowledge management system. This SharePoint can be accessed and used by all the individuals that are given access by the CIE holding team. It is under development of being rolled out over the total CIE organization, so also the NPD involved people are being given access within short time.

7.3.6 Information updating

The first time this database is filled will be a large amount of work. CIE DIP will request this to be done by several representatives of the Opcos. Furthermore, the database will have to be dynamically updated. At first, when a new project is constituted, the information that is available on it must be reported in the database. Also, when the project has been finalized and a new product has been launched, the project should be reported as finished and the file for the product should be created.

7.3.7 Gains and limitations of the design part

If these classification systems are fully in use, there will be more gains. Moreover, they will not only facilitate the CIE Innovation Process, but also the cooperative Opco innovation projects, because the identification of potential cooperative projects is easier with this system.
The system has three limitations to take into regard:

- The extent to which the right classifications are given; this should be checked in the first months of its operation
- The fact that it requires updating on the products and projects
- The accessibility of the system, for which explicit involvement from the CIE holding is needed

So these issues should be handled with in order to make optimal use of the system.

7.4 Design Part C: Vitality Index and NPD Efficiency Index

This chapter discusses the third part of this thesis' design: the Vitality Index and the NPD Efficiency Index. This is comprised of a set of five KPI's to be used for measuring the innovative performance of the Opcos. This is needed in order to have an evaluation method with which progress of the innovation performance can be measured. The predecessor consisted of only one Vitality Index:

Vitality index: Sales new products / Total sales

As an complementary note with this formula, it was indicated that here new products are products introduced in the last 3 years.
As discussed in Chapter 6.3, the Vitality Index was coping with the fact that it did not account for differences in exploitation and exploration and neither for the efficiency of the innovation process.

7.4.1 New design

In order to cope with these problems, the Vitality index has been changed and complemented with one additional index: the NPD efficiency index The new vitality index will be constituted with two levels. The two new sets of measures are provided in the following two boxes.

Vitality Index: Sales new products / Total sales

Time frame for 'new' label	*Innovation orientation*	*Organizatinoal orientation*
3 Years	Exploitation	Local / Opco
5 years	Exploration	Transnational & central / CIE

This box shows that a new twofold Vitality Index has been introduced. This set distinguishes between exploitation and exploration based on the timeframe it works with.

NPD Efficiency Index: PBIT new products / Investments in new products

Time frame for 'new' label	*Innovation orientation*	*Organizatinoal orientation*
2 Years	Product improvements	Local / Opco
3 Years	Exploitative new products	Local / Opco or Transnational & Central
5 years	Explorative new products	Transnational & central / CIE

This box shows three NPD Efficiency Indices, which assesses the investments in new products divided by the PBIT over a specific time frame. It has a threefold setting, where the two-year time frame addresses product improvements, the three year time frame exploitative new products and the five-year time frame the explorative new products, i.e. the radical innovations.

7.4.2 Use

These measures will have their use in three ways:

- They provide insight into the innovation performance of the local Opco innovation processes
- They provide insight into the innovation performance of the transnational and CIE innovation processes
- They form a basis for strategy making, as assessments of the innovation capabilities of the Opco are possible

7.5 Design Part D: Rewarding structure

This chapter introduces design part D: a rewarding structure for the involved individuals in CIE innovation. The newly introduced design parts A, B and C are the basic elements to structure the holding coordinated innovation with. However, these transnational and central innovation processes do need resources from the local Opco innovation processes to be viable. So this will put increased demands on the innovation personnel that is available in the CIE Opcos, which already is critically low to only serve the local innovation processes, as Chapter 6 revealed. Although during the Innovation Meeting the general enthusiasm was quite good, it may be that in the rush of the other processes and organizational demands that need attention and effort, the MD's may be not happy to provide their scarce resources for the sake of transnational or CIE innovations. Therefore, this final design element, Part D, is designed in order to activate and install when this barrier is identified.

The rewarding structure for providing Opco resources for transnational innovation processes is twofold:

1. Monetary rewards for the personal salaries of the MD of the involved Opco
2. Monetary rewards for the personal salaries of the NPD representatives involved

7.5.1 Rewarding MDs

The monetary rewarding system for the MD will be based on a longer-term profile, because the devotion of the MD towards holding innovation should be ensured for long periods. The proposed rewarding structure for the MD will be based on the overview provided in Table 7-1. This table serves as an example and works as follows. When an MD is supplying FTEs for CIE innovation projects, he will be rewarded with a percentual salary increase as indicated in the table. If he has provided more resources on average during the year, his reward will be larger, just as when he is providing resources for longer periods of time. The maximum salaries increase is 25% which is the percentage allocated with three consecutive years of supply and with more than 0.4 FTE on average supply of personnel for CIE innovation for the past year.

Consecutive years of innovation supply	*Average supply of past year (FTEs)*	*MD Salary increase for current year*
1	0 < x < 0.2 FTE	5 %
1	0.2 < x < 0.4	7.5%
1	x > 0.4	15%
2	0 < x < 0.2 FTE	5%
2	0.2 < x < 0.4	10%
2	x > 0.4	20%
3	0 < x < 0.2 FTE	5%
3	0.2 < x < 0.4	12.5%
3	x > 0.4	25%

Table 7-1 Rewarding structure for the MD of the supplying Opco

7.5.2 Rewarding NPD personnel

The rewarding structure for the MD in isolation may be motivating for the MD to deliver personnel for CIE innovation projects, but that does not necessarily mean that the personnel itself is motivated to put efforts in the CIE innovation projects. Therefore, also a rewarding structure for the involved NPD

personnel is proposed. This is done on the direct activities supplied to CIE innovation projects. A proposition is given to reward the employee with a 25% salary increase for the hours spent on the CIE innovation activity. These hours should however be in agreement with the activities that are aligned with the CIE DIP plans.

7.5.3 Considerations of the design part

This design part D is not directly necessary to introduce. However, because it may occur that the CIE Innovation Process remains empty, this rewarding structure for the involved individuals may activate CIE to really become more innovative. Additionnally, this design is a proposal from which may be deviated. If it is activated, it will evoke increased investments in salaries. These costs could sum up to over €100,000.- a year if Opcos are really innovative, but the potential returns from generally more innovative Opcos could evoke several millions in return, if really product leadership is reached with it.

7.6 Cohesion of the design parts

The set of four design parts will constitute in the development of holding innovation at CIE. At first, with design part A, the holding innovation processes are constituted, totally new to CIE. Design part B, the portfolio classification system, will aid in the coordination that will be needed to manage the different innovation processes in parrellel to each other, so the combination of the CIE innovation process, next to the transnational innovation processes and the local innovation processes. Design part C, the renewed set of KPI's, will aid in the improvement of the local innovation processes and will also improve the visibility of the innovation developments. Therefore it may aid in motivation among the Opco personnel to utilize and supply the holding innovation processes that are created. Indirectly this will also aid in the improvement of the transnational innovation processes, because more local innovations are developed that can be transferred transnationally. The last design part, the rewarding system to supply the central CIE innovation process, will serve as a backup system if the other three parts appear to be insufficient.

7.7 Change plan

The introduction, implementation and the development of the designed set of four parts should be done in a way that it is successful in terms of the goal: to reach product leadership by means of increased innovativeness. In order to do so, the four design parts have to be developed and expanded as the need for them increases.

For each of the individual design parts, the installation of it was presented firstly to the holding team members and secondly to the MDs to take into consideration. With this step taken, the further implementation and expansion of the design should be set in, with the proposed following order as follows:

At first, the overview should be developed about the current products and projects present within CIE. When this is at a sufficient level, well grounded decisions can be made after analysis of potential improvement areas and potential transfer projects between the Opcos. From that moment, the CIE innovation process and the coordination of the transnational innovation projects may be started off officially. In regard of the third design part, the KPI's, the following steps should be taken. In parallel to the development of the overview of the products and projects, the elaboration and installation of the new set of KPI's may be put into practice. This will be done in cooperation with the Financial Controller of the holding team, who has to ensure that the Opcos deliver their performance each year on these newly created measures.

With this as a start, the number of CIE innovation projects, and the number of transnational innovation projects should rise. Also, the number of explorative innovation projects should rise with this. Next to this, the local innovation processes should improve as time passes.

If this does not appear to work, the design may be improved with the implementation of design part D, the reward system.

7.8 Launch, future development and evaluation of the design

The first three design parts have been taken into development by CIE DIP. The fourth part is designed to be ready to activate if necessary. The three first design parts also have been introduced to the total group of MD's and NPD representatives at the Innovation Meeting October 8th, 2008. The general posture towards the new systems by the group was positive. The extent to which this complete object design is successful, is measured against the evaluation criteria provided in the beginning of this Chapter. The evaluation is done although no actual test of the new design of any increased innovativeness is performed.

- Functional requirements
  - The realization of the solution should solve the problem
    - ⇒ It facilitates in the improvement of the innovation performance, both for local innovation processes as well as holding innovation processes
  - The benefits of the solution should outweigh its investment costs
    - ⇒ No hard conclusion can be drawn, but the potential gains are extremely large and the investment costs are not very high
- User requirements
  - The people working in the business system should have the competences to work with the new system
    - ⇒ The system fits as close as possible with the existing situation, while facilitating slow adaptation of the business system towards an innovative CIE
  - The new system should be user friendly
    - ⇒ The one user for whom this can be assessed is CIE DIP; the user fiendliness is optimized in this respect, because CIE DIP has been developer of, or otherwise been closely involved in the creation of this system, except for Design Part D. The extent to which it will be user friendly for other, to-be-added users, depends on the elaborations in practice
- Boundary conditions
  - The system should comply with legal, health and safety requirements
    - ⇒ The designed parts do not affect any of these issues
  - The system should comply with the existing business policies, for as far these are not changed with the design
    - ⇒ Some policies for budgeting projects and for assessing the Opco innovation performance are changed, but this is part of the design
  - The system should fit with the current culture in the company
    - ⇒ This may be the hardest condition, as the innovation mindedness is inadequate, but this is one of the issues to be changed with the new system
- Design restrictions
  - The project should take no more than 7 months
    - ⇒ Confirmed
  - The level of organizational change constituted with the solution should fit the level of influence of CIE DIP
    - ⇒ CIE DIP has been involved throughout the process, therefore this is secured

So, if the evaluation of the solution design is regarded, only the cultural change still appears to be a potential barrier. In the other respects, the solution design can be regarded as a solid base to develop further in improving the innovation from the holding organization setup. The actual value can only really be assessed if we leapfrog a few years into the future, and assess whether this moment in time initiated the start of big improvements of CIE's competitive position, and whether CIE could say to have reached its 'product leadership' position.

8 Managerial implications

The managerial implications of this thesis project are provided in this chapter. The implications for the holding team, for CIE DIP and for the Opcos are discussed subsequently.
For the holding team, the introduction of the new design will change the degree of integration that is faced among the Opcos. That means that the assessment of the Opco performance should be done with the degree of cooperation of innovation taken into consideration, as higher degrees of cooperation could potentially provide synergetic results for CIE. Also, the performance assessment of the Opcos should incorporate a review of their innovative performance. This may support the design and it may also make the SPICE strategic plans become reality, as the Opcos will probably react on this changed assessment.
For CIE DIP, the design may be a building block to put into practice in order to give shape to the innovation development plans. Furthermore, it should be developed further, i.e. adapted to the practical situation, and with this it can serve as a part to base a part of the CIE DIP innovation activities on.
For the Opcos, this design will instill big changes too. It will make the CIE strategy towards product leadership more explicit and their performance assessment will become different. Moreover, they will be more assessed on their innovativeness, next to their usual yearly profit and loss accounts. This will mean that their daily operations will have to shift towards more innovation. More fundamental, explorative innovation will be demanded by CIE DIP through the CIE innovation processes.

9 Conclusion & Recommendations

This design project attempted to facilitate in the development of a solution to improve the innovation performance of CIE. The conclusion from the analysis phase was that the creation of a central innovation process and a set of transnational innovation processes would be possible in CIE. The central innovations however would best be done without the creation of a new department, because the holding setting is not optimal for it. Therefore this would require more coordination of transnational innovation, together with more allocation of external resources for innovation. Next to these overarching innovation processes, also a coordination system for the simultaneous management of the different processes would be needed. In addition, these more holding level developments had to be facilitated by improvements of the local Opco innovation processes. The latter would mainly mean more resource allocation by the Opcos for innovation, together with a more formal approach of the innovation process, e.g a Stage Gate approach.
The conclusion from the design phase is that a set of four elements was found necessary and was therefore created. It consists of the following elements:

- The CIE Innovation Process, including a threefold project type classification
- A Product and Project Classifcation system
- A set of five KPIs: Vitality Indices and NPD Efficiency Indices
- A reward structure for the supply of human resources to the CIE innovation process

The CIE innovation process can be used for producing central and transnational innovations. This introduces a big gain in terms of increased efficiency into the total innovation facilities of CIE. In order to manage these innovation processes next to the local innovation processes, a new product and project classification system was created that could overcome the existing problems with the old system at CIE. The set of KPIs was needed in order to stimulate the local innovation processes. By means of this, also the transnational innovation processes would become more efficient, as they may be supplied with an increased amount of local innovations to transfer or co-develop. In the case the three design parts do not work, a reward structure may be necessary in order to instill increased innovativeness. Although the general willingness to start holding based innovation in the final Innovation Meeting, still this last element may serve as an important part to make the whole design successful.
The current design, as it is now, is to serve as a blueprint for improving the innovation facilities at CIE. However, the practical elaboration still needs to be done.

If the design is installed, it may mean for the holding team that the assessment of the Opcos will become more done based on their innovation performance. For CIE DIP, it may serve as a basis for the activities to improve innovation within CIE. For the Opcos it will mean a changed organization, that is more innovation oriented, in terms of more resources working on innovation and also more formal local innovation processes.

CIE and CIE DIP are recommended to adopt this design and put full efforts into it, in order to develop the organization for innovation at CIE. Moreover, it is recommended to pursue the change plan in order to implement the design within the organization. This may serve as a basis in putting the strategic plans regarding product leadership into practice. It is recommended to use the broadly described change plan in the further constitution of the design, as the design needs a lot of adaptation in order to apply it in the practical situation of CIE.

This thesis is accompanied by several limitations. Moreover, the validity of this project needs some remarks. At first, the internal validity of the analysis was harmed due to the fact that the involvement in the Opcos was very limited. This made the number of interviews less and also the duration less; there fore the data analysis was less rich of information. Also, most interviews were done by means of video conference, due to time and costs considerations in preventing expensive traveling throughout Europe. It appeared that the video conference connection can be a disturbing factor, as reactions can get delayed and non-verbal information is limited. This was especially limiting due to the fact that the video conference interviews were first meetings with these people. If somebody has been met in real life, more insight in his non-verbal communication system is developed, which may help in understanding during a follow-up video-conference. The internal validity of this project was increased however by the fact that the complete set of eight Opcos of the focal sample was analyzed.
The external validity is also regarded. This is limited due to the N=1 case study setting, but that is inherent to such a study. In the use of the reflective cycle (Van Aken *et al.*, 2006) however, general learnings can be drawn and design rules for similar business systems may be developed.

The process of defining the problem definition has evolved during the project. The first problem definition was followed up by an analysis, that provided new insights that made the problem definition evolve over time. The final constitution of the problem definition has been finalized very late in the project.

This thesis provides some insights for science that should be noted. The literature search revealed that the topic of innovation in holding companies was not written about in the scientific databases that where reviewed. Closely related literature about innovation in multinational companies was present. The differences found in this holding case were that the level of integration is generally lower than described in the mentioned body of literature and that the basic holding structure logically does not allow for organizational units that do not make their own returns, e.g. innovation / R&D departments. This makes the transnational innovation concept partly applicable to the holding organization, namely without the central innovation department usually located at the headquarters.

This case study can serve as an example for other holding organizations aiming for improving their innovative performance. This is reflected in terms of the process and in terms of the design.
At first, the theoretical chapter provides insights into the relevant literature for this topic, including a set of key innovation success factors.
The CIE Innovation Process together with the threefold project type classification is developed in such a generalizable manner that it could be applied to a lot more multi-national multi-business holding organizations. This is independent on the degree of innovativeness of their industry.
The project and product classification template could in basics be applied to all business. However in the setup as it is presented in the Appendices of this document, it can only be used by companies operating

within a similar setting. That means a similar industry, customer types, application types, materials and product types as CIE.
The KPI set can be applied to all businesses that conduct product development within their organizations. However, these companies should be sophisticated enough that they are actually measuring the financial numbers used for the set of KPI's.

Furthermore, the approach may be learned from for masters thesis students, to the extent that first the problem definition should be very clear before proceeding. The use of interviews, strategy documents, and questionnaires is recommended in order to improve validity of the analysis. The logical linking from the analysis phase to the design phase may be subject to improvement, and was done in a very late stage because the problem definition had not been clear when proceeding from the analysis phase to the design phase. That resulted in less focus during the project.

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