MASTER

Enhancing new business development success
a new portfolio management method for Fujifilm Tilburg

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Enhancing New Business Development Success: A New Portfolio Management Method for Fujifilm Tilburg

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Preface

This master thesis was written as final assignment in order to graduate from the master course Innovation Management at Eindhoven University of Technology. The thesis is the closure of twenty-four years of personal development, growing up and education, and the beginning of a new adventure as an independent member of society. It was written during my half year internship at Fujifilm Manufacturing Europe B.V. in Tilburg. In this preface, I would like to take the opportunity to thank the people who have supported me during this graduation project and beyond.

Firstly, due to my great colleagues of the New Business Development department, I have had a lot of fun during the past months. Therefore, I would like to thank my colleagues Joyce, Chris and Ralf for their support and the fun that we had. Special thanks goes to Jaap Schut, who supervised me day by day and provided me with a lot of helpful feedback and information. His extensive research experience as a PhD was a great help to me. Finally, I would like to thank all the participants in the interviews and all other colleagues who contributed to this thesis and to the nice time I have had.

Another person I would like to thank in particular is Onno Gerrits. As the company’s first supervisor he provided me with the opportunity to graduate at such a great organization. I would like to thank him for all the fun, learning and opportunities he has given me. Moreover, very special thanks goes to dr. J. D. van der Bij, my first supervisor of TU Eindhoven, whose feedback and steering during this project was very valuable. I would also like to thank prof. dr. ir. Weggeman for being the second reader of this thesis.

Last but certainly not least, I would like to thank the persons who were not directly involved in this project, but who have always been there for me. Firstly, I would like to thank my parents, my brother and my sister for their great support in every possible way. Secondly, I would like to thank all my dear friends who have inspired and supported me each in their own specific way.

Tilburg, August 2008
Bart van Denderen
Executive Summary

Introduction
This master thesis report was written in 2008. It is the final part of a graduation track that started with an extensive literature review (Van Denderen, 2008a) and a research proposal (Van Denderen, 2008b). The literature review discusses radical innovation in general, ways of organizing radical innovation, and concepts and theories related to radical innovation. In the research proposal, a preliminary orientation was executed to determine the research direction. This final document presents the results of the field study that was conducted within Fujifilm Tilburg. The most important conclusions of the literature review and the research proposal are integrated in this comprehensive document.

Subject of research project
Fujifilm Tilburg is part of the Fujifilm Corporation and was originally a production location. However, in the past few years Fujifilm Tilburg started to become an innovative company. Therefore, it uses a project management system that is based on the funnel model (Wheelwright and Clark, 1992) to manage its radical innovative projects. Since the current business of Fujifilm is threatened by new technological developments, the importance of creating new business is evident. Therefore, an effective exploration process is of key importance for a profitable future for the company.

The primary starting point of the research project was that the current explorative activities do not result in financial benefits fast enough. During the orientation phase, the project and portfolio management processes were identified as the main subject of research. Therefore, the following problem statement was formulated:

\[ \text{NBD project and portfolio management processes within Fujifilm Tilburg do not result in a successful exploration phase in terms of financial benefits} \]

The author has only research Fujifilm Tilburg, thus Fujifilm global falls outside of the scope. Also, the commercialization phase is not researched extensively since the marketing and sales department is located in Düsseldorf. Then, incremental innovations are not researched since the primary subject of this research project is radical innovation. The actual implementation and evaluation is not subject of this thesis due to the limited time frame.

Analysis & diagnosis
In order to do company relevant research, the author used the business problem solving approach as proposed by Van Aken et al. (2007). Thus, a specific problem situation within the company provided the starting point of this research. Also, the research project has a strong theoretical base since scientific literature is extensively used.

The author of this thesis selected eight radical innovative projects for analysis. These project were recently executed or still in progress, cross-sectional executed, and radical innovative. Consequently, these projects were compared to each other in order to draw general conclusions about project management practices within Fujifilm Tilburg. In addition, the project and portfolio management process was researched by conducting a total of 17 interviews, unobtrusive data-gathering and participant-observation.

Fujifilm Tilburg aims at establishing a new third pillar by exploring market opportunities for their technologies. The management team determined four technical business areas. Within the Tilburg Research Laboratories, there are two groups that are busy with explorative activities, namely Life Sciences group and Digital Inkjet Paper group. Both groups have the target to generate new business, however, they don’t work in the same way. The project management system is only used within the Digital Inkjet Paper group. Also, Life Sciences is more fundamental research oriented, where Digital Inkjet Paper group is more application development oriented.
From a portfolio point of view, it appears that most resources are allocated to the fundamental research projects. These projects are long-term projects with high risks, where no concrete business plans are present. Furthermore, most of the explorative projects are in the front end of the funnel. Therefore, the current funnel occupation is unbalanced.

From the interviews the following most important issues were derived:

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Based on the above-mentioned results of the analysis, an extensive cause and effect tree was constructed to identify root causes for the problem statement. The four root causes that were identified are:

1. Resources not optimally tuned to strategy;
2. Lack of research focus;
3. Difficult commercialization path;
4. Funnel processes not optimal.

This resulted in potential directions for redesign. It was decided that the most relevant and suited option was to make a redesign that aligns strategy to practice by implementing a portfolio management system for balancing resource allocation.

**Solution design & implementation plan**

The redesign that was chosen includes a lot of strategic and organizational challenges. The author proposes a solution design that exists of four parts that form a total solution when implemented simultaneously. The four solution designs are described in a nutshell below.

- **Part I**: A new organizational structure for the Tilburg Research Laboratories is proposed. This is a matrix structure that builds on technical business areas and New Business Development.
- **Part II**: Strategic portfolio management should be done with the strategic buckets method. In practice, resources should be strategically divided over technical business areas.
- **Part III**: Tactical portfolio management is modeled and integrated in the current project management system of Fujifilm Tilburg. Using the proposed model enhances a balanced resource allocation within the strategic buckets.
- **Part IV**: A tailor-made strategy for the fundamental research oriented and the application development oriented technical business areas is formulated, where more market focus is integrated in the fundamental research activities and a concrete pathway towards a new third pillar is described for the application development technical business area.

This thesis also contains an implementation plan to enhance the practical implementation of the solution design. Issues that are important to take into account in organizational change processes are mentioned. The most relevant part of the implementation plan is a detailed elaboration of the solution design in which roles, responsibilities and activities are proposed. The establishment of a workgroup to facilitate the implementation of the proposed solution design as presented in this thesis is suggested.

**Recommendations**

The author makes the following recommendations:

- Implement a new organizational structure within TRL as proposed in figure 7.1 (page 45), based on technical business areas;
o Allocate resources in a more balanced way between fundamental research and application development, and between technical business areas in line with the strategy;

o Use structural prioritization methods for explorative projects in order to guarantee that the right number of projects and the most promising projects are selected. During the prioritization, alignment with the strategy should be the dominant method;

o Introduce project databases to store ideas, terminated projects, and projects that are on hold in order to improve evaluation loops, learning, knowledge sharing, and good prioritization decision-making;

o Apply the same project management system for research oriented and development oriented projects, but be flexible and use a project-specific approach;

o Limit the manpower that can execute fundamental research activities and increase manpower based on concrete business plans;

o Increase manpower to find more applications for technology B2 and work towards a new third pillar for FFME;

o Decrease manpower that is allocated to technology C until a concrete business plan is present;

o Integrate technology C and D projects with technology B2 projects by having cross-sectional NBD-TRL meetings to increase market focus and to create new knowledge. Also, technology D can be linked to the established technologies since there is a clear overlap;

o Establish a working group that can facilitate the implementation of the proposed redesign. Preferably, an external person is included and technology and market focused members are balanced.

The author believes that the implementation of the proposed redesign will contribute significantly to a better and more structured radical innovation process for Fujifilm Tilburg. It can be seen as the next step in the pathway towards a new third pillar and it will improve and focus the current explorative activities.
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Chapter 1 Introduction

This report is the final and most extended part of my graduation project. The first part (Van Denderen, 2008a) provided the theoretical foundation for the project in the form of a literature review, where the second part (Van Denderen, 2008b) provided the starting point for the internship in the form of a research proposal document. This final master thesis document is a report of my internship at Fujifilm Tilburg. The main results of the literature study and of the research proposal are integrated and sometimes extended in this report. Therefore, this report can be considered as an integrated, complete overview of all three documents.

I started my internship within Fujifilm in February 2008 with an extended orientation phase based on the business problem solving approach as described in Van Aken et al. (2007). The period of my internship can be roughly subdivided in four phases, namely orientation, research preparation, analysis and diagnosis, and plan of action (fig. 1.1).

Firstly, the orientation phase resulted in a research proposal document of which the main results are summarized in chapter 2, where the problem context is described, and in some additional appendices. Chapter 3 describes the project, including the problem description, the scope and the chronological progress of the project.

Then, in order to conduct a decent analysis and diagnosis, a well-suited research methodology should be used. Methodology is described in detail in chapter 4. In addition, more specific scientific theory had to be studied, which is described in chapter 5. Chapter 4 and 5 can be considered as a preparation for the analysis and redesign. Subsequently, the empirical analysis and diagnosis, which is considered to be the core of this thesis, is conducted. The actual empirical analysis can be subdivided in project level analysis and cross-project analysis. The results and diagnosis of these analyses are presented in chapter 6. The diagnosis resulted logically in some potential directions for redesign of which one is selected as primary subject for the redesign.

Finally, a solution design and implementation plan are presented in chapter 7. This redesign is supposed to provide (part of) a solution for the problem as it is defined in the orientation chapters. In chapter 8, an overview is given of conclusions that can be drawn from this research project and recommendations for Fujifilm are formulated.

For reasons of confidentiality this report does not mention stakeholders names, interviewees, technologies, project names and other company specific confidential information. Therefore, some of the appendices that present confidential information are only available for employees of Fujifilm Tilburg and the supervisors of Eindhoven University of Technology. Despite this restriction, the author tried to conduct a report that is also readable without this information.
Chapter 2 Company Description

2.1 Fujifilm Holdings Corporation

Fujifilm Corporation is a worldwide organization that was founded in 1934 as Fuji Photo Film Co. in Ashigara, Japan, at the foot of mount Fujifilm. Fuji Photo Film Co., Ltd., established, based on a government plan to establish a domestic photographic film manufacturing industry. The new company inherited the split-off photographic film operations of Dainippon Celluloid Company Limited. The firm started with 340 employees and they sold their first film roll in Japan in 1936.

In the next years, the firm increased capital and opened numerous of subsidiaries all over the world. Today, Fujifilm Co. consists of 233 subsidiary companies and 61 affiliated companies. The total number of employees exceeds 72000.

All Fujifilm subsidiaries worldwide are supervised by Fujifilm Holdings Corporation. This corporation controls the strategy of the whole Fujifilm group. Fujifilm and Fujifilm Xerox are the largest operating companies from this group. Since October 2006, the name of Fuji Photo Film Co. was changed into Fujifilm Corporation, which is supposed to be a better reflection of the reorientation of Fujifilm to other markets than the traditional imaging market.

Fujifilm Corporation has an annual turnover of approximately US$ 23.6 billion and an R&D expenditure of approximately 7% over the annual turnover in FY (Fiscal Year) 2007. The European region accounts for 15.2% of the total revenue.

![Figure 2.1: Business fields of Fujifilm Co](image)

Fujifilm Corporation is active in three business fields, namely imaging solutions, information solutions, and document solutions. Each field includes several products and/or services as described in figure 2.1. The field of document solutions is in grey, because this is associated with Fujifilm Xerox.

Fujifilm uses production plants worldwide for the imaging and graphics business domains. From the three largest production plants, the oldest plant is stationed in Ashigara, Japan. The second oldest is the factory in Tilburg, on which this thesis will focus, and the youngest plant is established in Greenwood, U.S.A. The marketing and sales activities of Fujifilm are centralized. The European headquarters is located in Düsseldorf, Germany.

2.2 Fujifilm Manufacturing Europe B.V.

In this paragraph, the company description is specified to FFME, because the research project will take place in this subsidiary of Fujifilm Co. Also, an historical overview of innovation within FFME is presented here.

In August 1982, the subsidiary in the Netherlands, Tilburg, was incorporated as the first production location outside of Japan. Today’s name is Fujifilm Manufacturing Europe B.V. referred to as FFME.
Internally, the abbreviations FFME and Fujifilm EF (European Factory) are used. FFME is one of the biggest production locations of Fujifilm worldwide and has about 1000 employees. Tilburg as a production location was chosen because of its central location in the selling area, its good infrastructure and its clean air and ground water. The latter is important because clean water and air are required in the production processes. FFME focuses on research, production, and distribution of photographic materials for Europe, the Middle East and Africa. The marketing and sales department is, as said, centralized from the office of Fujifilm in Düsseldorf, Germany. The annual net sales of Fujifilm Manufacturing Europe B.V. (FFME) in FY 2007 were approximately €517 million, with a net profit of approximately €32 million.

Originally, FFME was a company that focused on the production of their goods in the most efficient way and they were, and still are, very good at that. Within FFME there are three production plants in which colour paper (CLP) (P1), colour negative film (CLN) (P2), and pre-sensitized offset plates (PS plates) (P3) were produced. However, at the end of the 2000's the demand for photo films decreased dramatically due to the digital imaging revolution and in only 2 years of time the demand and thus the production decreased from the highest level ever to a level that was no longer profitable anymore. Subsequently, P2 was closed and is currently used for testing purposes. Also the demand and profit margins for CLP has decreased significantly due to the digital revolution in the imaging industry. Obviously, FFME is looking for new business opportunities, which can preferably be fulfilled by the production assets of P2. From an historical perspective, a chronological flow diagram can be constructed for FFME. This diagram can be found in confidential appendix A.

The mission, vision and strategy of FFME are stated in the box in figure 2.2. From the vision and strategy only the relevant aspects are stated. For a whole company description with complete vision and mission, see the Company Policy 2007.

**Mission**
FUJIFILM Manufacturing Europe B.V. is an important production location of the FUJIFILM Corporation.

We contribute to the FUJIFILM Corporation in being an excellent production company in Europe. We produce and create superior products by using our innovative technologies.

**Vision on new product development**
We are a spearhead for research and development for new products in Europe. We create new business activities for FUJIFILM Manufacturing Europe B.V.

**Relevant strategy points**
- Obtain higher margins by:
  1) Producing product with higher margins;
  2) Reducing costs in business domains;
  3) Continue internal cost-reduction.
- Continuity: construct a new pillar for FUJIFILM Manufacturing B.V. to maintain a healthy profit level and to keep employment on a comparable level by:
  1) Explore the feasibility of potential products/services that fits production by FUJIFILM Manufacturing B.V.;
  2) FUJIFILM Manufacturing B.V. continue to finance R&D activities to maintain a technological advantage;
  3) Structure development of new activities.

The new company slogan of FFME is “Producing our own future”, which refers to becoming an ambidextrous company with a broad focus on new opportunities.
To complete the company description, an organization chart of FFME is added (appendix B). The most relevant business units for this study are the New Business Development group and the Tilburg Research Laboratories (TRL).

General information about Fujifilm Co. and FFME is mainly derived from the websites and intranet (see references). For a more detailed description and a more extended financial analysis see Fujifilm Annual Report 2007 or Fujifilm intranet.
Chapter 3 Project Description

3.1 Project Background
Fujifilm Manufacturing Europe B.V. (FFME) in Tilburg, The Netherlands, produces pre-sensitized offset plates and photographic paper. They also produced color negative film up to 2006, but due to a major decrease in demand, caused by the digital photography revolution, this plant was closed. As a result, recently FFME started to implement an innovative approach in order to develop new products that can form a new third pillar for FFME. The Tilburg Research Laboratories (TRL) were reorganized to adopt a focus on the development of new businesses and also a new business development (NBD) department was established. The funnel model (Wheelwright and Clark, 1992) was adopted to structure the NBD projects, however, this approach is not yet commonly applied throughout the firm. FFME is still inexperienced in innovation, their project management systems and processes are immature and some activities are happening in an unstructured way. Since the future of FFME depends significantly on their ability to succeed in new business development, the urgency for improving their innovative capabilities is evident.

3.2 Problem Description

3.2.1 Problem Evolution
As mentioned above, an NBD department was established and the TRL department was reorganized in order to create an ambidextrous organization. Both, TRL and NBD, are exploration-oriented departments that focus on creating a new third pillar for FFME. Due to the major decline of conventional photo films that resulted in the closure of plant 2 and a decline in photo paper demand, there is an urgent need for new business.
However, although FFME has started with its new business development activities, the success of their efforts is not yet visible. Profits derived from new-to-the-fmn products are insufficient. Thus, the exploration process within FFME is considered to be unsuccessful or at least not successful enough. Therefore, FFME needs to make their NBD process more mature and successful.
Within FFME the funnel model (Wheelwright and Clark, 1992) is used as a project management system (PMS) (confidential appendix C) for innovations. During the fuzzy front end ideas for new products are generated and when an idea is promising enough, it will enter the funnel as an NBD project. The TRL researcher becomes project leader and explores technological opportunities whereas an NBD officer is assigned in order to explore market opportunities. The management of these projects and of the portfolio as a whole will be investigated during this research project.

The primary starting point of the project was provided by FFME and can be described as that the current explorative activities do not result in financial benefits fast enough. After the orientation phase, FFME's project and portfolio management processes were identified as the main subject of research (Van Denderen, 2008b). Therefore, it was decided to analyze a sample of NBD projects. Eight projects were selected and researched with a focus on how they were managed. In addition, a cross project analysis was executed to identify common practical problems, hindrances, ideas and enhancers.
However, from the interviews it appeared that the problem more a portfolio management problem then a project management problem. Therefore, additional interviews and analysis was conducted from a more holistic point of view. Thus, during the analysis the focus of the research project shifted from a project level point of view towards a portfolio level point of view.

After studying the project management system (PMS) document in practice, core competencies and technologies, current resource allocation and the historical perspective of the current situation, the author constructed a cause and effect tree. It appeared that the main problem for FFME lies in the current imbalance between resource allocation and strategy, the lack of research focus, a hard commercialization phase, and an immature innovation process.

Based on this diagnosis, three potential directions for redesign were formulated. Then, in line with the project scope and in agreement with the supervisors, the author chooses to focus on the implementation of portfolio management as primary subject for redesign. According to the author,
this will result in the largest benefits for FFME. Thus, the redesign direction of the research project is almost exclusively focused on a more portfolio/strategic level perspective. The author also provides some practical guidelines for the actual implementation of the solution design in the form of an implementation plan. In this way, the practical relevance and the likelihood of actual implementation are enhanced.

3.2.2 Problem Statement
Firstly, the problem statement was formulated after the orientation phase. During the research project, the problem statement was extended and accentuated. In line with the project evolution, the focus in the problem statement shifted towards portfolio management processes instead of project management processes. Finally, this resulted in the following problem statement:

**NBD project and portfolio management processes within FFME do not result in a successful exploration phase in terms of financial benefits**

Within FFME radical innovations are defined as new-to-the-firm innovations. The innovations that are considered as new-to-the-firm are managed by the NBD department in cooperation with TRL or by TRL alone. The funnel model (Wheelwright and Clark, 1992) is used as a project management system (PMS) (confidential appendix C) with several go/no-go points to provide direction to the radical innovations in the exploration phase. Exploration is associated with activities that explore the technical and market aspect of a possible new business. Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation (March, 1991). In general, exploration is associated with organic structured, loosely coupled systems, path breaking, improvisation, autonomy and chaos, and emerging markets and technologies according to He and Wong (2004). The success of the exploration process is measured in terms of profit derived from radical innovative new products.

3.3 Project Scope
For a start, FFME is a subsidiary of Fujifilm Corporation, a worldwide organization. Primarily, FFME was a production location that also performs research activities for Fujifilm Corporation, but FFME has become a more and more autonomous new product developer. Thus, the research project will focus on the situation within FFME. Consequently, Fujifilm Corporation falls outside of the scope of this research.

Further, the research project will focus on the exploration phase of radically innovative technologies within FFME. For FFME, radically innovative technologies are defined as new-to-the-firm technologies.

Furthermore, this study focuses on the new product development process, but the fuzzy front end will not be taken into account. That part has already been researched. Also, the technical improvement of the project management system document used by FFME will not be primary aim of the research project.

Also, the commercialization phase will not be researched here. FFME lacks data and experience in the field of commercializing radical innovations, therefore a research focus on this subject is assumed to be too broad. Furthermore, although FFME is practically commercializing their own new products, formally this is the responsibility of Fujifilm Düsseldorf. Therefore, there might be too many hindrances to implement a redesign for this subject.

Moreover, since the subject of this thesis aims at radical product innovation, the incremental innovation process will not be extensively researched in this thesis. FFME has innovative projects ranged from very incremental to very radical. Some of the more radical incremental innovation projects may be taken into account in the research project depending on their perceived relevance. However, process innovations and small incremental innovations will not be researched at all.

Finally, this study will result in a theoretically founded solution design and an implementation plan for FFME. However, due to the limited time frame of only 5 to 6 months the actual implementation, and evaluation stage (fig. 4.1, page 11) of this redesign will fall outside of the scope. Nevertheless, the suggested solution will be validated and justified to the highest possible extent.
Chapter 4 Methodology

4.1 Research Approach

4.1.1 Business Problem Solving

In this research project, the business problem solving (BPS) approach (Van Aken et al., 2007) is applied. This is done in order to increase practical relevance and to improve organizational performance. At the end, this should increase the profit of the company. The BPS methodology that is used in this case is theory-based. This means that problem analysis and diagnosis and solution design should be based on comprehensive, critical and creative use of scientific literature. Primarily, this is ensured by the scientific literature that was reviewed in advance (Van Denderen, 2008a). This literature review provides the theoretical foundation for this project. Nevertheless, throughout the project additional literature is used that is relevant for the specific problems that popped up. Also, additional scientific literature is used as a basis for the proposed solution design.

Then, in order to structure the research project the reflective cycle (Van Aken, 2004) combined with the regulative cycle (Van Strien, 1997) will be used as a guideline (see fig. 4.1), as described in Van Aken et al. (2007).

![Figure 4.1: Reflective and regulative cycle (based on Van Aken et al., 2007)](image)

Research based on the paradigm of the design sciences, aimed at developing prescriptive knowledge in the form of field-tested and grounded technical rules or solution concept, does usually follow the above-presented reflective cycle. The basis of the reflective cycle is a business problem solving activity, following the regulative cycle. The reflective cycle consists of choosing a type of business problem, then solving that problem by using the regulative cycle, reflecting on the results and learn from the project for future projects, establishing preliminary technical rules (often a solution concept) and then starting a new project dealing with the same kind of problem. In this project the type of business problem was confined to the topic of the literature review.

The regulative cycle is initiated by a collection of problems or an unwanted situation that motivated the initial company assignment. In the orientation phase, the researcher is confronted with problems and symptoms that should be translated into a problem statement. This has been done by conducting orientation interviews, unobtrusive data-gathering and desk research (Van Denderen, 2008b). Subsequently, an in-depth analysis and diagnosis is done. In this case, the analysis and diagnosis is done in the form of a field study within a company, FFME in Tilburg. Based on the results of this analysis, the author constructs a plan of action, which includes a solution design and an implementation plan. Then, the actual implementation, or intervention, can be done. After the implementation of the solution design, its results can be measured and evaluated. Since the limited time frame of this graduation project, the focus will be on the analysis and diagnosis and on the solution design. The author will leave the actual implementation and evaluation of the redesign to the company.
4.1.2 Conceptual Model

A conceptual model, which is mainly based on Verschuren and Doorewaard (2005), is presented. It reflects the theories and practices that are used to come to the results. The rationale behind their research model is based on four elements, namely the determination of the subject of analysis, the theoretical perspective that is required during the process, the confrontation of these first two elements, and finally the result of this confrontation. In practice this confrontation will be a comparison of practical results with literature or an explanation of phenomena with scientific literature during the analysis and diagnosis phase. In the redesign phase, the creative leap (see chapter 4.4) can be considered as the confrontation.

![Conceptual Model Diagram](image)

**Figure 4.2: Conceptual model as used in this research project**

This research project follows the problem-oriented approach and therefore it can be roughly subdivided in two phases. Firstly, the analysis and diagnosis phase to validate the problem and its causes can be identified. This phase results in potential directions for redesign. Secondly, the redesign phase which will result in a thorough specific solution design that will contribute to solving the problem. The results are achieved by combining the theoretical perspective with the practical outcomes of the empirical analysis. Thus, in this research project theories as described in the theory boxes were combined with practical results in the form of interviews, case studies, unobtrusive data-gathering and participant-observation in order to come to design guidelines. In accordance with these guidelines a redesign for the implementation of portfolio management practices within FFME was proposed.

4.1.3 Scientific Justification in Case Study Research

The relation between the open-minded approach of practical problems and scientific rigor is discussed based on Van Strien (1986). Van Strien describes the relation between idionomic (single-case) theory and a general theory. Three level theories are distinguished, namely level A theory, level B theory and level C theory. The level C theory is an idionomic theory that describes one specific case \( (N = 1) \). By using inductive generalization, an isonomic (“similar named”) theory \( (level \ B, \ N = k) \) can be constructed. This is a theory that applies for a specific category of cases. Level B theory does have an inductive base in practical relevance with singular level C experience, but also a deductive relation with the level A nomothetic (“general law making”) theory. Level A theory can be considered as a general theory on the \( N = \infty \) level. Via downstream logical deduction and upstream inductive generalization these different level theories can be connected to each other (fig. 4.3, page 13).

In this research project, a number of projects is independently researched \( (N = 1) \). The results are generalized and translated to an \( N = k \) theory by conducting a cross-project analysis that applies on the category of “NBD projects within FFME”. The phenomena that are observed are explained and interpreted by using general theory, obtained from scientific literature. Thus, this theory describes how scientific rigor is related to practical relevance in a case study.
4.2 Methodology for Literature Search

In preparation of this thesis, a literature review was performed based on literature from scientific journals and books. These articles were found by searching via ABI Inform, Blackwell Synergy, Google Scholar, and Emerald at the Eindhoven University of Technology. Books were looked up via the catalogue search engine of the library at Eindhoven University of Technology. A number of broad search terms were used to start the searching. These terms include “radical innovation, new product development, exploration, new business development, open innovation, etc.”. During the research project, new subjects did pop up and, consequently, were also searched on. These subjects include “project management, portfolio management, knowledge management, R&D strategy”. The relevance of the articles was first judged based on titles and after this scan the article was judged on the content of its abstract. Furthermore, important authors in the relevant fields were searched in order to find more work of them. Also, references of articles were studied in order to identify other useful scientific articles.

4.3 Methodology for Field Study

4.3.1 Unit of Analysis and Unit of Measurement

4.3.1.1 Unit of Analysis

First, within FFME new products/technologies are commercialized via project teams. Therefore, the first unit of analysis was projects. Both projects from the past that are already closed and projects that are currently in progress are researched. Also, the projects that are researched are executed by different departments within FFME. Therefore, this research project is cross-sectional by nature. Since the focus of this research project is on radical innovation, the studied projects are new-to-the-firm innovation projects. Second, the project and cross-project analysis emphasized the importance of portfolio management and strategic direction. Therefore, the NBD oriented departments of FFME were researched from a more holistic point of view. Thus, the explorative business processes within FFME can be considered as the second unit of analysis.

4.3.1.2 Unit of Measurement

Since, the field study focuses on radical innovation project success, the unit of measurement is profit derived from new-to-the-firm products. This profit can be achieved by increasing quantity and/or quality of projects. Quantity can be increased by increasing the number of projects, increasing the percentage of projects that make it to the market and decreasing the time-to-profit. Quality refers to introducing new products that have large, sustainable profit margins.
4.3.2 Project Selection Methodology

As mentioned above, the unit of analysis of this research project is projects. It is necessary to select the right, relevant projects from the total project portfolio of FFME. Firstly, the number of projects should be determined. The sample should be large enough to be reliable and small enough to be executed within the limited time frame of the research project. Therefore, a number of seven/eight cases is preferred. In order to select relevant projects, the following four selection criteria need to be taken into account.

Firstly, according to the literature review the main subject of this master thesis is radical innovation. Therefore, projects that are selected need to be as radical as possible. Incremental innovations fall out of the scope of this research project (see paragraph 3.3) and therefore they will not be investigated. However, it should be noted that it is hard to judge on the radicalness of an innovation. In practice, most innovations will be somewhere in between incremental and radical.

Secondly, the selected projects need to be a realistic reflection of reality. For example, within FFME there are two main sections in TRL that focus on exploration. It is necessary to include projects from both of these sections in order to draw conclusions that are relevant for the organization as a whole.

Thirdly, another less prevalent but also important selection criterion is the historical time frame of the project. The more recent a project had been executed, the more relevant it is to the current situation. Therefore, the author selected projects that were executed in the last few years. Especially in the particular case of FFME this is very important, since FFME has gone through major changes the last few years in order to become an ambidextrous, innovative company.

Fourthly, since this research project is problem-oriented there is a focus on failure and problems in the projects. Strictly, failure is the opposite of success and therefore can be defined as any project that did not result in financial benefits (chapter 5.3). In the specific situation of FFME most projects are still in progress, therefore the theoretical definition of failure cannot be applied. In these cases, a focus on improvement of the project management practices is applied, based on problems that are identified in the process so far. Thus, these projects are not judged as failures nor successes.

4.3.3 Project Comparison Criteria

In paragraph 6.2.3.1 a number of criteria are used to compare the different projects to each other. These criteria are general project properties that make objective comparison possible. They were selected based on their general applicability, their relevance with respect to project/portfolio management and their measurability/availability. The used criteria are determined by the author based on common sense. The list of criteria can be found in paragraph 6.2.3.1, the comparison table can be found in confidential appendix J.

4.3.4 Interviews

In the first part of this research project, interviews will be the primary source of information. Thus, the obtained data will be qualitative by nature. Therefore, interpretation from the author is important. Face-to-face interviewing is preferred for several reasons. Firstly, both verbal and nonverbal communication is possible. Secondly, a trustful relationship with the interviewee can be more easily build in a face-to-face interview. Also, interviewees can be motivated more actively by exuding enthusiasm. A final advantage is that visual aids can be used during the interviews. The interviewees will all be internal employees of FFME.

Interviews can be structured or unstructured (Sekaran, 2003). Because the aim of this research project is to analyze projects and compare different projects with each other, a certain level of consistency throughout the obtained data is required. Therefore, the first part of the interviews will consist of structured questions about different aspects. In this way, the kind of information that will be gathered will be useful for comparison. Then, the second part of the interview is more unstructured. The interviewees will be challenged to provide their own insights and an open discussion and exchange of thoughts and ideas is the most important aim in this part of the interview. By combining structured questions with unstructured discussion, the author intend to obtain both consistent data suited for comparison among the projects and as much information-gathering as possible. The interview schedule as used by the project level interviews is presented in appendix E.
Obviously, there are a lot of other general aspects important in taking a successful interview. For example, the questions should be formulated objectively in order to prevent biased answers. Further, the interviewer should clarify issues, explain unknown concepts, and encourage the interviewee to provide the information. Also, it is important to create a trustworthy and non-hostile environment in which the interviewee will be willing to provide all the information he has. In order to guarantee that the interview report is a realistic reflection of the interview, it needs to be checked and approved on by the interviewee afterwards.

The interviews were subdivided in three different levels, namely project level interviews, supportive level interviews, and strategic level interviews. For the project analysis, the results from the project level interviews were used. These interviews were conducted with the project leaders and NBD officers. A list of interviewees and codes related to projects can be found in confidential appendix M. The supportive and strategic interview schedules were specified to the interviewee and not included in the appendix. The supportive level interviews were used to make sure that all related aspects and departments are being considered in this project. Finally, the strategic level interviews were conducted to get insight in the strategic direction of the company with respect to NBD and in the portfolio management activities.

It should be noted that interviews were conducted in April and May of 2008. Since FFME is actively working on the improvement of their innovation processes some changes may have been made after the interviews that are therefore not taken into account.

4.3.5 Unobtrusive Data-Gathering and Participant-Observation

Unobtrusive data-gathering means that data is gathered without the (direct) involvement of people. In this research project, the following unobtrusive sources of information are used: the PMS document, data from intranet of FFME, FFME annual reports, corporate policy, all kinds of company documents as well as literature about practices in other companies. A specific list can be found in appendix G. Further, the author participated in the daily activities of the NBD departments. That means that the author attended in internal meetings, had informal chats with colleagues, etc. This contributed to the understanding of the organization.

4.3.6 Methodology for Diagnosis

Based on all the information that is derived from project level interviews, strategic level interviews, supportive level interviews, participant-observation, desk research, unobtrusive data-gathering, etc., the diagnosis was logically deduced. The most important deliverable of the diagnosis is a validated cause and effect tree that presents root causes. This cause and effect tree is the starting point for potential redesign directions. To construct this cause and effect tree, Minto (1987) was used. This book discusses best practices in how to structure thoughts and results in a logical way. The pyramid principle, as described in this book, is used as a method to construct the cause and effect tree (confidential appendix I).

4.4 Methodology for Redesign

As described in Van Aken et al. (2007), it is hard to describe a methodology for the redesign. The methodology that is used in order to justify the proposed solution is described in chapter 7.3. Further, the process towards a proposal of a redesign is often been described as the creative leap (Van Aken et al., 2007), which is mainly an uncontrolled individual-specific process. In general, the key activities in designing are synthesis-evaluation iterations (fig. 4.4, page 16). The synthesis stage embodies the creative leap, the evaluation of the redesign is done to check whether the redesign is likely to result in the desired performance improvement or not. If this is the case, the final design document is ready to be implemented.
Before the synthesis-evaluation iterations can start, design specifications need to be formulated. Design specifications include functional requirements, user requirements and boundary conditions (Van Aken et al., 2007). Functional requirements refer to the performance that should be provided by the redesign. User requirements are requirements that are important from a user (stakeholder) point of view. Thus, what requirements should be met in order to make the system usable for the people who are supposed to use it. Boundary conditions provide a framework of preconditions that should not be violated by the system.

4.5 Quality of Research

According to Van Aken et al. (2007), academic research should meet certain standards in order to guarantee its quality. The criteria they describe are:

4.5.1 Controllability

Controllability is a prerequisite for the evaluation of validity and reliability. The pathway to the research results should be made visible by the author. In this research project, controllability is achieved by describing as much as possible what has been done and how it has been done. Documentation and appendices are very important in this matter. For example, all interviews are documented and checked by the interviewees. This methodology chapter is also very important for the controllability of this research project. The tools and research approaches used are described and thus, this allows others to replicate and control the research.

4.5.2 Reliability

The results of a research can be considered reliable when they are independent of the particular characteristics of that research and can therefore be replicated in other studies (Swanborn, 1996). Four potential sources of bias are identified: the researcher, the instrument, the respondents, and the situation. Bias due to the researcher will be minimized by evaluating the results with other persons, which will make the results more independent of the researcher. Also, the interviews are checked by the interviewee for misunderstandings and/or misinterpretations. Different research instruments will be used in order to prevent a bias due to the instrument. This approach is also called triangulation (Braster, 2000).

The primary instrument are interviews, additional instruments are the use of scientific literature, company documents, observation, and other unobtrusive data-gathering methods. A bias due to respondents is minimized by comparing the views of different interviewees to each other. If an opinion is widely shared among employees it is assumed to be more reliable then when an opinion is mentioned by only one respondent. Further, interviews were held cross-sectional in order to reduce bias linked with sections/functions. However, it is inevitable that the respondents are all employees of FFME, therefore a certain degree of bias due to shared organizational believes might be present. Bias due to situational factors is reduced by conducting interviews at different moments in time. Also, the author was present in the organization for 6 months, and thus he is familiar with different circumstances. By reducing all these possible biases, the level of reliability of this researched is maximized to the large possible extent.
4.5.3 Validity

Validity refers to the relationship between a research result or conclusion and the way it has been generated. Different kinds of validity can be distinguished namely construct validity, internal validity, and external validity.

Construct validity is the extent to which a measuring instrument measures what it is intended to measure. In order to obtain construct validity, the questions of the interviews are formulated and thought over in advance to improve relevance. The relations between different concepts are made plausible by using scientific literature.

Internal validity concerns conclusions about the relationship between phenomena. Thus, conclusions are justified and complete. This is attained by making sure that conclusions are in line with scientific literature. Furthermore, the author conducted a structured cause and effect tree in order to increase the internal validity (see paragraph 4.3.6).

External validity refers to the generalizability of research results and conclusions to other people, organizations, countries, and situations. This is especially important in theory-oriented research, and thus less important in this case study that focuses on one specific area. Therefore, obtaining external validity is not considered in detail.

4.5.4 Recognizability

Recognizability refers to the degree to which the principal client, the problem owner and other organization members, recognize research results in the business problem solving project. The results have to sound reasonable, plausible or at least possible to them. In order to achieve recognizability, regularly feedback and interaction is used during the research project. Possible solution directions are discussed during the interviews and therefore the research results should at least to a significant degree make sense to the stakeholders.
Chapter 5 Theoretical Background

5.1 Introduction
This master thesis project started with a literature review in order to establish a theoretical foundation in the field of radical innovation. However, the author was confronted with a lot of new situation-specific concepts. Therefore, this theoretical background chapter was added in which additional concepts, theories, etc. that are used within FFME, that are important to come a redesign, or that are relevant in any other way, can be discussed. Together with the literature review, this chapter forms the theoretical basis of this master thesis project.

5.2 Summary of Literature Review on Radical Innovation
The literature review provides a broad theoretical base that prepared the author for his research project. The concept of radical innovation is discussed, including its importance, an historical perspective, a definition for radical product innovation, the organization of radical innovation and some thoughts about future developments in this field.

For a start, radical innovations, often introduced by small firms, have the capacity to destroy the fortunes of the established firms (Foster, 1986). They have a disproportionate contribution to a company’s profitability (Urban and Hauser, 1993). In addition, the effect of radical innovation on firms profits can also be long-lasting (Geroski, Machin, and Van Reenen, 1993). Thus, developing new products is very important, because companies who fail in developing new products might disappear in the future (Christensen, 1997; Cooper, 1998). Unfortunately, because of the risk associated with and required investment for the development of breakthrough or discontinuous innovations is often high, companies are often reluctant to undertake them (Wind and Mahajan, 1997).

In the literature review, radical product innovation was defined as a product innovation that is "technically substantially different from existing products, of which its perceived added value is much greater relative to existing products, and which causes substantial change within the organization." Thus, the radicalness of an innovation is considered from a technological, market and organizational perspective.

Then, different ways to organize radical innovation were described and discussed. The main competing research streams propose to organize radical innovation outside the company (Christensen, 1997) or to organize radical innovation within the company (Henderson, 1994; Tushman and O’Reilly, 1997; Tripsas, 1997). The researcher tended towards the latter, which is in line with recent trends. However, it should be mentioned that companies have to adapt their business processes and their company culture to facilitate and enhance radical innovation. A lot of research in this field has been done over the past ten years.

A general trend in radical innovation is that the company culture and a learning environment are more and more considered to be critical in achieving innovative success. Further, the integration of market knowledge within the new product development process is necessary to prevent developing a product that cannot be sold on the market (Herrmann et al., 2006). Thus, explorative theories like knowledge management, learning, leadership and communication are important (Berends et al., 2007; March, 1991). Many popular recent concepts like open innovation, increasing alliances, increasing training and education, outsourcing and so on can be related to these explorative theories.

The future of radical product innovation is obviously hard to predict, but it seems assumable that open innovation (Chesbrough, 2003) will become a widely accepted practice in most large firms. In addition, this will result in an increase in number of patents. Internal business units will be established that will explore opportunities from both technological perspective and market perspective, focusing on the environment. Also, company cultures will change, but obviously this will be a time consuming process. Supporting risk-taking and change, and support for tolerance of mistakes will slowly become common in the large incumbent firms. Nowadays, very innovative companies do already fit within this profile to a certain extent, and in my opinion lots of others will follow them.

Furthermore, future research directions are likely to be in line with the trends. The concepts of open innovation, knowledge management and the relation between those two concepts can be researched in more quantitative studies in order to provide additional insights in this matter. Also, the relation
between implementing open innovation and innovative performance might be researched in greater
detail. Further, scientific literature is not always consistent about radical innovation and how it should
be organized and enhanced. According to Damanpour (1991), it could be recommended to research
different organization types/characteristics as a moderator in the relationship between possible
determinants and innovation performance. This could provide a more nuanced view on radical
innovation. Comparing radical innovation in different industries might also be a possible future
research direction.

A more extensive discussion about the above-mentioned topics can be found in Van Denderen
(2008a)

5.3 Definitions and Concepts

During this project a lot of concepts and terms are used. In most cases, these terms and concepts are
explained and defined in greater detail. However, this is not always the case. Therefore, according to
the author it would be valuable to make a summary of important definitions and concepts that are used
in this thesis. Thus, this paragraph is a brief enumeration of terms and concepts.

- **Ambidexterity**: FFME is aiming at becoming an ambidextrous organization, which means aligned
  and efficient in their management of today's business demands, while also adaptive enough to
  changes in the environment that they will still be around tomorrow (Tushman and O’ Reilly, 1996).
  Thus, finding a balance between exploration and exploitation (He and Wong, 2004).
- **Commercialization**: This term is often used during the project, but a clear definition from scientific
  literature was not found. The author defines commercialization as all activities that are associated with
  bringing a product to the market. That means for example market research during the NBD process,
  but also marketing efforts and product launch activities later on.
- **Exploitation**: Exploitation is the opposite of exploration, and is associated with mechanistic
  structures, tightly coupled systems, path dependence, routinization, control and bureaucracy, and
  stable markets and technologies (He and Wong, 2004). Exploitation includes things such as
- **Exploration**: Exploration is associated with activities that explore the technical and market aspect of
  a possible new business. Exploration includes things captured by terms such as search, variation, risk
  taking, experimentation, play, flexibility, discovery, innovation (March, 1991). In general, exploration
  is associated with organic structured, loosely coupled systems, path breaking, improvisation,
  autonomy and chaos, and emerging markets and technologies according to He and Wong (2004).
- **New business development**: New business development includes explorative activities that are
  researching new business opportunities. New business development is often organized in the form of
  project teams and generally aims at more radical innovative products or technologies. Compared to
  new product development, new business development is broader and more strategic-oriented.
- **New product development**: New product development is the term that is used for the process of
developing a new product or service. Nowadays, the use of a stage-gate model is commonly accepted
and used by large, innovative firms in order to direct the new product development process (Cooper).
- **Open innovation**: Open innovation is a term that was introduced by Chesbrough (2003). The central
  idea behind open innovation is that in a world of widely distributed knowledge, companies cannot
  afford to rely entirely on their own research, but should instead buy or license processes or inventions
  (i.e. patents) from other companies. In addition, internal inventions not being used in a firm's business
  should be taken outside the company (e.g., through licensing, joint ventures, spin-offs).
- **Portfolio management**: Portfolio management is a dynamic decision process, whereby a business’s
  list of active new product (and R&D) projects is constantly up-dated and revised. In this process, new
  projects are evaluated, selected and prioritized; existing projects may be accelerated, killed or de-
prioritized; and resources are allocated and re-allocated to the active projects. The aim of portfolio
  management is to achieve a project portfolio with balanced risks, long vs. short term projects and the
  right number of projects. Maybe even more important, portfolio management provides very specific
  strategic direction to the researchers, since it can be considered as the link between company strategy
  and practice (Cooper).
- **Radical innovation**: From the literature review, radical product innovation is defined as a product innovation that is technically substantially different from existing products, of which its perceived added value is much greater relative to existing products, and which causes substantial change within the organization. Within FFME, an innovation is called radical when it is a new-to-the-firm innovation, from both market and technological point of view.

- **Stage-gate system**: A stage-gate system is a conceptual and operational road map for moving a new-product project from idea to launch. Stage-Gate divides the effort into distinct stages separated by management decision gates. Cross-functional teams must successfully complete a prescribed set of related cross-functional tasks in each stage prior to obtaining management approval to proceed to the next stage of product development (www.prod-dev.com). FFME uses the PMS document as a stage-gate system to manage their projects.

- **Strategic bucket**: A strategic bucket can be considered as a focus area, often based on a type of technology, type of market, product category, etc. Strategic buckets are commonly used to direct portfolio decision-making on a strategic level.

- **Success**: Obviously, success is a very broad term. In this research project, success is defined in terms of substantial and sustainable financial benefits.

- **Third pillar**: The third pillar is a company-specific concept that is often mentioned during the project. FFME used to have three profitable plants, or pillars, on which they could build. However, one of these plants has to be closed a few years ago. Thus, currently FFME has only two plants left. Therefore, they are trying to fill the closed plant in order to create a new third pillar.

### 5.4 Japanese Culture

Since the internship takes place in a Japanese company, differences between the Japanese culture compared to other cultures are looked up. Within FFME, some important functions are employed by Japanese employees and obviously the company policy and strategy is in line with the global, Japanese, strategy. Therefore, a significant Japanese influence in current activities is assumed to be present. This paragraph reflects on the Japanese business culture in short. This paragraph is mainly added for the sake of completeness and context description and will not actively be used later on. It is based on one of the most comprehensive cross-cultural studies, which was done by Hofstede (1993). He scored different countries on five cultural dimensions, namely:

- Power distance: the degree of inequality among people which the population of a country perceive as normal;
- Individualism: the degree to which people in a country prefer to act as individuals rather than as members of groups;
- Masculinity: the degree to which tough values like assertiveness, performance, success and competition prevail over tender values like quality of life, maintaining warm personal relationships, service, solidarity etc.;
- Uncertainty avoidance: the degree to which people in a country prefer structured over unstructured situations;
- Long term orientation vs. short term orientation.

**Culture Dimension Scores for Ten Countries**

<table>
<thead>
<tr>
<th>Country</th>
<th>PD</th>
<th>ID</th>
<th>MA</th>
<th>UA</th>
<th>LT</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>40 H</td>
<td>81 L</td>
<td>62 H</td>
<td>46 L</td>
<td>29 L</td>
</tr>
<tr>
<td>Germany</td>
<td>35 L</td>
<td>67 H</td>
<td>66 H</td>
<td>65 M</td>
<td>31 M</td>
</tr>
<tr>
<td>Japan</td>
<td>54 M</td>
<td>45 M</td>
<td>96 H</td>
<td>92 H</td>
<td>80 H</td>
</tr>
<tr>
<td>France</td>
<td>68 H</td>
<td>71 H</td>
<td>43 M</td>
<td>86 H</td>
<td>30 L</td>
</tr>
<tr>
<td>Netherlands</td>
<td>38 L</td>
<td>80 H</td>
<td>14 L</td>
<td>33 M</td>
<td>44 M</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>68 H</td>
<td>25 L</td>
<td>57 H</td>
<td>28 L</td>
<td>16 H</td>
</tr>
<tr>
<td>Indonesia</td>
<td>78 H</td>
<td>14 L</td>
<td>46 M</td>
<td>48 L</td>
<td>22 L</td>
</tr>
<tr>
<td>West Africa</td>
<td>77 H</td>
<td>32 L</td>
<td>46 M</td>
<td>54 M</td>
<td>10 L</td>
</tr>
<tr>
<td>Russia</td>
<td>97 M</td>
<td>39 M</td>
<td>40 L</td>
<td>59 H</td>
<td>10 L</td>
</tr>
<tr>
<td>China</td>
<td>87 H</td>
<td>27 L</td>
<td>50 M</td>
<td>66 M</td>
<td>11 H</td>
</tr>
</tbody>
</table>

* estimated

Figure 5.1: Culture dimension scores (Hofstede, 1993)
It appears that Japan scores especially high when it comes to masculinity, uncertainty avoidance, and long term orientation. It is hard to link these concepts to radical innovation; however, uncertainty is inherent to radical innovation. Therefore, it might be possible that the avoidance of uncertainty frustrates radical innovation, because the firm may tend to focus on more certain projects. Contrary, the long term orientation, which is quite typical for Japanese companies, can be positively associated with radical innovation since radical innovation is especially a long term activity.

5.5 Portfolio Management

Since the redesign is mainly focusing on the implementation of project portfolio decision-making in the PMS document, portfolio management practices are extensively discussed in this paragraph. Cooper, Edgett and Kleinschmidt are prominent researchers in this field and therefore often cited here. Their results and conclusions are considered to be reliable since they are based on a research among over 200 companies.

5.5.1 The Importance of Portfolio Management

Portfolio management for product innovation is considered as one of the most important senior management functions (Cooper & Kleinschmidt, 1996; Roussel et al., 1991). It is considered as the manifestation of the business strategy. Cooper et al. (2001) describe portfolio management as a "dynamic decision process, whereby a business's list of active new product (and R&D) projects is constantly up-dated and revised. In this process, new projects are evaluated, selected and prioritized; existing projects may be accelerated killed or de-prioritized; and resources are allocated and re-allocated to the active projects. The portfolio decision process is characterized by uncertain and changing information, dynamic opportunities, multiple goals and strategic considerations, interdependence among projects, and multiple decision-makers and locations."

Based on Cooper et al. (1998, 1999, 2000), eight key reasons for the importance of implementing portfolio management practices are identified:

1) Financial — to maximize return and R&D productivity, and to achieve financial goals.
2) To maintain the competitive position of the business — to increase sales and market share.
3) To properly and efficiently allocate scarce resources.
4) To forge the link between project selection and business strategy: the portfolio is the expression of strategy; it must support the strategy.
5) To achieve focus — not doing too many projects for the limited resources available; and to resource the “great” projects.
6) To achieve balance — the right balance between long and short term projects, and high risk and low risk ones, consistent with the business’s goals.
7) To better communicate priorities within the organization, both vertically and horizontally.
8) To provide better objectivity in project selection — to weed out bad projects.

![Figure 5.2: Importance of portfolio management (Cooper)](image-url)
Further, the importance of portfolio management can also be seen in figure 5.2 (page 22), where differences in portfolio management practices between best and worst performers are presented (Cooper). It can be concluded that the presence of a portfolio management system is a good predictor for being a successful performer. Also, the importance of aligning a business’s resources with its strategy is a very strong enhancer for being successful.

5.5.2 Portfolio Management Context

Portfolio management is obviously not a stand-alone issue. It is the connection between the product innovation strategy and actual resource allocation. According to Cooper, four major factors drive a business’s new project performance, namely a product innovation and technology strategy, solid portfolio management, an effective and flexible idea-to-launch system, and the right climate and culture combined with cross-functional teams and management commitment. These four points can be presented in “The Innovation Diamond” (fig. 5.3).

The product innovation and technology strategy should contain different elements. Elements that can be identified as successful are: clearly defined NPD goals, role of NPD in business goals, strategic arenas defined, long term commitment (which is positively associated with Japanese business culture, see paragraph 5.4), use strategic buckets and product roadmap usage. The process to come to a clear definition for the innovation strategy is described in fig. 5.4.
Thus, firstly goals have to be defined. An example of an innovative goal is a certain percentage of business sales that should come from new businesses. The role of NPD in the business strategy should be made clear here. Secondly, strategic arenas should be defined in order to provide focus in your NPD activities. For this purpose, a strategic map (appendix K) can be used. Thirdly, an attack and entry strategy should be formulated. Thus, how to attack the market? Should we focus on being low-cost, on being a first-mover, etc? Finally, resource allocation should be executed in line with this strategy. Actual resource allocation can be done on two different levels, namely on strategic and on tactical level. Strategic portfolio decision-making considers how to allocate resources among different strategic buckets. A strategic bucket can be considered as a focus area, often based on a type of technology, type of market, product category, etc. Tactical portfolio decision-making focuses on resource allocation issues within the strategic buckets, thus, with a focus on individual projects. There are several portfolio management methods available to rank and prioritize projects. These portfolio management methods are discussed in the next paragraph.

5.5.3 Portfolio Management Methods

In the previous paragraph, the importance for implementing a portfolio management system was discussed. However, the contents of the portfolio management system should be specified. Portfolio decision-making can be done based on different methods, this paragraph will start looking for these methods and their perceived effectiveness. There are different portfolio management methods that are used in companies, but some methods are used more often than others (table 5.1, page 25; derived from Cooper et al., 2001). These methods can be considered as suggestions for FFME. The following portfolio management methods were subject of research:

1) **Financial methods** typically aim at the economic value of projects to rank projects. This method is assumed to be the most popular because it's a very concrete, quantitative measure that focuses directly on profit, the ultimate target of every company. However, it should be noted that, especially in radical innovation, predictions of profit are very uncertain. Therefore, the reliability of this method can be questioned.

2) **Strategic approaches** are allocating resources to different strategic buckets. This method is less frequently used as dominant method, however, it appears to be a very effective method for establishing a successful portfolio. Resource allocation based on strategy is often less formalized and more a custom-made solution. Therefore, it might be well suited for radical innovation decisions.

3) **Scoring models** are also quite widely used. Projects are scored based on different aspects and prioritized relative to each other. An advantage of these models is that different criteria can be used. Especially criteria that can be linked to strategic fit, financial reward pay-off and risk and probability of success appear to be successful.

4) **Bubble diagrams** are also a popular tool, but are more often used as a supporting tool. Examples of popular bubble diagram plots are risk vs. reward plots, newness plots and ease vs. attractiveness plots.

5) **Checklists** are the least popular method for portfolio decision-making. Just like bubble diagrams, checklists are preferably used as a supporting tool. Relative to scoring models, checklists are more often used for Go/No Go decisions of individual projects, whereas scoring models are more often used for ranking projects.

In appendix K, an overview of examples of these methods can be found. All these examples, diagrams etc. are extracted from articles of Cooper, Edgett and Kleinschmidt.

Cooper et al. (2001) conducted a research to link these methods to best performing and worst performing businesses. This can be used as an indicator for the effectiveness of the relevant portfolio management method. These results are presented in figure 5.5 (page 25). The popularity of the methods is stated in table 5.1 (page 25).
Table 5.1: Usage of different portfolio management methods

<table>
<thead>
<tr>
<th>Portfolio Management Method</th>
<th>Usage (%)</th>
<th>Dominant method (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Methods</td>
<td>77.3 %</td>
<td>40.4 %</td>
</tr>
<tr>
<td>Business Strategy Alignment</td>
<td>64.8 %</td>
<td>26.6 %</td>
</tr>
<tr>
<td>Bubble Diagrams or Portfolio Maps</td>
<td>40.6 %</td>
<td>5.3 %</td>
</tr>
<tr>
<td>Scoring Models</td>
<td>37.9 %</td>
<td>13.3 %</td>
</tr>
<tr>
<td>Check Lists</td>
<td>20.9 %</td>
<td>2.7 %</td>
</tr>
</tbody>
</table>

Note: Dominant methods employed adds to 100%.

Figure 5.5: Usage of portfolio management methods: best vs. worst performers (Cooper)

Thus, it seems that balancing your portfolio based on business strategy oriented prioritization methods can be associated with high performance. In addition, the results of Song and Montoya-Weiss (1998) state that the strategic planning phase, defined as “preliminary assessment and integration of a project’s resource requirements, market opportunities, and strategic directives”, is generally the most underemphasized determinant for really new innovation projects. This emphasizes the importance of strategic alignment as a predictor for radical innovation project success. The research of Song and Montoya-Weiss is based on a study on over 330 innovations and therefore its results are reliable. In addition, it should be mentioned that high performing businesses often use more than one method (2.43 on average), where worst performing businesses rely on 1,83 methods on average.
Chapter 6 Field Study: Analysis & Diagnosis

6.1 Introduction

In this chapter, recent projects are selected and discussed in detail. After selecting the projects that will be subject of research, interviews are conducted to provide better insight in how radical innovative projects within FFME are directed and managed. In addition, documents will be studied to verify and/or extend the outcomes of the interviews. For confidentiality reasons, these documents are not included in the appendix. However, for verification reasons, a list of used documents and files is given in appendix G. After the analysis on project level, a cross-project level analysis will be executed and presented in this chapter. This cross-project analysis includes a comparison between projects and a search for common problems. Where the results of the analyses are mainly descriptive and objective by nature, the results presented in the diagnosis are mainly interpretation of the researcher. The final result of the diagnosis is the conducted cause and effect tree that can be found in confidential appendix I. Based on this cause and effect tree a direction for redesign was selected.

6.2 Analysis of Project and Portfolio Management Practices within FFME

6.2.1 Selected Projects

Based on the methodology as described in paragraph 4.3.2, projects are selected for research. There are two main sections within TRL that focus their R&D activities on NBD, namely Life Sciences (LS) section and Digital Inkjet Paper (DIP) section. Therefore, projects from both sections are selected. Two projects from the past, project A and B, were terminated because they did not meet the evaluation criteria. Both projects are clear failures since they did not make it to the market. The DIP group was established to work on project B (were its name is based on), but is currently busy with more radical innovations that are not related to digital inkjet paper anymore. Project A was an innovative project that was executed within TRL but that was more related to PI, since TRL was intended for product support for the plants in that time. Due to the fact that NBD is relatively new for FFME, its history in this field is limited. Therefore, a lot of projects, project C, D, E, F, G and H, are still progress. Projects C and D are projects that are executed within the LS section and projects E, F, G and H are executed within the DIP section. Project F is very close to market introduction, where project E, G and H are in early development phase. Project C and D are more research-oriented and they are not close to the market.

6.2.2 Analysis of Individual Projects

This paragraph presents summaries of the eight observed projects. The used interview schedule can be found in appendix E, the interview reports on project level can be found in confidential appendix F, the used unobtrusive data is described in appendix G, and the historical process flow diagrams of the different projects are presented in confidential appendix H.

6.2.2.1 Story of Project A

Project A is a failure since it was terminated in 2007. Thus, it was quite recently executed. This project did not aim on a purely radical product. Following the interviewees, the project was neither incremental nor radical, but somewhere in between. Nevertheless, since NBD was involved and the funnel was used, this project is considered to be relevant.

Project A was practically initiated in June 2006 by company 1. The concept was to coat photographic material on a deformable substrate. This potential product could be used to print photos on shaped objects like furniture and the like. FFME was contacted to provide the production technology for this product.

From June 2006 to June 2007 the project muddled on without too much results. The cooperation with company 1 was not that good, appointments were not met, promises were not kept, and claims about patents were doubtful when checked. Because of this, the gut feeling of interviewee 1 was not that positive. However, in June 2007 the funnel model was applied to this project and interviewee 9, an
NBD officer, conducted a market study. An official project team was established which resulted in an increase in commitment. There were visits to the company in London, but the NBD officer was not present here as he had not yet been involved.

The main result of the market study was that customers were not willing to pay for the top quality of this new product. Because of the viewing distance from print, high quality was not needed. Also, the market was very competitive, the product was considered to be 5-10 years too late. Further, the market trends were going downwards instead of upwards. The results of this market study were discussed in October 2007 and the MT decided to terminate the project. All participants agreed with this decision, since the potential was not promising. According to interviewee 1 the project could have been terminated 9 or 10 months earlier if the market study was conducted earlier.

6.2.2.2 Story of Project B

Project B was a failure since it was terminated. The project, that actually consisted of two projects namely project B1 and project B2, can in general be considered as somewhere in between incremental and radical innovative. The B2 project was more radical than the B1 project. However, from a technological point of view, the projects can be considered quite radical. Like project A, project B is also executed a few years ago and it was terminated in 2006. Therefore, it is less recent than most of the projects.

Since people made their photographs with digital cameras, they were printing more photos with their own inkjet printers. As a result, the demand for CLP decreased. Therefore, FFME wanted to develop a digital inkjet paper (DIP) on which people could print high-quality images at their own printer at home. During the B1 project a digital inkjet paper was developed for this purpose based on Technology B1, but there was hardly any market study done. The quality of the product was high, but customers didn't want to pay for that quality. Also, there was a lot of competition and therefore the feasible profit margin on the product was too low.

Then, the B2 project was launched to develop DIP based on Technology B2. This technology had the advantage that it could provide a paper with high absorption combined with sustainable quality. However, this product was also not sold because the sales organization in Düsseldorf did not see the potential of it. FFME tried to sell the product themselves, but they didn't succeed. Also in this project, there was very limited market study done. The market appeared to be very price-competitive and the product wasn't able to compete in the market. Also, the market trend was downwards instead of upwards. The funnel was not used at all during this project.

6.2.2.3 Story of Project C

Project C was evaluated based on the earlier-mentioned criteria. Firstly, this project is currently still in progress and therefore it is very recent. It is not possible to judge this project as a failure or a success, since it is still in progress. Therefore, the focus will be on improvement and learning points that can be derived from it. Project C is executed within the LS group, and the funnel is not used. This project is very radical.

In short, project C aims at producing a version of raw material A, that is stable and pure enough to be used in medical applications. This project is in progress for about 10 years now. In the first years the research was more fundamental without a clear focus. Currently, the project gets a higher priority and some broad potential markets are identified. The project leader aims to have a product that is ready to be tested on humans in 2009.

Project C is the responsibility of both FFME and FTYO, since FTYO provides significant funds for the project. The funnel is currently not used to direct the development process. The business side is underrepresented in this project, which is a learning point according to the project leader. NBD is not involved in this project so far. There is a substantial level of uncertainty present with respect to market expectations. It is not clear yet whether the project is likely to generate significant profit per year or not. It might have the potential to become a business domain, but since market opportunities are not clear, the financial potential is hard to predict.
6.2.2.4 Story of Project D

Project D is very radical from both market and technology perspective. It is executed within the LS group and the funnel is not used. The project is very recent because it is still in progress. Therefore, the focus is on improvement points in the organization and process of this project and it will not be judged as a failure or success.

The project started about 10 years ago and can be divided in several smaller projects that are all based on technology D. It started with project D1 that appeared to be too expensive and therefore it was terminated. However, a follow-up project D2 was initiated, based on the knowledge that was created during project D1. The aim of project D2 was to stabilize technology D and this project was a success. A spin-off project of project D2, project D3, is a project that provided very interesting results that could result in a new product in a relatively short time frame. However, the project leader lacks manpower to execute this project. It is mentioned that the project could not even exist without the manpower used from universities and third parties. However, there are sufficient funds available since FTYO is also providing substantial funds to this project.

Currently, with respect to project D, a follow-up project of project D2, namely project D4, is in progress. This project is based on a very new technology that is still in its infancy, but that might have the potency to grow large. However, there is not enough data or market study done to determine a target market and opportunities for this project.

Project D is very technological and research oriented, and the evaluation criteria are purely technical. The business side is done by the project leader, who is obviously not trained for that. Consequently, the market side of this project is underrepresented and NBD and the funnel are not used in this project. There is not a clear focus on what market to aim on and the research is not directed by strategy. That means, content-wise, the project leader is free in researching in the direction he wants.

6.2.2.5 Story of Project E

Project E is very radical and currently in level 3 of the PMS document. Because the project is currently in progress, the focus will be on improvement and learning points. This project is executed within the DIP group and the funnel is actively used. It is too early to rate this project as a success or a failure, however, no significant failures or problems have occurred so far.

The project was initiated in November 2006 and in January 2008 it entered level 3 of the funnel. The idea of this project is to create a non polluting, renewable source of energy, based on technology E, which is not dependent on the weather, does not disturb nature and environment, and provides a constant flow of energy. This can be achieved by using a new technology E developed by FFME. Project E is considered to be a long-term project (5-10 years).

During this project, there is a very strong network of partners built, including Eindhoven University of Technology, a centre for sustainable water technology, a company specialized in energy consultancy, a large energy company, etc. Also, FFME attracted additional funds in the form of subsidy. Further, there are also some spin-off applications that can be realized in a shorter time frame (1-2 years).

It was stated that project E could have been terminated in an early stage when the funnel was used strictly and aiming on cost efficiency, however, it proceeded. On the long run, it might have the potential to become (part of a) third pillar for FFME. However, it was mentioned that currently, there are not enough resources in terms of manpower to accelerate this project.

For this project, a chronological process flow diagram was constructed. Due to confidentiality issues, this diagram can be found in confidential appendix H.

6.2.2.6 Story of Project F

Project F is somewhere in between incremental and radical innovative, but more radical then incremental. Project F is currently in level 1 of the funnel and therefore, it is about to enter the market. This project is executed within the DIP group. It is a special case, because it is the first project that has been gone through the whole funnel.

Project F can be considered as a successor of project B2. The product of project F was based on the technologies of project B1 and B2. By using technology F, a high quality of photographic images is achieved that can be used in the advertising out and indoor market. The product has a very high quality, less energy and ink usage, and it can be used both in day and night.
This project is executed in a relatively short time frame. It was initiated in February 2007 and its market introduction is planned in June 2008. This was possible since FFME was quite familiar with the market. The project started with a focus on technology. The PMS document was used, however, not all requirements were met in time. Also, evaluation criteria were not clear, incomplete and sometimes irrelevant. Therefore, the project had sometimes entered a level where it shouldn't be since it did not meet the criteria. In this case, that did not result in large problems, but it could have. Further, when the product had to be produced in the plant, there was not any manpower allocated to it. Therefore, the transition of the product to the plants was laborious in the beginning.

In this project, the cooperation between NBD and DIP was perceived as good. Feedback from the market was used to direct the development and vice versa. Although, a market evaluation could have been executed earlier. Also, it was mentioned that time could have been gained by ordering printers earlier although they were expensive. Further, selling the product internally was hard and establishing sales channels was difficult. These aspects were most prevalently mentioned as weak aspects of this project. Of course, this is partly due to a lack of an internal sales organization.

It seems that project F is likely to become a commercial profitable product. Nevertheless, it seems to lack the potential to become FFME's desired third pillar, because profit margins and volumes are expected to be limited, however it can be a part of the third pillar. Therefore, the quest for the third pillar as mentioned in the company policy will have to continue.

6.2.2.7 Story of Project G

Project G is somewhere in between incremental and radical, but more radical then incremental. The project is currently in level 4 of the funnel that applies for this project. There are some technological hindrances and problems and therefore success is uncertain. The project was initiated by a market pull and it started with a market study one year ago.

The basic idea of project G is to develop a foil that reflect infrared radiation and transmits visible light. Such a foil could be used in greenhouses for climate control purposes, because it does not disturb the growing of vegetables, while it does reflect infrared which results in a temperature that can be regulated easily. Therefore, there will be less energy usage.

Currently, project G is facing technological issues because not all the critical property levels are present yet. According to the project leader, prove of principle is actually done, but during stage-gate meetings, additional criteria were formulated by management. The deadline for entering level 3 in January 2008 is not met and was postponed to April 2008. However, also this deadline was not met. The project has changed its track several times. According to the funnel model, in level 4 only a small test machine can be used. However, a large machine is required in this project, because the small test machine lacks speed which results in too thick layers.

During project G, some track changes have occurred. Therefore, the project was not terminated. It is mentioned that hard criteria are necessary to determine whether the project should proceed or not. Also, recently it appeared that the product might be too expensive from a cost-price point of view. Thus, also its commercial viability is doubtful.

6.2.2.8 Story of Project H

Project H is quite radical, especially from a market point of view. This project is currently in level 3 of the funnel and is about to enter level 2. The project started before the introduction of the funnel model. The project cannot be rated as a failure or a success since it is still in progress.

The concept of project H is developing and producing gas separation components that save energy, are chemical free and that are relatively cheap. The current performance of these components is sufficient to enter the market, but a higher performance is required to dominate the market.

There is a well-perceived cooperation between NBD and TRL. This project is executed within the DIP group and the funnel is used. Results from the market exploration were used to determine the research direction and research results influenced the market segments that FFME is focusing on. The project is almost 2 years in progress. During the first year, the project leader had to do the business side for himself since NBD was not established yet.
It was mentioned that manpower and funds are not sufficient, but this is understandable according to the project leader because there is a high uncertainty. Strong points of this project that are mentioned are the cooperation with third parties and the communication with potential customers. However, during this project there were some problems with NDA's (non-disclosure agreements). Currently, these NDA's with other companies were based on a standard NDA that was present within FFME. However, this seems to be insufficient because they are too general. Therefore, this is a learning point for FFME to change its NDA strategy. These NDA issues were totally new for FFME in the NBD field. All in all, this issue will result in an expected delay of the project with two months. Within this project, a b2b strategy might be the best solution, since FFME lacks an own marketing department and experience in this new market. Also, FFME is only capable of producing one component of the end product. Although this component is the most functional one in the unit, cooperation with third parties to produce the total unit seems to be inevitable.

6.2.3 Cross-Project Comparison Analysis

6.2.3.1 Comparison of Projects
Projects are compared to each other in order to provide insights in the differences and similarities between projects. This is especially useful when the project portfolio of FFME is reviewed from a more holistic point of view. A project comparison overview is given in the form of a table. However, this table contains confidential information and therefore it is presented in confidential appendix J. In this table the projects are described and compared based on certain criteria (see chapter 4).

- Status (terminated - in progress)
- Term (short term - mid term - long term)
- Potential in terms of profit (small - significant - third pillar)
- Technological radicalness (scale from 1 - 5 = incremental - radical)
- Market radicalness (scale from 1 - 5 = incremental - radical)
- Resources (number of FTEs involved)
- Section (by which section is the project executed?)
- Funnel use (yes/no)
- NBD involved (yes/no)
- Technology (which technologies are involved?)
- Market study (yes/no)

6.2.3.2 Management of NBD Projects
As mentioned earlier, FFME wants to become an ambidextrous organization. That means, exploiting current business and exploring new business simultaneously. Within the plants, FFME is exploiting their current business and within TRL and NBD they started exploring potential new businesses. TRL consists of approximately 150 FTE and NBD of 4 FTE. Within TRL there are two groups that focus on explorative research for new business, namely Digital Inkjet Paper group (DIP) and Life Sciences group (LS). Currently, FFME is actively searching for new competent NBD officers, but it is hard to find them because both affinity with technology and market is required. Recently, FFME has implemented the project management system document (PMS) as a guideline for the management of NBD projects. This PMS document is based on the funnel model (Wheelwright and Clark, 1992) and describes evaluation criteria for the projects to enter the next level. Level 4 of the funnel, the initiation phase where opportunity scanning and development has to be done, is entered when a feasible idea is generated. Subsequently, in level 3 the business concept development takes place, in level 2 company strategic shuttles are established, level 1 focuses on the implementation of the innovation, and level 0, the final phase, is the maturity stage in which the project is completed from an NBD perspective (fig. 6.1, page 32). The complete PMS document as used within FFME can be found on the intranet of FFME.
Currently, the PMS document is only used within the DIP group and not within the LS group. This is caused by the perceived special position of LS within TRL and the fact that NBD lacks manpower to support the projects within LS. When the project leader thinks that his project should enter the next level a decision document is prepared and a stage-gate meeting is held. In this meeting management decides whether the project can enter the next level or not. Theoretically this decision should be made based on objective criteria, but in practice it is often based on gut feeling due to a lack of reliable, quantitative data.

Further, when someone has an idea or initiative that is promising enough, it can become a project. An experienced researcher within TRL becomes project leader/manager of the project. In the beginning, there is not that much manpower allocated to the project, but this generally increases when the project is going further into the funnel. Supportive departments are approached when their expertise is necessary. Resource allocation among the projects is not formalized and mainly based on the judgment of the TRL and NBD managers. Also, there is no formal prioritization procedure. Thus, there is no formal portfolio management present. Especially in the NBD department there is a lack of manpower. Currently, the funnel is unbalanced in terms of level occupation. This is also due to the fact that FFME started with radical innovation only a few years ago.

As can be seen in confidential appendix J, projects C and D are executed within the LS group and projects E, F, G, and H are executed within the DIP group. The division of the projects over the different funnel levels can be visualized as presented in figure 6.2. As can be seen, the current funnel occupation is unbalanced since the projects concentrate in the early phases of the funnel. The funnel levels of project C and D are indicative since the funnel is not used in these projects. NBD is currently not involved in these projects and thus their focus is mainly technological.

![Figure 6.1: Stage-gate model as used within FFME](image)

![Figure 6.2: Funnel occupation for FFME](image)
6.2.4 Analysis of FFME’s Problem Situation

6.2.4.1 Results of General Interviews

In addition to the information that was derived from project level interviews, the supportive and strategic interviews (appendices F2 and F3) contributed significantly to the understanding and problems in FFME’s innovation process.

With respect to the commercialization of new products, the lack of an aggressive marketing and sales organization is mentioned. Especially when entering new markets, where the brand name of Fujifilm is less established, marketing and sales are important. This is especially important in radical innovation. The interviewees state that there is not a formal resource allocation or portfolio management system present.

When it comes to the innovation process, it was mentioned that the MT determined a target for NBD that can be calculated by multiplying the change of success with the expected profit of a project. However, in practice this calculation system is not used since there is too much uncertainty in these numbers. Further, it was stated that communication, performance indicators and feedback and evaluation loops should be improved/introduced.

Then, the TRL manager states that the DIP group and the LS group should essentially work in the same way. However, it is recognized that this is currently not the case. LS is more technology-oriented and therefore more focused on fundamental research, where DIP is more development oriented and focusing on creating new business. The target of both DIP and LS is to create new products/business for FFME.

Further, the market side is underrepresented, especially in the LS group. There is a consensus among the interviewees that applying the funnel to the projects within LS would be beneficial. Other statements from the strategic interviews are that some MT members want to be involved earlier in the process, that employees should go outside to build networks, and that it might be useful to have NBD in the TRL building. Also, the establishment of objective project managers as project leader instead of researchers is proposed.

Furthermore, also in the supportive interviews it was mentioned that the market side is often underrepresented. Almost all involved sections state that early involvement in the NBD process is very fruitful. For example, procurement is actively involved early in the process and therefore they can direct the researchers to choose for particular raw materials that have purchasing advantages. Another important section that is involved in the process is the IP section. It was stated that, mainly due to a lack of manpower, the role of IP is currently not dominantly positioned within the process. The awareness of the importance of IP is not sufficient among the researchers, according to the IP manager. This should become a way of thinking that is embedded in the all-day activities within FFME. The personal slogan of the IP manager is “from reactive filing to proactive protection”. Thus, IP should become more prevalent in the NBD process since patent filing is important, especially when you want to practice open innovation.

From all the conducted interviews, some issues were identified based on the frequency of mentioning. The most important issues (based on the frequency of mentioning in the interviews) are stated in table 6.1 (page 34). The interviewees that mentioned these issues were marked with an X. It is important to keep in mind that not all issues were relevant for all interviewees. For example, strategic interviewees (14-17) cannot perceive an unclear strategy for researchers. The interviewees are subdivided in project level interviews (project leaders and NBD officers), supportive level interviews (IP, procurement, etc.), and strategic level interviews (MT members). The issues were derived from the official interview reports as presented in confidential appendix F.
Table 6.1: Frequency of causes mentioned by interviewees

<table>
<thead>
<tr>
<th>Issue</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underrepresented market side</td>
<td>9</td>
</tr>
<tr>
<td>Resource allocation issues</td>
<td>8</td>
</tr>
<tr>
<td>Research without clear focus</td>
<td>7</td>
</tr>
<tr>
<td>Hard cooperation other subsidiaries</td>
<td>6</td>
</tr>
<tr>
<td>Unclear funnel criteria</td>
<td>5</td>
</tr>
<tr>
<td>Unclear strategy for researchers</td>
<td>5</td>
</tr>
<tr>
<td>Not using funnel</td>
<td>4</td>
</tr>
</tbody>
</table>

In general, the underrepresented market side is the most frequently mentioned issue. This issue was usually mentioned in relation to the LS projects. Furthermore, the resource allocation and absence of formal portfolio management is often mentioned. This issue is also confirmed when the project comparison table (confidential appendix J) is studied. Almost all the interviewees who have had experience with cooperating with other Fujifilm subsidiaries state that this cooperation is hard, especially when new products need to be commercialized. Then, not using the funnel within LS is often mentioned as a point of attention. In addition, the evaluation criteria in the PMS document are often perceived to be too abstract or not relevant. Furthermore, the strategy of FFME is not clear among researchers. Therefore, it is stated that it is hard to direct research. Finally, it was mentioned that there were several projects that muddled on for too long. In the diagnosis these causes are interpreted and related to each other and finally presented in the form of a cause and effect tree. Also, the current innovation practices and context will be related to the problems of FFME.

6.2.4.2 Innovation within FFME from an Historical Perspective

In this paragraph, the chronological flow diagram as constructed in confidential appendix A, is explained in greater detail. FFME was established in Tilburg in 1982 as the first production location outside Japan. For over 20 years FFME produced profitable products in three plants. FFME was not really involved in innovation and R&D activities. Except from some small incremental innovations. Customers worldwide came to Fujifilm because of their high quality products, their low prices and their established brand name. As a result, Fujifilm did not need to have an aggressive sales and marketing organization. The sales department was practically order-intake. There was no direct need for generation of new business because the current business was very profitable.

In the late 90s the Japanese TRL manager got interested in technology C and D and he started research within a Life Science section in these fields. Practically, these were the first explorative activities within FFME. Later on, this Japanese manager went back to Fujifilm Tokyo in Japan, but his commitment to the Life Science activities in Tilburg was still present. Currently, the Life Science group gets funding from strategic budgets of Fujifilm Tokyo. Consequently, Fujifilm Tokyo has a significant influence in the activities of LS. Nevertheless, formally the Life Science group falls under the president of FFME.

Then, in the beginning of the 2000s, the digital revolution expanded. Digital cameras replaced old cameras that used color negative film. As a result, the market for color negative film decreased enormously and also the color paper market became much tougher. Margins and volumes decreased and some major players in this market went bankrupt. For FFME, the digital revolution resulted in the closure of their most profitable plant, P2, and in a decrease of demand for the product of P1. This happened within a time span of only a few years.

When FFME was confronted with the digital revolution, they tried to develop a digital inkjet paper. This paper could have been used to print on high quality on your own home printer. However, the digital inkjet paper (DIP) they developed was not commercially viable due to its lack of margin, a very high competitive market, and an over engineered product which quality was not appreciated by the customer. Also, there was unwillingness within the European sales organization to sell the
product. As a result, FFME tried to commercialize the product themselves, but they were not successful. However, during the development of DIP new technologies were identified.

After the DIP story and the closure of P2, FFME recognized the importance of creating a new third pillar. Therefore, FFME needed to become an innovative company instead of only a production location. A new strategy was formulated and a large reorganization took place. From then, TRL adopted a focus on new business development activities instead of providing technical support for the plants. The technical support was moved to the plants. Based on the technological knowledge that was generated during the development process of DIP, different projects were initiated and allocated to the DIP group.

Then, FFME stated that they should be ambidextrous and therefore a New Business Development department was established as a staff department. NBD and TRL are supposed to cooperate to develop new business, where NBD provide the market side and TRL the technology side. For the DIP group the funnel model was implemented and used to direct the NBD projects. Actually, DIP and LS have a similar target, namely generating new business for FFME, but they are not working in the same way. This is mainly due to the special relationship between LS and Fujifilm Tokyo. Further, the current NBD department lacks manpower to handle all the projects. FFME is still in an early phase of the transition from a production location to an innovative company.

6.2.4.3 Core Competencies of FFME

Recently, FFME has formulated four technical business areas (TBA's) or core competencies. These core competencies originate from FFME's earlier and existing business experience. The four technical business area's are technology B2, C, D, and G. Technology G can be considered as the basic core competency of FFME which is embedded in their current production lines, technology B2 and D are technologies that can be combined with technology H and therefore can be added to the current production lines. Technology C is more or less an independent technology that could have been used in the production process of P2. However, since P2 is closed, new applications are being researched for this technology. Due to confidentiality issues, these technologies are not described in greater detail.

Within the LS group technology C and D are researched. These technologies are both very radical technologies that are not only new-to-the-firm, but also new-to-the-world. Project C and D are based on these two technologies. Then, within the DIP group project E, F, G and H are in progress. These projects are based on technology B2 (project E, F, and H) and technology G (project G). However, there is some overlap of technologies among different projects (confidential appendix J). Technology D can be compared with technology B2, because they can both be integrated in the current production lines that are specialized in process technology G. In the current situation, technology D is an isolated technology. The LS group and the DIP group don't have much contact and therefore there is a lack of communication between the researchers involved in the research of technology D and the developers that are busy with technology B2 and G. The relation between the TBA's within FFME can be visually represented as in figure 6.3.

![Figure 6.3: Relations between technologies within FFME](image-url)
The dark boxes represent the four defined core technologies within FFME, where technology B2 and G are DIP group research areas and technology C and D are LS group research areas. The light boxes represent two technologies that can be made with technology B2 and that, consequently, are also being researched by the DIP group.

<table>
<thead>
<tr>
<th>TBA</th>
<th>R&amp;D FTE's</th>
<th>Maturity</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology B2</td>
<td>5</td>
<td>Medium/High</td>
<td>DIP</td>
</tr>
<tr>
<td>Technology C</td>
<td>20</td>
<td>Medium</td>
<td>LS</td>
</tr>
<tr>
<td>Technology D</td>
<td>5</td>
<td>Low</td>
<td>LS</td>
</tr>
<tr>
<td>Technology G</td>
<td>2</td>
<td>High</td>
<td>Overall</td>
</tr>
</tbody>
</table>

Table 6.2: R&D resource allocation between technical business areas

From table 6.2 it can be seen that the current resource allocation among the core technologies is unbalanced. Technology C, of which its consumer benefits are unclear and which is not close to a market introduction, absorbs a large part of the R&D resources. Although it is hard to make a hard distinction between research and development, it could be concluded that research absorbs the main part of the resources (table 6.2), since technology C and D are research-oriented. Table 6.2 is derived from an internal document (see confidential appendix L) and checked with the numbers that were derived during the project level interviews (confidential appendix F). No significant differences were found.

The third column of table 6.2 states the level of maturity of the TBA both in terms of technology and in terms of market, where technology G is the most mature TBA that is currently used in the plants. FFME has a lot of experience with this technology and the high quality, high speed and high volumes they can produce with it are unique. Then, technology C has a medium level of maturity, where the technological maturity exceeds the market maturity. Consumer benefits are still not clear, but the technology is quite rare and not easy to imitate. Technology D is the most immature technology, but it might have large potential benefits. However, the exact benefits are not clear since the market side is very under-represented here. The maturity of these TBA’s is also represented in terms of PMS document progress (fig. 6.4).

In short, technology B2 and technology G are more application development oriented, where technology C and technology D are more research oriented. In technology C the level of development and market opportunity search is larger then in technology D. According to the author, a different approach for research and development activities is beneficial.
6.3 Diagnosis of Problem Situation

In this paragraph, the diagnosis of the problem situation is presented in the form of a cause and effect tree. The data presented in the above-described analysis is connected and interpreted in a logical way and a validated cause and effect tree is constructed based on Minto (1987). This cause and effect tree is presented in different parts in confidential appendix I. The first two levels of the validated cause and effect tree are presented in figure 6.5. The presented root causes are presented in greater detail in confidential appendix I.

![Figure 6.5: Top level of validated cause and effect tree](image)

The validated cause and effect tree starts with a problem statement, which was the starting point for this project. This problem statement is briefly formulated as: the exploration process of NBD projects is not optimal. Based on the interviews and unobtrusive data-gathering four root causes were identified and elaborated. Each arrow between two boxes in the cause and effect tree states: why is that? In that way, a logical subsequence of causes and effects and a thorough insight in the problem situation was derived.

Here, the author discusses the four root causes in greater detail.

1) Firstly, the fact that resources are not optimally tuned to the strategy was identified as a root cause. The available manpower is limited and the distribution of this manpower is unbalanced due to unstructured resource allocation process. The underlying root causes are that FFME lacks a portfolio management system and, as a consequence, there is no structured prioritization between projects. In the previous paragraph, the imbalance in resource allocation is clearly presented in table 6.2 (page 36).

2) Secondly, especially in the interviews with the researchers (confidential appendix F), it is frequently mentioned that there is a lack of research focus. It is often not clear on which markets or technologies they should focus. Shortly, the strategy of FFME is not clear in terms of goals and how to achieve these goals. Within LS there is a lack of focus on creating products since the business side is underrepresented and the PMS document is not used. For a more detailed presentation, see confidential appendix I (part I).

3) Thirdly, the difficult commercialization path within FFME is mentioned. It is a given fact that FFME has always been a production location and that sales and marketing was done by other subsidiaries. The cooperation with these subsidiaries is laborious which is assumed to be caused by differences in (business) culture and by the fact that in the past there was an unwillingness to commercialize some products that were developed by FFME. All in all, there is no internal sales organization and therefore FFME lacks experience in commercialization. Even Fujifilm worldwide lacks experience in aggressive marketing and sales since customers always came to Fujifilm. Due to the digital revolution, this has changed dramatically. Also, in the NBD process the number of market oriented FTE's is far less then the number of technology oriented FTE's. A more extended description of this root cause can be found in confidential appendix I (part II).
4) Fourthly, a suboptimal funnel process was identified as a root cause. The process is not optimal since the PMS document is only recently implemented and improvements based on experienced cannot be done yet. Judgement of projects is hard since criteria are not clear. Also, people don’t want to kill projects since they fear for an unbalanced funnel and since there is an urgent need for new business. In addition, the IP department is quite underrepresented and more reactively then proactively involved. Further, FFME lacks external control for example in the form of an innovation council. A more detailed overview of this cause can be found in confidential appendix I (part III).

6.4 Potential Directions for Redesign

Here, the cause and effect tree is translated into three potential directions for redesign. The author presents the three most relevant directions for redesign to show which considerations were made when selecting a suited redesign. The selection of the direction for redesign was done in accordance with the supervisors. The redesign directions should have a significant contribution to the solution of the formulated problem statement, should fit within the scope of the research project and the available time frame, should be feasible and applicable for the specific situation within FFME and should be challenging. Therefore, I will start with the elimination of some potential redesign subjects that don’t meet these criteria.

Firstly, one of the most prevalent root causes is the hard commercialization path. Officially, FFME is dependent of other Fujifilm subsidiaries when it comes to the commercialization of new products. Improving the commercialization process means that other Fujifilm subsidiaries will become subject of this research project. Due to time restraints and practical applicability, the scope of this research project was limited to FFME. Further, FFME lacks sufficient internal sales and marketing people and an internal organization that might facilitate this. Even when a good redesign is proposed, FFME will lack the manpower and infrastructure to implement it. Therefore, it is suggested that this root cause will not be subject of a redesign.

Secondly, the cooperation with other subsidiaries could be improved. However, proposing a redesign for Fujifilm worldwide is also out of scope and politically not possible. Such a redesign has very little chance to be implemented, because the principals lack the required influence to do this. Therefore, this optional redesign was eliminated.

Thirdly, an unstructured Fuzzy Front End popped up as an important cause. However, this subject is already investigated by a former student. The author will recommend that his theoretical model will be implemented, but this subject is therefore not relevant to research again.

Fourthly, unclear stage-gate criteria popped up as an important cause. Currently, another student was assessed to improve these criteria and therefore this will also not be subject for a redesign. Also, this cause is assumed to be not enough a “root cause” according to the author.

Thus, in line with the cause and effect tree the following three potential directions for redesign are proposed:

1) Propose a radical innovation portfolio management system.
   • **Content:** Currently, there is no formal portfolio management system in use. In practice, this means that allocation and prioritization of resources is unstructured. As a result, the distribution of manpower among projects or technical business area’s is unbalanced. Further, the potential of projects is not officially evaluated in order to prioritize. It was very often mentioned that resources are limited, especially within NBD but also within TRL. Due to this fact there are only a limited number of projects that can be handled simultaneously, which emphasizes the importance of effectively allocating the scarce resources. Further, a portfolio management system could reduce the gap between the company strategy and the practical execution. It could direct research because it supports prioritization and selection of the right projects. From literature, there are some authors who recently constructed a portfolio management system (Paulson et al., 2007; Cooper and Edgett, 2006). In the literature, portfolio management is found to be a practice that is not present in many companies. However, the companies that use portfolio management are mainly the more successful,
Innovative companies (see chapter 5.5). Therefore, it could be assumed that the implementation of a decent radical innovation portfolio management system will significantly contribute to the solution of the formulated problem statement.

- **Advantage:** A portfolio management system has significant practical relevance and, simultaneously, a lot of aspects are related to portfolio management, for example strategy, practice, and theory. Therefore, it is challenging enough to be subject of redesign.
- **Disadvantage:** The success of a portfolio management system depends on the underlying strategy, since this strategy is not that clear its success might be undermined.
- **Deliverables:**
  - A portfolio management system that is: (1) aligned to the strategy, (2) fine-tuned to the NBD situation of FFME, (3) suited for supporting resource (re)-allocation and prioritization among projects.
  - An implementation plan that will facilitate the actual implementation of the suggested redesign.

2) Construct a "product innovation and technology strategy" for NBD-TRL to direct explorative activities.

- **Content:** According to a lot of interviewees, the current strategy of FFME does not provide sufficient direction for the researchers. When it comes to target markets, target technologies, becoming a "green" company or not, focusing on b2c or b2b etc. the strategy does not provide sufficient direction for the researchers. As a result, there is a lack of research focus and it is hard to adequately allocate resources in line with the strategy. According to Song and Montoya-Weiss (1998), strategic planning (defined as: preliminary assessment and integration of a project’s resource requirements, market opportunities, and strategic directives) provides the largest opportunity for improvement in radical innovation projects. This stresses the importance of clear strategic direction when it comes to radical innovation. Thus, translating the broad company strategy into a more practically relevant strategy for the NBD-TRL team can contribute to a more successful exploration process. Related to the cause and effect tree, this redesign contributes to the solution of the two most left root causes, namely "resources not optimally tuned to strategy" and "lack of research focus". Furthermore, it could indirectly influence the process as a whole (e.g. when a commercialization strategy is formulated, the commercialization difficulties might be solved to a certain extent).

- **Advantage:** A clear strategy on NBD level can be very useful for a practical translation of the strategy of FFME. It is the fundament for what you are doing and therefore it requires, maybe even more than redesign 1, a thorough understanding of the practical situation and relevant theory. A concrete product innovation and technology strategy will increase research focus and could form the basis for a resource allocation that is tuned to the strategy. Therefore, it will contribute to the solution of the formulated problem statement.

- **Disadvantage:** Developing an NBD-TRL strategy is practically doing the job of the MT. Also, for the development of a strategy, it is necessary to have an extensive knowledge of the organization, even worldwide. There are a lot of political and practical hindrances and a risk that the redesign will fall outside of the scope (FFME). Therefore, there are a lot of challenges to overcome before such a redesign will be implemented in practice.

- **Deliverables:**
  - A well-considered strategy for NBD-TRL in terms of target markets, technologies, commercialization approach etc.
  - A strategy communication plan that makes sure that the strategy will be more than a sheet of paper.

3) Propose a redesign for the organization of NBD projects.

- **Content:** Currently, the funnel as used within FFME is not optimal yet due to a lack of experience in using the funnel. As a result, the organization of NBD projects can be improved in many ways. According to Burgers et al. (2008), responsibility for NBD projects should
change over time, since the focus of these projects is also changing from exploration to exploitation. Song et al. (1998) researched the patterns of cross-functional joint involvement and their integration levels. Further, O'Connor and DeMartino (2006) are analyzing different organizational designs for radical innovation in terms of discovery, incubation and acceleration of projects. These articles can be starting points for the development of a redesign for the organization of NBD projects. Important considerations about the role of the project leader, responsibilities during different levels, how and when to involve stakeholders, using an external innovation council, cross-functional teams etc. can be made. This redesign will not only contribute to a more mature funnel model, but it might also be helpful in balancing the market and technology exploration.

- **Advantage:** this redesign can be both very practical-oriented and theory-based and it is also likely to contribute to a smoother NBD process. Also, there are some very concrete action points that can be carried out, which will result in a design that can be implemented quite easily.

- **Disadvantage:** people are already busy with the improvement of the funnel processes; therefore there might be overlap with current activities. Further, the awareness of this problem is already broadly present among the NBD officers and TRL researchers. It is likely that a lot of improvements in this field will take place anyway as a result of the vertical line meetings (company-wide meetings with a purpose to improve the innovation process within FFME).

- **Deliverables:**
  - An organizational redesign that will facilitate a more refined approach for the current NBD process.
  - An implementation plan that will facilitate the actual implementation of the suggested redesign.

According to the author redesign option 1 is the most suited for a redesign. This is supported by considering the causes in the cause and effect tree that can be solved by the implementation of this redesign. Therefore, in accordance with the supervisors, this redesign direction was selected to construct a redesign for. However, the redesign will also take into account aspects that are mentioned in redesign options 2 and 3 since there is a clear connection, especially with strategic issues. In the next chapter, a redesign is presented that fulfills the requirements as presented above.

### 6.5 Conclusions

In this chapter, an analysis was executed based on data derived from interviews and unobtrusive data-gathering. Since project and portfolio management practices are the primary subject of this research project, the author started by analyzing eight projects (paragraph 6.2.2.). On forehand, these projects were carefully selected based on their radicalness and temporal relevance. Also, the researched projects were selected in a way that they are a good representation for all explorative activities in the organization. Then, the results of the analysis of the projects were compared to each other to draw more general conclusions about the management of explorative projects within FFME. In short, these conclusions were the following:

- FFME introduced the PMS document as a funnel model to manage their explorative projects;
- Explorative projects are executed within the DIP and the LS group, where DIP uses the PMS document and LS doesn’t;
- There are no NBD officers involved in the activities within LS;
- Currently, the funnel is unbalanced since there is only one project close to market introduction and a lot of projects in the first two levels.

Then, based on additional interviews with supportive departments and strategic oriented employees the problem situation within FFME was analyzed. The first step was to identify possible root causes by screening the interview reports and gather statements/issues that were often mentioned (table 6.1, page 34). Hereafter, the problem situation and the issues FFME is dealing with were put into historical context. This is especially important to understand the underlying structures and story that caused the problem as it is perceived today. Furthermore, the author analyzed the technologies that are explored within FFME. The relation between the technologies, their status and maturity and the
manpower allocated to them are presented. The main conclusions that were derived from this part of the analysis were the following:

- The market exploration within the LS projects is underrepresented;
- The researchers perceive a lack of strategic focus;
- Four technical business areas (TBA) are present within FFME, namely technology B2, C, D, and G;
- Technology C and D are more research-oriented, technology B2 is more application development oriented, and technology G is an established technology that is not involved in extensive explorative activities;
- Resources concentrate on fundamental research rather than on development of a new third pillar;
- The internal cooperation with other Fujifilm subsidiaries hard.

After the analysis of the situation, the author made a diagnosis of all the available information. Causes and effects were linked to each other and related to the problem statement as formulated in paragraph 3.2.2. This is visually presented in the form of a cause and effect tree (confidential appendix I). Based on this cause and effect tree, root causes for the problem statement are identified and explained. Briefly, the four root causes that were identified are:

- Resources not optimally tuned to strategy;
- Lack of research focus;
- Difficult commercialization path;
- Funnel processes not optimal.

In order to provide an effective solution for the problem, three potential directions for redesign which will contribute to the solution of the problem were presented. In accordance with the supervisors, the implementation of a radical innovation portfolio management system was selected as direction from redesign. When the cause and effect tree is considered, this redesign direction is likely to contribute the most to the solution of the problem. Since the potential directions for redesign have some overlap, it is possible that relevant aspects of the other redesign directions are also taken into account.
Chapter 7 Solution Design & Implementation Plan

7.1 Introduction

This chapter discusses the proposed solution design and implementation plan that aims at implementing successful portfolio management within FFME. First, based on the selected direction for redesign, design specifications are formulated. Then, the author decided to split up the solution design in four parts. The author suggests to conduct strategic portfolio management decision-making by using strategic buckets that are based on technical business areas (part II). In order to facilitate this, a new organizational structure based on technical business areas for TRL is proposed in advance (part I). Subsequently, a solution design is presented that provides a solution for tactical portfolio decision-making (part III). After proposing these new structures, the author specified the solution design to the situation within FFME. This is done by suggesting a different approach for the research and development related activities (part IV). Then, a solution justification is presented in which the effectiveness of the proposed solution design is confirmed. Finally, some recommendations in the form of an implementation plan are proposed. This part emphasizes issues that are important in the organizational change process. Further, it translates the solution design into practice by describing concrete roles, responsibilities, meetings etc. that should be used.

7.2 Proposed Solution Design

7.2.1 Design Specifications

Based on the diagnosis, the specifications for the redesign have been formulated and are presented in table 7.1. Design specifications include functional requirements, user requirements and boundary conditions (Van Aken et al., 2007), as described in paragraph 4.4.

<table>
<thead>
<tr>
<th>Functional requirements</th>
<th>The redesign should:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- provide strategic focus for the projects</td>
</tr>
<tr>
<td></td>
<td>- be suited to facilitate resource allocation</td>
</tr>
<tr>
<td></td>
<td>- be suited to facilitate prioritization decisions</td>
</tr>
<tr>
<td></td>
<td>- select projects as soon as possible, but based on a decent business case</td>
</tr>
<tr>
<td></td>
<td>- consider all explorative projects within FFME</td>
</tr>
<tr>
<td></td>
<td>- provide section-specific solutions</td>
</tr>
<tr>
<td></td>
<td>- have higher benefits then costs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>User requirements</th>
<th>The redesign should:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- be realistic and practical by nature</td>
</tr>
<tr>
<td></td>
<td>- take into account the relevance of involving people</td>
</tr>
<tr>
<td></td>
<td>- make roles and responsibilities of involved people clear</td>
</tr>
<tr>
<td></td>
<td>- be flexible, enhance learning knowledge sharing, and stimulate an innovative culture</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boundary conditions</th>
<th>The redesign should:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- fit within the FFME’s strategy and company policy</td>
</tr>
<tr>
<td></td>
<td>- take into account the available resources, existing structures, etc.</td>
</tr>
<tr>
<td></td>
<td>- not negatively influence the current successful activities within FFME</td>
</tr>
<tr>
<td></td>
<td>- be compatible with the PMS document</td>
</tr>
<tr>
<td></td>
<td>- take into account the political spheres of influence</td>
</tr>
</tbody>
</table>

Table 7.1: Design specifications for the solution design for FFME
The root causes for the problem studied in this thesis are the discrepancy between strategy and resource allocation as well as the lack of research focus. Therefore, the main functional requirements are to provide strategic focus for the projects and to facilitate resource allocation. This should be done by aligning strategy and practice and by proposing a portfolio management system. Thus, a holistic approach should be applied in order to construct a redesign that is suited for prioritization decisions and resource allocation. Further, the redesign should provide section-specific solutions by considering the differences between the defined core technologies. Thus, a specific tailor-made system should be proposed. Obviously, the costs for implementing the redesign should not exceed the benefits. Therefore, investing in new equipment etc. should be limited, unless it will result in great benefits.

The redesign should meet the general user requirement of being realistic and practical in order to be relevant. Further, one of the most important user requirements is that roles and responsibilities of involved people should be clear, especially in decision-making. Before that can be done, it should be discussed which people (in terms of functions) are suited for these roles and responsibility. Since the redesign focuses on the improvement of radical innovation, it should be flexible, enhance learning and knowledge sharing and stimulate an innovative culture (Freeman and Soete, 1997; Galunic and Rodan, 1998). The author emphasizes that radical innovation requires a lot of flexibility. Using tools can be fruitful, but they should be used flexibly and never become a target on their own.

The redesign should also meet some boundary conditions. Firstly, it should fit within the company strategy and policy of FFME. In order to be relevant, it should take into account the available resources and the existing structures as much as possible. To achieve this, preferably it should be integrated in the PMS document that is currently used. Also, the current successful activities that take place within FFME should not be disturbed or negatively influenced by the implementation of the redesign. Furthermore, there are a lot of political spheres of influence, for example the large Japanese influence in LS that should be taken into account when proposing a redesign.

### 7.2.2 Solution Design Part I: New Organizational Structure

In the current situation of FFME, the organizational structure within TRL is outdated. Firstly, the name of the DIP group is not appropriate anymore, since DIP is not at all focusing on the development of digital inkjet paper. Secondly, the LS group is working on different technologies of which technology D is not a life science. Thus, there is a clear discrepancy between the defined technical business areas and the current organizational structure of TRL.

It should be mentioned that core technology G is currently not involved in extensive explorative activities since it is an established technology. Technology B2, C and D are more intensively explored, where technology B2 is the most established technology (both, in terms of market and technology) and technology C and D are not established yet and more research-driven.

Paragraph 6.2.4.3 discusses that the organizational structure is not in line with the technologies. In order to create a clear exploration process where portfolio decisions and resource allocation can be performed properly, the underlying organizational structure should be clear. Therefore, an organizational division based on core competencies is proposed as can be seen in figure 7.1 (page 45). Currently, the exploration activities that are focusing only on technology G are not that prevalent. The technological knowledge of technology G is also embedded in technology B2 and technology D. Therefore, it is suggested that this core technology of FFME does not need a separate section (yet).
The author believes that the organizational structure in figure 7.1 will contribute to a more clear research focus, since a clear strategic direction can be constructed per TBA. Also, a more structured resource allocation based on strategic alignment (Cooper et al., 1997-2000; Song and Montoya-Weiss, 1998) can be established throughout the sections. The NBD department should focus on the business development of all these three core technologies. Also, this structure fits the current IP activities, which are currently focused on these three research directions.

Further, it can be seen (fig. 7.1) that the proposed organizational structure is a matrix structure, which means that projects fall under the responsibility of both NBD and TRL. The advantage of this matrix structure is that both aspects, market and technology, have formal responsibility. In that way, it will enhance the market exploration. In a previous study within FFME (Doodeman, 2007) a matrix structure for the current DIP group was proposed in order to achieve structural ambidexterity. This organizational design can be considered as an extension, because it redesigns TRL as a whole and because it makes a distinction between TBA’s.

Furthermore, since exploration requires flexibility (March, 1991) this has some implications for the organizational design. Based on the available manpower, the current maturity of the TBA’s and the level of explorative activities that need to be executed, the author decided to establish three sections and to exclude technology G. Thus, the organizational structure is fine-tuned based on the current situation. However, in the future there might pop up some very promising new exploration directions related to technology G or maybe even related to a complete new technology. As a result, it might be possible that a new section will be added in the future or that a current section will be deleted in the future since it lacks explorative potential. Thus, FFME should continuously re-evaluate their core competencies and be flexible in changing processes and structures when necessary.

7.2.3 Solution Design Part II: Strategic Portfolio Management

This paragraph will focus on the strategic portfolio decision-making process (see paragraph 5.5.2). The author suggests to use strategic buckets (paragraph 5.5) to make strategic portfolio decisions. In the case of FFME, the core technologies that are organizationally separated in three sections are the strategic buckets. Therefore, the proposed organizational structure can be considered a starting point for resource allocation on strategic level.

The current situation does not match with the strategy that focuses on the development of a third pillar for FFME. Most resources are allocated to long-term, high-risk projects that are not likely to form the third pillar within a reasonable time frame. Technology B2 roughly exists of three projects (E, F and H), of which project F resulted in a product that is currently introduced in the market. Project E and H are aiming on different markets than project F, but the underlying technology is the same. Within these projects, there are different optional tracks and applications that are under investigation. Thus, technology B2 has a broad potential to form a third pillar that will consist out of different applications based on the same underlying technology. Since technology C and D are more research-oriented and
technology B2 is more application development-oriented a different strategic approach for these groups is proposed. In paragraph 7.2.5, these approaches are elaborated in greater detail. When considering table 6.2 (page 36), the imbalance in resource allocation should be resolved. In practice, that means that resources that are currently allocated to technology C should be re-allocated to technology B2. There are two clear arguments for this proposal. Firstly, since there is a clear urgency for a third pillar a focus on new business development is required. Thus, the resources that can be divided over research and development should concentrate on the latter. Secondly, the current resource allocation is very unbalanced with approximately 20 FTE's allocated to technology C, of which the prospects are unclear and business plans are not present, and only 5 FTE's to technology B2, which does have concrete business plans and multiple spin-off applications available that can be introduced within a reasonable time frame. Also, in technology B2 there is a lack of manpower to research all the spin-off applications that might be viable.

7.2.4 Solution Design Part III: Tactical Portfolio Management

7.2.4.1 Integration of Portfolio Management System

In the previous paragraph portfolio management on strategic level was discussed. In this paragraph, portfolio management on tactical level is discussed. Portfolio management on tactical level means resource allocation within the separate strategic buckets. A portfolio management system needs to be implemented into the current innovation process of FFME (fig. 7.2, page 47). The importance of portfolio management has extensively been discussed in chapter 5. FFME has a limited number of resources that have to be divided over the explorative projects. In the previous paragraph, it was suggested to primarily allocate resources based on TBA's rather then on individual projects in order to guarantee the alignment of resource allocation with strategy.

In general, the tactical portfolio management system needs to fulfill both general needs (as described in chapter 5) as well as some additional company-specific requirements (based on the functional requirements, see table 7.1 on page 43):

1. It should consider all explorative projects within FFME;
2. It should fit within the current Project Management System (PMS) of FFME;
3. It should prioritize projects as early as possible based on a decent business case.

The first requirement reflects the current situation, where explorative projects are individually assessed and where explorative projects throughout the organization are not managed in the same way. The portfolio management system need to take into account the different level of maturity among the technical business areas that require a different approach, while it should simultaneously provide a focus and prioritization method that can be used in resource allocation issues.

Secondly, the proposed portfolio management system should preferably be implemented in line with the recently implemented PMS document. A prerequisite to direct the whole portfolio is that the funnel model should be used in all explorative projects, also within the current LS group.

Thirdly, the portfolio management system should prioritize projects as early as possible, based on a business plan. This requirement is important in general, but the limited availability of manpower within FFME emphasizes this aspect in particular. Projects should be assessed as early as possible in order to waste as little manpower as possible on non-feasible projects. However, the assessment of projects should be done based on a reliable business case, which requires both technological and market research. Thus, a balance needs to be found between fast assessment and qualitative assessment of a business case.

In figure 7.2 (page 47), the integration of the proposed portfolio management system into the PMS document is visually presented. The balance between fast assessment and building a representative business case will be ensured by implementing the prioritization after the level 3 entrance document. Thus, when an idea is generated and accepted it enters level 4, where opportunity scanning and development occurs. As described in the current PMS document (confidential appendix C and FFME intranet), the level 3 entrance document consist out of an indicative market study, a technical proof of principle and some additional requirements. According to the author, this should be sufficient to assess the project and compare it to other projects.
In figure 7.2 it can be seen that two databases are added to the current system. Since FFME lacks an extensive history in explorative projects a clear filing system is currently not in place. Especially the on-hold database is important, because in every portfolio prioritization session these projects should be re-evaluated and compared to other projects. The value of the terminated project database is described in terms of learning and knowledge that should be gathered in evaluation reports. This market and technology knowledge might be useful in future projects. Also, evaluating the project process can be valuable in improving the PMS document or the innovation management process, which is currently quite immature.

The above-described figure should be used within the strategic buckets or, in the case of FFME, the three sections based on the proposed organizational structure. Thus, first the resources are divided over the three sections and second the resources are allocated to concrete projects within these sections by using the tactical portfolio management system as presented in fig. 7.2.

This tactical portfolio management system can be used for all explorative projects that use the PMS document. It is integrated into the PMS document as used within FFME and therefore the usage will be enhanced and current activities and processes are not significantly disturbed. Therefore, the actual implementation will be made easier. By implementing portfolio decisions directly after the level 3 entrance document an early prioritization and the presence of a business case is guaranteed. It is intended that the number of projects that are present in the funnel after level 4 correspond with the available resources to execute them. In that way, a fast path to the market can be achieved and projects that achieve level 3 entrance can be accelerated. This is an important attention point since one
of the most prevalent weaknesses of companies is that they have too many projects underway for the limited resources available (Cooper, Edgett and Kleinschmidt, 1997, 1998, 1999, 2000). Further, it should be taken into account that the number of employees required to execute the project will increase when the project becomes more concrete and enters next levels of the funnel. Therefore, this restriction should be taken into account when selecting projects. Each project leader should provide an estimation for the required manpower and when all the manpower is allocated, no further projects should be selected.

The author of this thesis emphasizes that, since the total number of projects and manpower within FFME is limited, decision-making on strategic and tactical level can be combined. In paragraph 7.4.4, the practical elaboration of this combination will be discussed.

7.2.4.2 Contents of Portfolio Management System

In figure 7.2 (page 47) the integration of a tactical portfolio management system into the PMS document is presented. However, the actual portfolio prioritization and assessment is not discussed yet. The author focuses on concepts in this thesis. Nevertheless, since FFME is not familiar with portfolio management practices, portfolio management methods are extensively described and discussed in paragraph 5.5. The author believes that adding concrete examples of methods (appendix K) will lower the barrier to implement the solution design. In short, it is recommended that FFME will not rely on only one or two portfolio management methods, since using more methods can be associated with higher explorative performance (paragraph 5.5.3). The dominant method should focus on assessing projects on their *fit with the business strategy* (paragraph 5.5.3). In addition, two other methods can be selected from the list in appendix K to support the prioritization decision-making process.

7.2.5 Solution Design Part IV: Research and Development Strategy

Technology B2, C and D have different maturity levels. Technology B2 is the only technology with production scale facilities; however, FFME is still quite inexperienced here. Technology C is available on pilot plant scale level, where technology D does only have lab-scale facilities. However, a pilot plant is planned to be established in 2009.

7.2.5.1 Towards a New Third Pillar

As mentioned earlier, technology B2 is the most established technology that is currently being explored. Therefore, it is suggested that manpower and efforts in this technology are increased. In that way, the explorative technology B2 section (as proposed) can slowly develop into a separate business unit that can form the new third pillar for FFME. In this paragraph, the broad outline for and the strategic pathway towards this third pillar is sketched. However, it should be mentioned that this is more indicative then the next paragraph since it is hard to concretely describe actions and predict developments in the field.

For a start, technology B2 currently consists of three main projects of which one (project F) already resulted in a product that is introduced to the market. Currently, FFME started with the exploitation of this product. It is likely that incremental innovations related to this product will result in different types of product F. Besides project F, project E and project H are making progress. Within both projects, different spin-off applications with other companies have been identified and researched. However, manpower is limited and therefore the number of applications that can be executed and researched in the short run is restricted.

The technology for all these projects can be produced in the P2 plant. Therefore, there is an excellent match with the production facilities of FFME and they are well suited to form a third pillar based on technology B2. The structure of this third pillar can be visually represented as in figure 7.3 (page 49). Thus, technology B2 can be considered as the fundament for a third pillar that consists out of different applications/products. Consequently, these different applications will evolve over time and new incremental innovations, versions and adaptations will be added.

The composition of the proposed third pillar should meet certain requirements. Since FFME is very good at producing high volumes of high quality, it is beneficial to produce products that have substantial demand in terms of volume. Preferably, the total number of applications that will form the
third pillar is limited, since this will limit reconfiguration times in the production process and therefore it will enhance a continuous efficient production process. When prioritizing projects, this should be taken into account and all the selected projects should fit within this picture.

![Figure 7.3: Structure of a third pillar for FFME based on technology B2](image)

When figure 7.3 is considered, it is obvious that resources should be added to work on the different applications. Because of the urgent need for a third pillar within FFME, a primary focus on more short-term and low entrance barrier projects is preferred. However, the key requirement is to focus on projects that can achieve high volumes and substantial margins, since those are key requirements for a third pillar.

Since FFME lacks experience in the target markets, cooperation with third parties is important. Also, new employees could be attracted who are familiar with these target markets and therefore can enhance a successful market introduction. Also, improving the cooperation with FTYO is very important, because they are responsible for the establishment of a sales organization that can attack new markets.

Over time, it is likely that the development section for technology B2 will change from its current radical innovation focus towards a more incremental innovation focus. It can slowly emerge towards an established business unit (Burgers et al., 2008). In practice, that means that the technology B2 section will be transferred from TRL to P2. Thus, currently technology B2 is in its discovery/incubation phase, but when more spin-off applications are introduced to the market and produced in the plant, it will shift towards acceleration (O’Connor and DeMartino, 2006). The targets and strategy that apply for the application development of technology B2 are summarized in table 7.2.

<table>
<thead>
<tr>
<th>Target</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create a third pillar</td>
<td>1. Identify additional spin-off applications</td>
</tr>
<tr>
<td></td>
<td>2. Increase TRL manpower (from C) and NBD manpower (attract)</td>
</tr>
<tr>
<td></td>
<td>3. Create an application portfolio</td>
</tr>
<tr>
<td>Successful composition of third pillar</td>
<td>1. Number of applications should be limited for efficient production process</td>
</tr>
<tr>
<td></td>
<td>2. Applications should be selected on volumes and margins</td>
</tr>
<tr>
<td>Create a balanced portfolio that is aligned to the strategy</td>
<td>1. Implement the suggested portfolio management system</td>
</tr>
</tbody>
</table>

Table 7.2: Targets and strategy for technology B2 section

7.2.5.2 Organizing Fundamental Research

Currently, technology C absorbs approximately 20 FTE and technology D absorbs approximately 5 FTE from R&D. In both technologies the business case is underrepresented and the funnel is not used, while the projects are in progress for about 10 years and the technologies, especially technology C, are quite established. Especially the many FTE’s that are allocated to technology C are remarkable since there is no concrete business plan. The main challenge here is to implement a more market-oriented approach in these groups. Within FFME it is often mentioned that the funnel should be used within LS, also by employees that work in LS (table 6.1, page 34). The author agrees with this
statement, but some remarks should be made. For the more research-oriented projects, the following approaches are recommended.

Firstly, implementing the funnel for technology C and D should be done, because in that way the portfolio management system can consistently be applied throughout FFME. However, technology C and D require more flexibility since these technologies are more research-oriented and long-term projects. Therefore, these projects are less predictable and more focused on technology push. These technologies can be considered as new-to-the-world technologies that can enable new markets. This is especially the case for technology D. Consequently, the funnel should be used in a flexible way and it should be accepted that the projects that are based on these technologies will consume more time then the projects that are based on technology B2. The PMS document is a tool that should be used as a checklist to force people to perform certain actions in time and to direct their research and development activities towards a commercial viable application. To do this properly, it is very important to assign at least one NBD officer per project who can focus on the market exploration.

Secondly, for the technologies C and D case a distinction should be made between fundamental research vs. business development (fig. 6.4, page 36). In the fundamental research phase available manpower should be limited. Additional manpower should be allocated based on a beneficial perspective. Thus, a concrete business plan or a business concept is required to claim additional manpower and funds. It should be clear that based on these criteria technology C is currently using too much manpower. Thus, it is proposed to re-allocate the manpower that is currently involved in the research for project C. The imbalance in the resource allocation should be solved. Since technology B2 is the most promising and most concrete technology, more resources can be used to accelerate the new business development of this technology. A lot of spin-off applications are researched and more applications might be found. The importance of creating more business opportunities based on technology B2 is also emphasized in NBD-TRL meetings. In practice, it would be logical to reduce manpower on technology C and to increase manpower on technology B2.

Thirdly, the research teams for technology C and D are really isolated from the rest of the company. This is not necessarily a problem in the case of technology C, because these applications are very different from the current core business of FFME. However, technology D can be used in the current production lines and this technology might have added value, especially when it is combined with technology G. Therefore, it is proposed to expand the NBD-TRL meetings and let the project leaders of project C and D join in these meetings. In that way, communication will be improved and knowledge dissemination and creation will be enhanced which will result in a more successful radical innovation process (Berends et al., 2007). Also, a more holistic view over the projects that are in progress can be established, when they are discussed in the same meeting.

Fourthly, technology C and D are largely being funded from Japan. Therefore, cooperation and communication with Japan is very important. Responsibilities and roles should be made clear and in the new business development process Fujifilm Tokyo should be informed early enough. On the long run, it would be better when the funds from Japan are transferred to FFME. In that way, FFME can allocate the funds to the projects that are most promising. Thus, funding, responsibilities, and decision-making in projects have to be done by the same authority in order to prevent decision-making conflicts. However, this recommendation will not be formulated as an action point since it is out of scope and not feasible on the short run. The targets and strategy that apply for technology C and D are summarized in table 7.3 (page 51).
### Target | Strategy
--- | ---
Increase strategic focus | 1. Implement PMS including the proposed portfolio management system
Increase business case | 1. Apply funnel
2. Assign additional NBD officers
3. Participate in NBD-TRL meeting
Balanced resource allocation | 1. Balance resources among fundamental research vs. business development
2. Allocate resources based on business plan
3. Transfer resources from C to B2
Alignment with Fujifilm Japan | 1. Increase communication and cooperation as early in the process as possible

Table 7.3: Targets and strategy for technology C and D

### 7.3 Solution Justification

#### 7.3.1 Problem Solving Justification

It should be mentioned that justification could be achieved by evaluating the effects of the solution design based on a trial implementation. However, due to time restraints and the simple fact that this was not inside of the scope of this research project this could not be done. Therefore, justification will be done by logical reasoning, by making sure that the proposed solution is in line with scientific literature, by following a structured research approach and by discussing with stakeholders of the system.

The solution design as described above is based on a thorough analysis and diagnosis (chapter 6) in which multiple data sources were used. Therefore, the cause and effect tree (confidential appendix I) as proposed in chapter 6, is a good reflection of the problem situation within FFME. The solution design focused on two of the four identified root causes, namely that resources are not tuned to strategy and that there is a lack of research focus. By implementing a portfolio management system, as suggested in the previous paragraph, the discrepancy between strategy and resource allocation will be solved. The lack of research focus, which is especially mentioned in the LS group, is solved by the implementation of the PMS document throughout the company and by the implementation of clear targets and prioritization structures. The involvement of NBD in the exploration of technology C and D will also contribute to a more focused research approach. Thus, in this way the contribution of the redesign to a solution of the problem is secured.

Then, the author participated in internal company meetings where opinions and visions on the innovation process within FFME where shared. Since the author was supervised by two company supervisors who were both involved in the research project, the practical relevance was ensured and possible conflicts about the contents of the solution design were prevented.

#### 7.3.2 Cost-Benefit Analysis

The costs of the proposed redesign should not exceed the benefits in order to be useful for the organization. Since the author lacks quantitative data, costs and benefits will only be discussed broadly and not quantitatively.

The solution design, as proposed above, does not require financial investments in tools, assets and the like, since it focuses on the implementation of an organizational structure and portfolio management methods. These methods are already described in this thesis and also available in scientific literature. However, the most important part of this redesign is the re-allocation of current manpower. The imbalance between research and development should be solved. Researchers that need to be transferred might need additional education and training. Since most employees work for FFME for about 20 years, they are mostly experienced in both fields, technology B2 and technology C. Therefore, the author states that education and training costs can be limited. Other costs of this redesign will be in terms of time consuming activities for employees. As described, it is suggested to
hold one portfolio management meeting per three months. According to the author, combined with the existing meetings and the informal communication, this should be sufficient to apply effective portfolio management. Researchers and NBD officers need some additional time to prepare for these meetings by rating their projects based on the proposed portfolio management methods. However, according to scientific literature structured portfolio management is a very good predictor for innovative success. Therefore, the author dares to state that the benefits of the proposed solution design will exceed the costs by far.

7.4 Implementation Plan
The change process is managed on the basis of the designed solution and the implementation plan. The solution design, as described in the previous paragraphs, defines the business system to be realized, where the implementation plan describes how that is to be done. The implementation plan starts with a so-called "delta-analysis" that describes the differences between the current system and the new system. Important aspects to keep in mind are the different sources of resistance that might be present and the influence of the proposed solution design on the technical, political and cultural system of the company. Also, the communication of the redesign to the stakeholders will briefly be discussed.

7.4.1 Delta-Analysis
In this paragraph, the main differences between the current and the suggested system (as described in this chapter) are mentioned. Table 7.4 considers only the major changes. There are a lot of smaller, more detailed changes identified and described in the previous paragraphs. During the change process the focus should be on these major changes. The four most significant changes according to the author are: (1) a new organizational structure (see 7.2.2); (2) implementation of portfolio management system (see 7.2.3 and 7.2.4); (3) re-allocate resources from research to development (see 7.2.5); (4) increasing business case in technologies C and D (see 7.2.5.2). In table 7.4 these changes are subdivided in strategic and tactical implications.

<table>
<thead>
<tr>
<th>Strategic change</th>
<th>Tactical change</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Organizational structure based on TBA’s</td>
<td>Use portfolio management system and methods</td>
</tr>
<tr>
<td>(2) Actively align project portfolio with strategy →</td>
<td>Use funnel, involve NBD, allocate resources based on business plans and join NBD-TRL meetings</td>
</tr>
<tr>
<td>(3) Balance resources between R &amp; D →</td>
<td>Slowly re-allocate manpower from technology C to technology B2</td>
</tr>
<tr>
<td>(4) Increase business case in technology C and D →</td>
<td>Use funnel, involve NBD, allocate resources based on business plans and join NBD-TRL meetings</td>
</tr>
</tbody>
</table>

Table 7.4: Delta-Analysis: Implications on strategic and tactical level

7.4.2 Implementation Strategy
The proposed solution design can be considered as very strategic-oriented. Therefore, the implementation is the responsibility of the MT. Strategic direction and decisions are the primary concern for the MT and therefore they should really think about how resources should be balanced, how they want to establish their third pillar and in what time frame this should be established. This chapter provides some very clear recommendations in these directions, which can form a starting point for a more detailed elaboration.

Since the changes are mainly NBD related, the TRL and NBD managers should very prominently be involved in the implementation phase. The plant managers, who are also part of the MT, are more exploitation-focused and therefore less informed about the explorative NBD activities and processes within the organization. It is suggested to establish a working group to detail the proposed solution.
This working group should be well and specifically informed by the MT about the strategic direction and long-term vision that is aimed for. Such a working group can consist of an experienced NBD officer, two TRL-related employees and an objective individual, for example a student or external consultant. In this group there should be a balance between technological oriented and market oriented members.

### 7.4.3 Implications of Change

The aim of this paragraph is to mention aspects that are related to organizational change in order to make sure that they are taken into account during the change process. Thus, the author will not go into too much detail.

Usually, people tend towards known and familiar concepts and systems. Also, stakeholders might have different interests, status, responsibilities, freedom etc. that they want to protect. Also, not all stakeholders might be familiar with the problem or they disagree about the contents of the solution. As a result, five different sources of resistance may be present (Van Aken et al., 2007), namely:

- Lack of understanding;
- Differences in opinion;
- Lack of trust;
- Low willingness of change;
- Conflicts of interest.

The most effective tools for overcoming these hindrances are communication and participation. Therefore, the author suggests that stakeholders like project leaders, project members, and NBD officers participate in the detailed elaboration of the solution design. Before actual changes are implemented, the management should communicate not only the contents of these changes, but also why these changes are necessary. The benefits both for the organization and for the stakeholders should be mentioned in order to create support.

Then, according to Tichy (1983), organizational change should be managed simultaneously in three intertwined aspect systems, namely the technical system, political system and cultural system. Technical system aims at the domain of technical and economic issues, like the problem, the strategic context and the redesign. The political system is the domain of formal and informal power individuals and groups may use to protect their interests. And thirdly, the cultural system which is the domain of business or department culture, group and individual identities etc. For FFME, the major change will lie in the reorganization of the current LS group, which has always been a group with his own targets, interests and a high autonomy. Also, FFME has always been a production location and as a result its cultural system is still focused on that. Therefore, the changes in cultural and political systems are most important.

### 7.4.4 Practical Recommendations for Implementation

In the previous paragraphs, attention points with respect to organizational change processes were discussed. Here, practical recommendations for the actual implementation of the solution design are formulated, where the above-mentioned attention points were taken into account. This paragraph discusses when to perform portfolio management, by whom it should be done and how it should be done.

- Firstly, FFME should introduce portfolio management meetings. Portfolio management is a strategic activity that should direct explorative activities with a long-term vision. Therefore, portfolio management is not necessarily a day-to-day activity, but an activity that is very suited for periodic steering. For that reason, the author recommends to have the portfolio meetings every quarter. The management team should be present here, since strategic direction of the company is their primary task. It is strongly suggested by the author to add the NBD manager to the MT (or provide him with formal responsibility in portfolio management decision-making), since he has the most significant knowledge with respect to the business cases of NBD projects, together with the TRL manager. During the quarterly portfolio meeting, all project leaders can present their project progress and their business plans very briefly. They should rate their projects with the proposed portfolio methods and present the results. Since the number of projects is quite limited, this is very feasible in practice. After the presentations, the MT can discuss and make a careful
decision about how they want to allocate their resources. This decision should focus on business strategy methods as the most dominant method, supported with two other methods (appendix K), for example financial methods and scoring methods. Since the total number of projects within FFME is limited, it is suggested that both strategic and tactical portfolio management decisions can be made in this quarterly meeting.

- Secondly, management should also focus on a balanced resource allocation among research and development (with a focus on development) and between the TBA’s. In practice, this means that R&D resources that are currently allocated to long-term, high risk research projects should be re-allocated to more low risk, short-term projects. Thus, the 20 FTE that are allocated to the exploration of technology C should be decreased significantly and re-allocated to technology B2 related projects. For example, 20 FTE for technology B2, 5 FTE for technology C, and 5 FTE for technology D might be a far more balanced division. It is proposed that the reallocation should be done slowly since an immediate reallocation of 15 FTE is not feasible. The exact number of FTE’s should reflect the strategic targets of FFME, and therefore, this is the responsibility for the MT. Obviously, when technology C evolves over time and clear business cases can be presented, resources can be added. However, the basic assumptions are that: 1) resources are allocated in line with a clear strategy; and 2) project leaders can request for additional resources based on a business case.

- Thirdly, as mentioned in paragraph 7.2.5.2 the LS department should actively participate in the portfolio management system. In order to achieve this, NBD should also be involved in the technology C and D related projects. Therefore, the author proposes to add at least one NBD officer to those projects and to apply the PMS document within these fields. Thus, new NBD officers should be attracted. FFME is already aware of this and therefore they are actively looking for new NBD officers. It is suggested that project C and D will also participate in the bi-weekly NBD-TRL meetings. For project D this is very relevant, since there might be technological overlap with current activities. Also a market focus can be better applied to the project. For project C this is also relevant to implement more market focus. Since the total R&D capacity and the number of explorative projects is limited, this should not be a problem. Furthermore, it is very important to use the PMS document in a flexible way and to align the system to the project instead of aligning the project to the system. Especially project D is very research-oriented and more long-term oriented. Therefore, more flexible approach and other expectations might be more suited here.

- Fourthly, in figure 7.2 (page 47) the author proposes to install two databases. The first database is an “On-hold projects” database. This database includes projects that were feasible from a market and technology point of view, but that were not chosen to proceed with since other projects were more promising or more in line with strategy. The database will be used during the portfolio meetings to reconsider the projects and compare them with the new projects. The second database is a “Terminated projects” database and will contain projects that were not feasible from a market and/or technological perspective and that were therefore terminated. After a project is terminated it is important to store the knowledge that has been gained and to evaluate the process. FFME is still immature in innovation and therefore a lot can be learned from project processes. Besides of these purposes, both databases can be used for learning and knowledge sharing throughout the company. Successful exploration is broadly associated with knowledge sharing, knowledge dissemination and learning, therefore the databases are likely to enhance exploration as such (i.e. Berends et al., 2007). A prerequisite to achieve this purpose is that the databases are broadly available and that the documents are clear, short and relevant. Therefore, it is suggested to make a special folder on the company server that is available for all TRL and NBD employees. Also, the project reports should be available in hard copy within NBD and TRL.

The above-mentioned practical aspects of implementation have some additional advantages. Currently, time frames of projects are mainly the responsibility of the project leader. A stage-gate meeting is held on initiative of the project leader. With this new structure, project leaders have to present the progress in their business case every quarter. This does not only enhance the possibility for periodic strategic steering, but it might also stimulate project leaders to make fast progress.
7.5 Conclusions

The starting point of this chapter was the selected direction for redesign as described in paragraph 6.4. Based on this redesign direction, design specifications for the FFME case were formulated to make sure that the solution design will be relevant. The proposed solution design exists of four parts, namely:

1) A new organizational structure for TRL, based on TBA's that are substantially involved in explorative activities. This organizational structure is a matrix structure for all explorative projects within FFME, with responsibility for both NBD and TRL.

2) A strategic portfolio management method, based on strategic buckets, that is in line with the proposed organizational structure. This method suggests that management should allocate exploration-oriented resources between the TBA’s. Also, a balance in resource allocation between research and development is discussed.

3) A tactical portfolio management model that is integrated in the current PMS document. This model proposes that projects should be prioritized early in the process based on a business case. Concrete portfolio management methods are proposed. Also, two databases are introduced to store both terminated and on-hold projects. Hereby, evaluation is enhanced and the best projects will proceed.

4) A research and development strategy that provides clear guidelines for the development of a new third pillar and clear guidelines for more output focused research. It is proposed that efforts in the application development of technology B2 have to be increased in order to establish a third pillar. Further, integration of the teams involved in the exploration of technology C and D in the NBD process is strongly recommended.

The author of this thesis is convinced that, due to the tailor-made approach for each explorative TBA, the relevance of the solution is high. This is also ensured by justifying the solution design by using a structural, logical research approach, by making sure that the solution design is in line within scientific literature, and by discussing the solution design with the supervisors, of which two of them are direct stakeholders. Since the solution design doesn’t require large investments, its benefits will exceed its costs by far.

Finally, an implementation plan is suggested that should facilitate the actual implementation of the proposed solution design. This implementation plan consists of some general considerations, with respect to organizational change processes, that should be taken into account. Also, a number of very specific actions, roles and responsibilities are described. These practical recommendations should be followed to effectively translate the proposed models, structures and methods into practice.
Chapter 8 Conclusions & Recommendations

8.1 Summary and Conclusions
The research project as executed within FFME followed the business problem solving methodology as suggested by Van Aken et al. (2007). Therefore, a specific problem situation within the company provided the starting point for this research. Also, the research project has a strong theoretical base since scientific literature is extensively used. After an orientation, a problem statement was formulated. During the research project, the problem statement was accentuated and extended. Finally, this resulted in the following problem statement:

NBD project and portfolio management processes within FFME do not result in a successful exploration phase in terms of financial benefits

From the project and cross-project analysis, it was concluded that a more holistic approach is necessary to optimize the exploration process. According to the author, the most important strategic target for FFME is to accelerate the establishment of a new third pillar. The author states that the current resource allocation is not in line with this target. Recently, the MT defined four technical business areas (TBA’s) to structure its exploration process. However, the organizational structure is not in line with these TBA’s yet. Within the Tilburg Research Laboratories, there are two groups that are busy with explorative projects, namely Life Sciences group and Digital Inkjet Paper group. Both groups have the target to generate new business, however, they don’t work in the same way. The project management system is only used within the Digital Inkjet Paper group. It was stated that the Life Sciences group is more fundamental research oriented, while the Digital Inkjet Paper group is more application development oriented.

From a portfolio point of view, it was concluded that most resources are allocated to the fundamental research projects. These projects are long-term projects with high risks, where no concrete business plans are present. Furthermore, most of the explorative projects are in the front end of the funnel. Therefore, the current funnel occupation is unbalanced. Finally, the diagnosis resulted in a cause and effect tree that presents the problem and its underlying causes. Four root causes were found, namely:

- Resources not optimally tuned to strategy;
- Lack of research focus;
- Difficult commercialization path;
- Funnel processes not optimal.

Furthermore, it was concluded that the business case is underrepresented in the Life Sciences group and that the funnel is not applied throughout the company. Formal portfolio management is not present. The author concludes that the prioritization of projects and their alignment with the strategy is the most urgent problem to be solved. Therefore, a combination of the first two root causes was chosen to be most suited for a redesign. The contents of the redesign should be a radical innovation portfolio management system that has both a strong theoretical foundation and practical relevance for the specific problem situation within FFME.

8.2 Recommendations
Based on the analysis and diagnosis, a redesign was proposed by the author of this thesis. This redesign fulfills the design specifications that were set by the author in advance. According to the author, this redesign will improve and focus the current explorative activities within FFME.

The redesign consists of a portfolio management system that provides a base to align explorative activities to strategy. The technical business areas within FFME were divided into research oriented and application development oriented technical business areas in order to develop specific solutions. The importance of portfolio management is discussed by Cooper, who states that portfolio management practices are especially present in best-performing companies. Following the redesign, the following recommendations are formulated:
Implement a new organizational structure within TRL as proposed in figure 7.1 (page 45), based on technical business areas;

Allocate resources in a more balanced way between fundamental research and application development, and between technical business areas in line with the strategy;

Use structural prioritization methods for explorative projects in order to guarantee that the right number of projects and the most promising projects are selected. During the prioritization, alignment with the strategy should be the dominant method;

Introduce project databases to store ideas, terminated projects, and projects that are on hold in order to improve evaluation loops, learning, knowledge sharing, and good prioritization decision-making;

Apply the same project management system for research oriented and development oriented projects, but be flexible in using a project-specific approach;

Limit the manpower that can execute fundamental research activities and increase manpower based on concrete business plans;

Increase manpower to find more applications for technology B2 and work towards a new third pillar for FFME;

Decrease manpower that is allocated to technology C until a concrete business plan is present;

Integrate technology C and D projects with technology B2 projects by having cross-sectional NBD-TRL meetings to increase market focus and to create new knowledge. Also, technology D can be linked to the established technologies since there is a clear overlap;

Establish a working group that can facilitate the implementation of the proposed redesign. Preferably, an external person is included and technology and market focused members are balanced.

8.3 Scientific Reflection

According to literature, portfolio management is not present in most organizations, while its benefits to business performance are significant. Therefore, the most important contribution of this research project is that it provides insights in the practical implications of implementing structured portfolio management practices. To the best knowledge of the author, the number of experts in the field of radical innovation portfolio management is limited. Interest in this particular field might be increased by showing the practical relevance and benefits of good portfolio management.

In scientific literature on radical innovation, there is a disagreement about radical innovation that should be mentioned. Some scholars propose that using structures will enhance radical innovative success, where other scholars propose that freedom is most important to enhance radical innovative success. This thesis might contribute to this discussion by stating that rules and procedures contribute to explorative success because they align practice to strategy and increase focus, but that they should be applied in a flexible way.

8.4 Limitations and Further Research

This research project has certain practical and theoretical limitations. The most important theoretical limitation is that the findings of this research project are based on a case study within one company. Therefore, its general applicability might be limited. As a result, it might be interesting to extend this research to other organizations in order to increase the generalizability of the redesign. Also, FFME is a Japanese company with Dutch influences since it is located in The Netherlands. It might be interesting to research the effect of radical innovation portfolio management in other organizational cultures, for example in the United States. The most important practical limitation is that the actual performance of the proposed solution design was not measured due to time restraints. It would be interesting to evaluate its actual effects on the performance of the organization after the implementation of the redesign. Also, this might result in additional practical insights that can result in an improvement of the current proposed solution design. Further, this case study provides insight in the differences between research oriented and development oriented activities. In a lot of companies these explorative practices are not strictly separated from each other, while this might be beneficial from a strategic point of view. This might be an interesting subject for future research.
References


*Company literature*

Company Policy (2007) of FUJIFILM Manufacturing Europe B.V.

Fujifilm Annual report (2007)

*Websites*

- http://www.fujitilburg.nl
- http://www.fujifilm.com
- http://fujiplaza/ (only available within the FFME computer network)
- http://www.prod-dev.com
Appendices

Appendix A: Chronological Flow Diagram for FFME (CONFIDENTIAL)

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Appendix B: Organization Chart for FFME
Appendix C: FFME's Project Management System (CONFIDENTIAL)

CONFIDENTIAL INFORMATION

Appendix D: Cause and Effect Tree to Determine Research Topic (CONFIDENTIAL)

CONFIDENTIAL INFORMATION
Appendix E: Interview Schedule Project Level

Introduction
- Personal introduction
- Information will be treated confidentially, project X, interviewee Y etc., interview report will ALWAYS be checked/controlled by the interviewee afterwards!
  Transparency is important → feel free to ask questions/interrupt
- Research explanation: context (generate new business, innovation, NBD, ambidexterity etc.), main subject, unit of measurement, explain about project management, portfolio management, exploration, radical innovation
- To do list:
  o introduction (5 min.)
  o answer and amplify on a number of structured questions (consistency between projects) (30-40 min.)
  o what could be improved and how? (open discussion/exchange of ideas) (10 min.)
  o margin/own interpretation (interviewee can address feelings/opinions that did not pop up during the questions but are important to him) (5 min.)
  o closure

Structured questions:
1) Can you give a short description of the project?
2) When did the project start? When did the project end or what is the current status of the project (time-wise)?
3) Rank the project on a radicalness scale of 1-5. (explain: incremental vs. radical (=new-to-the-firm))
4) How was/is the project organized? (responsibilities, who did what?, organization chart etc.)
5) What kind of resources were allocated to this project (money, manpower)? Is/was this sufficient to meet expectations of the management?
6) When the project started, was there a clear time schedule/planning? If yes, do/did you run on schedule (optional: why not)?
7) Can you tell me what went well and what went wrong during this project? Why? What were the consequences?
8) Can you tell me something about the practical progress of the project? (what activities were done together, what activities were done alone, how did different project members influence/complement each other (f.e. NBD and TRL))
9) Was the funnel (PMS document) being used during this project? If so, did the funnel contribute to a successful progress of the project? How? If not, might this be beneficial in the future?
10) Were the evaluation criteria for this project clear enough?
11) How was the balance between business and technological exploration during the project?
12) Do you have a clear picture about the strategy of FFME with respect to innovation? Does the management provide sufficient direction in the innovation process? Do you know what is most important to research for management (portfolio management)?

What could be improved when it comes to enhancing radical innovative project success?
(discussion, exchange of ideas/thoughts, try to obtain as much relevant information as possible, initiative from participant!)

Free space: the interviewee can bring up his own ideas/thoughts/feelings that might be relevant from his perspective, but that did not popped up during the interview.

Closure
- An interview report will be sent by email asap
- Consider possible contact in the future (yes/no, how, why)
- Thank you very much for participating in this interview
Appendix F: Interviews Conducted by the Author (CONFIDENTIAL)

Appendix F1: Project Level Interviews

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Appendix F2: Supportive Level Interview

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Appendix F3: Strategic Level Interviews

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Appendix G: List of Documents Used in Project Analysis

Project A:
- Excel organization chart
- Market study document
- Project evaluation document
These documents can be found on the internal company server.

Project B:
- Powerpoint document: chattering duck presentation
This document can be found on the internal company server.

Project C:
- No additional documents used

Project D:
- No additional documents used

Project E:
- Powerpoint documents: stage-gate presentations
- Official stage-gate documents
These documents can be found on the internal company server.

Project F:
- Powerpoint documents: stage-gate presentations
- Official stage-gate documents
These documents can be found on the internal company server.

Project G:
- Powerpoint documents: stage-gate presentations
- Official stage-gate documents
These documents can be found on the internal company server.

Project H:
- Powerpoint documents: stage-gate presentations
- Official stage-gate documents
These documents can be found on the internal company server.

- The stories of the projects as told by the interviewees were confirmed and sometimes extended by these official documents. No serious contradictions or inconsistencies were found.

- Besides these documents, also interview reports from a former student were used to verify the stories. These reports can also be found on the internal company server. However, this source is not officially referred to, since it is a secondary data source that did not add new information, but was only used for checking on contradictory phrases of interviewees. These were not found.

- Further, the author attended in a number of meetings that were related to these projects. The issues that popped up during these meetings did not contradict the stories as they are represented in this thesis. Minutes of these meetings are confidential and available on the internal company server.

All data sources that are mentioned here were used as a source of inspiration and therefore they were very useful in for example the construction of the interview questions etc.
Appendix H: Historical Project Process Flows (CONFIDENTIAL)

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Appendix I: Cause and Effect Tree Based on Diagnosis (CONFIDENTIAL)

OVERVIEW

PART I+II+III (CONFIDENTIAL)

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