CRANFIELD UNIVERSITY

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LEARNING FROM RESEARCH & DEVELOPMENT PROJECTS: THE ROLE OF POST-PROJECT REVIEWS

CRANFIELD SCHOOL OF MANAGEMENT

PhD THESIS

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Learning from Research & Development projects: The role of post-project reviews

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ABSTRACT

Successful innovation depends to a high degree on an organization's ability to develop an effective Research & Development (R&D) process and during the last decades many companies have adopted Stage-Gate® or similar methodologies. Although such methodologies are credited with significantly improving R&D results at many companies, there is still potential for improvement, if organizations can learn from projects. Each and every R&D project should not only result in a successful new product but also generate learning for the organization, because this has a high importance for the competitive advantage of an organization.

Post-project reviews (PPRs) are recognized by both practitioners and academics as an appropriate mechanism to stimulate project-to-project learning in R&D project teams. However, PPRs are used by relatively few companies, and those that do utilize them often fail to do so adequately. Surprisingly, although PPRs are widely perceived to be a useful tool, empirical research on how they can best be used and how they support learning within a project team is very limited. This thesis addresses this gap in the extant knowledge and describes five in-depth exploratory case studies, which investigated how PPRs are conducted, how they are perceived by R&D managers and the project-to-project learning that can result from PPRs.

Based on a complex research design which combines qualitative and quantitative data from documents, interviews and the observation of PPR meetings, the results show that current PPR practices vary much across different organizations. Furthermore, R&D managers perceive PPRs as important for learning in R&D project teams but difficult to manage effectively. An important result was also that tacit knowledge and experiences play an important role when analysing project-to-project learning. Although the operationalization of tacit knowledge is difficult, the detailed analysis of lessons learnt and metaphors used allowed to gather conclusions on the supporting role of PPRs for the creation and transfer of both explicit and tacit knowledge.

ACKNOWLEDGEMENTS

Conducting PhD research parallel to a full time job is always challenging, frequently frustrating and sometimes even impossible. As a German part-time student who lived in England, France and Germany during the course of this research, I was not able to actively participate in discussion groups with other PhD students or researchers from Cranfield University. Therefore, it was even more important to have a small circle of people who supported this PhD in different ways from the very beginning.

The first person I want to mention is my PhD supervisor Professor Keith Goffin. Not only his academic advice and enthusiasm accompanied me from the first day onwards, but also his never-ending belief in my capacity to finish this PhD despite the many hurdles that crossed my way. There are no words to describe the value of his support on a daily basis, or the calming effect of meeting him in Stuttgart or Kirchheim whenever I felt I ended up in a dead end. I think the only term which describes at least partially the role of Keith in this PhD and the time he dedicated to my thesis is the German word *Doktorvater*, because he is really in a literal sense the father of this PhD.

I also want to express my gratitude to all people in the companies I visited during the course of this research and who prefer to stay anonymous. All the R&D managers I met were very open, supportive and deliberately willing to invest their time for the objectives of my research, which nowadays cannot be taken for granted.

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The experience of this PhD was one of the most challenging ones in my life so far, and I can honestly say that I probably would not have started it if I had known what was lying ahead of me. However, looking at it in hindsight today, I am pleased to say that I would definitely do it again.

Vergelt’s Gott !

„Das schönste Glück des denkenden Menschen ist, das Erforschliche erforscht zu haben und das Unerforschliche ruhig zu verehren.“

Johann Wolfgang von Goethe

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CHAPTER 1 INTRODUCTION

"Most companies do not audit development projects to find out what they learnt or failed to learn – and why."
(Bowen et al, 1994)

1.0 INTRODUCTION

The importance of industrial Research & Development (R&D) for the future competitiveness of an organization is well accepted and also frequently mentioned in connection with the development of industrial nations (Gupta & Wilemon, 1996). The constant support of R&D activities as well as the continuous improvement of processes within new product development (NPD) is widely recognised as a vital prerequisite for a company's future success (Bartezzaghi et al, 1997; Caffyn, 1997; Wheelwright & Clark, 1992). Nowadays, successful R&D depends not only on the development of technologically superior products, but also on the improvement of management processes and procedures which might turn into the true new core capabilities of R&D intensive companies. Therefore it is essential to foster the capability to learn from each and every R&D project. One way of stimulating such learning in R&D is to conduct *post-project reviews* (PPRs). How PPRs can be effectively used in R&D is the subject of this thesis.

A PPR can be described as a meeting of a project team some time after the project is completed in order to collectively reflect on the key lessons learnt. It is generally conducted with the intention to apply such experiences where appropriate to future project activities. Apart from representing the formal closure of a project, PPRs are a potentially valuable method to generate and share knowledge created during the course of a R&D project. They are increasingly recognised as being useful in complex product development contexts, as one of the problems for R&D organizations today is the risk of losing valuable knowledge and lessons learnt at the end of a project (Tidd et al, 1997). If such knowledge is lost, future projects can suffer from past mistakes being repeated. It is also argued that PPRs can have a positive impact on the learning capacity of R&D units as they have the potential to contribute to the development and continuous improvement of R&D management processes (Abel-Hamid, 1990; Huber, 1996).

Although the utility of PPRs is frequently stressed by academics and practitioners alike, their usage is not widespread. Similarly, rigorous and valid research into PPRs is still very scarce. Existing literature is often restricted to the design of PPR checklists or sample questions to be discussed during an actual PPR. Additionally, the potential learning generated by PPRs has so far not been investigated in detail and thus offers considerable scope for research. Based on these facts, this thesis intends to explore the potential of PPRs by looking at them as possible learning events.

This chapter covers the following topics:

- Discussion of the background to the research;
- Presentation of the research outline, including the research objectives, a short description of the research design and methodology as well as a brief outlay of the research stages;
- Description of the intended contribution of the research;
- Explanation of the overall thesis structure.

1.1 BACKGROUND TO THE RESEARCH

The idea and motivation for this research is based on previous practical experience of the researcher. Working as a project management coach in the central Research & Technology unit of DaimlerChrysler helped the researcher to gain detailed insights into a significant number of R&D projects. The research focus became particularly clear when the author observed that project teams at DaimlerChrysler viewed PPRs negatively and as yet another reporting requirement instead of an ideal opportunity to share valuable experiences and lessons learnt. If PPRs were conducted at DaimlerChrysler, they could best be described as marketing presentations for the senior management and as events from which hardly any review of past experiences took place. In other words, the PPRs were used to praise the achievements of the team so that new budgets were available for future projects in a similar technological field. If a more detailed discussion took place during the PPRs, the analysis typically used the traditional "project management triangle" of *time*, *quality* and *cost*, i.e. the retrospective discussion usually centred exclusively on deadlines, deviations from budget and quality of the final product. Less tangible project outcomes such as lessons learnt, experiences or team-internal communication were hardly mentioned. Based on these observations, the researcher saw the need to investigate PPRs in R&D organizations from a different viewpoint, with more emphasis on learning and the exchange of valuable experiences as the outcome of R&D projects.

A review of the literature in the field of R&D management[1] increased the motivation for this research, as the body of knowledge on PPRs in R&D was found to be very limited. More importantly, the same publications which identified PPRs as an important approach for improving R&D frequently suggested that very few organizations actually used them effectively - many not at all and the rest not to their full potential. The potential of PPRs to contribute continuous improvement to a R&D organization appeared not to have been analysed in detail.

[1] A detailed review of the literature on R&D management including references will be presented in Chapter 2.

The literature review was then extended to the field of project management[2]. Although project management handbooks written for practitioners provided some definitions and guidelines on PPRs, it was evident that no common understanding regarding PPR practices in general existed. One reason for this might be that the literature used many different terms for very similar phenomena. These terms include amongst others *project audit*, *after action review*, *postmortem*, *kick-out meeting* or *manouvre critique*. Some of these terms are directly comparable with post-project reviews, while others have different objectives or different other characteristics. The fact that most existing publications had in common, though, was a variety of reasons why PPRs are not conducted by many R&D organizations.

As it was intended to look at PPRs from a learning perspective, the third literature to be reviewed was the vast body of knowledge on organizational learning[3]. Initially, mainly the literature on learning from experience seemed to be relevant. From this, it became evident that the differences of tacit (non-tangible) and explicit (tangible) knowledge seemed pertinent. During the course of the research, the literature review was extended to the social learning theories which supported the idea of PPRs as ideal events for knowledge creation. Previous research on PPRs has viewed them as mere discussions where participants bring along their experiences to the meeting. Contrary to this, this thesis intends to illustrate why and how PPRs can enable the creation of knowledge at the time of the PPR itself.

In order to verify these preliminary ideas from the literature, the researcher decided to conduct a small pre-pilot study on PPR practices in four R&D organizations (see Appendix 1.0 for a short overview). It was found that practitioners not only defined the term PPR very differently, but it also showed that PPR practices varied a lot between the different R&D organizations. The pre-pilot study also illustrated that the potential contribution of PPRs towards a learning R&D organization was not generally recognised.

Based on these insights from the three different bodies of literature and the limited empirical understanding from the pre-pilot study, several important aspects for this thesis on PPRs were identified by the researcher. Firstly, empirical evidence on current PPR practices in R&D organizations is very limited and often based on single case studies only. Secondly, it has not yet been investigated in detail how PPR participants and R&D managers perceive the PPR practices applied in their companies. Finally,

[2] Chapter 3 gives a comprehensive review with references – here only a cursory overview will be given.

[3] See Chapter 4 for a detailed review with references.

although the difference of tacit and explicit knowledge is frequently mentioned in the R&D literature, detailed investigations into lessons learnt from PPRs with a focus on these different knowledge types have not yet been conducted on a sound empirical basis.

Based on these aspects, the next section will give a brief overview of the research outline, i.e. the research objectives, the chosen methodology and the stages of the research.

1.2 RESEARCH OUTLINE

The practical experiences of the researcher combined with the insights from the literature reviews highlighted above, resulted in a research approach regarding PPRs which is based on specific objectives and methodologies.

1.2.1 Research Objectives

The main area of interest of this thesis is current PPR practices in R&D organizations as well as the apparent lack of recognition of PPRs as an event for knowledge sharing and transfer. Therefore, this thesis has the following three objectives:

- To investigate current PPR practices of R&D organizations and the evaluation of these practices;
- To analyse R&D managers' perceptions of PPRs as potential learning events;
- To generate propositions as to why and how PPRs have the potential to support the generation and transfer of knowledge and the analysis of typical lessons learnt.

1.2.2 Research Design and Methodology

This thesis describes an investigation of the phenomenon of PPRs from a perspective for which there has been only very limited management research so far. Consequently, it was necessary to choose a research design that matches this exploratory nature, and multiple exploratory case studies were identified as the most appropriate approach.

The five case studies which were conducted following some pilot work combined a variety of data sources which included document analyses, interviews and observations. The choice of a multiple-method approach was a conscious one, taken to facilitate data triangulation. The data sources used and analysed at each case were:

- Company documentation like guidelines for PPRs and minutes of PPRs;
- Interviews with R&D managers and members of product development projects;
- Observation of PPRs.

The findings from these data sources were then analysed on the basis of specific frameworks and focused on the research objectives outlined earlier.

1.2.3 The Stages of the Research

The research presented in this thesis was conducted in three stages:

- *Research Stage 1*: Literature review and development of theoretical basis - discussed in Chapters 2, 3 and 4;
- *Research Stage 2:* Research design and pilot case study - discussed in Chapters 5, 6 and 7;
- *Research Stage 3*: Empirical data collection and analysis - discussed in Chapters 7 to 12.

Although these stages indicate a stepwise approach, a certain degree of interaction and loops were necessary in between the three stages, for example when empirical insights informed the theoretical basis or when new literature was published and reviewed.

1.3 INTENDED CONTRIBUTION OF THE THESIS

The intended contribution of this thesis is to add to the knowledge on PPRs in R&D. Not only current PPR practices, but also the personal perceptions of R&D managers regarding PPRs are analysed, along with their learning potential for the continuous improvement of R&D organizations.

1.3.1 Contribution to Knowledge

The academic contribution of this thesis includes several aspects:

- The three bodies of literature which form the theoretical basis of this thesis have not been drawn together in any previous research focusing on PPRs;
- The topic of PPRs in R&D organizations is inspected from various angles, ranging from PPR practices over perceptions of PPRs to the learning potential of PPRs. The investigation of all these aspects within this research goes beyond existing literature in the field of PPRs;
- Current evidence on PPRs is almost exclusively anecdotal as opposed to empirical. In contrast to this, this thesis is based upon five case studies which were conducted systematically;
- The chosen methodology used a wide array of sources of empirical data and techniques to investigate complex constructs related to knowledge and learning. This provides insights into how knowledge can be operationalized;
- The need for more research on knowledge creation in R&D is identified and evidence for such knowledge creation during PPRs is discussed on the basis of particular analysis tools targeted at the discussion of tacit knowledge.

1.3.2 Contribution to Practice

The most important insights for R&D practitioners which are provided by this thesis are:

- Real-life evidence of how PPRs are and should be conducted in R&D organizations is presented. This allowed "best practices" to be identified which will be useful to R&D managers;
- The research provides R&D managers with an understanding of what can be learnt via PPRs and also how these learnings can be disseminated within their organization;
- This thesis not only provides a wider empirical basis than previous research, but also looks at the PPR discussions as a mechanism to support the transfer of tacit knowledge and contribute to a learning organization. This approach is supported by the growing realisation in industry, that competitive advantage is nowadays strongly based on tacit assets and not only depends on innovative new products.

1.4 THESIS STRUCTURE

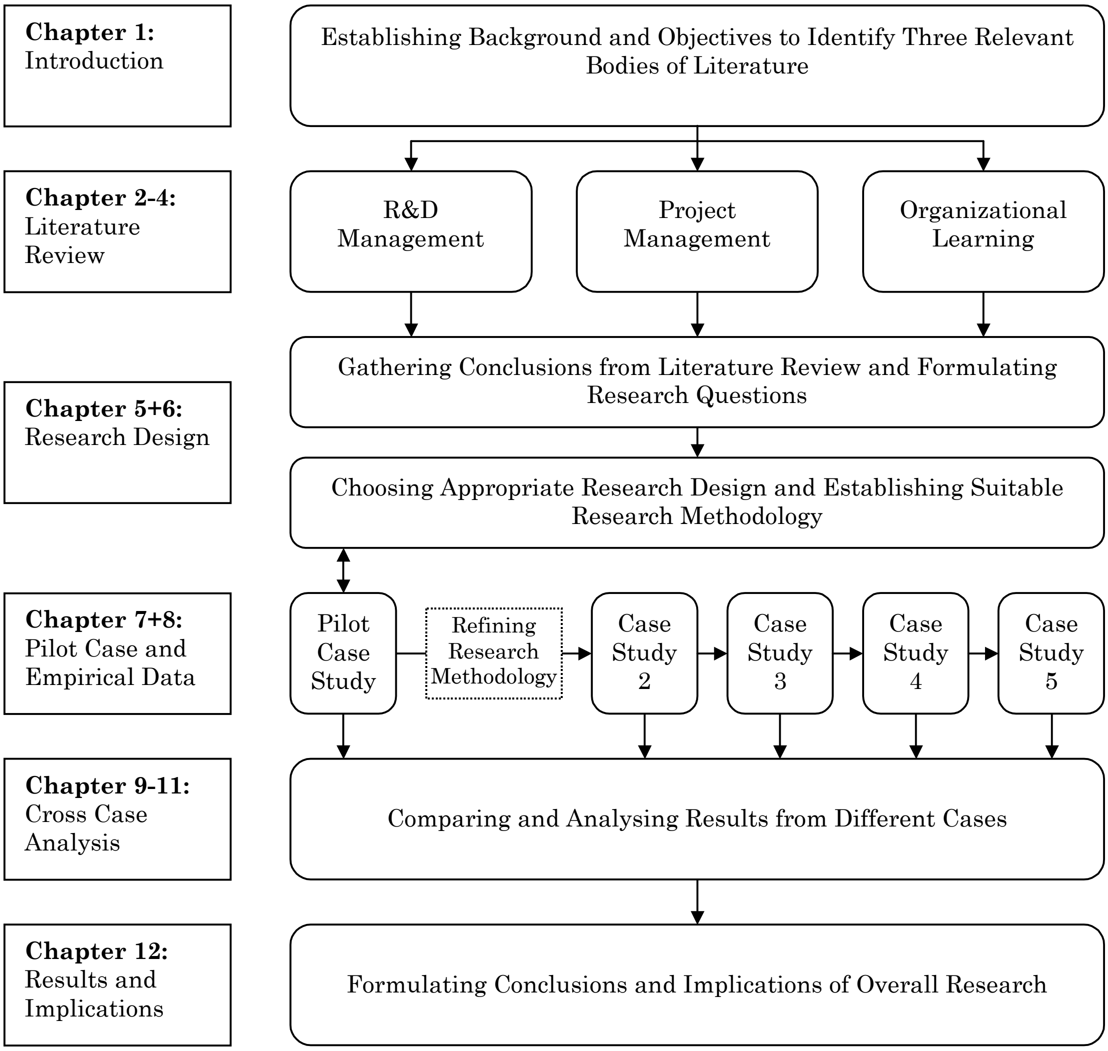
This thesis is divided into twelve chapters as illustrated by Figure 1.1. Since the research is based on various bodies of knowledge, the next three chapters concentrate on the detailed review of the relevant literatures. Building on these literatures, later chapters concentrate on the research design, methodology, empirical data and research results.

Chapter 2 covers the literature on R&D management. It illustrates the overall importance of R&D for a companies' success, some general R&D process models and discusses different streams of literature regarding learning and knowledge creation in R&D. Finally, existing research on PPRs in R&D like general guidelines and checklists for PPRs is presented and the limitations of this research is highlighted.

Chapter 3 reviews the literature on project management. It starts by looking at the history and evolution of project management and highlights learning as a complementary side to the traditional view of project management. Then, the focus turns towards the definition of PPRs and their difference in comparison with several other debriefing methods used at the end of projects. Furthermore, various guidelines for PPRs are discussed which share the limitation that none of them reflect the need for community based learning. Finally, the challenges and hurdles for conducting PPRs in practice are investigated.

Chapter 4 concentrates on the vast body of literature on organizational learning. After discussing the history and definitions of organizational learning, the focus shifts towards the different kinds of relevant knowledge in R&D projects. Finally, it investigates different learning frameworks and discusses which ones are particularly suitable for researching knowledge creation during PPRs in R&D. It also shows that knowledge creation and learning via PPRs is closely connected to the concepts of metaphors and storytelling.

Figure 1.1: Structure of the Thesis



Chapter 5 summarises the implications from the three literatures and illustrates the development of three different research questions which are closely connected to the main aspects derived from the literature. Based on this, it discusses also the philosophical basis of this study and illustrates in detail the methodological choices which were considered for the research design. Finally, it explains the research design chosen as well as the empirical sample selected.

Chapter 6 describes the research methodology based on the overall research design elicited in Chapter 5. It explains in detail all stages of the data collection and data analysis, and also looks at the issues of validity and rigour. Finally, it introduces insights into the approach taken for the data triangulation within and across the case studies.

Chapter 7 summarises the pilot case study for which the research methodology was applied for the first time. It discusses in detail the practical collection and analysis of the pilot case data and their triangulation. Finally, it highlights first results, but also discusses necessary changes for the research methodology based on the first practical experiences of data collection.

Chapter 8 presents the background information on case studies 2 to 5 and illustrates in detail what kind of data was collected during the site visits. It also highlights specific characteristics of each single case study which are relevant for the research.

Chapter 9 presents the cross case analyses regarding current PPR practices at all five case studies. It gives details on a selected number of PPR characteristics detected at the five case companies and also compares these with evidence from the existing literature. Finally, practical recommendations on PPR practices based on these findings are discussed.

Chapter 10 examines the perceptions regarding PPRs across all five case companies. Thus, it compares personal opinions expressed by the interviewees with actual practices found at the case companies. Finally, it discusses the apparent gap between practical application of PPRs and members' personal opinions regarding PPRs.

Chapter 11 presents the findings of the cross case analysis regarding lessons learnt from R&D projects in general. It also presents evidence that PPR meetings can facilitate the creation and transfer of tacit knowledge within a project team. Finally, it discusses the use of metaphors as one source of evidence for tacit knowledge being created and shared.

Chapter 12 summarises the research results of this thesis and draws overall conclusions across all research questions. It studies the wider implications of these findings and also highlights the limitations of the research approach used for this thesis. It concludes with a discussion of the contribution of this thesis for academics as well as practitioners and proposes first ideas for further research in this area.

1.5 SUMMARY

PPRs offer the opportunity for learning in a R&D environment, where complex projects are conducted on a regular basis. Although the importance of PPRs is widely recognised by academics and practitioners alike, their potential for learning and knowledge transfer has not yet been the subject of rigorous empirical research. Often, experiences are only documented in reports, but these cannot capture all issues mentioned during a PPR which are important to be shared within a R&D organization. Furthermore, PPRs are not widely spread in R&D organizations and are often not used to their full potential.

The research objectives were formulated on the main aspects found during the literature reviews. No common understanding of PPR practices exists and the term PPR alone is not defined in an unambiguous way. Furthermore, it was intended to look at PPRs from a learning perspective as opposed to a purely bureaucratic event as witnessed by the research in previous companies.

This thesis intends to illustrate current PPR practices based on five in-depth case studies using an array of data source. In addition, typical lessons learnt from completed R&D projects are compared to the outcome of the processes of knowledge creation and dissemination which take place during a PPR meeting. Based on the findings, the contribution to the academic field as well as to practical management is discussed and a number of directions for future research are proposed at the end of the thesis.

CHAPTER 2 R&D MANAGEMENT

"Given the centrality of R&D as an organizational learning mechanism, there is a surprising paucity of research across all traditions on the broad question of learning in R&D, its promotion and funding."
(Dodgson, 1993)

2.0 INTRODUCTION

This chapter establishes the context of the research as Research & Development (R&D) and the focus as PPRs. It includes not only the discussion of existing literature on PPRs in R&D, but also looks at several related subjects. For example, PPRs in R&D are directly related to several R&D process models. Furthermore, PPRs need to be investigated from the viewpoint of learning and knowledge creation in R&D. Therefore, this chapter covers the following topics:

- The definition of R&D;
- The importance of R&D activities;
- The description of R&D models;
- Learning and knowledge creation in R&D;
- The existing literature on PPRs in R&D.

2.1 THE DEFINITION OF R&D

The term R&D comprises not only activities in scientific research, but also the development of new products. In other words, research provides the fundamental knowledge whereas development tries to turn such knowledge into new and innovative products (Dumbleton, 1986; von Zedtwitz, 1999). While the term *research* is generally more connected with basic investigations (e.g. the development of new technologies) without a particular product in mind, the term *development* refer to the activities which are closer connected to the actual product launch as illustrated in Figure 2.1.

Figure 2.1: Classification of R&D

Class	R&D Activity
Basic Research	Original investigation undertaken in order to gain new scientific knowledge and understanding, not primarily directed towards any specific practical aim or application.
Applied Research	As above, but directed primarily towards a specific practical aim or objective.
Development	Use of scientific knowledge in order to produce new or substantially improved materials, products, processes or systems.

(Source: Dumbleton, 1986)

It is important to mention that R&D activities do not necessarily result in a visible and physically tangible product. Gwynne (1998) states that R&D used to be associated mainly with the manufacturing sector, but the last 20 years saw a significant increase of R&D activities in the service sector as well. These services cover a variety of areas, such as communication, finances, tourism, transport, etc. All of these also rely on R&D activities in order to market new service products or to improve existing ones. In addition, many companies also combine traditional product launches with service innovations. A classical example of this trend are car manufacturers who also offer financial services (e.g. loans) to their customers (Horovitz, 1996).

For the purposes of this thesis, research and development are seen as different stages within the same organizational process as illustrated in Figure 2.1, i.e. it looks at the whole R&D process instead of only concentrating on a single phase. Furthermore, the empirical focus of this thesis is exclusively on traditional R&D activities from manufacturing companies in several different industry sectors. The main reason for choosing this focus is the difference between service products and traditional tangible products. New service development is often less structured, follows different development processes and is therefore not always comparable in terms of learning processes and knowledge transfer (Metters et al, 2003). Consequently, it was seen as necessary to chose only one of the two sectors and tangible products were chosen for this thesis.

2.2 THE IMPORTANCE OF R&D

2.2.1 Advantages of R&D

It is frequently mentioned in the literature that modern R&D is more than just the process of generating, developing and diffusing new knowledge to develop products, processes and services (Liyanage et al, 1999; Trott, 1998). It is one of the most important functions of a company that is essential for successful innovations which will generate future revenues.

In order to keep a competitive edge, companies are forced to launch new innovative products faster and more efficiently than their competitors, and innovation rate appears to be directly linked to market share and profitability (Ali, 1994). In addition, it was found that companies with a focus on innovation generate about 23% of their profits from products which are less than four years old (Roper et al, 1996). These are some of the main reasons why top managers perceive R&D and new product development as a core competence of their organizations that should bring a competitive edge (Harmsen et al, 2000).

2.2.2 R&D Budgets and Expenditures

The increasing importance of R&D is also reflected in current R&D spending patterns. In 2004, R&D ratios of the top 700 companies world-wide were at 4.2% on average, slightly below the all-time high of 4.3% in the year 2001. These details on international R&D investments are published every year by the UK Department of Trade and Industry in their R&D scoreboard. For example, the 12th annual R&D scoreboard shows that between 1998 and 2001, about twice as many companies have increased rather than decreased R&D intensity, often by a rate that exceeded their sales growth (Department of Trade and Industry, 2002).

Table 2.1 shows example figures of the overall global trend: the ten companies with the highest R&D expenditure in 2004, their R&D ratios[4] as well as the compound annual growth rate of their R&D investments. It is interesting to note that three out of the top ten still have double digit growth rates for R&D costs, whereas five out of the top ten show a negative trend regarding their R&D growth rate. Yet, of the five companies with a negative R&D growth rate, four are from the automotive sector which is currently under high competitive pressure. In general terms, though, *"…even in difficult economic conditions the majority of leading companies in high technology sectors are conscious of the importance of R&D to the company's future and are loath to reduce R&D intensity"* (Department of Trade and Industry, 2002).

Table 2.1: Top Ten Companies in R&D Expenditure (2004)

Company	Country	R&D expenditure in Bn GBP	% Growth	% of Sales
Ford Motor	USA	4.2	-3	4.5
Pfizer	USA	4.0	+38	15.8
DaimlerChrysler	Germany	3.9	-8	4.1
Siemens	Germany	3.9	-5	7.4
Toyota	Japan	3.5	+13	4.3
General Motors	USA	3.2	-2	3.1
Matushita Electric	Japan	3.0	+5	7.7
Volkswagen	Germany	2.9	-5	4.7
IBM	USA	2.8	+7	5.7
Nokia	Finland	2.8	+15	13.5

(Source: Department of Trade and Industry, 2004)

Table 2.1 also shows that R&D intensity differs significantly between different industrial sectors. Pharmaceutical companies (e.g. Pfizer 15.8%) generally invest a much higher percentage of sales into their R&D activities than traditional manufacturing industries (e.g. Ford 4.5% and GM

[4] R&D ratio reflects the percentage of sales spent for R&D.

3.1%), where R&D ratios are still in single digits. This is mainly due to long-term fundamental pharmaceutical research which is not comparable in terms of complexity, for example, to the development of a new car generation. Electronic sectors (e.g. Siemens 7.4% and Matushita 7.7%) can be found somewhat in between these two extremes. Therefore, R&D ratios are interesting benchmarks within a industry sector. However, it only refers to the R&D input, but has no implications for the return on R&D investments. The latter can more easily be valued by looking at the number of new products that are launched by a company (Goffin & Mitchell, 2005).

Yet, the intention is not to imply that paying more attention to R&D does necessarily mean spending more on it. *"It is not what you spend, it is how you spend it. It is no longer enough to concentrate on the total value of a research budget – what matters is the effectiveness of that research"* (Department of Trade and Industry, 1998).

The apparent link between the level of R&D expenditures and the size of a company is also frequently discussed in the literature. Research provides various viewpoints on this question. Findings run from economies of scale, i.e. large companies invest more in R&D (Schumpeter, 1934) to the opinion that especially small companies develop a high proportion of new products. The latter phenomenon is mainly attributed to their creative staff and their internal flexibility regarding their development processes which enables them to react very quickly to new market trends and customer demands (Cohen & Klepper, 1996). Thus, it is also important to look at typical R&D processes and how these are managed in order to illustrate the importance of companies' R&D activities.

2.3 PROCESS MODELS IN R&D

2.3.1 General Process Models

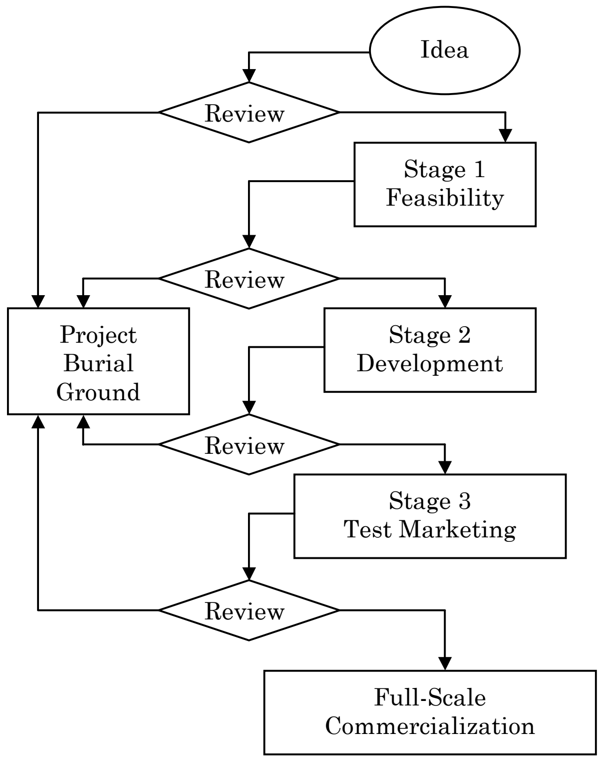
Different models for typical R&D processes can be found in the literature. Generally, these models divide the new product development process into several steps which describe the different tasks to be performed on the way from an idea to the product launch. A well-known model was developed by Booz, Allen & Hamilton (1982) and consists of seven different steps which are illustrated in Figure 2.2.

Figure 2.2: The BAH Model

(Source: Booz, Allen & Hamilton, 1982)

The main shortcoming of this model is that it does not link the different steps and that no analysis or review takes place during the NPD process. This shortcoming was identified by Balachandra (1989), who developed a different model for the stages of the industrial R&D process as illustrated in Figure 2.3. His model consists of only four stages, but includes four different review steps as well. These review steps are integrated after each of the development steps and all projects which do not pass these reviews are transferred to the so-called "project burial ground" because their suitability might change in the future, for example when the market needs have changed.

Figure 2.3: Stages of the Industrial R&D Process



(Source: Balachandra, 1989)

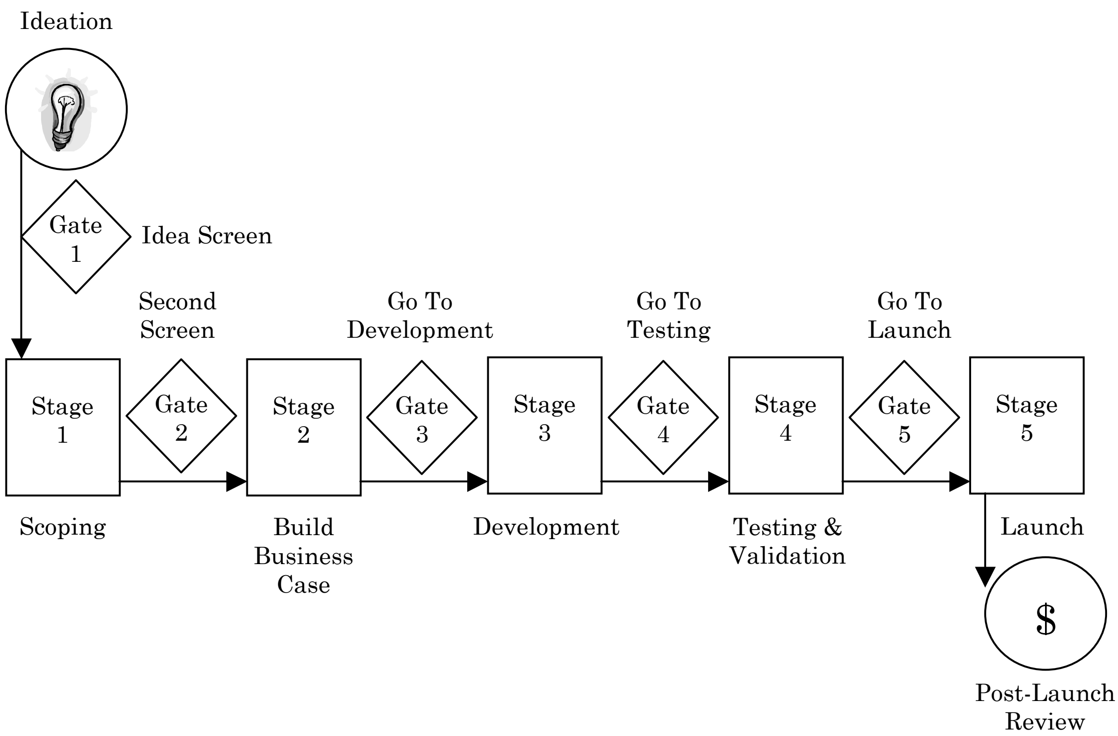
The focus of Balachandra's model is to support the difficult project termination decisions that have to be made during a project's life time. Therefore, he also claims that the earlier a review is done, the cheaper it is and the less formal it has to be organized. However, reviews at the end of a R&D project, i.e. PPRs, are not mentioned.

2.3.2 Stage-Gate® Process Model

One of the first and most comprehensive NPD process models developed parallel to the general process models described above stems from the Product Management Institute led by Robert Cooper. This model is most often referred to as the "Stage-Gate® Model" and Figure 2.4 illustrates its latest version, whereas many variations of this model exist in the literature (Tidd et al, 1997).

Cooper (2005) proposes that each time a project team wants to step from one development phase to the next ("the gates"), a review and discussion with management or steering committees ("the gatekeepers") should take place. This approach ensures that problems encountered and created in the beginning of a project are not neglected until the project end and cannot risk to cause unsolvable problems which are not discovered until the project end. In addition, it forces the project team to define clear objectives for each development phase which can be assessed at each gate (Cooper & Kleinschmidt, 1992).

Figure 2.4: Stage-Gate® Model



(Source: Cooper, 2005)

The most important aspect of the latest Stage-Gate® model, though, is that it includes a post-launch review, which was not mentioned in earlier models. Cooper (2005) describes two different post-launch reviews:

- An interim review about two to four months after the launch when everything is fresh in the minds of the team members. It identifies the strengths and weaknesses and highlights the learnings for the next projects. In addition, it looks at the first commercial results;
- A final review about 12 to 18 months after the launch when the project team is released and the final data on revenues, costs and expenditures is discussed.

2.3.3 Learning as an Element of NPD Models

It is interesting to note that only later Stage-Gate® process models include the final PPR step, while earlier versions (see for example Cooper, 1994; Cooper & Kleinschmidt, 1992) did not specifically mention a detailed review of the whole project after its completion or market launch. In other words, until recently the established process models for NPD did not consider lessons learnt in hindsight as a worth while activity to conserve valuable know-how.

Consequently, for R&D organizations which follow the established and basic NPD process models, a lot of insights of causes and consequences are potentially lost. This stands in sharp contrast with the fact that learning and knowledge creation is more and more considered to be a vital part and outcome of all R&D activities in an organization.

2.4 LEARNING AND KNOWLEDGE CREATION IN R&D

2.4.1 Importance of Learning and Knowledge Creation

Overall, terms like learning, knowledge and R&D have been increasingly used in connection with each other in the academic literature during the last few years. In fact, the "*product innovation literature in the last few years has progressively highlighted the importance of knowledge management as the main source of long-term competitive advantage*" (Corso et al, 2001) and during the 1990s researchers in organizational learning were attracted more and more by the field of product innovation (Bartoletti et al, 2002). However, so far the different learning theories were only rarely applied to the NPD process. *"It is time to launch more specific empirical research to discover more precisely the factors which influence specific types of organizational learning...with the ultimate goal to improve and accelerate the rate of successful new product outcomes"* (Saban et al, 2000).

One reason for the increasing focus on learning in the R&D literature is that R&D projects and NPD processes have two different types of outcome. Firstly, there is the new product as a source of new revenues. Secondly, all projects generate a vast body of knowledge related to the product as well as to organizational R&D processes (Cohen & Levinthal, 1989). This second outcome should not be neglected, because a company's future competitiveness depends heavily on the awareness that learning and knowledge creation is one of the critical success factors in R&D today (Baker et al, 1986; Balachandra & Friar, 1997; Leonard-Barton, 1992; Lester, 1998). In other words "*...competitiveness depends on how well R&D organizations can leverage from past experience*" (Corso & Paolucci, 1997).

The ability to sustain significant improvements in R&D over long periods of time and to enhance an organization's competitive advantage, rests mostly on the capability of an organization to learn (Gupta & Wilemon, 1990; Takeuchi & Nonaka, 1986; Wheelwright & Clark, 1992). In fact, organizational learning was identified as a fundamental core competence of R&D organizations (Drejer & Riis, 1999; Prahalad & Hamel, 1990) which is extremely difficult for competitors to imitate and thus of particular importance.

Furthermore, R&D is a highly knowledge-intensive activity which develops not only tangible knowledge assets, but also invisible aspects like tacit knowledge, know-how and experiences.[5] Therefore, it asks for particular approaches when it comes to learning and knowledge transfer (Mehra & Dhawan, 2003; Johannessen et al, 1997). Thomke & Fujimoto (2000) recognise the difference of tacit and explicit experiences in the R&D context and claim that tacit knowledge is only transferable through face to face communication and direct personal contact which relates back to PPRs. "*Tacit-to-tacit exchange is greatly enhanced by close personal contact: in dwelling with others, sharing common emotions and experiences*" (Mascitelli, 2000).

Based on the importance of learning and knowledge creation in R&D environments, it was possible to identify various streams within the R&D literature which are more relevant for PPR research than others, because they refer to the final project phase as an important learning process.

2.4.2 Individual Learning

Many academic researchers have identified individuals as the basis of learning in R&D, although most R&D employees are still rewarded for tangible work results and less for their willingness to learn (Bowen et al, 1994). For example, Barker & Neailey (1999) suggest *"learning logs"* which help detailed recollection of project experiences based on their investigations in the UK automotive industry. These could then be shared and discussed in team learning reviews which can be compared to PPRs. Similarly, O' Mara et al (1999) also refer to individuals as the learning base in organizations and identify various behaviours as useful for the transfer of experiential knowledge:

- Individuals use project write-ups after completion to record successes and failures;
- Individuals embody knowledge into vehicles that can be more promptly disseminated;
- Individuals make experiences explicit and communicate thus acquired knowledge.

Individual learning during the final project phase was also identified as an important enabler for knowledge transfer by a study based on two

[5] Details regarding the different kinds of knowledge within organizations are discussed in detail in Chapter 4.

major R&D projects funded by the Swedish government. "*The termination period makes it possible for the participants to summarise experiences and learn for the future. Individual learning is thus a bridge to future temporary organizations and learning the glue in a work of temporary organizations and individuals moving around in temporary and permanent settings*" (Björkegren, 1999).

2.4.3 Project Team Learning

The importance of learning on a project or team level in R&D is highlighted by various authors. In fact, Österlund (2001) even states that certain issues cannot be discussed and analysed before the end of a project. *"By exchange of experience between group members, the group as a learning system will develop a deep competence in its special field. It is in this way that core competencies unique to the company will be created"* (Österlund, 2001).

Although the learning processes within a project team might often be informal and depend very much on an interpersonal level, they should be supported by formal requirements within the NPD process. That means the development process has to indicate clearly when team knowledge should be captured from within the organization be it via databases, archives or experience listings (Green & Wilemon, 1999). By doing so, an organization ensures that key knowledge regarding new products and processes will be stored at the group level, which is where it offers the highest success potential for the organization. "*Emphasis should lie on investigating tacit knowledge, learning and acquisition at the group level and not just to perceive it only operating at the individual level*" (Howells, 1996).

A survey of 160 engineers and project managers also found that for R&D project teams planned learning is more efficient than ad-hoc learning and face-to-face learning is more efficient than that generated by written communication (Nobeoka, 1995). These findings clearly support the importance of established PPR practices in R&D organizations and also highlight the need for verbal exchange of knowledge that cannot easily be articulated or documented. However, it was also stressed that tacit experience is rated very high by R&D managers, but that such experiences are also extremely difficult to capture within a project team (Kerssens-Van Drangelen et al, 1996).

2.4.4 Project-to-Project Learning

Available mechanisms for project-to-project learning in R&D were analysed in detail by Bartezzaghi et al (1997) on the basis of 19 in depth case studies in three different industries. They identified three enablers which help project-to-project learning. First of all, project classification schemes, secondly transfer vehicles like people, documents or databases, and thirdly the management of project feedback. The latter enabler is specifically linked to the termination phase of projects because this phase is viewed as the most effective one in order to facilitate project-to-project learning. Unfortunately, the focus of their study was on technical learning, while "intangible" learning aspects were not considered at all.

The importance of project-to-project learning was also identified by Lynn (1997). He analysed successful products at Apple and IBM and found that one project characteristic they all shared was that they had used internal post project analysis as a form of cross-team learning. In addition, the application of post-mortem project reviews was also identified as useful for project-to-project learning by most R&D managers (Lynn, 1998).

2.4.5 Continuous Improvement

Another body of literature often used in connection with learning and R&D is continuous improvement (CI) (Hughes & Chafin, 1996). Contrary to the Stage-Gate® model presented earlier, Caffyn (1997) conducted action research in more than 70 companies and found that *"existing models for NPD tend to describe the stages in the process, but do not include feedback loops for process learning, i.e. how learning about the process that could lead to an improvement may be incorporated into the company's official NPD process*." She therefore identified the use of post-project evaluations as a critical facilitating factor for the implementation of CI in R&D organizations.

Maidique & Zirger (1985) established the idea of "learning by failing" in NPD. Their work - which is based on a survey of success and failures within 159 projects in the electronics industry - is quoted in many publications on learning in R&D. They observed that new product failures most often represented important milestones in the development of the innovating firm and many of these failures were the clear basis for major successes that followed shortly afterwards. Ideally, these failures are not repeated by R&D organizations, but it has been proven that especially the ignorance regarding the learning contribution of failure as well as the missing recognition of the project-termination phase enable the repetition of mistakes (Bourgault & Sicotte, 1998).

2.4.6 Limitations of Existing Research

Overall, it can be seen that the literature discussed mentions the impact of PPRs in R&D and also highlights their role regarding learning and experience transfer. However, the analysis does not go beyond the identification of PPRs as one of various positive factors for learning and knowledge creation in R&D. None of the papers investigated the PPR event as such or analysed in detail and with empirical data how learning processes during PPRs in R&D actually work. In addition, only a few papers are based on organizational learning theory.

Summarising, the analysis identified three shortcomings which seem to be representative for the whole body of literature on learning and knowledge creation in R&D:

- The processes for learning, knowledge creation and dissemination in R&D projects are often generalized and not investigated in detail. *"Many contributions about organizational learning were written during the last few years, however, the underlying processes, the decisive dimensions and sources are still scarcely known*" (Reger & von Wichert, 1997);
- The focus on knowledge and learning is mainly placed on tangible aspects which are easy to document, share and transfer and usually do not consider intangible knowledge aspects;
- Investigations on learning processes after an R&D project has been finished are still missing.

2.5 POST-PROJECT REVIEWS IN R&D

2.5.1 Importance of PPRs in R&D

Overall, the importance of PPRs for an R&D organization is frequently mentioned in the academic literature. As important lessons learnt are gathered, PPRs can play an active role in making R&D organizations "smarter" by learning from experiences and previous mistakes. *"Without an effective postmortem diagnostic exercise to identify problems and their causes, managers cannot adequately scrutinize project deficiencies, and may repeat errors on future projects. The payoff from an effective postmortem is a smarter organization that truly learns from its failures" (*Abel-Hamid, 1990). Based on this, PPRs are also a suitable mechanism to contribute to the continuous improvement of the R&D processes (Caffyn, 1997), which was discussed previously.

Furthermore, evidence from the International Research Institute showed that a PPR makes it possible that certain experiences can be shared within the team or with other project teams within the same R&D organization. Based on findings from 19 in-depth case studies, PPRs were identified in many member companies of the Industrial Research Institute as one of the better practices to capture new learning and to implement Knowledge Management in R&D (Armbrecht et al, 2001). Yet, apart from highlighting PPR as better practice, no clear guidance on the conduct of PPRs is given.

Meyers & Wilemon (1989) confirmed that PPRs represent a learning opportunity and facilitate the establishment of feedback loops between R&D project teams. They found that 20% of the 80 R&D team members interviewed indicated that much of the learning that is created in a NPD project team is never passed on to the subsequent teams in the organization. If the transfer of learning takes place, though, it might even lead to faster development times. This was found by Gupta & Wilemon (1996) based on a mail survey of R&D directors in 120 technology based firms.

Yet, a PPR should definitely not be considered as a guarantee for project-to-project learning or the improvement of a R&D organization. *"Postmortems are a very good example of effective transfer mechanisms when the information being transferred can be economically encoded; however, that may not always be the case*" (Thomke & Fujimoto, 2000).

2.5.2 Usage of PPRs in R&D

One of the main problems for any research on PPRs in R&D is the well accepted fact that not many R&D organizations actually conduct PPRs.[6] Various authors stress that PPRs are either a rare event for organizations to transform their experiences into common knowledge (Huber, 1996) or that PPRs are not done at all so that the same mistakes are repeated in future projects. "*The final stage in any innovation process is one of review of the completed project, and an attempt to capture learning from experience. This is an optional stage and many organizations fail to carry out any kind of review, simply moving on to the next project and running the risk of repeating mistakes made in previous projects. Others do operate some form of structured review or post project analysis, however this does not in itself guarantee learning since the emphasis may be more on avoiding blame and trying to cover up mistakes"* (Tidd et al, 1997).

The usage of PPRs in R&D intensive organizations has been investigated in various studies which are based on very different sample sizes:

- Brady & DeMarco (1994) present examples from Apple, where post-mortems had recently been formally introduced;
- Huber (1996) mentions a series of discussions with executives from three large technology consulting firms and found that none of these use any kind of debriefings to capture lessons learnt;
- Bowen et al (1994) conducted case studies at five different companies and found that only one of these uses post-project reviews. In addition, the authors have *"collectively studied or participated in hundreds of development projects at numerous companies in a range of industries… Only a handful have any kind of auditing system, and often the purpose of those audits is to ensure that the project is complying with bureaucratic procedures rather than to analyse both the positive and negative aspects of the project so the company can learn" (ibid);*

[6] There are several explanations for the lack of PPR usage in R&D. Most of them are the same as for PPRs in general and will be discussed in detail in Chapter 3. However, R&D projects are also often seen as more complex than other types of projects, which might be yet another potential hurdle for PPRs in R&D (Lilly & Porter, 2003; Wheelwright & Clark, 1992).

- Boag & Rinholm (1989) found that only two companies in their sample of 33 small and medium-sized high technology companies used formal post-mortems to evaluate completed development efforts;
- Goffin and Pfeiffer (1999) mention that only four of their 16 case study companies used PPRs;
- Menke (1997) found that less than a quarter of the 79 R&D organizations in his benchmark actually used PPRs, although thorough reviewing of completed projects was identified as one of ten best practice approaches for continuous improvement in R&D;
- Von Zedtwitz (2003) found that only 12 of 63 survey respondents indicated that their companies use PPRs on as many completed projects as possible;
- Saban et al (2000) state that 55.6% of the 212 companies they studied in selected regions of the USA employ formal review processes;
- Hoegl & Schulze (2005) investigated the knowledge management practices of R&D organizations and found that around 80% of their total sample of members of 94 NPD projects knew and deployed so-called "experience workshops".

The above list of previous studies shows sharp contrasts regarding the frequency of PPR application, but the majority of the studies show that PPRs are a rather rare event in R&D organizations. One possible reason for the different findings of the above studies might be that the terms *PPRs*, *post-mortem*, *formal review process* or *experience workshops* are defined and understood very differently across the respondents. In addition, the companies which claim to apply PPRs might not do so on all of their completed projects, although the formal review process as such exists.

The drawback of most of these studies is that they do not provide any details regarding the PPR practices in the R&D organizations studied. Therefore, the next section discusses the guidelines in the literature for conducting PPRs in R&D organizations

2.5.3 Existing Guidelines for PPRs

Various authors have produced guidelines for PPRs in R&D. Table 2.2 provides an overview of existing guidelines within the R&D management literature which provide detailed checklists, sample questions or recommendations for the conduct of PPRs.[7] Looking at the six different guidelines listed, several comments have to be made regarding the quality of these guidelines.

Firstly, the sample size of most papers is limited or not discussed in great detail. It ranges from single case studies (Duarte & Snyder, 1997) over

[7] The numbering 1 to 14 in Table 2.2 refers to Data Analysis Instrument 1 which will be explained in Chapter 6.

various case studies (Ayas, 1997; Wheelwright & Clark, 1992) to personal experience of the authors (Smith, 1996). Only two papers are based on specific samples which are also specifically described in the publication (Lilly & Porter, 2003; von Zedtwitz, 2003).

Secondly, all guidelines and PPR approaches suggested have not been tested for their general applicability in other organizations or their suitability for R&D projects. Overall, they are comparable to the popular project management literature which is based very much on vague recommendations how the post-project phase could or should be managed.

Thirdly, it is unclear how the guidelines and checklists which are presented can be applied because the recommendations in the papers do not seem to be directly derived from the data or the papers do not provide enough details of the research methodology which was used. Two papers do not provide any details of the research methodology (Smith, 1996; Wheelwright & Clark, 1992), two others used action research approaches without discussing the details of this approach (Ayas, 1997; Duarte & Snyder, 1997), and the remaining two are based on exploratory surveys but do not link the data collection to the recommendations either (Lilly & Porter, 2003; von Zedtwitz, 2003).

Fourthly, not only the proposed process steps, but also the expected PPR outcome discussed in these six papers centres very much on insights and knowledge that can be written down, documented and easily shared. Apart from that, the papers recommend a great variety of aspects to be considered during PPRs as shown in Table 2.2. Overall, several PPR aspects which are mentioned in most of these papers were identified (e.g. formal PPR process, timing of PPRs, etc.), but the discussion of these aspects are very vague so that no clear guidance on PPR practices can be derived from these guidelines.

Within the R&D literature one can also find guidelines for PPRs which are specifically designated for software development projects. The full list of these guidelines is presented in detail in Table 2.3. Again, there are a number of drawbacks across these publications which are important to mention.

Firstly, most publications listed in Table 2.3 are not only targeted at practitioners, but often also written exclusively by practitioners who attempt to share their professional experiences in software development (Birk et al, 2002; Chikofsky, 1990). As a result, just like the papers summarised in Table 2.2, most of them are based on single case studies and none of them offers any evidence about the collection or analysis of empirical data. Even a teaching note from the Harvard Business School (Sinofsky & Thomke, 1999) uses the best-selling book "Microsoft Secrets" (Cusumano &

Selby, 1997) as the sole basis for their recommendations on what they call post-mortem analysis. On the other hand, though, Sinofsky & Thomke (1999) provide detailed checklists for the conduct of PPRs which are also applicable in general.

Based on these general shortcomings it became evident that applying software development papers to this thesis is problematic as new IT projects are often only a synonym for the next update or software version and cannot be compared to industrial R&D where new projects often represent completely new products and technical platforms. Therefore, with the exception of Sinofsky & Thomke (1999) the guidelines listed in Table 2.3 will not be followed up in later stages of this thesis.

Table 2.2: Guidelines for PPRs in the R&D Management Literature

	No	1	2	3	4	5	6
	Reference	Ayas (1997)	Duarte & Snyder (1997)	Lilly & Porter (2003)	Smith (1996)	Von Zedtwitz (2003)	Wheelwright & Clark (1992)
	Empirical basis	Case study from aircraft manufacturing industry	Single case study at Whirlpool Corporation	Two stage research in various organizations	Consultancy practice of author combined with anecdotal examples	Convenience sample of 63 R&D managers plus interviews at 13 companies	Various case studies
	Methodology used	• Action research • No further details given	• Action research using NPD learning template • Claims to be based on Huber's OL model – but it is unclear how	• Exploratory interviews with 16 NPD managers in 8 organizations. • Mail survey across 49 companies • Focus on explicit knowledge	• No details given	• Survey questionnaire • Qualitative feedback from interviewees	• No details given
1	Objective of PPRs			X	X	X	X
2	Timing of PPRs				X	X	
3	Duration of PPRs						
4	PPR participants			X	X	X	X
5	Moderation of PPRs		X		X	X	
6	PPR discussion method	X					
7	Location for PPR					X	
8	Use of guidelines for PPRs				X		
9	Preparation of PPRs			X		X	
10	Atmosphere during PPRs		X		X	X	
11	Results of PPRs				X	X	
12	Dissemination of PPR results			X			X
13	Creation of action points	X					
14	Agreement on improvement suggestions	X	X				

Table 2.3: Guidelines for PPRs in the Software Development Literature

	No	1	2	3	4	5
	Reference	Birk et al (2002)	Chikofsky (1990)	Collier et al (1996)	Pitman (1991)	Sinofsky & Thomke (1999)
	Empirical basis	Personal experience of authors	Software management experiences of author	Practical examples from Apple plus personal experience from 22 projects	Uses CIPPI Model from software (context, inputs, processes, products, impacts) and personal experience of author	Examples from Microsoft and other software developers
	Methodology used	No details given	No details given	No details given	No details given	No details given
1	Objective of PPRs	X	X		X	
2	Timing of PPRs					X
3	Duration of PPRs					X
4	PPR participants	X				X
5	Moderation of PPRs					
6	PPR discussion method	X	X	X	X	
7	Location for PPRs					X
8	Use of guidelines for PPRs				X	
9	Preparation of PPRs	X		X		X
10	Atmosphere during PPRs					
11	Results of PPRs		X	X	X	X
12	Dissemination of PPR results			X		X
13	Creation of action points		X			X
14	Agreement on improvement suggestions		X			

2.6 CONCLUSIONS ON THE R&D LITERATURE

The importance and need for PPRs in R&D is well-recognised in the literature. Particularly their impact on continuous improvement of R&D processes and the resulting competitive advantage is frequently mentioned. However, the existing literature on PPRs in R&D is currently limited to simple recognition of their importance and the fact that not many R&D organizations use them. None of the papers reviewed offers reliable and generalizable data on how PPRs are and should be conducted.

Although PPRs are recognised as events where knowledge creation and sharing can take place, existing research on PPRs is somewhat superficial and has focused on generating guidelines. The rich literature of organizational learning is rarely applied to R&D management and thus no detailed investigation regarding learning in PPRs exists. McKee (1992) confirms stating "*academic research on innovation has a strong learning orientation. The problem is that much of the work that has been done is not organised in terms of underlying learning theory*." The only paper which specifically tests organizational learning theory regarding the back end and evaluating stage of the NPD process stems from Saban et al (2000). Their "new product learning model" includes a knowledge development process which is largely based on the information systems point of view, i.e. information acquisition and information dissemination.

Furthermore, none of the reviewed papers seemed to take a detailed look at the social element of PPRs or the fact that different types of knowledge might be more suitable to be discussed and disseminated via PPRs than others. Such collective learning in an R&D organization lies at the very heart of a core competence because internal processes and systems hold substantial elements of tacit knowledge and are therefore very difficult for competitors to imitate.

Overall, the five key aspects from the literature review are summarised in Table 2.4 below. These will be referred to again when developing the research questions as well as the research design and methodology in later chapters of this thesis.

Table 2.4: Summary of R&D Management Literature Review

No	Key aspects from the literature	References
1	Learning and continuous improvement influences competitive potential in R&D	Corso et al, 2001; Leonard-Barton, 1992
2	Tacit knowledge requires different management and transfer mechanisms than explicit knowledge	Thomke & Fujimoto, 2000
3	Importance of PPRs for a learning R&D environment is a well accepted fact	Gupta & Wilemon, 1996; Meyers & Wilemon, 1989; Österlund, 2001
4	Empirically based research on PPRs is very limited	Saban et al, 2000
5	Existing research on PPRs in R&D is seldom based on Organizational Learning theory or concepts	McKee, 1992

2.7 SUMMARY

This thesis looks at research and development as two different steps of the same business process. The importance of R&D for the future competitiveness of organizations is widely accepted and also reflected in current R&D spending patterns of companies world-wide.

Recent process models for R&D include a final learning stage at the end of every NPD project, which has not been considered in earlier versions of these models, because learning is considered to be an important outcome of every single project in R&D. In addition, aspects from organizational learning theories are increasingly considered by researchers in product innovation, but not often empirically applied and tested.

PPRs are generally recognised as important, but various papers confirm that they are not frequently used by R&D organizations. Existing guidelines in the literature are not based on thorough empirical data and the testing of these guidelines has so far not been done.

Based on these findings and conclusions, this thesis aims to develop further insights and a better understanding of the learning potential of PPRs in R&D. Thus, it is intended to look at the details of PPR practices in R&D organizations and how these practices can support the creation of tacit as well as explicit knowledge. Thus, it is not only important to review the literature on organizational learning (see Chapter 4) but also to discuss PPRs in general within the body of knowledge of Project Management which will be done in the next chapter.

CHAPTER 3 PROJECT MANAGEMENT

"PPRs offer insight into the success or failure of a particular project as well as a composite of lessons learnt."
(Cleland, 1999)

3.0 INTRODUCTION

This thesis views PPRs as the final milestone of a project and thus as part of the overall Project Management (PM) process in organizations. As a short definition of PPRs was already given in Chapter 1 and their usage in R&D was discussed in Chapter 2, it is now necessary to review what has been written about PPRs in the PM literature including:

- The evolution of the project management discipline;
- The recent focus on learning and knowledge creation in projects;
- The definition and history of PPRs;
- The importance of PPRs;
- The existing PPR checklists;
- The barriers for PPRs in practice.

3.1 EVOLUTION OF PROJECT MANAGEMENT

Although projects have already run for centuries, formal project management emerged in the late 1950s (Cleland, 1999). At that time, a number of major defence programs were in development and techniques such as the Program Evaluation Review Technique (PERT) and Critical Path Methods (Fondahl, 1987) emerged and much of the early theory on the topic was developed through the military. Nowadays, project management can be found in almost all types of organization and is rightfully recognised as a management discipline.

One of the first comprehensive papers recognised by the PM community was published by Gaddis in 1959. This was also the time when the difference between ordinary production-type work and something which was clearly becoming identified as project work occurred (Snyder, 1987). From then on, the application of project management in practice and also the literature published grew with increasing speed – a development which is still going on in the 21st century and which is unlikely to stop in the near future. The main problem regarding the further development of the PM discipline lies in the fact that *"PM research has still to be established effectively as a major discipline...as it is widely misperceived as a collection of planning and control techniques rather than as a rich and complex management process"* (Söderlund, 2000). Current drawbacks of the PM body of literature include a lack of a clear theoretical basis, distinct concepts and empirical proof.

However, more recent streams in the PM literature have started to focus more on aspects like knowledge management and learning in project environments (Bresnen et al, 2003; De Filippi, 2001). These are frequently linked to theoretical frameworks that view organizations as knowledge-intensive entities or places of social communication, both of which refer back to the theoretical basis of this thesis, which will be discussed in Chapter 4.

3.2 LEARNING AND KNOWLEDGE CREATION IN PROJECTS

3.2.1 Learning in Project Environments

Projects are traditionally managed as technical systems aiming to achieve a company's target dates within a given budget in order to achieve a certain outcome. The strength and domination of this way of thinking is reflected in the PM definitions given in the popular project management handbooks (Partington, 1997). In the 1990s, the literature started to recognise that these traditional concepts of cost, quality and time are not the only ones having an impact on the success of a project (Vriethoff, 1986). Instead, other factors need to be identified (Belout, 1998; Clarke, 1999; Gemünden & Lechler, 1997). According to Gemünden & Lechler (1998) the illusion that projects can be managed with formal rules and regulations has to be thrown overboard along with the assumption that one can learn automatically as much as desired from previous experiences.

An important element of project success is learning from past experience that is often quoted in the academic literature, but is not so widely understood or applied in practice (Darnell, 1982; Kleiner & Roth, 1997; Wideman, 1995). Project outcomes should be both task and learning based (Rhodes & Garrick, 2003) because "a *project may be seen as a vehicle enabling a manager to undertake a journey resulting in both learning and practical benefit to the business"* (Sense & Antoni, 2003). Thus, projects should be seen as opportunities for organizational learning, which also offer substantial learning opportunities for individual project team members (Sense, 2003).

Although projects are increasingly perceived by practitioners and academics as arenas for knowledge creation (Björkegren, 1999), academic research is still very limited when it comes to learning processes within and between projects. Some preliminary studies have shown different potential approaches how a learning project management environment can be enforced (Lundin & Midler, 1998). For example, Boudes et al (1998) developed six principles for designing a learning program for project management and one of their principles is to organize interfaces between team members of projects in the finishing stage with those just starting a new project. In addition, Müllern & Östergren (1998) found that learning depends on the project stage, because each stage asks for different learning processes. However, these findings are still mainly theory driven and based on limited exploratory research.

3.2.2 Challenges for Project-based Learning

Overall, organizational learning could be a positive result of well managed projects (Müllern & Östergren, 1998), but since projects are non-repetitive activities, learning does not happen in the context of a standard learning curve. "*Learning is not a natural outcome of projects and a project-based organization is not necessarily conducive to learning*" (Ayas & Zeniuk, 2001).

Since the lifecycles of many projects are long and project teams are mostly dissolved very quickly after the project finishes, learning in projects requires some deliberate attention, commitment and resources (Loch & Morris, 2002). Consequently, the end of the project often also represents the end of collective learning (Schindler & Eppler, 2003), although the analysis of successes and failures would be of crucial importance for future projects and the whole organization (Pinto & Kharbanda, 1997). Therefore, learning in project organizations should employ an approach based on experiences, lessons learnt and the exchange of knowledge *(*Shenhar, 1999).

3.2.3 Knowledge Creation in Project Environments

One factor for successful project management identified from a survey in 70 large organizations is "*…an effective means of learning from experience on projects, that combines explicit knowledge with tacit knowledge in a way that encourages people to learn and to embed that learning into continuous improvement of project management practices*" (Cooke-Davies, 2002). The importance of knowledge management in project environments is also highlighted in a special issue of the International Journal of Project Management (Vol. 21(3)) in which the editors stated that "*…the management of knowledge, be it explicit or tacit, is a necessary prerequisite for project success in today's dynamic and changing environment*" (Love et al, 2003).

However, frequently the analysis of project learning concentrates on capturing explicit knowledge with the help of intranets and database applications. The social mechanisms that might support knowledge sharing across projects have unfortunately only enjoyed very limited academic attention from PM researchers. In fact, a neglect of tacit knowledge issues represents one of the main obstacles to understanding PM learning. One reason is that *"…the tacit knowledge accumulated in project-based learning is never as clear-cut (or beneficial) as some of the glossy KM and organizational development literatures would have it"* (Rhodes & Garrick, 2003). Especially tacit knowledge possessed by individual project members can only be harvested in community based environments (Fernie et al, 2003) in which narration and joint work provides the basis for effective learning in the project team (Bresnen et al, 2003). Turner et al, (2000) found that 85%

of personnel perceive they gain both explicit and tacit knowledge through experience but "*experience needs to be accompanied by structured reflection and observation from several perspectives, leading to abstract concepts and generalizations, enabling the learner to develop theories for performance improvement*" (ibid). Consequently, the use of PPRs to support a learning project environment is recommended by Sense (2003): "*If one views the project teams as an experimental forum for public reflection, then individual knowledge generated during a project may be shared amongst project team members and the broader organization via reflection on project content, process and premise.*"

3.3 POST-PROJECT REVIEWS IN PROJECT MANAGEMENT

3.3.1 Definition of Post-Project Reviews

The first problem one encounters when attempting to do research on PPRs is that there is no established definition one can refer to. Although various definitions for PPRs can be found, it is interesting to note that the well-known "Project Management Body of Knowledge (PMBOK)" (Project Management Institute, 1996) does not mention them at all (Williams et al, 2001). Only the recent edition of the PMBOK (Project Management Institute, 2000) has added the term "lessons learnt" to its glossary and adds the following advice: "*The causes of variances, the reasoning behind the corrective action chosen, and other types of lessons learnt should be documented so that they become part of the historical database"* (Williams et al, 2001). Two official PM standards - PRINCE 2 and ISO 10,006 - suggest organizations to conduct a review at the end of every project (Turner et al, 2000).

Publications from different professional project management associations offer the following definitions:

- "*A post-project review is a formal review of the project which examines the lessons which may be learnt and used to the benefit of future projects.*" (Source: Project Manager Today, 1999)
- "*A post-project review is an appraisal of all aspects of a project upon completion, with a view to examining and documenting variation and events to augment the organization's historic database.*" (Source: Wideman, 1992)

Occasionally, PPRs are also referred to as post-project appraisals, which are defined as "*an activity which completes the project management process and provides feedback in order to learn for the future; a job close out/historical report will be generated and a review carried out once the project has been completed and accepted by the customer/owner."* (Source: Project Manager Today, 1999)

Schindler & Eppler (2003) looked at project debriefing methods in general and differentiate between process-based and documentation-based methods (see Table 3.1). Although they offer a good overview of debriefing methods at the end of a project, their definitions are often based on single cases and the distinctions made are often based on one specific publication instead of grouping several ones with similar findings. In practice, however, the methods described are often not as clear-cut and distinct. It is therefore very important to emphasise that PPRs might be given the same name - PPRs - in different organizations, but the practical details may be very different. Therefore, Table 3.1 can be seen as an attempt to categorize different methods, although it is not based on a wide empirical base.

It is also important to note that PPRs should be differentiated from the following three terms (which are unfortunately sometimes used as synonyms for PPRs in both academic and management literatures):

- Regular *project reviews* which take place *during* the project lifetime, e.g. milestone reviews (see Kozar, 1987);
- Official *project audits* which are initiated by the top management to uncover major project performance problems during a project or after it is completed (see Duffy & Thomas, 1989; Neale & Homes, 1990);
- Initial *project evaluations* which are used to investigate the potential benefits of a project proposal before it is (dis-)approved (see Saladis, 1993).

For the purpose of this thesis, none of the definitions quoted are satisfactory as most of them fail to emphasise the learning potential of PPRs. Consequently, this thesis uses the following working definition:

> "*A post-project review is the final meeting of a project team in order to jointly reflect on lessons learnt and thus creating the setting for detailed exchange of experiences and stories*."

Table 3.1: Overview of Debriefing Methods

	Project-based				**Documentation-based**		
Method	Project audit	Post control	Post-project appraisal	After action review	Micro Article	Learning histories	Recall
Timing	After project completion	Exclusively at project' s end	Approximately two years after project completions	During work process	On demand, regularly	Once per project, after completion	On demand
Facilitator	Moderator	Project manager	External post-project appraisal unit	Facilitator	Reviewer	Learning histories	Working group for reviewing
Participants	Project team and involved third parties	Project manager and team	Project team and involved third parties	Project team	Focus on one author	Individuals and teams	Working group
Interaction mode	Face to face meetings	Non-cooperative form of recording experiences	Document analysis, face to face meetings	Cooperative team meeting	None	None	None
Codification	Partly reports with no predefined circulation	Partly reports with no predefined circulation	Booklets	Flip charts	Paper based report up to one page for databases or intranets	20 to 100 pages, cases with accompanying workshops	Several screens on databases or intranets
Example or source	Traditional PM literature	Traditional PM literature	BP, Gulliver (1987)	US Army	Willke (1998)	MIT, Kleiner (1998)	NASA

(Source: compiled from Schindler & Eppler, 2003, p. 222-225)

3.3.2 History of Post-Project Reviews

PPRs started off by the simple need to exchange experiences with work colleagues in a very informal way (and as such have probably existed for centuries). The need to review activities and work results in a more formal and structured manner became apparent around the end of the 1950s - parallel to the emergence of the PM discipline itself - when the first major projects in software, military and aeronautics were created (Smith & Rao, 1994; Weinberg and Freedman, 1984).

Freedman and Weinberg, whose research focus lies on technical reviews and inspections, also state that most large projects had some sort of reviewing procedures, which evolved through the 1960s into more formalised ideas. In the 1970s, publications espousing various review forms began to appear in the literature and nowadays - although not heavily used - they are widely accepted as a potential milestone in the closure phase of a project or even years later (Gulliver, 1987).

3.3.3 Importance of Post-Project Reviews

In the first two chapters of this thesis, the importance of PPRs was already frequently stressed. From a PM perspective, their importance is mentioned in the academic literature as well as in best-selling handbooks for project managers (e.g. Cleland & King, 1988; Coles 2000; Turner, 1993). However, there are also three different literature streams within the PM field which refer to the importance and potential impact of PPRs.

3.3.3.1 Learning from Past Projects

Reinventing the wheel and solving the same problem various times by subsequent project teams time and time again is a very costly exercise (Pitman, 1991). In fact, the price of repeating old mistakes might even be higher than the investments in learning. The perception of cost-effectiveness is confirmed by Kransdorff's (1996) work who refers to his own consultancy experience alongside studies performed by Warwick University. *"No company can afford the luxury of re-discovering its own prior knowledge"* [8] and doing so might even result in the loss of competitive advantage (Prahalad & Hamel, 1990).

However, not only project-to-project learning needs to be emphasised, but also the potential to improve the knowledge of the project team has to be considered. PPRs potentially create knowledge in a team which ultimately might transfer to other projects once members are assigned to new teams. "*Despite the volume of data out there, the most valuable learning about past projects often comes from listening to those few individuals that assume the role of storyteller*" (McMasters, 2000).

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[8] Quote from Procter & Gamble's former vice president – J.G. Pleasenants

3.3.3.2 Disseminating Experiences and Lessons Learnt

Another issue that is of critical importance for learning in project environments is the dissemination of lessons learnt to make sure that crucial information is not lost (Williams et al, 2001). The tools most often mentioned in the literature include experience databases, personnel rotation, review reports and intranet applications (Balthazor, 1994; Holtshouse, 1999; Keegan & Turner, 2001; von Zedtwitz, 1999). Even the PPR itself is a dissemination tool, although its effect depends heavily on the participants and also on the documents or information produced during or after the review. PPRs are an appropriate tool to ensure that the lessons available from each project are identified, shared and applied throughout the organization.

Schindler and Gassmann (2000) conducted action research in various German and Swiss companies and their attempts to capture project experiences. Unfortunately, however, they give no details of how the research was conducted and it does not appear to have been systematically conducted (for example, the recognized literature on action research appears not to have been consulted). They carried out 41 in-depth interviews and moderated various workshops identifying two essential functions: the "project knowledge broker" who concentrates on the transfer of experiences within large project teams and also on the inter-project level and the "project debriefer" who is most often an external coach supporting the project team to gather lessons learnt. Depending on the size of project teams and organizations, these two functions can either be replaced by PPRs or they could be in charge of organising and facilitating PPRs.

3.3.3.3 Improving Core Capabilities and Competitive Advantage

PPRs can function as support mechanisms which are necessary and useful for developing skills and capabilities in order to confront new and different issues in future projects. From a long-term perspective every project needs to contribute to an organization's continuous improvement (Prahalad & Hamel, 1990).

Another popular management tool often claimed to improve skills and capabilities are external benchmarks (Turner et al, 2000). However, Kransdorff (1996) observed that PPRs are not only much cheaper in terms of costs and time, they are also more effective. Since no context specific details of external organizations need to be filtered out it is easier to re-apply lessons learnt from company-internal projects.

3.3.4 Existing Guidelines for Post-Project Reviews

Although rigorously conducted research in the PM field is still scarce, some authors have attempted to determine the main success factors of projects (e.g. Balthazor, 1994; Saladis, 1993). Especially in the case of long-term projects it is important that experiences are captured during the project's life cycle and not exclusively at the end (Schindler & Gassmann, 2000). The project plan should already contain a specific strategy for PPRs, and project team members should know that the success (or failure) of the project will be evaluated at the project' s completion (Cleland, 1999). *"If you wait until the end of the project to begin its review, you will be too late and you will not be able to do a very good review"* (Pitman, 1991).

A first overview of guidelines for PPRs was already presented in Chapter 2, and Table 3.2 gives an overview of guidelines from the PM literature. Looking at the content of Table 3.2 in detail, it is clear that the guidelines are very general and do not refer to PPRs as social events for knowledge creation and transfer. Two of the guidelines are not empirically tested and are mainly based on consultancy work (Freedman & Weinberg, 1977; Right Track Associates, 2000). In fact, the empirical basis of most of the studies is limited in that the data were not collected systematically and it is unclear how the guidelines were derived (Baird et al, 1999). Therefore, how generally applicable these guidelines are, or to what extent they are context dependent, is unclear.

Reviewing the individual guidelines shows that some of them are quite vague (e.g. "encourage deep analysis" or "discourage glib categorization" in Busby, 1999). Although empirical research on guidelines for PPRs is scarce, this thesis does not intend to develop yet another set of guidelines. Instead, it intends to look at current PPR practices in different organizations in order to find general best practices and illustrate the potential learning effect of PPRs. The motivation for this approach is the "*great discrepancy between the need for project debriefing and its actual development*" (Schindler & Eppler, 2003). Therefore, the next section discusses the challenges in PPR research.

Table 3.2: Guidelines for PPRs in the Project Management Literature

	No	1	2	3	4	5
	Reference	Baird et al (1999)	Busby (1999)	Freedman & Weinberg (1977)	Right Track Associates (2000)	Schindler & Eppler (2003)
	Empirical basis	Anecdotal examples from US Army Projects	4 PPRs in 3 different capital equipment organizations	Personal experiences of authors	Practical consulting experience	Action research in nine multinational companies
	Methodology used	• No details given, only discusses how the guidelines could be used by companies	• PPRs were observed and discourse analysis was performed • It is unclear whether the study was systematically conducted • No clear link between the findings and the recommendations	• No details provided	• No details given	• Semi-structured expert interviews • Half-day follow-up workshops • Gives almost no details of the methodology • Apparently no use of the recognised approaches to action research
1	Objective of PPRs					
2	Timing of PPRs					
3	Duration of PPRs					
4	PPR participants		X	X		
5	Moderation of PPRs					X
6	PPR discussion method		X	X		X
7	Location for PPRs					
8	Use of guidelines for PPRs					
9	Preparation of PPRs			X		X
10	Atmosphere during PPRs	X		X		
11	Results of PPRs			X	X	X
12	Dissemination of PPR results		X	X		X
13	Creation of action points					X
14	Agreement on improvement suggestions					

3.4 BARRIERS TO LEARNING FROM PROJECTS

The reasons why academic research on PPRs and their practical application is rare can be explained with the simple fact that PPRs are not easy to conduct and optimise. Overall, there are three different types of barriers which can be identified in connection with PPRs from the PM literature.

3.4.1 Inability to Reflect

Business decisions today are generally not based on reflections of the past, but are characterised by constant pressure. One reason is the argument that past experience does not apply if circumstances change (Kransdorff, 1996). Most often it is found that managers have little awareness of past actions and rationales and the idea that experience is a teacher in its own right is very dominant (Busby, 1999; Cicmil, 2005). In other words, the past is not the focus of management and traditional approaches to project management do not treat reflection as central. Consequently, these activities are usually not considered as a vital part of the project management task.

The most frequent reason stated when asking project managers why PPRs are not conducted is time constraints (Keegan & Turner, 2001). People are unlikely to devote time and effort to yesterday's problems since incentives favour pressing forward on the next problem (Levene & Gale, 2000; Williams, 2004). This is verified by Kotnour (1999) who argues as a result of his questionnaire survey of 43 experienced project managers *"most project managers viewed producing lessons learnt as a valuable and important exercise. However, they felt they did not have enough time to complete a formal lessons-learnt process."*

The experience of many project managers and anecdotal evidence in the literature shows that PPRs in practice tend to concentrate on the three parameters budget, time and output. However, based on the discussion so far, one could argue that any project that produces an excellent product on time and within budget has only obtained half of the benefit. In fact, even projects that failed or had to be terminated early could be turned into a success for an organization, if the lessons learnt and the problems leading to the termination were analysed in hindsight (e.g. Balachandra & Raelin, 1980 for R&D projects). Consequently, the purpose of PPRs is often reduced to ensure that the project complied with all bureaucratic procedures since the inherent important learning function is not recognised at all.

3.4.2 Team-based Barriers

Overall, PPRs have to deal with the selectivity of memory. Repression is commonly considered to apply to unpleasant experiences, forcing us to forget the actual incident that led to the experience but leaving us with a mental model that may be ambiguous. "*Learning in a reflective manner throughout projects is damaged by practices that exist to defer learning until projects are completed*" (Keegan & Turner, 2001).

Furthermore, team members may be poorly suited to accept criticism although they might share a common goal and functional responsibility. On the one hand, frank feedback is suppressed because it may adversely affect relationships between individuals, on the other hand, much information is not passed on because its importance is undervalued or its perceived validity is limited. One explanation why reviewing past projects does not always lead to successful learning is that it necessarily involves looking back at the past. Although Gulliver (1987) established in his in-depth case study of the BP organization that people genuinely want to review past behaviours, reviews often suffer from the reluctance to allocate blame and criticism since they might uncover cynical or embarrassing events. Unfortunately, this reluctance can be stronger than the realisation that the organization has a potential to learn constructively from a project's experience (Kransdorff, 1996). In extreme cases, project members cast the blame away from themselves, citing unclear goals, insensitive and unfair leaders and ignorant clients (Barry, 1991).

Excellent communication has always been considered as critical for project teams. For the context of R&D, Allen et al (1980) described how team-internal communication affects the productivity of the R&D function. Their arguments are convincing, but in practice some people are able to share information better than others. In extreme cases, critical information is hidden in order to gain unfair advantage in performance recognition or promotions. Team members with different technical, functional or cultural backgrounds do not share the same vocabulary or referential context, which leads to misunderstanding and reduced knowledge exchange.

3.4.3 Knowledge-based Barriers

Knowledge may be the basis for competitive advantage if it is well embodied in an organization (Hamel & Prahalad, 1994), but generalising from specific experiences is one of the main hurdles. Many people find it hard to think abstractly, in a way that experiences can be applied to future projects. In addition, managers are often not sure if they can learn from experiences different from their own (Boudes et al, 1998). Even if project teams had the time and interest to fully devote their attention to history, they would still have difficulty grasping the most important issues. As discussed earlier, certain types of experiences are inherently hard to express and hence to share with colleagues. Group based discussion on commonly shared experiences may thus be the only way to bring forth distributed key lessons for future project teams.

The nature of process-related knowledge, experiences and insights implies that they cannot be shared in the same way as information stored in reports, databases or prototypes. Durrance (1998) claims that especially Western cultures still prefer explicit knowledge, which is quantifiable and definable. Despite increasing awareness of the difference between tacit and explicit knowledge, companies are still struggling to convert tacit into explicit knowledge. "*Learning lessons from projects is important, but there is a difficulty in project post-mortems in identifying the "hard" non-intuitive lessons*" (Turner et al, 2000).

3.5 CONCLUSIONS ON THE PM LITERATURE

Overall, the importance of PPRs and the difficulties of trying to conduct them in an optimal way is often mentioned in the academic literature. However, the PM literature is largely based on anecdotal evidence and single cases of PPRs. In fact, the PM discipline as a whole does not provide a high number of empirically sound research studies: *"the field lacks in-depth case studies, studies of processes, and studies in real time - studies that would be beneficial in building theories for understanding fundamental issues of projects and project organizations*" (Söderlund, 2004).

Similar to PM itself, learning is mostly viewed according to the traditional and formal definitions which do not consider tacit knowledge aspects or socially constructed knowledge. The learning aspects of projects must not be seen as a substitute, but rather as a complementary side to the traditional view of PM (Björkegren, 1999). Projects and consequently PPRs should be seen as an event during which valuable knowledge can be created and lessons learnt disseminated. "*If post-event analysis has any purpose at all, it is to learn from experience, yet traditional methods of identifying and conveying the lessons of the tested past are often ineffective learning tools*" (Kransdorff, 1996). Ideally, the event of the PPR as such, triggers the exchange of experiences and project based stories.

This thesis aims to investigate how PPRs facilitate learning from projects. However, the PM literature often overlooks the managerial and procedural aspects of a project. Existing guidelines for PPRs do not reflect that PPRs represent an event for community-based learning, where experts are able to share their context-related knowledge. Interactive methods like face-to-face communication are ideal for the transfer of tacit knowledge (Turunen, 2001). The key aspects from the literature review in PM are summarised in Table 3.3 below. All four key aspects will be referred to again when the research questions and the research methodology are discussed in later chapters of this thesis.

Table 3.3: Summary of Project Management Literature Review

No	Key aspects from the literature	References
1	Projects are important vehicles for learning	Sense, 2003
2	The term post-project review is defined very differently in the literature and applied very differently in organizations	Schindler & Eppler, 2003; Williams et al, 2001
3	Empirically based research on PPRs is very limited	Busby, 1999; Schindler & Eppler, 2003
4	Practical PPR application faces various challenges	Turner et al, 2000; Williams 2004

3.6 SUMMARY

This thesis views project management not only as a planning and organizational activity, but also as an opportunity for learning in an organization. Generally, little evidence is found in the literature that puts PM in this larger context, but this chapter also illustrated that the importance of learning and knowledge management in project environments is increasingly recognised in more recent literatures.

Although the existing definition of PPRs found in the literature vary a lot, the importance of conducting PPRs is well accepted. One of the reasons for the great variety of PPR definitions is, that there are a lot of other debriefing methods that can be found in the literature as well as in the organizational practice, which need to be distinguished very carefully from PPRs. Yet, overall, most debriefing methods and in particular PPRs are important because they support learning processed from past projects, facilitate the dissemination of experiences and help to improve the core capabilities of an organization.

Unfortunately, though, existing guidelines for PPRs are often based on personal experience or limited sample sizes and often it is unclear on which empirical basis the guidelines for PPRs and checklists were built. In addition, the literature offers a whole variety of reasons why PPRs are not conducted or why they are difficult to be conducted in an optimal way (e.g. inability to reflect or team-based barriers).

Based on these findings, this thesis intends to take a detailed look at PPRs, i.e. the detailed practices in organizations and how these practices can support the learning effect of PPRs. In order to do so, it is necessary to review the literature on Organizational Learning, which will be done in the following chapter.

CHAPTER 4 ORGANIZATIONAL LEARNING

"Organizational learning may be the only sustainable competitive advantage."
(Stata, 1992)

4.0 INTRODUCTION

This chapter focuses on organizational learning (OL). Many researchers in the R&D field use the term "learning" in a broad sense and do not attempt to look at the processes of knowledge creation in detail. However, since one of the objectives of this thesis is to investigate the role of PPRs for learning and knowledge creation, it is important to discuss the theoretical concepts from the OL field, which might be applicable to PPRs.

This chapter concentrates on the following areas:

- The history of organizational learning;
- The definition of organizational learning;
- The different types of knowledge which exist in organizations;
- The theoretical frameworks regarding knowledge creation;
- The most relevant theories for this research;
- The importance of metaphors and stories for knowledge creation and transfer.

4.1 HISTORY OF ORGANIZATIONAL LEARNING

The academic literature on organizational learning started to emerge in the 1960s (Cangelosi & Dill, 1965), followed in the 1970s by an influential book called "*Organizational learning: a theory of action perspective"* by Argyris & Schön (1978). However, it was not until the 1990s that the topic was extensively discussed in both the academic and practitioner literature (Crossan & Guatto, 1996). A special edition on organizational learning in Organization Science in 1991 and the publication of "*The Fifth Discipline*" by Senge (1990) contributed largely to this increasing recognition. In the 1990s it was acknowledged that learning makes a critical difference to organizations, since it is an enabler of change, it helps to avoid the repetition of past mistakes and it supports the retention of critical knowledge that would otherwise have been lost (Jensen & Sandstad, 1998).

Although a number of influential literature reviews exist (Dodgson, 1993; Fiol & Lyles, 1985; Huber, 1991; Levitt & March, 1988; Mills & Friesen, 1992), it has been argued that the literature is still fragmented and needs to be refined before it can be of any value to practitioners (Spender, 1996). One of the reasons for this fragmentation might be that several very different theoretical schools of thought show an interest in OL concepts. Therefore, it is difficult to find overall proven theoretical frameworks

(Easterby-Smith et al, 1998). Overall, *"there is no published paper that provides researchers with a definitive statement on what has been written on the subject of OL"* (Crossan and Guatto, 1996).

A similar situation exists for the development of the Knowledge Management (KM) literature. While Spender & Grant (1996) consider that interest in knowledge first arose as a result of criticising rational economics, Easterby-Smith & Lyles (2003) claim that the importance of knowledge has only been recently recognised by scholars, while OL has been discussed for several decades already.

Romme & Dillen (1997) classified the different concepts on the basis of four alternative theoretical frameworks as illustrated in Table 4.1. These four theoretical approaches developed gradually over the years, starting from the *contingency theory* which claims that organizations are open systems that regularly adapt to their environment or to unforeseen events and thus learn because of this adaptation process. The *psychological* perspective assumes that individuals within an organization agree on common perspectives and thus create organizational learning. The more recent theoretical branches are *information theory* which focuses on learning mechanisms and tools, and *system dynamics* which sees learning as part of a complex organizational process.

Table 4.1: Schools of Thought in Organizational Learning

Theory	Approach to organizational learning
Contingency theory	Learning is primarily seen as an adaptation process (Cyert & March, 1963)
Psychology	Members of organizations develop collective perceptions of the organizational environment (Weick, 1979 "enactment principle")
Information theory	Organizations are processes of acquisition, distribution, interpretation and storage of information (Dixon, 1992; Huber, 1991; Nonaka, 1991; Walsh & Ungson, 1991)
System dynamics	Organizations are characterised by "dynamic complexity" which makes models with simple cause-effect relationships no longer applicable (De Geus, 1988; Kim, 1993; Senge, 1990; Stata, 1989)

(Source: Romme & Dillen, 1997)

In practice the four approaches may overlap. Furthermore, the first two schools of thought were frequently integrated into the latter two which now dominate the literature.

4.2 DEFINITIONS OF ORGANIZATIONAL LEARNING

There is rarely agreement within, or between, disciplines as to what organizational learning is or how it occurs (Chiva & Alegre, 2005; Dodgson, 1993). Therefore, Table 4.2 gives an overview of the most cited definitions in the literature (Garvin, 1993). These definitions are derived from the different schools of thought presented in Table 4.1. For example, some definitions are more based on the information theory (Huber, 1991) or system dynamics (Garvin, 1993) than others.

Table 4.2: Sample of Definitions on Organizational Learning

Reference	Organizational learning definition
Argyris (1977)	*"Organizational learning is a process of detecting and correcting error."*
Fiol & Lyles (1985)	*"Organizational learning means the process of improving actions through better knowledge and understanding."*
Huber (1991)	*"An entity learns if, through its processing of information, the range of its potential behaviours is changed."*
Garvin (1993)	*"A learning organization is an organization skilled at creating, acquiring and transferring knowledge, and at modifying its behaviour to reflect new knowledge and insights."*
Levitt & March (1988)	*"Organizations are seen as learning by encoding inferences from history into routines that guide behaviour."*
Stata (1989)	*"Organizational learning occurs through shared insights, knowledge and mental models and builds on past knowledge and experience, that is on memory."*

(Source: Garvin 1993)

A useful way of categorisation is to differentiate between normative and descriptive definitions (Romme & Dillen, 1997). A *normative* definition claims that an organization has to fulfil certain requirements in order to be classified as a learning organization (see e.g. Garvin, 1993). *Descriptive* definitions, on the other hand, argue that all organizations learn, whether consciously or not, since it is a fundamental requirement for their survival. (see e.g. Kim, 1993; Levinthal & March, 1993). The common denominator in most definitions for organizational learning, is the increase of knowledge and repertoire of action that can be observed as a result (Probst et al, 1998). Thus, the fact that new knowledge might be created and shared during PPRs can be considered as evidence for learning.

The confusion in the OL literature is caused by the fact that it is a dynamic field and by the equivocal terminology in the literature (Chiva & Alegre, 2005; Linderman et al, 2004). Various academics attempted to distinguish the terms Organizational Learning (OL), Learning Organization (LO), Organizational Knowledge (OK) and Knowledge Management (KM) (Chiva & Alegre, 2005; Easterby-Smith & Lyles, 2003; Vera & Crossan, 2003).

Chiva and Alegre (2005) integrated the two concepts OL and OK as illustrated in Table 4.3: The *cognitive-possession* perspective claims that an organization learns if any of its individual parts learn, while the *social-process* perspective argues that communities form the basis of knowledge creation and learning in organizations.

Table 4.3: Integration of OL and OK Perspectives

Learning	Organizational learning	Knowledge	Organizational knowledge
Individual learning	Cognitive	Cognitive-possession	Individual knowledge shared between all the members of a company. Knowledge embedded in rules and routines. Personifies the organization. Individual knowledge generates and contributes to the development of organizational or collective knowledge.
Social learning	Social	Social-process	Implicit and social, beliefs developed by individuals in groups or through inter-personal relationships. Forms the base of a dynamic theory of the company (knowledge is a process).

(Source: Chiva & Alegre, 2005)

Social learning theory in OL is based on the criticism of individual learning theory (Elkjaer, 2003). When studied from a social constructivist perspective, OL and OK share the recognition that learning and knowing are situated in practice. "*Social construction perspectives on OL emphasize the social context. Such perspectives assume that learning is embedded in the relationships and interactions between people. Learning is thus social and is grounded in the concrete situations in which people participate with others*" (DeFillippi & Ornstein; 2003).

Based on the difficulties of distinguishing the terms OL/LO and OK/KM, there is also an ongoing debate how knowledge is created and transferred. One of the consequences is that there is also "*a passionate debate about what knowledge is and what forms or types of it are available*" (Vera & Crossan, 2003).

4.3 TYPES OF KNOWLEDGE

4.3.1 General Statements

Just as the term learning is difficult to define unambiguously, so is the term knowledge. In fact, one of the drawbacks of current research on knowledge is that most papers fail to look at the different kinds of knowledge as the outcome and result of learning. This is confirmed by Leonard-Barton (1995) who claims that we need not merely identify knowledge assets but also try to understand them in depth and in all their complexity.

First of all, it is essential to differentiate knowledge from terms like data and information (Brown & Duguid, 1998; Marchand, 1998; Tsoukas, 2001):

- *Data* is completely context free and can be shared without any interpretation;
- *Information* ("know-what") is never context free and always includes the activity of sharing or distributing it to others;
- *Knowledge* ("know-how") always resides in people and is therefore always personal and context dependent.

However, this differentiation is not detailed enough to capture the term knowledge in its whole variety. Nonaka (1994) discussed the term knowledge in detail and differentiated between tacit and explicit knowledge.

4.3.2 Tacit and Explicit Knowledge

According to Cook & Brown (1999), the discussion of explicit and tacit knowledge has a long history, but as yet no agreement exists how the terms are related and how they should be used. The term tacit knowledge is fundamentally based on philosopher Polanyi (1962) and his famous quote that *"we can know more than we can tell"*. He can be regarded as the originator of the concept tacit knowledge, because all authors in this field refer back to his publications (Büschken & Blümm, 2000).

Various authors provide descriptions of tacit and explicit knowledge as summarised in Table 4.4.

Table 4.4: Characteristics of Tacit and Explicit Knowledge

Tacit knowledge	Explicit knowledge
• Gained via experience • People possess it but may not be able to articulate it • Highly personal, hard to formalise, difficult to communicate • Deeply rooted in action and context which are easy to protect, but hard to spread • Includes experience based on personal observation, practical knowledge, procedures, techniques, heuristics, informal co-ordination • Lives in our hunches, gut-feel, intuition, emotions, values and beliefs • Know-how is the product of experience and the tacit insights experience provides	• Can be codified, abstracted and stored • Can be communicated and transferred without in-depth experience • Can be acquired by formal study • Can be aggregated at a single location; • Can be found as quantifiable, definable information that makes up reports, memos, manuals and instructions • Can be specified verbally, in print or graphically • Know-what that can be shared by several, which circulates easily and is hard to protect

(Source: Jimes & Lucardie, 2003; Johannessen et al, 2001; Lam, 2000; Leonard & Sensiper, 1998; Nonaka, 1994; Teece, 1998; von Krogh et al, 1998)

The most important distinction between the two knowledge types is that explicit knowledge can be easily documented and shared, while tacit knowledge cannot easily be expressed or easily disseminated. "*As common experience can verify, the knowledge people use in organizations is so practical and deeply familiar to them that when people are asked to describe how they do what they do, they often find it hard to express it in words"* (Tsoukas, 2003).

Although it is possible to distinguish theoretically and conceptually between explicit and tacit knowledge they are not separate and discrete in practice, because all knowledge has tacit dimensions to some degree (Lam, 2000). Nonaka himself concluded that knowledge always has an inarticulate component. He argued not for two types of knowledge, but merely for two dimensions (Brown & Duguid, 2001). Thus, not all academics agree with the argument that tacit and explicit knowledge can be seen as two ends of a continuum. For instance, Tsoukas (2001) argues that tacit and explicit knowledge should not be viewed as different types of knowledge, but are instead inseparably related (explicit knowledge is always grounded on tacit components). Therefore, it is important to look at the different locations of tacit and explicit knowledge within an organization.

4.3.3 Location of Tacit and Explicit Knowledge

There are two different streams of opinion as to where knowledge - and particularly tacit knowledge - resides in an organization. The followers of Polanyi (1962), and later work of Nonaka & Takeuchi (1995), state that the natural place where knowledge resides is in an individual. Others claim that more emphasis should be placed on investigating tacit knowledge and learning at the group or firm-wide level (Howells, 1996). However, *"organizations are better understood if explicit, tacit, individual and group knowledge are treated as four distinct and coequal forms of knowledge*" (Cook & Brown, 1999).

Both viewpoints were combined by various authors in a two by two matrix as illustrated in Figure 4.1. Whereas individual knowledge resides with employees, collective knowledge is stored in the rules, procedures and culture of an organization. Collective knowledge exists between rather than within individuals (Spender, 1996) and is therefore more than only the sum of all individual knowledge. Because of its intangible nature, tacit knowledge embedded within an organization determines the degree to which companies remain competitive (Jimes & Lucardie, 2003; Mehra & Dhawan, 2003). "*Much of the research on tacit knowledge focuses on the individual - perhaps because most investigators are psychologists. …therefore, we need to examine more closely both tacit knowing and creativity as they are expressed by members of groups - singly and collectively*" (Leonard & Sensiper, 1998).

Figure 4.1: Location of Tacit and Explicit Knowledge

		Ontological Dimension	
		Individual	Group
Epistemological Dimension	Explicit	Conscious (Spender) Embrained (Blackler) Concepts (Cook & Brown)	Objectified (Spender) Encoding (Blackler) Stories(Cook & Brown)
	Tacit	Automatic (Spender) Embodied (Blackler) Skills (Cook &Brown)	Collective (Spender) Embedded (Blackler) Genres (Cook & Brown)

(Source: adapted from Lam, 2000; Linderman et al, 2004; Richtner, 2004)

Consequently, it can be claimed that certain types of knowledge only emerge in a group setting or collective learning context (Brown & Duguid, 2001; Howells, 1996). However, the exact details of these processes of knowledge creation between individuals and groups were not explained. Hence, it is now essential to look at theories and models of knowledge creation.

4.4 FRAMEWORKS FOR KNOWLEDGE CREATION

4.4.1 General Statements

Overall, it is a well accepted fact that knowledge creation plays an important role for an organization's competitive advantage (Kogut & Zander, 1992; Leonard-Barton, 1995; Nonaka, 1994; Nonaka & Takeuchi, 1995; Prahalad & Hamel, 1990). Yet, it is not clear which processes support the creation of knowledge (Chou & Wang, 2003; Nonaka et al, 1994). In fact, von Krogh (1998) claims that the key challenge in OL research today is to identify the factors that facilitate knowledge creation. Furthermore, "*a focus on the processes of knowledge creation from a multidisciplinary project team perspective is compelling as research specifically addressing this issue appears to be very limited*" (Fong, 2005).

An influential review of the OL literature by Crossan et al (1999) claims that the theory of knowledge creation is characterised by three things:

- It is explicitly concerned with product innovation;
- It links different levels (individual - group);
- It focuses on processes that link individuals and groups to each other, i.e. the focus, or unit of analysis, is within the company.

Based on these three characteristics, different frameworks from the literature were reviewed which might be helpful when investigating the learning and knowledge creation potential of PPRs. These are discussed in the following sections.

4.4.2 Single- and Double-Loop Learning

One of the core concepts was developed by Argyris & Schön (1978) who identified *single-* and *double-loop* learning. *Single-loop learning* takes place when simple errors are detected and corrected without having a wider influence on routines or practices. *Double-loop learning*, on the other hand, is based on new insights which question existing processes and usually change well-known routines (Romme & Dillen, 1997). Double-loop learning requires reflection and abstraction (which were identified in Chapter 3 as not necessarily easy). Argyris (1991) frequently uses the following analogy to illustrate the concept: "*A thermostat that automatically turns on the heat whenever the temperature in a room drops below 68 degrees is a good example of single-loop learning. A thermostat that could ask why am I set at 68 degrees and then explore whether or not some other temperature might more economically achieve the goal of heating the room, would be engaging in double-loop learning.*"

Single-loop learning is appropriate for routine and repetitive issues, while double-loop learning proves to be more useful for complex issues. (For PPRs, both processes seem to be relevant.) The focus of this thesis is whether knowledge is created and disseminated and less on the question of what type of learning occurs and so the concept of single- and double-loop learning was not applied in this research.

4.4.3 Senge's "5th Discipline"

A second OL framework was established by Senge (1990) and lists five key elements of learning organizations:

- *Personal mastery*, i.e. the individual commitment to develop one's own learning capacity. Such individual learning does not guarantee organizational learning, but without it no organizational learning occurs;
- *Mental models*, which illustrate the way in which we think an organization works. These often limit us from discovering new ways of thinking and acting so that new assumptions are not tested;
- *Team learning*, i.e. teams which continuously foster learning through inculcating successful practices and skills of other learning teams;
- *Shared vision*, which is the collective form of personal mastery, focuses on providing aims and energy for learning, which is only possible if people try to achieve something that deeply matters to them;
- *Systems thinking*, i.e. the ability to understand the cause and effect relationships inherent in the variety of systems in which individuals and groups operate. It is the cornerstone of organizational learning and inter-links the other four elements.

Senge's work is at abstract level and does not really explain the processes that enable learning and knowledge creation. His work identifies more the preconditions for a learning organization in general (Crossan & Guatto, 1995). Thus, it informs this thesis, but does not give a clear induction of how to investigate knowledge creation and learning.

4.4.4 Huber's "4 Constructs"

Huber's (1991) four constructs are :

- *Knowledge acquisition* includes congenital learning existing at the birth of an organization as well as experiential learning;
- *Information distribution* claims that only shared learning contributes value to an organization;
- *Information interpretation* is seen as a prerequisite for applying lessons learnt;
- *Organizational memory* is a way to store knowledge so that it can be accessed as required as well as learning that can be memorised.

The drawback of Huber's framework, however, is that it is based on an information systems viewpoint which almost ignores the differences between tacit and explicit knowledge. In other words, his four steps are more applicable for knowledge management activities which focus on explicit, tangible data.

4.4.5 Communities of Practice (CoP)

CoPs can be described as a group of people who are informally bound to one another by exposure to a common class of problems (Stewart, 1996). Others claim that a CoP is "*a group of people who share expertise and passion about a topic and interact on an ongoing basis to further their learning in this domain"* (Wenger & Snyder, 2000).

CoPs form part of social learning theory which claims that knowing and learning involves primarily active participation in social communities (Stewart, 2001). Learning is no longer equated with the appropriation or acquisition of pieces of knowledge, but it is acquired by means of social participation (Gherardi & Nicolini, 2000). Situated learning theory (Lave & Wenger, 1991) and the CoPs help to understand how different social contexts impact learning (Fox, 2000; Sense, 2003). CoPs can be used to explain how knowledge and learning can develop in specific social contexts (Garrety et al, 2004).

CoPs are linked to more recent theories which view organizations as social knowledge systems (Kogut & Zander, 1992). They are based on the following assumptions (On Purpose Associates, 1998; Wenger, 1998):

- Learning is fundamentally a social phenomenon;
- Knowledge is integrated in the life of communities that share values, beliefs, languages and ways of doing things;

- The processes of learning and membership of a CoP are inseparable;
- Knowledge is inseparable from practice;
- Empowerment - or the ability to contribute to a community - creates the potential for learning.

Overall, CoPs are helpful to explain if and how knowledge - especially tacit knowledge - can be created and shared within a group setting. People remember through verbal interaction with their group (Richter, 1998; Sapsed et al, 2000), so that micro-communities such as projects are in themselves potential enablers for knowledge creation. This is confirmed by Probst et al (1998): "*It is not the aggregation or multiplication of individual interpretations which leads to group knowledge, but the synthesis of several interpretations*." Examples which illustrate CoPs in its most extreme form are orchestras or sport teams, where tacit knowledge may even be transferred and shared without any verbal interaction.

The concept is also in line with recent developments in organizations, which place importance on learning. In fact, interactions with colleagues at work represent a large part of learning today (Boud & Middleton, 2003). According to Wenger (2000), a number of trends can be observed in that communities:

- Have become more formally recognised;
- Have become the cornerstone for knowledge strategies;
- Are also expanding beyond the traditional organizational boundaries to include vendors, partners, and customers.

However, it is important to state that CoPs must not be confused with project teams (Mc Dermott, 1999). While there are a number of similarities, there are also differences as illustrated in Table 4.5. Yet, there are enough similarities to claim that the CoP concept is applicable to project teams in R&D when it comes to learning and it is possible for a team to become a CoP as informal relationships begin to develop (Hildreth et al, 2000). Thus, it can be stated that project teams differ from CoPs in many details, but a project team can be considered an embryonic CoP because it provides a focal point for individuals' interest (Sense, 2003).

CoP theory views learning as a social phenomenon and claims that knowledge - and in particular tacit knowledge - can only be produced and held collectively (Howells, 1996). However, it still needs to explain how knowledge creation happens. Brown & Duguid (2002) claim that "*within communities, knowledge is continuously embedded in practice and thus circulates easily. Members of a community implicitly share a sense of what practice is and what the standards for judgement are, and this supports the spread of knowledge*." Furthermore, CoPs very often develop their own language and jargon which is meaningless for outsiders (Garrety et al, 2004), but helps to share tacit knowledge.

Table 4.5: Similarities and Differences between Teams and CoPs

Communities of Practice	Project teams
Informal network	Formal project organization
Emerge of their own accord	Are set up by the company or management
Collaborate directly	Dito
Share experience and passion for a joint enterprise	Could be claimed partly, but as participation is not voluntarily, passion for the enterprise is rare
Know-how and sense-making are shared	Only happening if fostered by management and organizational culture
Count on internal leaders and community organizers	Have specific management and organization structure and pre-determined leaders
Have a history	Not necessarily as they might be set up from scratch
Fuzzy front end as well as back end	Have a defined start and finish point
Develop over time	Are usually set up and then start to develop further
Have a common interest and enterprise, but not an agenda	Have clear cut objectives, deliverables and agendas
Not defined by the organization chart	Usually based on matrix organization
Involve many different roles and characters	Dito
Experience an ongoing flux of members	Dito in practice, although probably less than CoPs
Basic building block of social learning system	Not necessarily as learning not always top priority - technological output is what usually counts
Driven by value - shared interest or practice - value discovered/evolves - value in ongoing process	Driven by deliverables - shared goals and results - value defined by - value in result delivered
Defined by knowledge - interdependent knowledge - permeable boundaries	Defined by task - interdependent tasks - clear boundaries
Develops organically - variable contributions - managed by making connections	Develops through a work plan - everyone contributes - managed objectives through objectives & workplans
Bound to identify - reciprocal contributions - based on trust - core group/co-ordinator	Bound by commitment - joint accountability - based on explicit agreement - team leader or manager

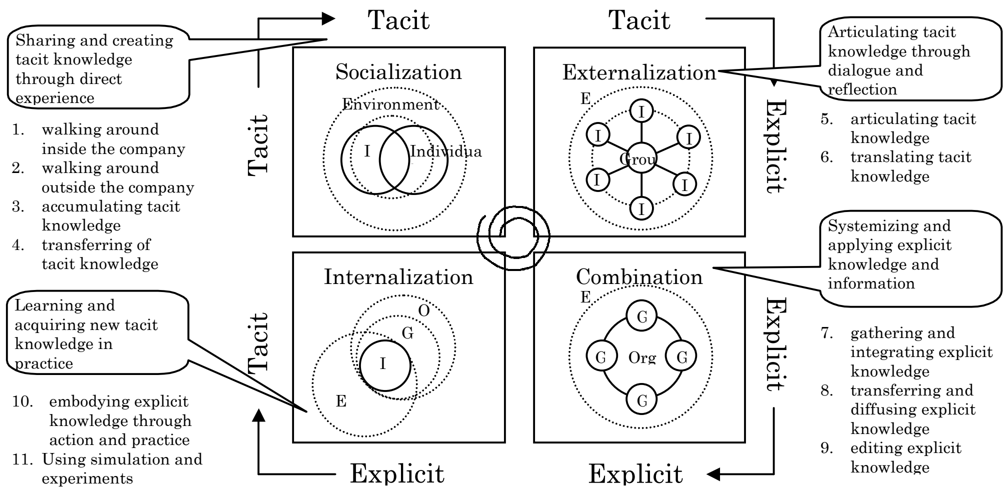
(Source: Garrety et al, 2004; Mc Dermott, 1999; On Purpose Associates, 1998; Sense, 2003; Sharp, 1997; Wenger & Snyder, 2000)

New product development teams can be linked to CoPs because they are conducted by a small number of specialists who learn together, just like CoPs do on a more informal basis (Sharp, 1997). Madhavan & Grover (1998) relate this fact to NPD teams and propose that the potential for new knowledge is embedded in the team and its interactions. "*We share explicit as well as tacit knowledge in interaction with other people and through* *experience and exercise. Whether the distributor of the artificial knowledge is conscious of the knowledge and the sharing or not is not of importance"* (Haldin-Herrgard, 2001). The drawback of applying CoP theory to this research is a lack of empirical basis. There are some in-depth case studies which provide details on CoP practicalities and characteristics (Brown & Duguid, 1991; Wenger, 1998) but these do not seem to be enough to claim that we have an established theoretical framework applicable to this research. In addition, it is still unclear how the knowledge creation processes in a CoP can be operationalized.

4.4.6 Nonaka's Four Modes of Knowledge Creation

Nonaka's knowledge creation theory is based on the distinction between explicit and tacit knowledge and their interactions and his work is cited frequently in the OL literature (Linderman et al, 2004). Nonaka claims that knowledge creation goes beyond traditional models in the OL literature as these are usually limited to the generation and transfer of explicit knowledge assets only. Figure 4.3 illustrates the four mechanisms for the generation and transfer of knowledge identified (Nonaka, 1994).

Figure 4.2: SECI Model of Knowledge Creation



(Source: Nonaka & Toyama, 2003)

The four modes in Nonaka's model, which will be explained are often mentioned in connection with product development or other innovative activities:

- *Socialization* (= watching somebody, then doing it) is the transfer of tacit knowledge from person to person. It generates redundant tacit knowledge, i.e. tacit knowledge that two or more people already share or possess so that no need for verbal explanation exists. It is best explained with the apprenticeship - mentor relationship which represents mainly the technical dimension of socialisation. The cognitive dimension, though, is triggered by informal meetings outside the workplace which result in invisible bonds of community and ultimately shared mental models. The learning experience resulting from socialisation is of high importance for an individual, but it is very difficult for an organization to leverage such learning on a wider basis. Only conversation via shared language, signs and symbols or facial and physical expressions are considered to support this process;

- *Externalization* (= doing it, then describing it) happens when the tacit knowledge of individuals becomes explicit by storing it in manuals, handbooks, etc. This process is not very well developed in the literature and mainly facilitated and triggered by meaningful dialogue and the use of metaphors and analogies. Through dialogue among individuals, contradictions between one's tacit knowledge and the structure, or contradictions among tacit knowledge of individuals are made explicit. Examples could be the development of concepts or prototypes, etc. This process works best via intense communication and dialogue or by integrating members from other projects or cultures. It is typically seen in the process of concept creation and triggered by collective reflection. The precondition, however, is that we believe that sharing knowledge is more useful than retaining it;
- *Combination* (= reading about it, then describing it) is the process of creating explicit knowledge from explicit knowledge through meetings, telephone conversations, etc. It is deeply rooted in the information processes of a company and does not really extend the existing knowledge base of an organization. Examples are the analysis of databases, the combination of information, filtering reports and other sources with changing lenses or filters. The goal is to create an archetype and promote justification throughout the company. Output = systematic knowledge (Linderman et al, 2004);
- *Internalization* (= reading about it, then doing it) turns explicit into tacit knowledge and is closely connected to the Western idea of a traditional learning process. It is best achieved through learning by doing and encouraged by experimentation. This process causes others to internalise the knowledge, i.e. to use it to broaden, extend and reframe their own tacit knowledge. The decisive factor is to expand the scope of direct experience and to encourage reflection on the experience. However, the problem of information overload and quality of available information should not be underestimated.

Nonaka's intention was not to offer four different ways of knowledge creation, but to demonstrate four complimentary processes which form his so-called "*spiral of knowledge creation*" as illustrated in Figure 4.2. The major goal of the model is to make much better use of tacit knowledge at the organizational level (Magalhaes, 1998). In other words, knowledge creation within individuals and groups is seen as an ongoing circular activity which is enabled by a common language and meaningful dialogue as soon as several people are involved (Nonaka, 1991; von Krogh et al, 2000).

Furthermore, it is stressed that knowledge is context specific and its creation happens during a dynamic interaction process between various participants (Büschken & Blümm, 2000). *"In knowledge creation, especially in socialization and externalization, it is important for participants to share time and space through direct experience. A close physical interaction is important in sharing the context and forming a common language among participants"* (Nonaka & Toyama, 2003).

The difficulty of transferring tacit to explicit knowledge is frequently discussed and most papers refer directly to the importance of the externalisation mode. Table 4.6 gives an overview of these papers which are all based on the SECI model (Nonaka, 1994). All of them claim that activities like storytelling, group reflection, common discussion or in-depth dialogues facilitate the creation and transfer of knowledge within a team setting. It is also claimed that the use of metaphors or analogies can be considered as evidence for the creation of tacit knowledge (Nonaka, 1994).

Table 4.6: Facilitators for (Tacit) Knowledge Creation and Transfer

Reference	Empirical basis	Facilitator for (tacit) knowledge creation and transfer
Chou & Wang, (2003)	Survey	Face to face interaction and willingness to share experience with the group; Express knowledge with metaphor or analogy;
Hernandez-Serrano et al (2002)	Survey-test in NPD organizations	Relating and listening to stories helps to think, explain, understand, remember and memorize;
Li & Gao (2003)	Theory only	Social interactions among organization members; IT only useful to support human communication;
Neve (2003)	Focused open-ended interviews in two knowledge intensive organizations	Narrating experience to construct and validate thoughts; Interacting in dialogues which aids to formulate thoughts and tacit skills; Knowledge increases when group questions each other and interpret the different opinions;
Nonaka & Tackeuchi (1995)	Various case studies in NPD organizations	Use of metaphors and analogy; Use of dialogue and discussion; Use of ambiguity and redundancy;
Roth (2003)	Single case study in R&D organization	Communication through shared experiences or stories (Brainstorming sessions) which cannot be replaced by other management tools;
Skovvang & Kaskgaard (2003)	Single case study in software company	Informal face-to-face knowledge sharing; See-again phase with project team;
Stenmark (2001)	IT based theory	Rich modes of discourse including analogies, stories, metaphors;

When applying Nonaka's work, it is important to note that his model has also been criticised because:

- It is based on a weak empirical basis, i.e. case examples from various Japanese organizations. However, no explanation was provided as to how and why the findings could be generalized (Chou & Wang, 2003; Roth, 2003). Even Nonaka himself said that his theory *"has been constructed mainly on the basis of hands-on research and practical experience of Japanese firms"* (Nonaka, 1994). Yet, he recently co-published a book (von Krogh et al, 2000) in which he elaborates practical ways of knowledge creation, so that firms can initiate organizational learning consistently and systematically. One of the practical examples he gives are *"knowledge debriefs"* at Unilever, which are partially comparable to PPRs. However, the explanations of what actually happens during such debriefs and consequently how knowledge is actually created are not very detailed;
- The distinction between explicit and tacit knowledge takes culture for granted. Therefore, it is not clear what happens when the knowledge-creating spiral expands outside a team, why some knowledge is created and why some knowledge is not (Fong, 2005);
- Nonaka's theory of knowledge creation rests heavily on a tacit foundation of Japanese values and management practices and cannot always be transferred to a non-Japanese context (Glisby & Holden, 2003).

4.5 THE MOST RELEVANT THEORY

4.5.1 Selected Frameworks

Overall, not all of the frameworks discussed offer an appropriate theoretical basis for investigating the processes of knowledge creation in PPRs. Only CoPs and Nonaka's four modes of knowledge creation were selected as a potential theoretical basis for this research for the following reasons:

- They recognise the difference between tacit and explicit knowledge;
- They view learning as a creative activity and not as the mere cognitive transfer of visible information;
- They support the social learning theory;
- They focus on knowledge creation instead of attempting to cover the whole learning process with a single framework.

Nonaka's work is relevant when researching PPRs, because converting and transferring tacit to explicit knowledge is a prerequisite for learning (Durrance, 1998; Mascitelli, 2000). However, the challenge for such research lies in finding ways to operationalize the concepts. The same applies to CoPs, where empirical evidence on the facilitated transfer of knowledge between members of a community is still very limited and ways to operationalize the CoP theory are not yet provided. Thus, the integration of these theories into the research design will be a major challenge of this thesis.

Consequently, it was decided to focus on Nonaka's theory and CoPs, as the theoretical support for the learning processes within project teams. This also applies to existing research which focuses on the sharing and transfer of knowledge. These are also highly relevant when looking at knowledge creation during PPRs.

4.5.2 Research Supporting the Selected Frameworks

It was already mentioned that some types of knowledge are easier to create, share and transfer than others. Brown & Duguid (1998) claim that contrary to common assumptions, it is not tacit knowledge that "sticks", but socially embedded knowledge because it is deeply rooted in practice. Similarly, Carvusgil et al (2003) studied 182 manufacturing and service firms in the US and found that *"explicit knowledge can be easily coded and transferred. Tacit knowledge, in contrast, is more difficult to articulate, formalize, interpret and transfer from one firm to another. The greater the extent of tacit knowledge transfer, the more likely the firm is to be able to innovate effectively*."

O'Dell & Grayson (1998), Szulanski (1996) and Szulanski & Winter (2002) all investigated the transfer of best practices within an organization and found that it is usually hindered by three factors:

- Ignorance on both sides (receiver and sender of best practices);
- Absorptive capacity of the recipient (tacit knowledge is difficult to transfer unless the recipient is aware of the contextual factors as well);
- Lack of relationship of source and recipient.

While these barriers for knowledge transfer should not be neglected, it is also important to look at the different factors which facilitate the sharing and transfer of knowledge. A study by Koskinen et al (2003) suggests that situations where the members of a project team can interact face to face with each other, reinforces tacit knowledge sharing, because:

- Face to face interaction is the richest medium for tacit knowledge transfer because it allows immediate feedback including body language, facial expression and tone of voice - thus misinterpretation is less likely;
- Figurative language is an important method for the externalisation of tacit into explicit knowledge;
- Trust developed during previous or current projects improves the possibilities to share tacit knowledge;
- Physical proximity helps to transfer tacit knowledge on a day to day basis.

Hansen (2002) looked at project knowledge in NPD and found that direct relations between different teams shortens NPD times especially when tacit knowledge is shared. "*Direct relations are especially helpful when a team is experiencing transfer difficulties, i.e. spending significant time extracting, moving and incorporating knowledge from other subunits -*

because the knowledge is non-codified, which is defined as knowledge that is difficult to adequately articulate in writing" (Hansen, 2002). This is supported by Bush (2000) and Büschken & Blümm (2000) who state that tacit knowledge can only be transferred during face to face contact and personal interaction, because body language and facial expressions, etc. play a vital role in this process.

The challenge is not so much to make tacit knowledge explicit, but to establish how social practices facilitate or inhibit learning and so to find ways of reconfiguring them to enable more effective cross-project knowledge diffusion and learning (Bresnen et al, 2005). Especially in project groups, words and expressions are frequently used that are not understood by outsiders, because someone cannot take advantage of such information without having earlier "social software" connected to it (Koskinen, 2000). While discussion groups tend to deal with explicit knowledge, much more tacit knowledge can be shared in settings like PPRs when people not only work, but also socialise together by sharing their experiences and impressions (Lubit, 2001).

In PPRs, the degree of common knowledge amongst the team (shared meaning, mutual language, etc.) means it is easier to integrate individual knowledge into the knowledge domain of the group (Grant, 1996). Thus, the prerequisites that individual tacit knowledge can only be transferred into collective and social knowledge - if experiences and thoughts which were gathered during a project are exchanged - are clearly given during a PPR.

Overall, the above discussion highlights social interaction and its role for knowledge creation and transfer. The use of metaphors and stories is particularly relevant and therefore warrants deeper discussion.

4.6 METAPHORS AND STORYTELLING[9]

4.6.1 Definitions

The definition most frequently cited in the literature stems from Lakoff & Johnson (1980) and their influential book "*Metaphors we live by*". They argue that "*the essence of metaphor is understanding and experiencing one kind of thing in terms of another"* (Lakoff & Johnson, 1980). A more general definition is: "*Metaphor = Figure of speech in which a word or phrase denoting one kind of object or action is used in place of another to suggest a*

[9] The importance of metaphors and stories for the purpose of this research was realised when analysing the data from the pilot case study. It was then realized that metaphors and stories are frequently used in practice and are also one of the very few accepted indicators for tacit knowledge. Consequently, this literature was reviewed parallel to the data collection and analysis.

likeness or analogy between them. A metaphor is an implied comparison, in contrast to the explicit comparison of the simile. Metaphor is common at all levels of language and is fundamental in poetry" (Encyclopaedia Britannica, 2005).

Storytelling, on the other hand, is defined as "*an exchange between two or more persons during which past or anticipated experience was being referenced, recounted, interpreted, or challenged*" (Boje in Connell et al, 2004).

4.6.2 General Statements

Overall, metaphors are so frequently used in every day life that they are very often not even noticed (Lakoff & Johnson, 1980). Metaphors help to translate knowledge and experiences with others and are thus facilitators to shape social knowledge (Gherardi, 2000). "*The OL literature points to the role of common cognitive schema and frameworks (Weick, 1979; Spender, 1989), metaphor and analogy (Nonaka and Takeuchi, 1995), and stories (Brown & Duguid, 1991) as vehicles for molding, integrating and reconciling different individual experiences and understandings*" (Grant, 1996).

Usually, metaphors are based on real-life experiences and help to explain implicit or highly abstract concepts (Lakoff & Johnson, 1980). They are one of the most important tools to understand partially what cannot be understood totally. Oztel & Hinz (2001) identified five benefits associated with metaphors:

- Multiplicity of creative interpretations;
- Openness to novelty;
- Narration;
- Relevance;
- Simplification of situations, creating templates for understanding.

Stories, on the other hand, act as templates, because present experiences are recognised as similar to past situations, so that a comparable outcome can be expected (Oztel & Hintz, 2001). Stories and dialogues are especially important to create meaning and understanding and to express tacit knowledge (Oswick et al, 2000).

4.6.3 Knowledge Creation through Metaphors and Stories

Metaphors are significant when discussing knowledge creation because they help to express experiences we are normally not able to express (Srivastva & Barrett, 1988). Metaphors support the understanding between group members and therefore help the growth and development of the group. "*Invoking a metaphor means opening the door for a listener to enter a subject in a different way*" (Kendall & Kendall, 1993).

Individuals use metaphors to help explain their intuition to themselves and to share it with others. As Tsoukas explains "*metaphors involve the transfer of information from a relatively familiar domain to a new and relatively unknown domain … as such, metaphors mark the beginning of the interpreting process*" (Crossan et al, 1999).

In Nonaka's knowledge creation model, a metaphor or story serves as a facilitator for the creation of new experiences and behaviours. Thus, metaphors represent the beginning of a learning process (Gherardi, 2000) and can be used to externalise tacit knowledge (Wong & Radcliffe, 2000). The use of a metaphor is evidence that learning has occurred. Therefore, when researching knowledge creation processes in groups, it is important to investigate the language used and more specifically the creation of metaphors (Srivastva & Barrett, 1998).

Storytelling helps to make sense of experiences and to interpret them (Abma, 2003)[10]. Furthermore, Connell et al (2004) found the following reasons why stories help to transfer knowledge:

- Listener role can be more active;
- Teller can modify the story;
- Story is more informal;
- Willingness on the part of teller and listener to be involved;
- Inherent capability to capture rich tacit knowledge;
- Shared exclusiveness between teller an listener;
- Used to share organizational knowledge, formally or informally, within some Communities of Practice.

Applying the insights from the literature on metaphors and storytelling to this research, it is vital to develop a research design that addresses the analysis of metaphors and stories in detail. The problem regarding the development of a research design, though, is that there is no established approach to be found in the literature which offers a basis to operationalize metaphors and stories and their role regarding knowledge creation and learning. Most research is influenced by the psychological and sociological schools, but not by frameworks applicable to management research. Consequently, the problem of operationalization has to be considered for the research design of this thesis. Nonetheless, it needs to be emphasized again that the mere existence of metaphors and stories expressed during a PPR seem to be relevant evidence for creating and transferring tacit knowledge within the team.

[10] Buckler & Zien (1996) found that companies where storytelling is supported and facilitated by the corporate leaders and the company culture, create an environment that encourages employees to explore new ideas and thus are more innovative than other companies.

4.7 CONCLUSIONS ON THE OL LITERATURE

Reflecting on the literature review on OL, there are several aspects which have to be related to this research on PPRs. Firstly, critics often argue that tacit aspects are very difficult to research or observe because of their intangible nature (Jones, 1996). Since knowledge in practice cannot be clearly divided into tacit and explicit elements, it is not only unwise, but also unfeasible to focus on only one knowledge type. Consequently, an attempt was made to empirically investigate not only explicit knowledge, but also tacit knowledge. Although there is no clear guideline in the literature about how tacit and explicit knowledge can be distinguished, it is crucial to establish how the different knowledge types are seen within this thesis. The following quote by Richtner (2004) describes the stance taken for this research: "*Tacit and explicit knowledge are two complementary forms of knowledge at any given point in time, but over time their combination and composition can vary depending on the context and on the individual. What is tacit for one person may be perfectly explicit to another person. In the same way, something that is tacit at instant t can be explicit at t+1.*"

Organizational learning can be initiated by various methods. "*The variety of learning levels and processes makes it unlikely that we will find any simple list of key determinants of valuable learning results*" (Miner & Mezias, 1996). For the purpose of PPRs in the context of R&D, however, two theoretical frameworks were identified to help understand PPRs: Nonaka's work as well as the literature on CoPs. Both suffer from a lack of empirical evidence, but complement each other with their suggestions as to how tacit and explicit knowledge might be created and disseminated and both rely on the social aspects of learning (DeFillippi & Ornstein, 2003). Generally, the approach of this thesis is that the creation of knowledge can be treated as an indicator for learning. In other words, learning is seen as a process whereas new knowledge is the result of that process (Bertels & Savage, 1998).

PPRs have the potential to support the creation of both explicit and tacit knowledge in R&D project teams. Yet, there is no existing empirical basis which puts this conclusion on a sound footing. What can be claimed however, is that PPRs ideally:

- Appreciate that tacit knowledge is deeply rooted in context and experiences, which all project members share to some degree;
- Allow time for reflection and interpersonal exchange, which is a basic requirement for tacit knowledge to emerge (McDermott, 1999);
- Offer an environment of trust, respect and commitment - providing the organizations' culture allows it (von Krogh, 1998);
- Facilitate intense communication and meaningful dialogue so that stories and metaphors can trigger the externalisation process to convert tacit to explicit knowledge;
- Enable know-how, i.e. socially embedded knowledge to be discussed.

One of the main implications of this literature review is the realisation that *"there is a need for more case studies of knowledge-creating organizations, knowledge work, and knowledge management that focus not only on the body of knowledge that an organization acquires, stores and transfers"* (Cook & Brown, 1999). According to Sense (2003) situated learning theory is not accepted as a *"legitimate perspective on learning"* so that researchers are now challenged to address social learning theory in project teams. So far, research on knowledge creation linked to project teams has been limited (Fong, 2003). The overall challenge, though, is that OL is a very wide concept and that no clear indication is given of how to conduct empirical research, because OL and knowledge creation takes place at different levels and the social component is an essential one. Therefore, empirical data collection needs to be conducted with consideration of how individual's learning contrasts to that of a project team.

Table 4.7: Summary of OL Literature Review

No	Key aspects from the literature	References
1	Social learning theory is one of the accepted perspectives on OL	Chiva & Alegre, 2005; Crossan et al, 1999
2	Distinction between tacit and explicit knowledge as well as individual and group held knowledge is crucial	Lam, 2000; Nonaka, 1994; von Krogh et al, 1998
3	Theories of CoP and Nonaka's SECI are suitable frameworks for knowledge creation, but empirical evidence is scarce	Wenger & Snyder, 2000; Nonaka, 1994
4	Face to face contact as well as metaphors and stories are accepted facilitators for knowledge creation and transfer	Koskinen et al, 2003; Grant, 1996; Srivastva & Barrett, 1998

4.8 SUMMARY

The literature review showed that although organizational learning has been discussed for more than 40 years, it was found that its definition is still not clear. However, most researchers agree on the difference between tacit and explicit knowledge and the locations of knowledge in an organization.

From the literature, two theoretical models which are based on the social learning theories were identified as relevant for this research: Communities of Practice and Nonaka's knowledge creation theory. Direct personal contact and interaction as well as the use of metaphors and stories are frequently mentioned in the literature as supporting knowledge creation. The challenge in applying the theoretical models, though, is that there is little guidance on how to apply them empirically - it is still an area of exploratory research. These aspects will be considered when choosing the research design and developing the research methodologies. The details of these will be discussed in the next two chapters.

CHAPTER 5 RESEARCH FOCUS AND DESIGN

"New product development is a journey in which management and teams travel together through the process, generating knowledge along the way. They will make mistakes and must learn from them. Few companies can afford to learn the same lesson twice."
(Lester, 1998)

5.0 INTRODUCTION

After the review of the three relevant bodies of literature, this chapter draws together conclusions from Chapters 2, 3 and 4 to outline the focus of this thesis. It represents the link between stage one and two of the research and describes how the research questions and the overall research design were derived.

Consequently, this chapter covers the following areas:

- Comparing the conclusions from the three literature reviews;
- Formulating research questions regarding PPRs in R&D;
- Discussing the philosophical stance of the research;
- Presenting the overall research design chosen for the research;
- Illustrating the unit of analysis for the research;
- Explaining the sampling logic applied.

5.1 COMPARISON OF THE LITERATURE REVIEWS

In order to describe the research gap that was identified regarding PPRs, it is useful to refer to the conclusions from the three literature reviews as described in Chapters 2, 3 and 4. Figure 5.1 illustrates the overview of these conclusions and also highlights common conclusions across the three bodies of knowledge of R&D management, Project Management and Organizational Learning.

In the literature reviewed, the focus on PPRs in R&D is often restricted to mentioning their importance, or listing general critical success factors and potential review questions. Neither the PM body of knowledge nor the publications on PPRs from the R&D field attempt to progress beyond this rather superficial level of understanding. As a result, there is a fairly well established notion that PPRs can contribute to learning and they might also facilitate knowledge creation. However, empirical evidence of how this process works is lacking.

It is key to note that concepts from the OL area have seldom been applied in the R&D context and especially not with a focus on PPRs. More importantly, while the work from Nonaka for knowledge creation and CoP theory is heavily quoted and increasingly prominent, the empirical basis of these frameworks has not yet been satisfactorily developed.

Figure 5.1: Conclusions on the Literature Reviews

No	Key Aspects from the R&D Literature	Key Aspects from the PM Literature	Key Aspects from the OL Literature
1	Empirically based research on PPRs is very limited	Empirically based research on PPRs is very limited	Empirical evidence is scarce for operationalization of CoP and Nonaka's SECI is scarce
2	Learning and continuous improvement influences competitive potential in R&D	Projects are important vehicles for learning and project management realises the value of OL theories	Social learning theory is one of the accepted perspectives on OL, CoP and Nonaka's SECI are particularly useful for PPR research
3	Tacit knowledge requires different management and transfer mechanisms than explicit knowledge.	The term post-project review is defined very differently in the literature and applied very differently in organizations	Distinction between tacit and explicit knowledge as well as individual and group held knowledge is crucial
4	Importance of PPRs for a learning R&D environment is a well accepted fact	Practical PPR application faces various challenges	Face to face contact as well as metaphors and stories are accepted facilitators for knowledge creation and transfer
5	Existing research on PPRs in R&D is seldom based on Organizational Learning theory or concepts		

The focus of this thesis is to investigate PPRs and their potential impact on learning in R&D. While a first important step will be to research current PPR practices, the prevalent purpose is to understand which type of knowledge creation takes place during PPRs and how it is exchanged during a PPR. Learning could then be an inevitable consequence if the PPR is conducted successfully. The underlying reason for this research focus is that "*...the future of technology management is moving on to an execution oriented paradigm. Instead of focusing on specific technologies to gain a competitive advantage, this paradigm shift will direct attention to the organization's execution capabilities*" (White & Patton, 2000). Therefore, the basic motivation of this thesis is to analyse in detail if PPRs could facilitate the continuous improvement of R&D management.

Based on these conclusions (compare Figure 5.1) it can be established that there is undoubtedly need for further research because:

- All three research disciplines present very limited empirical evidence for their conclusions on PPRs, i.e. the importance of PPRs to develop and introduce continuous learning in R&D is frequently mentioned, but has not yet been rigorously explored and remains a phenomenon which is only supported by anecdotal evidence;
- R&D researchers have hardly applied concepts from the organizational learning field to PPRs, although these are very relevant. Social knowledge theories support the view of PPRs as suitable events for knowledge creation and transfer;
- The learning focus has to be directed not only on explicit facts and data but also on tacit knowledge and experiences, since these are most difficult to be copied by competitors and are also largely underestimated regarding their impact on project success.

5.2 RESEARCH QUESTIONS

According to the conclusions drawn from the literature, three research questions were established. These questions represent the core focus of the research and, in turn, influenced the choice of research design and methodology.

The first research question is based upon the fact that no previous studies have analysed PPR practices in R&D organizations in detail.

Research Question 1: ***"What are the current practices of R&D organizations for conducting PPRs?"***

The research also investigated the perceptions of R&D managers of PPRs.

Research Question 2: ***"How are PPRs perceived by participants and R&D managers?"***

Finally, it was seen as vital to investigate if PPRs have the potential to generate both explicit and tacit knowledge.

Research Question 3: "***What are the typical lessons learnt and can PPRs promote the creation and dissemination of both explicit and tacit knowledge?***"

All three research questions cover important aspects of PPRs that have so far not been investigated empirically to any depth. The questions intentionally vary in terms of their character and complexity:

- Research Question 1 represents a more descriptive approach by looking objectively at current PPR practices in different organizations;
- Research Question 2 analyses the subjective perceptions of R&D managers regarding PPRs, i.e. focuses on those people that are directly affected by them;
- Research Question 3 looks at the more complex process of knowledge creation and transfer during or as a result of PPRs.

After having established the research focus and the three research questions, the next section discusses the philosophical foundation of this research. This has various implications for the overall research design which will be discussed afterwards.

5.3 PHILOSOPHICAL STANCE

According to Easterby-Smith et al (1991), there are three reasons why an understanding of philosophical issues is beneficial when doing academic research:

- It helps to clarify the research design;
- It helps to understand which approaches might be more suitable than others;
- It helps the researcher to develop designs which are outside of his experience.

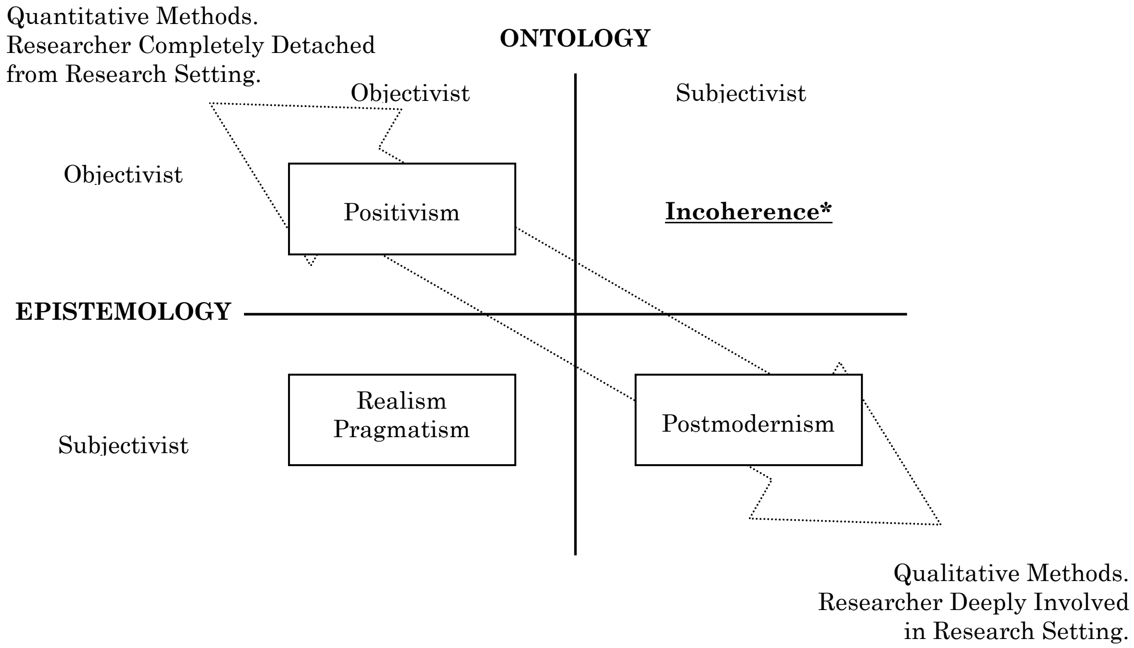
Consequently, before going into the details of the research methodology it is important to clearly set out the philosophical basis. The suitability of the philosophical viewpoint is determined by the degree to which it reflects both the personal perspective of the researcher as well as the phenomenon to be studied.

5.3.1 Ontology and Epistemology in General

Generally, one has to consider two different aspects of scientific philosophy which are inter-related: *ontology* ("what do we know about social reality?") and *epistemology* ("how do we derive knowledge of social reality?"). In other words, while ontology reflects the view of social reality which the researcher chooses to adopt, epistemology concerns itself with assumptions about how knowledge is obtained or created.

Figure 5.2 illustrates the different relationships of epistemology and ontology and their implications for management research. The extreme objective viewpoint of ontology believes that our World follows the laws of natural sciences. The other extreme of the ontological spectrum, however, is convinced that no unified knowledge exists and that knowledge always derives from human cognitive processes (Blaikie, 1993).

Figure 5.2: Positioning Realistic Pragmatism



*Please note that an objectivist epistemology is necessarily dependant on objectivist ontological assumptions, which is why the other quadrant in the matrix is considered incoherent

(Source: adapted from Johnson & Duberley, 2000)

On the other hand, the objectivist view of epistemology assumes that it is possible to look at the external World completely unbiased and detached, believing that the World exists independent of our knowledge of it. Yet, the subjectivist epistemology believes that all knowledge is always filtered through the people who own and apply it and therefore changes due to social and cultural forces (Hatch, 1997).

Within the matrix illustrated by Figure 5.2, it is possible to position different philosophical paradigms, although such binary matrix models can only reflect a rough orientation regarding different aspects of philosophical paradigms:

- *Positivism* believes that neutral knowledge and tested theories are the only true foundation for scientific knowledge. Positivists follow the logic that explanations of social reality are only true if they have no logical contradictions and are also consistent with observed facts (Neuman, 1991). Its origins lie in the empirical methods of natural sciences which look at reality as external and objective. It is therefore suitable for observable objective processes and phenomena which can be investigated via quantitative experiments like surveys or statistics, which are easy to measure and where the researcher has the possibility to stay completely detached from the object of study;
- *Postmodernism* views the purpose of research as the understanding of social life and the discovery of how people construct social meaning

(Neuman, 1991). It focuses on multiple versions of reality, which demands a very reflective approach from researchers before making any claims about reality (Johnson & Duberley, 2000). It also emphasises the importance to share the feelings and interpretations of the subjects being studied, as a theory can only be true if it makes sense to those being studied. Consequently, the researcher is deeply involved into the study and uses multiple methods to establish different views of a phenomena. Therefore, postmodernists usually follow highly qualitative research methods and action research approaches.

However, positivism and postmodernism were not considered as suitable for the purposes of this research. Positivism was rejected because it views the world completely external and objective, i.e. the researcher ideally formulates hypotheses, tests them and aims to operationalize concepts so that they can be measured, which is not the intended approach of this thesis. Postmodernism was rejected, because the researcher preferred to stay an outsider to the research subjects.

Although positivism and postmodernism are mutually exclusive (Burrell & Morgan, 1979), there are other schools of thought seeking to bridge the gap between the two extremes. Overall, everybody has a certain tacit preference regarding the question of what social reality is and what true knowledge is. In fact, we need these preferences every day to make sense of our experiences (Johnson & Duberley, 2000). Thus, various philosophical schools emerged which position themselves in between the traditional extremes. Examples for these more contemporary approaches are critical theory, hermeneutics, feminism or realism[11]. The latter represents to a great extent the philosophical viewpoint chosen by the researcher for this study: *realistic pragmatism*. The reason for its suitability for this PPR research and details regarding its characteristics are presented in the following section.

5.3.2 The Choice for Realistic Pragmatism

None of the traditional and extreme standpoints suited either the personal outlook of the researcher or the theoretical angle and basis of this thesis. Yet, the approach of *realistic pragmatism* was identified to represent exactly these very well:

- It gains from positivism because it believes to a certain degree in objective knowledge and shares its objective ontology;
- It gains from postmodernism because it believes and accepts that social actors give meaning to the World and reality is partially constructed by respondents.

[11] These philosophical viewpoints are not discussed more detailed in this thesis, but a sound overview can be found in Blaikie (1993), Bryman (2001) and Johnson & Duberley (2000).

Pragmatism, is defined as a "*method of philosophy in which the truth of a proposition is measured by its correspondence with experimental results and by its practical outcome. Thus pragmatists hold that truth is modified as discoveries are made and that it is relative to time and place and purpose of inquiry*" (Highbeam Research, 2001). Pragmatism was established in America in the last years of the 19^{th} century and is mainly reflected by the work of Charles Peirce (1838-1914) and William James (1842-1910). Its roots go back to ancient Greece and academic scepticism which denies the possibility of achieving authentic knowledge (Johnson & Duberley, 2000). Nowadays pragmatists value the effectiveness of an idea merely in their adoption by a community rather than in the success the community may encounter as it puts those ideas into practice (Margolis, 1986). Pragmatists claim that "*ideas should be tested by their relation to life...that philosophy step down from the world of abstraction into the living world*" (James, 1928). Thus, for an extreme pragmatist, truth is whatever works out most effectively. Pragmatism is not a theoretical school of thought but more the demand to act in a specific way when investigating a phenomenon. While most philosophers regard their own viewpoint as the only right one, pragmatists would most likely not agree to such a statement. For them, each philosophy has its pros and cons and not all viewpoints are helpful to explain a specific phenomenon (Jacoby 1909).

Pragmatism is related to Realism because both place importance on concrete experiences. While pragmatists claim that experiences are continually changed and developed due to further insights, realists look at experiences more objectively and see them as the only source of knowledge about social reality (Eidgenössisch Technische Hochschule, 2001). Realists view reality as three overlapping domains (Blaikie, 1993):

- The empirical domain: events which can be observed;
- The actual domain: events whether or not they are observed;
- The real domain: structures and mechanisms which produce these events.

Realistic pragmatism believes that reality exists independently of the observer and phenomena can be looked at objectively, but it also believes that social reality is partly produced by its members. However, the knowledge that is generated must not be considered as objective in the sense that it can be measured in a quantitative sense only. For realistic pragmatists, knowledge is true if it is supported by successful practical experience and is demonstrated to be useful. That means that "*knowledge will only be socially justified if it is supported by the pragmatic consensus of people within a specific community*" (Rorty, 1982 in Johnson & Duberley, 2000).

5.3.3 Limitations of Realistic Pragmatism

Realistic pragmatism is occasionally criticised for its lack of academic rigour since facts and experiences are often interpreted with great liberty (Durkheim, 1914). In other words, there is always the risk of some sort of bias influencing research results. Another frequent argument to devalue pragmatism is to use it as a synonym for common sense (Mauthner, 2000).

Yet, such superficial arguments are counterbalanced by the fact that pragmatism uses careful step-by-step generalisation of findings based on real-life evidence. This in turn reduces the risk of bias and also guarantees that results are applicable to both academic and practical communities. In addition, it goes hand in hand with the intended data collection technique for this thesis.

5.3.4 Applying Realistic Pragmatism

Overall it is important to stress that only the way a research technique is used and the manner how data is analysed reflects the philosophical viewpoint fully. Realistic Pragmatism suits the phenomenon of PPRs for four reasons:

- Although the research is fundamentally exploratory, it should be possible to identify underlying mechanisms and processes which help to understand the observed events, in this case PPRs;
- The approach of using multiple data sources, as no method is superior to any other not only follows the pragmatic viewpoint, but is also compatible with the goal of the research and the underlying research questions. Pragmatists choose *"...multi-methodological approaches where there is room to utilise the full range of methodological techniques that are available to management researchers..."* (Johnson & Duberley, 2000). No methodology should be seen as superior to any other as different methods may illuminate different aspects of a phenomenon;
- Pragmatism is linked to learning theory where reflection is used to a specific situation or problem (Elkjaer, 2003), and is always focused on concrete action instead of vague concepts (Cook & Brown, 1999);
- Realism claims that a social phenomenon can be at least partly observed as it actually happens. Applying this to PPR research, it is necessary to observe PPR practices in order to be able to make valuable conclusions regarding their importance.

Yet, the philosophical basis is only the starting point for any discussion on research methodology. Details regarding the research design will be discussed in the next section, while specifics of data collection and analysis will be presented in Chapter 6.

5.4 TOWARDS A RESEARCH DESIGN

5.4.1 Reflecting the Alternatives

Choosing an appropriate research design is a very complex decision, because it includes a whole variety of aspects which need to be considered. Before making a final choice, it was therefore essential to consider all of the possible methodologies, in order to check what would be appropriate for research on PPRs (see Appendix 2.1 for details on different research methods available to the social scientist). The main alternatives considered were experiments, quasi-experimental designs, action research and case studies.

Experiments were disregarded due to their focus on closed systems and total control of the researcher over the research settings and its conduct. This conflicts directly with the issues of the proposed PPR research where the researcher does not want to influence or determine anything, but remain a complete outsider and observer. A more natural setting could be provided by a *quasi-experimental design*, but their emphasis on longitudinal studies before and after a conscious intervention led to dismissing this methodology, too. It is not intended to investigate the impact of PPRs on future projects, otherwise quasi-experiments should have been considered more thoroughly. *Action research* was rejected because it follows a similar approach as traditional consultancy projects. In other words, a pre-defined problem is tried to be solved by involving the researcher completely into the research setting. This allows a richness of insights which could be advantageous for this PPR research, but also asks for solutions to a specific problem. In this thesis however, PPRs as a phenomenon are the focus of the study without attempting to chose a specific problem which needs to be solved.

5.4.2 Choice of Multiple Case Studies

Various factors indicate that the most suitable approach for PPR research was *multiple case studies*:

- Case studies are useful when researching complex social phenomena in real-life contexts (Yin, 1994) such as PPRs in R&D organizations;
- The existing literature does not allow strong hypotheses about PPRs to be formulated, because *"the theory base is comparatively weak and the environment under study is messy"* (Harrison, 2002). Instead, a more detailed and empirically based understanding of PPRs in R&D, following an exploratory approach, is needed. Exploratory cases represent a disciplined attempt to identify themes and patterns (Eisenhardt, 1989);
- Case study research enables a more integrative perspective of a complex subject of investigation, allowing a deeper investigation of related phenomena that would otherwise remain undiscovered. Although case studies are very time consuming, they allow for a large number of variables and different aspects of a phenomenon to be investigated, while these have not been previously determined (Yin, 1993). It was also

necessary to obtain data from multiple levels and perspectives in order to answer the three research questions;

- The case study approach is effective for understanding formal and informal processes in organizations (Hartley, 1994), which is again directly applicable to the proposed PPR research. What is needed is "*a research strategy which focuses on understanding the dynamics present within single settings*" (Eisenhardt, 1989);
- R&D managers are particularly interested in case study results in order to apply experiences of other organizations within their own context (Gassmann, 1999). Consequently, academic research in R&D might be more oriented towards practical problems than other scientific branches, while still being based on a thorough theoretical basis.

However, identifying the case study method as the preferred research strategy must not be confused with an exclusive choice of qualitative research approaches. It is solely the heading for one or more sources of evidence and data collection methods which may be used in fieldwork (Hartley, 1994). This multiplicity in fact represents a major strength of the case study method (Yin, 1994) and also characterises the preferred research approach of pragmatism (Johnson & Duberley, 2000)[12]. In addition, one has to be aware that it is not possible in research practice to precisely differentiate quantitative and qualitative methods (Mayring, 2001). *"The range of possible approaches to qualitative research indicates clearly that the dichotomization between quantitative and qualitative methods is a rough and oversimplified one"* (Morgan & Smircich, 1980).

In fact, a vital element of a research design for case studies in R&D before starting the data collection process is the development of first theoretical viewpoints (Gassmann, 1999). This is not only vital to keep the study within feasible limits, but also helps in deciding what kind of data to collect. *"Without such a theoretical framework, the researcher is in severe danger of providing description without wider meaning*" (Hartley, 1994).

Applying this to the proposed thesis, a *retroductive* approach - in other words the interplay of induction and deduction (which characterises a realistic philosophy) - is most appropriate. One phrases questions about the reality on the basis of a first theoretical understanding. Data about the reality is then critically reflected and might lead to a further differentiation or change of the theoretical understanding (Blaikie, 1993). More specifically, the theoretical concepts for knowledge creation and Communities of Practice identified earlier served as the starting point of this PPR research. These concepts were then informed in an iterative research process which included a variety of data collection techniques. This approach goes hand in hand

[12] The different data sources and data collection methods applied are discussed in Chapter 6.

with the demand for a replication logic when applying multiple case studies. The replication logic does not select cases in order to generalize its findings (sampling logic) but identifies cases based on the principle that similar results will be found so that the development of robust findings can be claimed (Yin, 1994).

5.4.3 Limitations of Case Studies

It is important to identify potential drawbacks of the case study methodology. Apart from the obvious points that they are very time consuming and require a very thorough preparation, there are generally three main concerns (Easterby-Smith et al, 1991; Harrison, 2002; Yin, 1994):

- They often lack academic rigour, a prejudice which originates most often from "quick and dirty" examples which can be found across all scientific disciplines;
- They may provide little basis for scientific generalisation, as case studies are usually only generalisable to a theoretical framework, but not necessarily to a population;
- They can result in massive, unreadable documents - again a criticism based on bad examples of case study research.

Thus, the task of designing case studies should not be underestimated, especially concerning the resources needed for preparing and conducting multiple cases in different organizations.

5.5 UNIT OF ANALYSIS

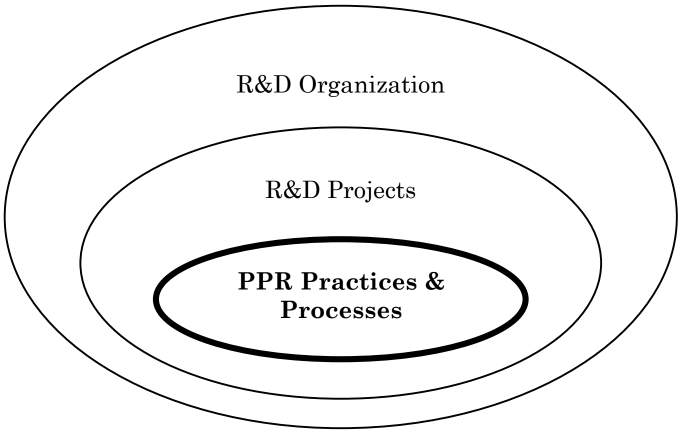
The unit of analysis represents the heart of a research study and also illustrates the boundary of the research (Miles & Huberman, 1994). Defining the unit of analysis is one of the most challenging tasks for researchers using case studies, because *"…you enter a treasure trove of fascinating data and can be dragged off in any one of numerous directions"* (Harrison, 2002).

The following points of advice can help in defining the unit of analysis for case study research (Miles & Huberman, 1994; Yin, 1994):

- It is often easier to describe what will *not* be researched than stating specifically what will be within the research boundary;
- The definition of the unit of analysis has to be closely connected to the research questions underlying the case study research;
- In order to be able to compare or contrast the case study results with existing research, it should either use a similar unit of analysis or a completely different one.

Following these points of advice, Figure 5.3 illustrates the unit of analysis of this research on PPRs. Based on the previously defined research questions, the unit of analysis are the PPR processes and practices within specific R&D organizations. The main reason for this definition is that not only one single PPR in a chosen R&D organization is being investigated, but mainly the general PPR processes and practices regarding PPRs. These are not specific to a single R&D project or PPR, but only specific to and imbedded in a single R&D organization. The same is true for the typical lessons learnt from completed R&D projects. These can be project specific to some degree (e.g. if a certain problem only occurred in one specific project), but are mainly dependent on the PPR processes used in a specific R&D organization and the PPR objectives that are valid in each R&D organization. Furthermore, focusing the analysis on the PPR practices & processes is also inline with the focus on knowledge creation theories explained earlier.

Figure 5.3: The Unit of Analysis



One aspect which is outside of this unit of analysis is the long term knowledge flow between different R&D projects in a specific R&D organization. Although these knowledge flows and consequently the project-to-project learning mechanisms might be influenced by the PPRs, a detailed analysis of these long term learning effects is outside the scope of this thesis. Instead, the description of the current PPR practices and processes include aspects of how these long term learning effects might be supported or not.

5.6 IDENTIFICATION OF EMPIRICAL SAMPLE

Eisenhardt (1989) argues that the aim of theoretical sampling is to find a reference population, assuming that the cases are not chosen randomly. However, this was one of the big challenges for this thesis. Previous research claims that not many organizations actually conduct PPRs, and care has to be taken to select comparable entities.

The approach taken for this research was an exploratory sample based on a specific geographic region. This is also in line with the exploratory approach chosen for this study as investigations on a wider scale are not the priority at this stage of researching PPRs. Thus, the focus of this thesis was placed on R&D organizations in the South-western area of Germany (Baden-Württemberg). This area provides a rich variety of R&D activities of which both the researcher and supervisor had in-depth knowledge. More importantly, Baden-Württemberg represents a perfect area for research in R&D (Wirtschaftministerium Baden-Württemberg, 2001) because:

- It is within Europe the region who spends most on R&D based on the GDP and is also the most R&D intensive region within Germany;
- Overall, 23% of all employees work for a high-tech company;
- It invests more than 10 Million Euro per day into R&D, i.e. 5.2% of the gross domestic product and therefore more than Japan and the USA;
- It has the highest number of new patents of all European regions (more than 120 patents per 100,000 inhabitants, while the average in Europe is 60).

After having chosen Baden-Württemberg as the focus area for this research, an objective list of the top 50 companies - based on turnover - in the region was provided by the ministry of economy (see Appendix 2.2). From this sampling frame of 50 companies, companies without R&D activities were eliminated and with all remaining ones access negotiations were started. Table 5.1 illustrates how the exploratory sample selection was conducted.

Table 5.1: Sampling Logic and Access Negotiations

	Number	
	Absolute	In %
Sampling frame of top 50 companies	50	100
⇨ *of these companies without R&D activities*	*11*	*22*
Net total population of companies contacted	39	78
⇨ *companies contacted by neutral letter without personal contacts*	*31*	*62*
⇨ *companies contacted by personal letter based on personal contacts*	*8*	*16*
Companies willing to grant access and used for case studies	4	8
⇨ *access granted based on personal letter*	*1*	*2*
⇨ *access granted based on neutral letter*	*3*	*6*
Additional case study outside of Top 50 list based on personal contacts (convenience sample)	1	
Total number of case companies selected for the research	5	

The number of case studies was not determined from the beginning, and was not based on a classical sampling logic of more quantitative approaches. Rather, the number of cases depended on the certainty needed for specific analyses and verifications following the theoretical sampling logic (Eisenhardt, 1989). Therefore, after having conducted four case studies, a fifth case study based on personal contacts of the researcher was added in order to increase the validity of the research findings. This fifth company is also located in Baden-Württemberg, but is not part of the top 50 list used for the original sampling. However, this convenience sample case was chosen because the company conducts considerable R&D and is comparable to the first four case companies[13].

Consequently, this thesis describes five case studies. Since all companies provided detailed insights into their R&D activities and internal processes and also granted access to internal documents and meetings, all of them preferred to remain anonymous. Therefore, Table 5.2 provides a short overview and introduces the synonymous case names for each company, which will be used in the remaining parts of this thesis.

Table 5.2: Overview of Case Companies

Case no.	Case name	Branch/Sector	Access via
1 – Pilot case	Engineering Co.	Engineering	Personal letter
2 – Case study	Appliances Co.	Electric appliances	Neutral letter
3 – Case study	MedCare Co.	Non-food consumer products	Neutral letter
4 – Case study	Machinery Co.	Automation machinery	Neutral letter
5 – Case study	Publishing Co.	Toy industry	Personal contact

5.7 SUMMARY

The three research questions of this thesis concentrate on different aspects of PPRs which are based on the main conclusions from the literature reviews on R&D management, Project management and Organizational Learning. In addition, the three research questions focus on PPR facets which have so far not been investigated in any detail.

Due to limited previous research on PPRs, the exploratory nature of this research can best be approached within a multiple case study approach. This approach also reflects very well the philosophical outlook of realistic pragmatism on which this thesis is based. The selection of five different case companies is based on the Top 50 list of companies within Baden-Württemberg, which is well-known for its R&D intensive industry. Within these five case studies, the focus of the analysis lies on the R&D practices and processes which are representative for different R&D projects within a specific R&D organization.

[13] A short overview of key figures for all case companies, e.g. turnover and number of employees will be given in Chapter 8.

CHAPTER 6 RESEARCH METHODOLOGY

"A major strength of case study data collection is the opportunity to use many different sources of evidence."
(Yin, 1994)

6.0 INTRODUCTION

Building on the last chapter, which set out the overall research design, this chapter describes the research methodology in detail. The objective of this chapter is to show how, for example, validity issues were addressed. Therefore, it covers the following issues related to the case study quality:

- An explanation of the different data sources and data collection;
- A discussion of the data reduction and analysis including data coding and within-case analysis, i.e. the logic for the data triangulation applied to each single case study;
- The reflection on the case study qualitiy;
- The methods used for cross-case analysis, i.e. the logic of the data triangulation applied across all five case studies.

6.1 DATA COLLECTION

6.1.1 Overview of Data Sources

Data was collected through three complementary routes as illustrated in Figure 6.1:

- Analysis of documents such as guidelines for PPRs and minutes of specific PPRs;
- Interviews with project managers, project members as well as general managers in R&D;
- Observations of actual PPRs.

<u>Figure 6.1: Overview of Data Sources</u>

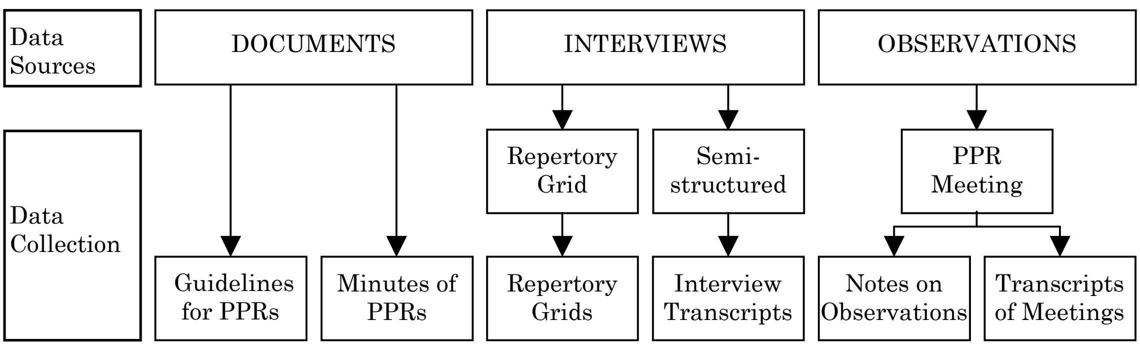


Figure 6.1 also shows the data collection approaches applied for this thesis. The three data sources and the six data collection approaches represent a conscious mix of quantitative and qualitative approaches, which

has the following advantages (Rossman and Wilson in Miles & Huberman, 1994, p. 41):

- It allows the scope and breadth of the study to be expanded;
- It provides richer data;
- It enables triangulation of data due to different data sources and cross-case analyses to find first patterns which are generalisable to initial theoretical understandings;
- It initiates new lines of thinking by providing fresh insights.

The real value of triangulation is not that it guarantees conclusions about which we can be confident, but rather that it provokes researchers to take a more critical, even sceptical, stance towards their data (Bryman, 2001; Yin, 1994). Both qualitative and quantitative research approaches are inter-related, with quantitative research contributing towards the precise identification of relevant processes, and qualitative research providing the basis for thick description (Fielding & Schreier, 2001). Mintzberg (1973) describes this synergy stating that *"...we uncover all kinds of relationships in our hard data, but it is only through the use of this soft data that we are able to explain them....*" This approach to data collection also follows Magalhaes (1998) call for new directions in researching organizational knowledge. He claims that too much emphasis has been placed on positivist and quantitative research methods and not nearly enough attention is given to interpretivist and qualitative methods.

Although multiple data sources have their advantages, there is a risk that the scope will be too broad. Eisenhardt (1989) recommends that *"no matter how small our sample or what our interest, we have always tried to go into organizations with a well defined focus - to collect specific kinds of data systematically*."

When investigating PPRs in R&D organizations, it was an unavoidable fact that a major part of the data was collected retrospectively. Therefore, special care had to be taken regarding the choice of informants as well as the phrasing of questions in order to offset unique biases of knowledge and selective memory recall (Huber & Power, 1985).

6.1.2 Document Analysis

6.1.2.1 Document Analysis in General

Document analysis can help to corroborate and augment evidence from other sources (Yin, 1994), but is also useful to gather first understandings, raise initial questions or prompt first critical points to be clarified in later steps of the research design. In all cases it is important in reviewing any document to understand that it was written for some specific purpose and some specific audience other than those of the case study being done. In addition, one has to be aware of the risk of reading documents with a certain degree of researcher bias (Huber & Power, 1985).

6.1.2.2 Document Analysis Applied to this PPR Research

As stated by Yin (1994), much documentation is likely to be relevant when researching projects within an organization. The same is true for PPRs as the final step within a project life cycle, where it is important to gather a first understanding via already existing written information. Documents which were collected for this research included:

- General descriptions of PPR processes and guidelines in the organization;
- Minutes of PPR meetings;
- PPR invitations and agendas;
- Final project reports.

Ideally, these documents were provided by the case companies in advance, so that a first analysis could already be done before conducting the first interviews. Where possible, these documents were provided to the researcher during or as the result of the initial contact visit. For case companies which did not provide copies of these documents because of confidentiality reasons, on-site inspection was conducted during one of the first site visits. Overall, the researcher was confronted with two scenarios:

- Some case study companies had written descriptions of their PPR process and were also able to provide minutes of several different PPR meetings;
- Other case study companies had no fixed guidelines for PPRs or only a limited amount of minutes of PPRs available which could be used for this research.

6.1.3 Interviews

6.1.3.1 Interviews in General

Conducting interviews is advisable when the researcher has to understand interviewees' opinions and knowledge attached to specific situations (Easterby-Smith et al, 1991). Depending on the purpose of the investigation, interviews can vary in structure and degree of formality (Dixon et al, 1987), ranging from one-to-one interviews with fixed questionnaires to open discussions with a group of people.

6.1.3.2 Interviews Applied to this PPR Research

The key challenge for this research on PPRs, is that it was essential to uncover or touch upon tacit knowledge elements during the interview apart from phrasing general questions regarding PPRs. Traditional interview techniques did not seem to be suitable to achieve this as "*individuals cannot be asked to state what they cannot readily articulate*" (Ambrosini & Bowman, 2001). Trying to solve this problem by looking at existing research only confirmed this difficulty as it is widely accepted that tacit knowledge has so far widely resisted operationalization. According to Haldin-Herrgard (2001), there is wide agreement in academic circles that the diffusion and sharing of tacit knowledge is extremely difficult, although various options exist. For example, Ambrosini & Bowman (2001) suggest the use of causal maps and story telling as useful methods when dealing with tacit skills. Causal maps force the interviewees continuously to reflect on their behaviour and respective explanations for this behaviour so that certain hidden structures and constructs can be rendered conscious. Thus, story telling is an appropriate device for studying tacit skills, because people often frame their tacit experience in stories. In fact *"stories are one of the many forms of implicit communication used in organizational contexts"* (Martin, 1982 in Ambrosini & Bowman, 2001).

6.1.3.3 Repertory Grid Interviews

A technique which is closely related to causal and cognitive mapping is repertory grid interviewing. This technique is based on Kelly's theory of personal constructs and represents a highly structured interview with the aim to investigate knowledge areas which are hard to articulate. Overall, repertory grid interviews are useful and recommended for the following areas (Goffin, 2002):

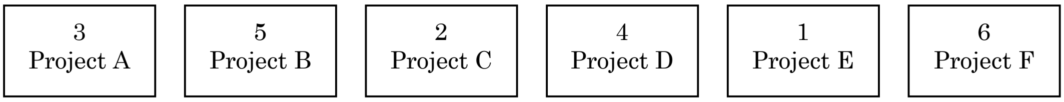
- The subjects might not be able to express their thoughts appropriately or objectively;
- The researcher cannot observe a specific phenomenon;
- The researcher might be biased himself or might not have enough shared background and experience with the interviewees.

In fact, Reed (2000) suggests personal construct theory and the use of repertory grids to research tacit and explicit knowledge in practice. He illustrates examples of practical methods to express the inexpressible which can also be used to investigate PPR related issues raised by this research. Repertory grid technique enables the verbalisation of issues like learning during or as a result of PPRs. According to Reed (2000) *"personal construct psychology has the potential to assist considerably in the nuts and bolts of knowledge transfer. Whilst Nonaka's ideas about metaphors, analogies and models as means to make knowledge available to others are useful as illustrations for his ideas, personal construct psychology can offer a lot in regard to the practical application of these ideas*." This is achieved by using repertory grid to look at the kinds of lessons learnt from different projects. Using repertory grids helped to explore individual understandings and concepts of learning from R&D projects. The use of repertory grid techniques within the NPD context is rare. A paper by Debaeckere et al (1996) applied the method successfully to investigate critical success factors in the design-manufacturing interface, but this had limitations (Goffin, 2002).

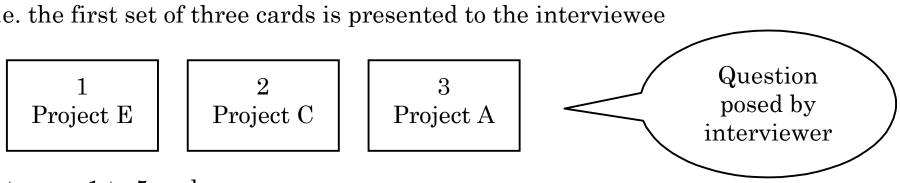
In practice, repertory grid interviews consist of several steps (Goffin, 2002) as illustrated by Figure 6.2:

Figure 6.2: Example of a Repertory Grid Interview

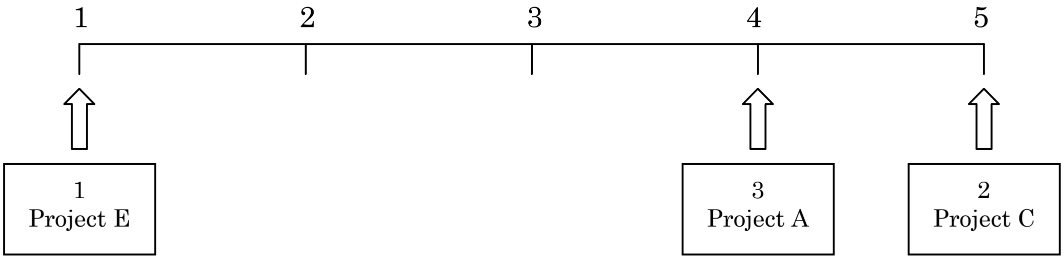
⇨ The elements of the test, i.e. the chosen projects, are written randomly on cards:



⇨ The first triad, i.e. the first set of three cards is presented to the interviewee



⇨ Rating of elements on a 1 to 5 scale



(Source: adapted from Goffin, 2002)

- An *introduction*, during which the researcher explained the aim of the research and the interview technique in particular to the respondent;
- The *elicitation of the elements*, here six different completed projects the interviewee had in depth knowledge about. The elements were then written on cards which had been randomly numbered as illustrated in Figure 6.2, where Projects A to F are written on cards out of sequence. It is important that elements are specific, discrete, as simple as possible, homogeneous and most of all the interviewee should have detailed knowledge about them (Goffin, 2002). It is also important to mention that a pool of provided elements was used at each company from which interviewees could choose their elements. This approach allowed a high degree of overlap between the elements chosen;
- The *presentation of triads* of elements to the respondent and asking each time the question "*looking at the three projects written on the cards - how are two of these projects similar and different to the third in terms of what you would do differently or exactly the same if you were doing the same projects again?*"[14]. Each answer to this question is called a construct which can be defined as the way in which the interviewee differentiates between the elements in the triad. This construct is then supplied by its counter-pole and all elements are ranked for example on a

[14] A slightly different question was used for the pilot case - details will be discussed in Chapter 7.

1 to 5 scale (see Figure 6.2)[15]. This was done until no further constructs could be found, no new triads were available or the time ran out. The interviewee should not repeat constructs, so that each triad will result in a new construct. It is important to mention that in each successive triad, at least two cards should be changed from the previous triad. This gives the interviewee a varied set of elements to compare and generally elicits more significant constructs. In the beginning of the interview, constructs are usually found easily. Basic or trivial constructs should not be disqualified by the researcher unless they are completely outside of the topic under study. One also has to be careful about the definition of specific constructs, as interviewees might elicit two synonymous expressions, but define them very distinctly.

The outcome of this structured approach was a matrix of quantitative data - the repertory grid - which identified the criteria which the interviewee took away from projects. Figure 6.3 shows an example grid. The stars around some of the ratings represent the triad chosen when eliciting the construct. Ratings are very helpful for the researcher when trying to understand the importance of constructs. The advantage of repertory grid interviews was that the researcher left the interview with a grid ready for thorough analysis using *Gridlab*[16] software.

Figure 6.3: Example of a Repertory Grid Regarding PPRs

Constructs	Project A Card 3	Project B Card 5	Project C Card 2	Project D Card 4	Project E Card 1	Project F Card 6	Pole
All Project Members Present	*4*	2	*1*	5	*3*	1	Only Managers Invited
Clear Agenda	3	*3*	*4*	*1*	2	5	Ad hoc Discussion
Constructive & Open Atmosphere	1	5	3	*2*	*4*	*4*	Political Event
Etc.							Etc.

It is also important to mention that apart from a quantitative repertory grid, one produces rich qualitative data, too. Not only in the closure phase of the interview, but also during the phase of eliciting constructs, interviewees give detailed insight into their thinking and process of deriving their personal constructs. Therefore, all interviews were tape recorded in order to make sure that all comments were captured and also to facilitate the analysis.

[15] Note that all elements, not only the triad elements, will be rated each time.

[16] Gridlab software is not an analysis method in itself, but represents a tool that enables one to extract different tables on the basis of rep grid data input. Examples: correlation between different constructs, the spread in the rating of elements or variability ratios.

The *conclusion* of the interview with some semi-structured questions giving rise to stories and deeper descriptions to supplement some of the constructs identified earlier or to further explain the poles chosen. During the closing phase, the interviewees had the chance to raise experiences, perceptions and other details which they wanted to share. For this study, the concluding semi-structured section lasted about 20 minutes.

6.1.3.4 Semi-structured Interview

The questionnaire (see Appendix 3.1. for the original version in German and the English translation) which was used in the closing phase of the interview was based on the literature. This was supplemented by ideas from the pre-pilot case studies (see Chapter 1). Its design was done in two steps: firstly the identification of section headings and secondly the phrasing of actual questions (operationalization). The headings used were:

- *Demographics:* this collected limited personal data about the respondent to be able to compare specific answers to the respondent's demographics;
- *General issues*: questions were mainly based on Analysis Instrument 1, which will be explained within this chapter;
- *Knowledge generation:* related to one of the research questions of this thesis. Knowledge generation can be considered as a synonym for learning (Bertels & Savage, 1998) and lies at the very heart of different theories regarding knowledge management and organizational learning. The questions under this heading are also based on Sinofsky & Thomke (1999). However, it was decided not to ask directly for the PPR topics mentioned by them. Instead, respondents were asked indirectly for the main topics mentioned and typically discussed during PPRs;
- *Knowledge sharing and dissemination:* these questions were based on social learning theory and the kinds of social engagement that provide a context for knowledge sharing to occur (Lave & Wenger, 1991). Both knowledge generation and knowledge sharing and dissemination represent the basis for any learning to occur in a social setting and community context. Gathering empirical data on these aspects in relation to PPRs is therefore the focus of the semi-structured interview. Questions of this section are strongly based on the ideas of Sinofsky & Thomke (1999) and open "how" and "what" questions were preferred in order to uncover learning mechanisms;
- *Learning:* this section aimed to look at learning more directly and PPRs as a learning event. The questions are based on sample questions for software PPRs listed by Chikofsky (1990) and intend to uncover the learning potential of PPRs more directly. They also try to identify any other potential mechanisms in the organization which might be preferred to PPRs or offer the same advantages.

It is important to add, that these particular headings were chosen, because they match the focus of the research. Similar to the repertory grid interview parts, all semi-structured interviews were tape recorded and then transcribed in order to facilitate a detailed analysis in later stages of the research.

6.1.4 Observation

6.1.4.1. Observation in General

The final step in the data collection process was the observation of a PPR in the case company. Although neutral observation (as opposed to participant observation) might be criticised for its tendency to promote researcher bias, Yin (1993) supports its applicability for case studies as *"observational evidence is often useful in providing additional information about the topic being studied"* (ibid). For all observations, one should try to follow simple rules (Laurie, 1999):

- Results are to a certain degree subject to researcher bias;
- Personal impressions should be documented along with objective facts and quotes;
- Apparent contradictions are especially important to watch out for;
- Listen empathically;
- Capture the observations.

6.1.4.2 Observation Applied to this PPR Research

For the purpose of this PPR research, the observation of one PPR per case in its full length was exclusively a neutral recording of the activities, discussions and processes taking place. Firstly, the PPR was tape recorded, and secondly a wide variety of observational notes (seating plan, body language, visual aids, etc.) were thoroughly noted by the researcher. Furthermore, e.g. changes in tone and atmosphere were recorded with the help of symbols, e.g. "≠" for disagreements, "?" for unclear statements, "!!!" feels strong about this, etc.

As already mentioned earlier, the main obstacle for data collection is that "*the transfer of tacit knowledge within and between teams cannot be directly observed and the output cannot be attributed to a particular employee. At best, one can observe the result of knowledge generation and transfer in terms of output. Explicit knowledge, on the other hand, is tradable*" (Osterloh & Frey, 2000). In other words, Nonaka's model and the concept of CoP might offer theoretical explanations how tacit knowledge flows, but this does not help in trying to observe it and in designing a rigorous methodology.

6.1.5 Concluding Comments Regarding the Data Collection

The range of data collection techniques used shows that the research strategy went far beyond a qualitative description of current PPR practices. For example, the variety of data collection techniques allowed links between PPR practices and knowledge creation potential to be investigated.

The different modes of data collection explained above also go hand in hand with the demand of pragmatism to support the participation of those being researched. As the focus of any pragmatic research approach lies on its practical relevance, one has to actively search for constructs and opinions expressed by research participants (Johnson & Duberley, 2000).

The fact that the repertory grids were conducted using specific R&D projects as elements and not PPRs is not a contradiction or anomaly. It is important to stress that the objective of the repertory grid was to check the learnings that managers perceived they gained from completed R&D projects and to compare these with the learnings from PPRs investigated via document analyses, PPR observations or semi-structured interviews. The comparison helped to illustrate the potential of PPRs as a specific learning mechanism within R&D organizations. Therefore, in order to specify the difference between what was learnt from a completed project and what was actually discussed during a PPR, the repertory grid elements needed to be completed R&D projects and not PPRs. The limitation that learnings differ because repertory grid elements and PPR documents or observations do not always refer to the same set of projects cannot be eliminated completely. However, the overlap of investigated projects between different respondents was very high and the minutes of PPR and PPR observations were also based on a selected set of projects. Therefore, different learnings cannot be attributed to the mere fact of investigating different projects.

The repertory grid method as such was particularly useful for this research, as direct questions regarding lessons learnt would not have provided the same quality of data. Comparing different triads of completed projects triggered sometimes unexpected insights and enabled the researcher to touch upon more tacit knowledge elements of an interviewee (Reed, 2000).

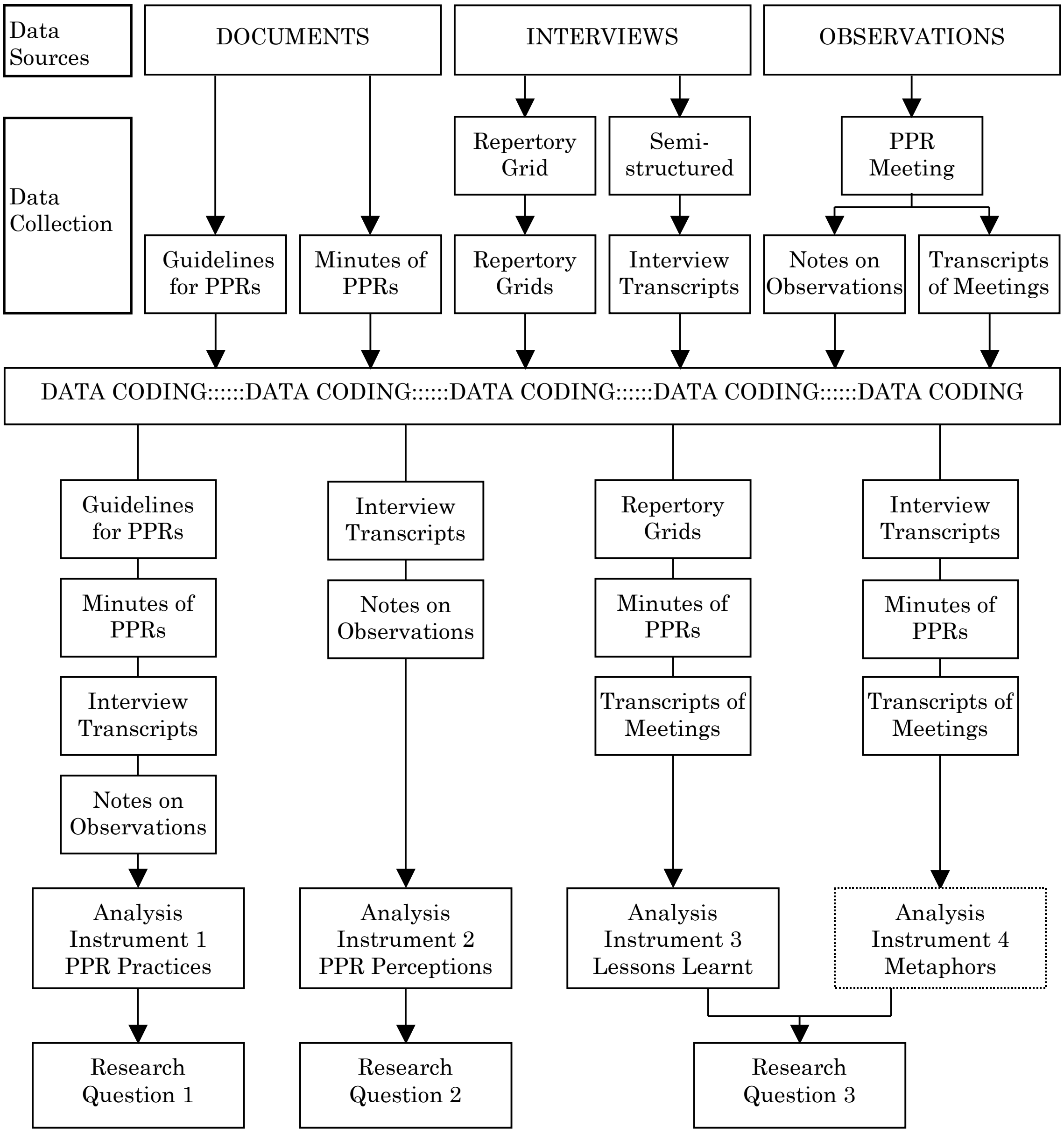
6.2 DATA REDUCTION AND ANALYSIS

One of the main challenges of this thesis was the analysis and reporting of findings which derive from different collection techniques. Yin (1994) lists four principles of good case data analysis:

- It should rely on all relevant evidence;
- It should include all major rival interpretations;
- It should address the most significant aspects of the case study;
- It should bring the researchers own prior, expert knowledge to the case study.

Figure 6.4 illustrates the data analysis steps visually and the following sections illustrate in detail how the data collected in various steps were coded and analysed for the purposes of this thesis. For example, for Research Question 1, Figure 6.4 shows that the four different data sources were used: Guidelines for PPRs, Minutes of PPRs, Interview Transcripts and Notes on Observations. Theses were coded and displayed on the basis of Analysis Instrument 1[17] and thus triangulated in order to be able to describe the PPR practices in each of the case companies.

Figure 6.4: Overview of Data Analysis[18]



[17] A detailed explanation of all Analysis Instruments is given in later sections of this chapter.

[18] Analysis Instrument 4 was added to the research design during the data analysis stage of the pilot study, because the importance of analyzing metaphors in detail was not realized before the first set of data was analysed in-depth.

6.2.1 Data Coding

Miles & Huberman (1994) suggest different approaches to coding, which can be used to extract relevant information from documents or transcripts in a very organized and clear way. Marginal codes, for example, are a combination of normal codes (which appear on the left side of documents or transcripts) and pre-analytic remarks on the right. While the first help to provide structure, the latter captures spontaneous remarks and reactions which are very important for later data collection stages, questions to be asked, etc. A very general pre-coding list is usually helpful before starting the coding process. However, too much could be missed if no further codes would be added during the analysis process, especially because document's contents might differ so much. Codes and categories need to be derived on the basis of the relevant literature, the research questions, etc. and also support the later stages when looking for patterns in the data. For exploratory research, it is also useful to apply emerging codes which develop during the course of the research and coding process.

Based on these recommendations from Miles & Huberman (1994), four different Analysis Instruments were developed for this research. These four Analysis Instruments are different in how they were derived. One is based on existing literature, one was derived during the course of the five case studies, one is based on the interview questionnaire and one was developed for the special purposes of this thesis. Each Analysis Instrument is targeted towards a particular research question as illustrated in Figure 6.4.

Since all Analysis Instruments were used for the data coding as well as the data analysis and triangulation, the following section on the within-case analysis will discuss all these aspects.

6.2.2 Within-Case Analysis

Since the process of data collection and analysis consisted of many individual steps, it was particularly important to find a practical way of dealing with all gathered data and also to find ways to illustrate and combine findings of different data sources and analysis steps. Firstly, it was important to derive logical ways of triangulating data and findings of the single cases individually. In other words, *"the idea is to become intimately familiar with each case as a stand alone entity"* (Eisenhardt 1989). Yet, as the three research questions target quite different aspects of PPRs, it made sense to use three different combinations of data analysis in order to answer the three research questions. Therefore, data from each case were analysed separately to give a complete picture of the company's approach to PPRs. The same data analysis framework was used for each case. Since a detailed description of the within-case analysis will be presented in Chapter 7 within the discussion of the pilot case study, the following sections only cover the most important aspects regarding the analysis of single case studies.

6.2.2.1 Research Question 1 - Analysis Instrument 1

The focus of Analysis Instrument 1 were the PPR practices applied in R&D organizations and was thus targeted at Research Question 1. It was derived from the literature as illustrated by Table 6.1. The literature helped to identify fourteen relevant categories which were selected as useful to describe current PPR practices in R&D organizations. The same fourteen categories were then used throughout all case studies as a coding scheme and also as a data presentation tool.

Evidence from the different interviews was collated with the help of tables based on Analysis Instrument 1. First of all the results from the different interviewees was gathered and merged in a concluding column. Then, these results from the interviews were triangulated with evidence from the documentation (guidelines for PPRs and minutes of specific PPRs) and observations. The outcome of this triangulation was separately displayed for each case. A sample outline of Analysis Instrument 1 without data is given in Appendix 3.2.

Table 6.1: Deriving Analysis Instrument 1[19]

No.	Coding	Wheelwright & Clark 1992	Sinofsky & Thomke 1999	Yianni et al, 1997	Kozar 1987	Skovvang & Kaskgaard 2003	Duarte & Snyder 1997	Smith 1996	Busby 1999	Baird et al 1999	Right Track Associates 2000	Schindler & Eppler 2003	Anonymous 1999
1	Objective of PPRs	X			X	X		X					
2	Timing of PPRs		X		X			X					
3	Duration of PPRs		X										
4	PPR participants	X	X		X			X	X				
5	Moderation of PPRs						X	X				X	
6	PPR discussion method								X			X	
7	Location for PPRs		X										
8	Use of guidelines for PPRs				X			X					
9	Preparation of PPRs		X									X	
10	Atmosphere during PPRs				X	X	X	X		X			
11	Results of PPRs		X			X		X			X	X	X
12	Dissemination of PPR results	X	X			X			X			X	X
13	Creation of action points		X									X	X
14	Agreement on improvement suggestions			X			X						

[19] Based on selected guidelines for PPRs discussed in Chapter 2 and 3 plus consultancy literature.

6.2.2.2 Research Question 2 - Analysis Instrument 2

The focus of Analysis Instrument 2 were the perceptions from R&D managers regarding PPRs and was thus targeted at Research Question 2. It was derived on the basis of selected questions from the semi-structured interviewee questionnaire (see Appendix 3.1). Several questions from the questionnaire were targeted particularly on personal perceptions and thus provided a useful tool for the coding and analysis of the transcripts. Table 6.2 presents the link between the questions and codes used.

Table 6.2: Deriving Analysis Instrument 2

Question targeted at personal perceptions (extracted from questionnaire)	Code
What do you personally think of PPRs in general?	PPR judgement
What do you personally want to achieve with a PPR?	PPR objective
How do PPRs support the learning from projects from your point of view?	Supporting role of PPRs
What should ideally be the outcome of a PPR?	PPR outcome
How should PPR results be disseminated?	Dissemination of PPR results
Can you think of any other mechanisms to share experiences and lessons learnt in your organization?	PPR alternatives

As illustrated by Figure 6.4 not only the interview transcripts, but also the observational notes were coded regarding the personal PPR perceptions. However, the main data source was undoubtedly the semi-structured part of the interviewees.

In order to answer Research Question 2 on PPR perceptions of R&D managers, evidence from the different interviews was compared with the observation notes based on Analysis Instrument 2. This comparison was then displayed for each case separately. An outline of such a table without data can be found in Appendix 3.3.

6.2.2.3 Research Question 3 - Analysis Instruments 3 and 4

The third step in the within-case analyses concentrated on Research Question 3, i.e. the lessons learnt from completed projects and those mentioned during PPRs as well as the evidence for tacit knowledge creation via metaphors and stories. Therefore, two different Analysis Instruments were applied.

The focus of Analysis Instrument 3 were the typical lessons learnt from completed projects. Although a coding scheme could have been derived from the literature, the researcher preferred to use an emerging coding logic. This means that codes were inductively created during the coding process. Yet, in order to give the coding logic some kind of structure, a classification of lessons learnt as illustrated in Table 6.3 was applied.

Table 6.3: Coding Categories for Lessons Learnt

No	Category	Code	Example
1	Bureaucracy	BURx	BUR2 – Use of bureaucratic guidelines
2	Capacity & resources	CAPx	CAP1 – Necessary capacities and resources
3	Communication	COMx	COM5 – Communication with external parties
4	Costs and budgets	COSTx	COST1 – Meeting of targeted project costs
5	Experience	EXPx	EXP4 – Reuse of previous project experiences
6	Marketing aspects	MARKx	MARK1 – Quality of market research
7	Organization	ORGx	ORG15 – Coordination between different departments
8	Product aspects	PRODx	PROD2 – International project requirements
9	Project management	PMx	PM4 – Quality of project management
10	Supply chain	SUPPLYx	SUPPLY2 – Use of external suppliers
11	Social aspects	SOCx	SOC3 – Working conditions
12	Technology	TECHx	TECH3 – Innovation degree of project
13	Testing aspects	TESTx	TEST2 – Length and depth of test phase
14	Timing aspects	TIMEx	TIME2 – Meeting of milestones & deadlines
15	Turnover aspects	TURNx	TURN1 – Turnover achieved after market launch

The different categories were based on the nature of topics that were mentioned. In other words, the fifteen different categories listed in Table 6.3 where developed by the researcher based on the insights from documents, interviews and observations and were mutually exclusive. During the coding process, a great variety of lessons learnt were allocated to each category. These were then simply numbered consecutively as illustrated in Table 6.3 which shows one specific example for each of the seven categories.

As illustrated by Figure 6.4 not only minutes of PPRs and the transcripts from PPR observations were coded with Analysis Instrument 3, but also the repertory grid constructs listed in the repertory grid matrices were coded on the basis of this logic, because these constructs also represented lessons learnt from R&D projects. This also facilitated the data triangulation in later stages of the analysis.

If new lessons learnt were found in documents which had not been elicited as repertory grid constructs or vice versa, new codes were created following the same logic and added to the total coding list. This was done from one case to the other, so that the list of codes increased from each case study to the next. Firstly, the constructs or lessons learnt from different interviewees were grouped in order to identify those lessons learnt which were mentioned by several interviewees and to display the frequency of each construct. In addition, the average variability for each of the lessons learnt was derived. This analysis step was then displayed as illustrated by Table 6.4.

Secondly, triangulation between these repertory grid constructs and the lessons learnt identified in the minutes of the specific PPRs and the PPR observation was conducted. The results of this data triangulation was displayed for each case study in the same format and an example table can be found in Appendix 3.4.

Table 6.4: Comparison of Lessons Learnt Across Interviewees

TYPE	CONSTRUCT	1	2	3	4	5	6	Variability	Frequency
PMx		X			X	X	X	13.48%	4
TECHx		X		X	X	X		5.27%	4
PMx						X	X	12.09%	2
ORGx				X	X			8.31%	2
SOCx			X	X				15.56%	2
BURx			X			X		3.57%	2
Etc.									

For the analysis of *multiple* grids, it would have been also possible to resort to using Gridlab, but one had to be aware of common mistakes in interpreting the data:

- Elements and constructs are specific to each interviewee. Although it might be possible to conduct interviews in on case company always regarding the same set of projects or PPRs (i.e. elements), one will never end up with the same constructs for comparison. And even if the same construct is mentioned by two different respondents, it is unlikely that they define them always in exactly the same manner;
- Constructs which are mentioned most often are not necessarily the most important ones in terms of the research or in terms of - in this case - lessons learnt. They might solely be easiest to articulate or the most prominent construct on the mind of interviewees.

The focus of Analysis Instrument 4 was the metaphors and stories used and expressed during the actual PPR meetings compared with those mentioned during the interviews and stated in documents. It was thus targeted at Research Question 3 and the intention to gather evidence for the creation and transfer of tacit knowledge. Overall, the use and analysis of metaphors is very difficult to operationalize, and no established methodology for the analysis of metaphors exists. The "Zaltman Metaphor Elicitation Technique (ZMET)" is frequently mentioned as one possibility (Coulter et al, 2002; Zaltman, 1996), but this technique is mainly known for the way metaphors are elicited (storytelling, missed images, repertory grid, etc.). Regarding the analysis of metaphors, it merely uses thematic categories which are then turned into conceptual metaphors. Another approach stems from Wagner and Sternberg (Wong & Radcliff, 2000) who established the "Tacit Knowledge Inventory for Managers (TKIM)" using Likert scales for a sequence of scenarios for which respondents are asked to pick a rank (Richards & Bush, 2000). However, both approaches are not useful for the operationalisation of metaphors in this research.

Consequently, Analysis Instrument 4 was derived specifically for the purposes of this thesis. Each metaphor found in the different data sources was linked to the construct in connection with which it was mentioned in the PPR or documented or expressed during interviews. Table 6.5 highlights the data source of each metaphor in the discussion and also links it to a specific construct or lessons learnt discussed during the PPR.

Table 6.5: Deriving Analysis Instrument 4

Data source	Metaphor	Connected construct

6.3 CASE STUDY QUALITY

Criteria for the quality of case studies results are not only the sampling logic but also how questions of validity and reliability are treated. According to Yin (1994), there are four common tests for all research methods in social science which need to be considered. Table 6.6 describes how the four most important quality aspects were approached.

Table 6.6: Criteria for Case Study Quality

Validity issue	Explanation	Tactic
Construct validity	Establishing correct operational measures for the concepts being studied	• Multiple sources of evidence are used • Informants proof-read case study protocols
Internal validity	Checking if findings make sense to respondents and external people	• Provide rich descriptions • Triangulation of methods and data sources
External validity	Checking if findings are transferable to other sample populations	• Generalize to theory instead of population • Suggest suitable setting for further testing
Reliability	Quality control of research process, i.e. stability of research process across time and across researchers and cases	• Use case study protocols • Design a case study data base

(Source: Miles & Huberman, 1994; Yin, 1994)

Construct validity was assured by establishing a set of operational measures for the phenomenon under study. For this thesis, it was necessary to find appropriate "measures" for the fact that tacit learning is potentially created and shared during PPRs. As this is extremely difficult for qualitative studies and even more for those dealing with intangible issues, it was vital not only to use multiple sources of evidence, but also to have respondents proof-read all aspects found and conclusions drawn.

Regarding *internal validity* one needs to be aware that it is inapplicable to exploratory studies, simply because one does not focus on the explanation of causal relationships (Yin, 1994). Consequently, one needs to concentrate on data triangulation which does not only guarantee conclusions about which we can be confident, but it also provokes in researchers a more critical, even sceptical, stance towards their data (Fielding & Schreier, 2001).

When dealing with the question of *external validity*, one has to be aware that findings - when derived from a limited number of case studies only - might not be generalizable to the population of R&D organizations. However, they can be used to demonstrate general assumptions in relation to the underlying theories of this thesis. Furthermore, as already mentioned earlier, they might also enable the development of hypotheses for future research.

Finally, *reliability* of case studies can be guaranteed by making each step of the data collection and analysis operational. In other words, the researcher should prepare his methodology as if a colleague would like to conduct exactly the same research without asking him a single question. Hence, detailed case study protocols, transcripts, etc. are of high importance.

Another method to increase the quality of case studies is to use *Data reduction*. This was performed and 2 to 3 page case descriptions were written on each company. The descriptions were then submitted to informants at the case companies for two reasons. Firstly, informants checked that the case descriptions did not contain obvious clues to their company's identity or information that was likely to compromise their NPD plans. Secondly, informants checked the details given in the case description - and a number of small corrections were made. Lincoln and Guba (1985) have identified observer bias as being a potentially real threat to reliable interpretation. To counter observer bias, "member checks" - feedback from informants - were used as the key method for establishing the credibility of an interpretation (Wallendorf & Belk, 1989).

6.4 CROSS-CASE ANALYSIS

6.4.1 General Reflections on Cross-Case Analysis

Overall, cross-case analysis helps to enhance generalizability and to deepen understanding and explanation. According to Miles & Huberman (1994), it is important to consider the following issues:

- Inspect cases to see if they fall into clusters or groups that share certain patterns;
- Look for themes that cut across cases;
- Consider the use of meta-matrices to cope with data volume;

- Consider scatter plots - they are useful when being in an exploratory mode and need a way to see all of the cases in two-dimensional space;
- Avoid aggregation;
- Preserve case configurations;
- Inquire into devious cases;
- Look for typologies, case families.

Although the use of a pre-structured case outline as suggested by Miles & Huberman (1994) might be helpful in turning the process of data analysis and reporting into an evolving procedure, such an approach might push the researcher into early conclusion drawing. Care has to be taken to stay objective and also to link the case study analysis back to the original theoretical concepts which are being tested in order to derive true and rigorous conclusions. In other words, it is essential to continually test and verify where generalisation applies and where not (Phillips & Pugh, 1994).

6.4.2 Cross-Case Analysis Applied to this PPR Research

Similar to the within-case analysis discussed earlier, the analysis across the five case studies was based on the Analysis Instruments 1 to 4, i.e. they followed the same logic that was applied for the coding and the analysis of single data sources and the within-case analyses described in detail in this chapter.

The details of the cross-case analysis will be discussed in Chapters 9, 10 and 11. Each chapter focuses specifically on one of the three Research Questions and presents the comparison and triangulation of data with the help of the four Analysis Instruments presented earlier.

6.5 SUMMARY

This chapter illustrated in detail how the processes of data collection and analysis were approached. It also showed how the four Analysis Instruments were derived and applied within and across the different case studies in order to find relevant data to answer the three research questions. All research methodologies were continuously refined based on the experiences gathered during the different case studies and site visits.

Undoubtedly, the research methodology used was more complex and multi-faceted compared to many other PhD theses. However, each step in the data collection served a very special purpose and centred around clear cut research questions. In other words, it was the phenomenon under study and the research focus chosen that dictated a more complex research methodology than originally intended and not the other way round. Furthermore, issues regarding the case study quality were discussed relating them to the research methodologies used for this PPR research, i.e. the questions of validity and reliability were answered in detail as well.

CHAPTER 7 PILOT CASE STUDY

"The pilot case study helps investigators to refine their data collection plans with respect to both the content of the data and the procedure to be followed."
(Yin, 1994)

7.0 INTRODUCTION

This chapter discusses the details of the pilot case study, which is from now on referred to as Engineering Co. As mentioned earlier, this pilot study follows not only the replication logic (i.e. gathering relevant data regarding the research topic), but also probes the overall research design. According to Yin (1994), the inquiry of a pilot case might be broader and less focused than the final data collection plan, but lessons learnt concerning research design and field procedures should be recorded carefully.

This pilot study chapter presents a within-case analysis based on the previously defined research objectives and questions and covers the following aspects:

- Background information on the case company and the data collection methods;
- Details regarding the collected data;
- Data analysis and triangulation of data sources regarding PPR practices, perceptions of PPRs and the knowledge creation and learning due to PPRs;
- First conclusions based on the evidence from this pilot case;
- Reflections on the research methodology.

7.1 BACKGROUND TO PILOT CASE STUDY

7.1.1 Selection of Case Company

The pilot company is located in the focus area of Baden-Württemberg in South-west Germany. It was selected by taking an opportunistic approach using contacts of the PhD supervisor within the area of Stuttgart in order to speed up the access process. However, the company chosen was also included in the top 50 list according to turnover in Baden-Württemberg published by the ministry of commerce which was used for the overall selection of case companies (see Appendix 2.2).

7.1.2 Negotiating Access

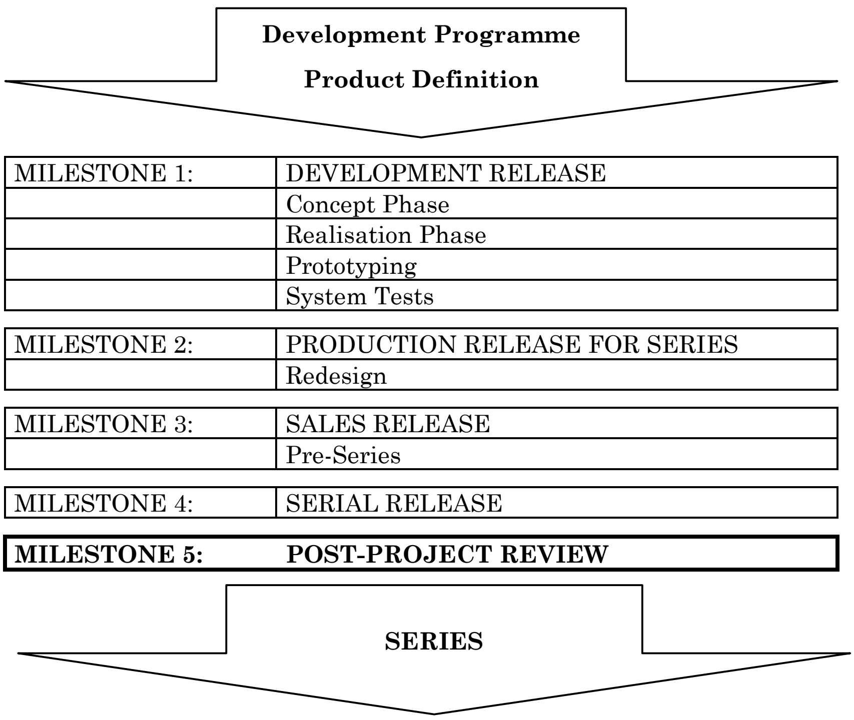
A written one-page summary of the research was initially provided to the company (see Appendix 4.1 for the original German version as well as an English translation). During the first site visit, the researcher and supervisor presented the motives and methods of the research to the R&D director, who then identified his own assistant to act as the contact person during the research. A confidentiality agreement was signed between the researcher and the case company which guaranteed to treat all information confidentially and to disguise the case company as an anonymous entity in this thesis and all other publications. Reports and academic papers which included findings from Engineering Co. were always sent to the contact person before publication in order to receive his feedback.

7.1.3 Background Information on Engineering Co.

Engineering Co. was founded in the early 1900s as a family business and is today one of the World's leading companies in their branch with an annual turnover of over 1 Billion Euro. The company employs about 5,000 employees spread over 40 subsidiaries in 24 countries. Engineering Co. is still directed by the owner, with the next generation already being active in different positions on the board of directors and the supervisory board. It consists of four different business units which are organised as the Engineering Co. holding. Investment in R&D accrues to about 5.8% of sales and more than 600 employees are working in the R&D departments.

Engineering Co. manages its NPD activities using the process shown in Figure 7.1. This process was created mid 2001 and is used as a guideline for NPD projects in all four business units. In this guideline, PPRs are an official milestone after the serial release and are a distinct activity before the official project termination.

Figure 7.1: New Product Development Process at Engineering Co.

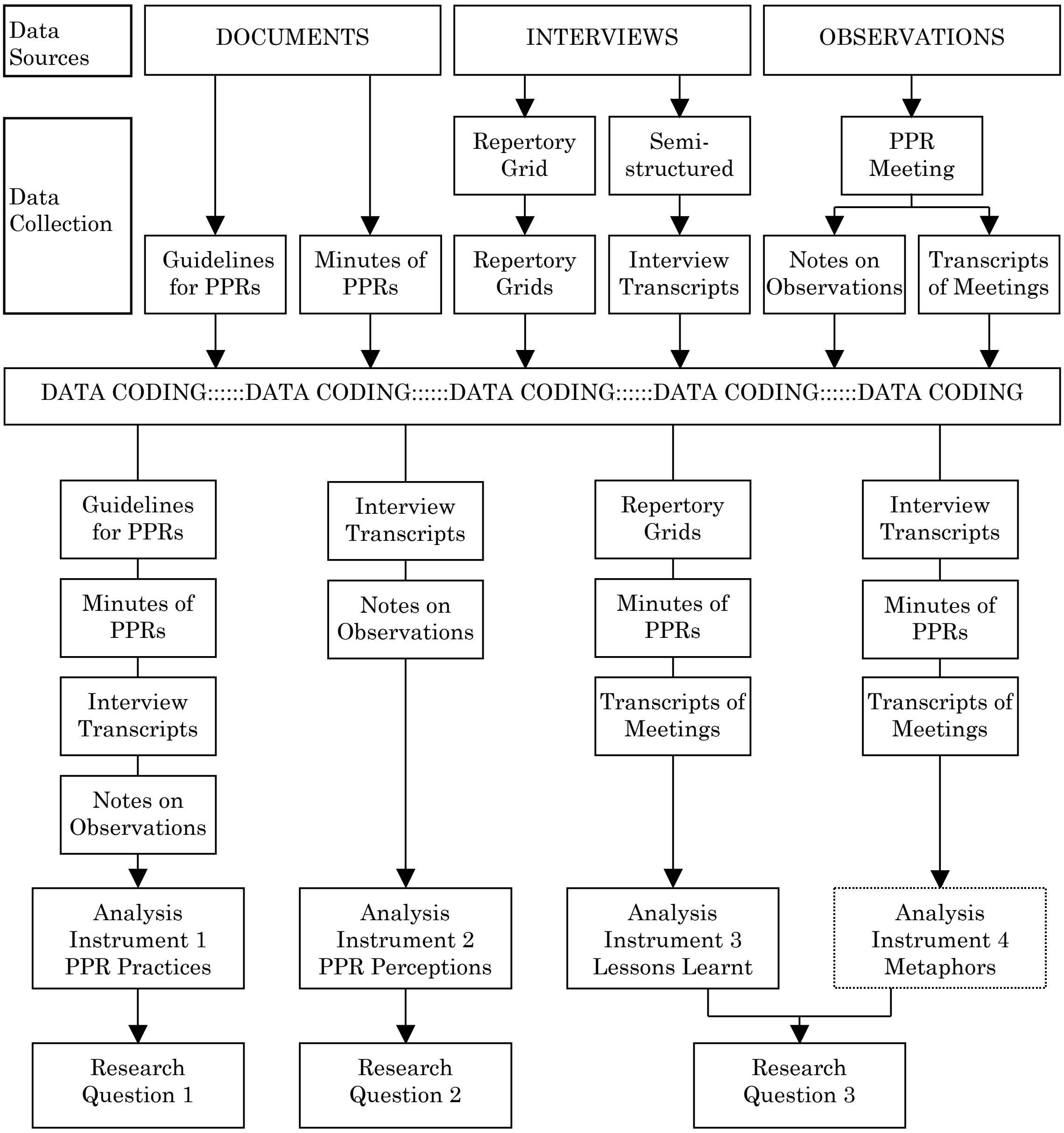


(Source: Engineering Co. documentation dated 14.11.2001)

7.1.4 Data Collection

Data collection at Engineering Co. took place during four on-site visits and covered all data sources illustrated in Figure 7.2, i.e. documents, interviews and observation.

Figure 7.2: Sources of Data at Engineering Co.[20]



After the first introductory visit, documents were provided by post and e-mail so that a detailed inspection and analysis was possible. Two

[20] Analysis Instrument 4 was added in hindsight after the first data analysis for Engineering Co. had been done. It was then that the importance of metaphors and stories was realized and Analysis Instrument 4 was developed and applied.

more visits were used for the conduct of interviews and one for the observation of the PPR.

7.2 DATA COLLECTED

7.2.1 Documents Analysed

Various confidential documents were provided by Engineering Co. First of all, the general guideline for new product development, secondly minutes of a recently conducted PPR and thirdly a variety of project specific documents regarding seven different strategic development projects[21] which were already at the stage of serial release. Table 7.1 provides an overview of all provided documents.

Table 7.1: Inspected Documents at Engineering Co.

No	No of pages	Document	Characteristics	Comments
1	56 pages	"Development process guideline"	Detailed description of the whole product development process (see Figure 7.1) including checklists, form sheets and other organizational requirements	PPRs are mentioned on page 50, details are given in a table covering half a page.
2	5 pages	"Minutes of a PPR"	Detailed documentation of PPR topics, discussion of problems and improvement suggestions as well as responsibilities for open issues	Structured and clear document providing also details on participants and distribution list.
3	Various	General project documentation regarding seven completed projects	Details on time plans, check lists, release reports, official presentations, minutes of meetings, technical progress reports, etc.	Provided background information on Engineering Co. projects, but not used for analysis.

7.2.1.1 Guideline for PPRs at Engineering Co.

The official NPD process guideline is a 10 page document with a 46 page appendix. The appendix is structured according to the development process illustrated in Figure 7.1 and consists mainly of various tables and checklists aiming to support the project manager when working towards a particular milestone. The section on PPRs is only half a page long, although it represents one of five official milestones (see Appendix 4.2). Compared to other project milestones like the development or serial releases, the PPR checklist offers much less detail. For example, there is no allocation of specific tasks to certain project participants, whereas other milestone

[21] The seven projects were selected by the R&D director and his assistant and represented projects of particular strategic importance for Engineering Co.

checklists illustrate exactly which tasks should be done by the core team, the project manager, R&D director or controlling. The suggested topics for a PPR are responsibilities, resources, deadlines, information chains and improvement potentials, but costs or budget are not stated at all. The PPR checklist mentions one overall aim: "*gather and analyse experiences and apply them to new or consecutive projects*" (NPD process guideline at Engineering Co. p. 50).

The detailed analysis of the guideline for PPRs was based on the codes or PPR characteristics listed in *Analysis Instrument 1*, which is looking for evidence regarding PPR practices. For example, the sentence *"after delivery and installing the first serial products and after the implementation of the most important changes and improvements (TIMING OF PPRs), responsible people from all involved departments (PPR PARTICIPANTS) will provide a short experience report concerning the project based on their own viewpoint"* received the codes "timing of PPRs" and "PPR participants" which are here visualised in parenthesis. Thus, this one sentence provided evidence from the guideline for PPRs regarding when the PPR should ideally take place and who should attend the PPR meeting at Engineering Co. (see Appendix 4.2 for the visual illustration of the coding process).

7.2.1.2 Minutes of PPRs at Engineering Co.

One set of official minutes of a PPR was analysed at Engineering Co. More minutes were not available at the time of the site visits, because formal minutes of PPRs were not compulsory until 2001 when PPRs became a project milestone. No minutes were available following the PPR observation either. This was due to the fact that the project manager was relocated to Engineering Co.'s US subsidiary shortly after the PPR took place and so the "compulsory" documentation was neither prepared nor disseminated.

Overall, the minutes of the PPR were only very loosely based on the official Engineering Co. development guideline. In fact, they resembled more the checklists of other release milestones. The coding was done in three steps - once for PPR practices based on Analysis Instrument 1, once for PPR topics or lessons learnt based on Analysis Instrument 3 and once for metaphors and stories based on Analysis Instrument 4. Appendix 4.3 illustrates this coding for a representative part of the minutes. For example, the first sentences of the minutes were coded in the following way: "*The meeting took place in a professional, fair atmosphere and was characterised by good ideas* (ATMOSPHERE). *The objective was to learn from mistakes in the same way than from successful project phases, in order to transfer these insights and improvements to future projects* (OBJECTIVE)." Examples for the coding of lessons learnt are provided by the following sentences: *"In hindsight the time plan was exceeded by approximately 30%"* (TIME2), or "*cost management is too time intensive for project managers*" (COST1).

7.2.1.3 Project Specific Documents at Engineering Co.

The project specific documents ranged from project plans, release documents, minutes of milestones to time plans, risk lists, etc. All documents were read with a focus on the mentioning of PPRs or lessons learnt. However, only very general statements with a strong focus on quantitative details (e.g. costs and timing) could be found. Furthermore, all project specific documents were derived during the projects' life cycle and not at the end, which is why their relevance regarding PPRs proved to be marginal.

The documents also provided insight into company-internal abbreviations and terms which were frequently used during the later interviews. An explanation or definition of these was not included in the project documents, so the researcher created a list before the next site visit and verified the missing definitions during the course of the interviews. Therefore, these documents were only used as background information and were not followed up any further in the main data analysis. This also represents the first learning from the pilot study, i.e. no project specific documents were asked for in the main case studies.

7.2.2 Interviews

Interviews were conducted with six different R&D managers. All interviewees were selected by the Assistant to the R&D Director of Engineering Co. in discussion with the researcher and represented a heterogeneous group of people which varied not only from their professional background, but also in terms of work experience at Engineering Co. as illustrated in Table 7.2.

Table 7.2: Overview of Interviewees at Engineering Co.

Interviewee No	Position	Department	Engineering Co. experience	PPR experience
1	Head of department	Development	15 years	Low
2	Main head of department	Development and mechanical design	6 years	High
3	Head of department	Software development	7.5 years	Low
4	Head of department	SPS software development	17 years	Medium
5	Main head of department	Development software and steering	20 years	High
6	Head of department	Development and mechanical design	10 years	Medium

The practical experience of the interviewees regarding PPRs was based on the number of PPRs they had already participated in at Engineering Co.:

- Interviewees who had participated in up to three PPRs were classified as having *low* PPR experience;
- Interviewees who had participated in up to five PPRs were classified as having *medium* PPR experience;
- Interviewees who had participated in more than five PPRs were classified as having *high* PPR experience.

Since official PPRs at Engineering Co. were introduced only a few years ago, even interviewees who were working for the company for many years, sometimes only had limited PPR experience (e.g. Interviewee 1), because not many of the projects they were involved in were already completed according to the recent guidelines which asks for a PPR.

Interviews took place during the second and third site visit within a period of five weeks. Each interview lasted 60 minutes and was tape recorded. The first 10 to 15 minutes were spent on the mutual introduction, the background of the interviewee, the explanation of the interview and the introduction to the repertory grid. The repertory grid was the focus for about 35 to 40 minutes and the remaining 15 minutes of the interview were used for further semi-structured questions on the basis of a prepared questionnaire (see Appendix 4.4 for the English translation of this questionnaire).

Before starting the actual repertory grids, the interviewees were presented with a pool of seven completed projects selected by the R&D Director[22] and asked to identify the ones they had in-depth knowledge about. A total of six elements (i.e. R&D projects) was required for the repertory grid. If the interviewee could not choose six projects out of the seven, he was asked to name additional ones out of his repertoire of experience at Engineering Co. This approach made sure that the overlap of elements between different interviewees was as high as possible.

The question posed to the interviewees when presenting the triad of cards remained the same during the whole repertory grid session: *"How are two projects different from the third in terms of what you personally learnt from it?"* The question was posed various times in the beginning when presenting a new triad, until the researcher felt that the interviewee does not need to be reminded of the question anymore. For example, one of the answers of Interviewee 6 was: "*Here* [interviewee is pointing to one of the elements of the current triad] *we have worked with many external suppliers*

[22] These were the same seven projects for which general documents were provided to the researcher.

regarding the software and also with the Swiss production site which is difficult. Well, they are Swiss, and the co-operation is very difficult." The researcher then discussed with the interviewee how the construct should be phrased and it was decided to note it as *complexity of project organization*. All constructs elicited by the interviewees were written in pre-prepared matrices and supplemented with the *pole constructs* and rankings regarding the different elements. Appendix 4.5 shows the repertory grid matrix for Interviewee 6 as an example. After the elicitation of the constructs, the interview was then continued based on the semi-structured questionnaire mentioned earlier.

7.2.2.1 Coding of Repertory Grid Constructs

In order to compare the different repertory grid constructs from all six repertory grid matrices, *Analysis Instrument 3* was applied. Every elicited construct was classified to a certain characteristic category and numbered consecutively. Within each interview, the constructs were always mutually exclusive, but across all six interviewees some overlap could be detected, so that the same code was allocated to constructs from two or more interviewees.

As mentioned earlier, the total list of repertory grid codes also served as the basic coding list for the document analysis regarding *lessons learnt*. This also facilitated the data triangulation in later stages of the analysis. If new constructs or *lessons learnt* were found in documents which had not been elicited as repertory grid constructs, new codes were created following the same logic and added to the total coding list. This was done from one case to the other, so that the list of codes increased from each case study to the next. The final coding list derived and used for all case studies of this research can be found in Appendix 4.6 and represents *Analysis Instrument 3*.

7.2.2.2 Interview Transcripts at Engineering Co.

The analysis of the interview transcripts had two objectives. On the one hand, further insights into PPR practices were provided by interviewees based on different questions listed on the questionnaire. On the other hand, the same questionnaire also contained questions regarding the interviewees' personal perceptions of PPRs. Furthermore, qualitative quotes provided rich descriptions of lessons learnt or even highlighted evidence for tacit knowledge aspects in form of stories or metaphors. Therefore, the interview transcripts were coded three times with different objectives:

- Coding based on Analysis Instrument 1 regarding interviewees' statements how PPRs are currently conducted at Engineering Co.;
- Coding based on Analysis Instrument 2 regarding interviewees' perceptions of PPRs at Engineering Co.;
- Coding based on Analysis Instrument 4 regarding metaphors and stories.

Since all three Analysis Instruments needed to be covered during the coding of interview transcripts, the transcripts were revisited several times by the researcher in order to guarantee that no important aspects were missed. This was particularly important because very often one sentence or phrase referred to various codes as illustrated in Appendix 4.7.

7.2.3 Observation of a PPR

The observation of a PPR at Engineering Co. took place during the fourth site visit. This particular PPR was proposed because the project manager was one of the interviewees and because the project itself was strategically very important for Engineering Co.'s future business.

The whole PPR was tape recorded after permission was granted from all participants. In addition, the two researchers present took notes during the discussion, focusing mainly on frequencies of contributions of individual participants and topics mentioned during the discussion. Researchers did not participate in the PPR. They were seated in a corner of the room, but were clearly visible and the purpose of their presence had been explained to all PPR participants.

The 12 participants came from all departments involved in the project and two project members from Engineering Co.'s subsidiary in Switzerland took part via a videoconferencing system. The meeting itself took place in a regular meeting room at the company headquarters.

The discussion was partly based on the agenda prepared by the project manager, but mainly followed the flow of arguments and topics expressed by participants. No visual aids were used for the discussion, only the project manager (who also acted as the PPR moderator) took notes of the main points and results from the discussion.

The analysis of the observation of the PPR concentrated on three different aspects, so the transcript was coded on the basis of three different Analysis Instruments (see Appendix 4.8):

- Analysis Instrument 1 was used for the analysis of actual PPR practices as far as they could be observed or were mentioned during the PPR;
- Analysis Instrument 3 was used for the coding of topics mentioned and lessons learnt during the PPRs;
- Analysis Instrument 4 was used to highlight all stories and metaphors in the transcript.

Consequently, evidence from the different data sources was easy to compare in the later stages of the analysis.

7.3 DATA ANALYSIS

7.3.1 PPR Practices at Engineering Co.

The first triangulation step in the data analysis concentrated on Research Question 1: "*What are the current practices of R&D organizations for conducting PPRs?"* using data from all three data sources. Based on these data sources, a comparative table following the form of *Analysis Instrument 1* was prepared which provides an overview of PPR characteristics and practices found at Engineering Co. as well as first conclusions. Table 7.3 represents this within-case analysis for Research Question 1 on PPR practices by presenting the fourteen different categories which were adopted for the description of PPR practices. These will now be discussed in more detail.

7.3.1.1 Objective of PPRs

All six interviewees at Engineering Co. supported the objectives documented in the guideline. *"There is no single project here from which you cannot learn with a PPR. These development projects are really huge, so you always can and even have to learn from your mistakes…"* (Interviewee 6). For Interviewee 5 the objective is the *"…continuous improvement of the development processes at Engineering Co.…"* and Interviewee 3 stressed that *"the aim is to document the mistakes that we made in order to have them in front of our eyes and then to think about how can we apply this to the next project as we cannot afford to do the same mistake twice."* Therefore, it is right to assume that the general objective of PPRs is well communicated and established in the organization.

This overall agreement on the objective of PPRs is also supported by the minutes of a PPR and PPR observation, where similar issues were mentioned. For example, the introductory sentence of the minutes states that: *"The aim was to learn from mistakes as well as from successful project phases in order to apply these knowledge aspects and improvement suggestions to the next projects*." Similarly, the project manager and moderator of the observed PPR said at the start of the meeting: "*I have thought we go through one critical point after the next, what was good, what was bad and if something was not good, what can we do better to change this in future?"*

Based on these findings it can be established that the PPR objective is very clearly communicated and established in the internal organization of Engineering Co. In addition, it is clearly desired to use the PPR as a tool to continuously improve the existing processes and to apply lessons learnt from positive as well as negative experiences to future projects.

7.3.1.2 Timing of PPRs

The timing of PPRs at Engineering Co. shows clear discrepancies between the different data sources. While the guideline merely states that the PPR should take place "*after the serial release*", evidence from minutes of the PPR and interviewees suggests that they take place much later in practice. "*For me the PPR does not depend on the serial release, but on specific problems that were encountered*" (Interviewee 6) and Interviewee 2 states *"it should not be directly after the serial release, but later. The aim is to do it two or three months later. Not too much later, but not directly after the series release either."*

In the PPR which was observed, the timing was even before the serial release (release to production), because already 60 machines were in the field due to pressure from strategic customers. This implies that the PPR timing at Engineering Co. is not so much dependent from the timing of the serial release, but more from various other aspects:

- the experiences already gathered from the field machines and the possibility to discuss these during the PPR;
- the availability of project members who are already active in new projects;
- the necessity to analyse specific problems which were encountered during the project and which are relevant for future projects as well.

7.3.1.3 Duration of PPRs

Regarding the duration of PPRs, all interviewees agreed that it must not be longer than half a day, although no details regarding the duration is provided in the guideline. "*I would not like to have it too long - maximum two hours to half a day*" (Interviewee 1). This was confirmed by the minutes of the PPR (2 hours) and the PPR observation (2.5 hours).

Across all data sources it was clear to see that the maximum length of half a day should not be exceeded. This was not only mentioned by four out of six interviewees, but also noted during the PPR observation, where the first people started to answer their mobile phones after the first two hours or left the room after about two hours in order to attend other internal meetings.

7.3.1.4 PPR Participants

Regarding the participants of PPRs all data sources provided the same information. Not only the core R&D team, but also involved responsible people from other departments are attending PPRs at Engineering Co. This is stated in the guideline, clearly visible in the minutes of the PPR and also confirmed by all interviewees. *"At least one person from each involved department should participate - that means not only the core team from the development side"* (Interviewee 3).

For the observed PPR, a total of 12 project members participated at the review. Furthermore, two colleagues at Engineering Co. Switzerland took part via a video-conference system. Participants came from different departments and included representatives from purchasing, service training, quality management, patents, technical documentation, product development, etc.

Members from the steering committee or other senior managers were not mentioned as necessary participants because only practical issues which are or were relevant for the daily work in the individual departments are discussed.

7.3.1.5 Moderation of PPRs

Although the guideline does not mention who is supposed to moderate the PPR, it was clear to all interviewees and also confirmed by the minutes and observation that this is always the responsibility of the project manager to lead and moderate the meeting. In fact, all interviewees agreed that only the project manager has the relevant background and know-how to moderate the PPR. *"A project outsider would not know what is important and where the discussion needs to be cut*" (Interviewee 2).

Special internal or external moderators where not mentioned at all and are also never used in practice at Engineering Co. Consequently, this is an aspect which could be reconsidered for the further improvement of the PPR practices in order to relieve the project manager from this task and to enable a more active discussion role for the project manager if he is supported by a moderator.

7.3.1.6 PPR Discussion Method

It was not possible to identify from the inspected documents which discussion method was used for the PPRs. The guideline did not provide any details at all, and the minutes of the PPR did not mention any aspects of how the discussion was facilitated, either. Furthermore, interviewees were not very detailed in their description of the PPR discussion method applied. "*We discuss together in the project team*" (Interviewee 4) or "*we exchange in the team all the relevant points*" (Interviewee 5) can be quoted as examples of these rather vague statements and confirm that the PPRs always follow an unstructured discussion approach.

Table 7.3: PPR Practices at Engineering Co.

No	PPR issue	Guidelines for PPRs	Minutes of one PPR	Six interviews	Observation of one PPR	Comments
1	**Objective of PPRs**	Mentioned in the introduction section as: *"to gather and analyse experiences and apply these in future projects*"	Was copied from the guideline for PPRs: *"to gather and analyse experiences and apply these in future projects"*	To gather lessons learnt, learn from mistakes, transfer experiences, exchange information and solve problems	To discuss positive and negative project issues, to find solutions to past and current problems, to suggest changes for future projects if applicable	Objective of PPRs is well communicated and clear to all PPR participants. Future improvement is very clearly in everybody's interest.
2	**Timing of PPRs**	Should take place after the launch of first serial products	Took place 6 months after series release	Usually takes place 2 months after official serial release	Took place when 60 machines were in the field, but official serial release had not yet been given	In practice, PPRs take place later than originally planned because of difficulties to get the whole team together and the wish to discuss field experiences independent of the serial release.
3	**Duration of PPRs**	No details provided in the guideline	Lasted 2 hours	Lasts on average half a day, i.e. 3 to 4 hours	Lasted 2.5 hours	Practice varies between 2.5 to 4 hours; this maximum length is considered as a vital topic by all interviewees.
4	**PPR Participants**	All responsible project participants should participate	Core team members	Core project team, usually not more than 10 people	Core project team with representatives from all involved departments, e.g. development, purchasing, documentation, etc.	Focus is always the core project team, however, this is not only the R&D team, but also other involved departments.

Table 7.3: PPR Practices at Engineering Co. (ctd.)

No	PPR issue	Guidelines for PPRs	Minutes of one PPR	Six interviews	Observation of one PPR	Comments
5	**Moderation of PPRs**	No details provided in the guideline	Project manager	Project manager	Project manager	PPR moderation is part of the responsibility of the project manager.
6	**PPR Discussion Method**	No details provided in the guideline	No details provided in the minutes	Team discussion without use of visual aids	Team discussion without use of visual aids	No visual aids to facilitate discussion were used. Project manager determines discussion mode.
7	**Location for PPRs**	No details provided in the guideline	Meeting room	Meeting room	Normal meeting room	Normal meeting room, alternatives to facilitate social setting should be evaluated.
8	**Use of guidelines for PPRs**	Use of guidelines for PPRs is not mentioned	Use of guidelines for PPRs is not mentioned	Guideline for PPRs is known and read, but not heavily used for the PPRs	Used by project manager in advance to double check rules	Guideline for PPRs is not heavily used for the PPR. If so, then only to double check specific rules. Guideline needs to provide more helpful information so that it will be used for future PPR preparations.
9	**Preparation of PPRs**	Should be prepared with the help of project documents, action lists, test reports, service reports, risk lists	Was done with the team and on the basis of project documents and phases	Informal networks, team-process, personal reflection, and project documents are preferred	Project manager asked for feedback regarding discussion topics prior to PPR	Very much focused on personal networks and feedback from the team as well as personal reflection.
10	**Atmosphere during PPRs**	Not covered in the guideline	Stated as *“factual, fair and open”*	Very open and not formal	Very open and positive discussion	Reflects the overall company culture as open and constructive.

Table 7.3: PPR Practices at Engineering Co. (ctd.)

No	PPR issue	Guidelines for PPRs	Minutes of one PPR	Six interviews	Observation of one PPR	Comments
11	**Results of PPRs**	Refers back to the underlying objectives mentioned in section 1	Written minutes of PPR, project specific and general improvement suggestions with responsible person allocated to most of them	Minutes are not always done as team learning is not necessarily documented. Results are derived during the discussion	Minutes were announced at end of PPR, but finally not written due to project managers relocation	Documentation of results not priority, discussion during the PPR and the possibility to solve problems during the meeting itself considered as more important.
12	**Dissemination of PPR results**	Use in subsequent projects	It was suggested to present the general improvement suggestions to other business areas and R&D managers and to include important aspects in the official guideline	Documents are disseminated to core team, otherwise results are stored in heads of participants; if documented maybe integrated into checklists; no transfer to other business units	Limited to PPR participants; discussion of results between project manager and R&D director took place	Dissemination needs to be addressed as information stays more or less within the project team and does not go anywhere else, even though general topics were discussed.
13	**Creation of action points**	No recommendations are included in the guidelines	Done, sometimes including deadline and responsible person	Included in the minutes if discussed during PPR	Agreed during the discussion and documented by project manager	Action points are documented in the minutes, but follow-up responsibility is not always clear.
14	**Agreement on improvement suggestions**	Improvement potentials are discussed and derived	Some general suggestions are listed	Included in the minutes if discussed during PPR	Agreed during the discussion and documented by project manager	Improvement suggestions are clearly part of the PPR and are documented in minutes.

The PPR observation also confirmed that no visual aids like flip charts were used. The project manager started the review stating "*right then, we want to start with the review now and I have mentioned some topics in my invitation which I would like to discuss today. How should we start the discussion? Should we do one point after the next or how is the opinion from the group?"* In addition, during the discussion a variety of questions was asked by the project manager and later from other PPR participants as well. These questions were mainly asking for feedback, personal opinions, confirmation of one persons hypotheses, finding explanation for contradictory experiences from two team members, etc. Some examples for such questions are:

- *"Was this point also critical for the other involved areas?"*
- *"Are there any other opinions or additions?"*
- *"How does the group feel about this?"*

Overall it can be claimed that the use of some visual aids or discussion techniques could facilitate or improve the PPR discussions at Engineering Co. Although none of the interviewees mentioned to miss such techniques, it was clearly visible in the observed PPR that the discussion jumped very much from one topic to the next and back again and lacked some professional structure.

7.3.1.7 Location for PPRs

At Engineering Co., PPR meetings always take place in a normal meeting room at the companies headquarter building. The location of PPRs is not specifically mentioned in the guideline, but the minutes as well as statements from five interviewees provided evidence that PPRs take place in the same location than other regular meetings. "*We meet in a meeting room - where else should we meet?"* (Interviewee 4).

The observed PPR also took place in a large meeting room equipped with a video conference system and a huge U-shaped table. Alternative locations were never considered at Engineering Co. and were also not mentioned by any of the interviewees. Thus, it represents another option to improve the current PPR practices by using a more social setting for the meeting or by adding a social event at the end of the PPR meeting.

7.3.1.8 Use of Guidelines for PPRs

The application of the guideline for PPRs is not mentioned as a compulsory activity in the guideline itself and is also not mentioned in the inspected minutes of a PPR. Yet, the project manager of the observed PPR stated at the end of the meeting that he "*referred quickly to the guideline to double check what was required*."

Statements from interviewees regarding the use of the guideline for PPRs differed. For example, Interviewee 4 stated that he never uses the guideline at all, while Interviewee 6 confirmed that "*yes - I use it - despite of the fact that it is far too long with 56 pages and that it does not really help from my point of view*."

Overall, it can be established that the guideline is well known at Engineering Co. but not heavily used in connection with PPR because of three different reasons:

- the guideline is not considered to be relevant for PPRs;
- the use of the guideline is too time-consuming as it is considered to be too long;
- the content of the guideline does not contain new information or information that cannot be found anywhere else in the organization.

Thus, Engineering Co. should definitely improve the content of the guideline based on the experiences gathered during previous PPRs in order to increase the likelihood of its application by R&D project managers.

7.3.1.9 Preparation of PPRs

The guideline does not provide a lot of details how a PPR should be prepared, but recommends the use of various documents like action lists, test reports and risk lists as helpful tools. Contrary to this, the inspected minutes of a PPR showed that the PPR discussion was prepared by the whole team because the project manager had asked for feedback from the team in advance to the PPR meeting. "*Please suggest which topics are important to mention for your area and which ones you want to discuss and send them back to me"* (extract from PPR invitation).

The majority of interviewees referred to their personal network for the preparation of PPRs instead of checking the official guidelines. That is they talk to colleagues or project managers they already know to get some advice and hints from previous PPRs. *"I am not sure if the guideline will help me a lot for the preparation. I reckon it would be more efficient to call some of my colleagues and ask how they usually do their PPRs. There is always someone you know around who is willing to give you a few pieces of advice"* (Interviewee 6).

It is interesting to note that all data sources except the guideline confirm that the PPR preparation is often a team process. An example was given by Interviewee 3: *"…the preparation was done by writing to the different people involved asking for a list of what did go wrong during the project. I gathered all this and presented it during the PPR and then we discussed it and partly added to it. So each one prepared a bit of the PPR..."* The same practice was used for the observed PPR where the preparation was also a team-internal process. *"I have mentioned some topics in my invitation which I would like to discuss today. I have received from various* *people some feedback and yesterday distributed to you what I had"* (Project Manager Engineering Co. at observed PPR).

In addition, some interviewees stated that they try to get hold of and re-read previous minutes of PPRs in order to know what is expected from them in terms of topics to be covered, etc. Thus, it can be concluded that the preparation of PPRs is not done on the basis of the existing guidelines, but depends much more on the internal networks, the team processes and personal experiences from previous PPRs.

7.3.1.10 Atmosphere during PPRs

No recommendation regarding the intended atmosphere during PPRs could be found in the PPR guideline. However, the inspected minutes of the PPR actually referred to the atmosphere in the very beginning of the document: "*The meeting took place in a factual, fair atmosphere characterised by good ideas*" (Extract minutes of PPR).

The atmosphere was also particularly positively confirmed by two interviewees. "*I think it* [the atmosphere] *was good. Often it is the problem that no one wants to admit that something did not go very well, but I think the meetings are very open and you can mention everything*" (Interviewee 4). Interviewee 5 mentioned that "*in general the atmosphere is very open, we also discuss openly*."

This positive atmosphere was also observed during the real-life PPR. Verbal contributions from individual participants were distributed very equally and no aggressions or loud voices were observed or transcribed. The project manager was seated alone at the head of the U and all other participants were seated along the branches of the U shaped table so that everyone could see each other during the discussion, which also supported the open and free flow of the discussion. Consequently, the atmosphere during PPRs does not ask for improvement based on the analysis of the data.

7.3.1.11 Results of PPRs

The guideline for PPRs only mentions a final report to the team based on the PPR objectives as the desired outcome of each PPR meeting without providing any details. The inspected minutes followed the regular form of minutes for all meetings at Engineering Co., i.e. it covered the main points of the PPR discussion sorted by each single development phase.

The observed PPR was not followed by a set of minutes, although these were announced several times during the meeting by the project manager. The reason in this particular case was that the project manager was relocated to the US subsidiary about six weeks after the PPR took place. In fact, it was also mentioned by two interviewees that not all PPRs are necessarily documented in form of minutes. Interviewee 5 stated that "*PPR results are not very often documented*" and Interviewee 6 confirmed this as "*not sure if there would be any minutes. You do not really have to write anything down at the end.*"

Apart from the official minutes, all six interviewees also mentioned a learning effect as a result of PPR meetings. Interviewee 3, for example, mentioned that in his opinion the result of each PPR is "*to learn and to do things better the next time round*". This is confirmed in a similar way by Interviewee 5 who stated that "*each one takes away some experiences so that he will work better in future".*

7.3.1.12 Dissemination of PPR Results

The dissemination issue is referred to in the PPR guideline by stating that previous PPR results should be used in subsequent projects. This is achieved in many different ways. First of all, the inspected minutes stated that selected discussion points should be presented to R&D managers from other business units. Parallel to this, the inspected minutes stated that "*it needs to be checked if the official new product development guideline should be supplemented*" (extract of minutes of a PPR at Engineering Co.).

Furthermore, statements from interviewees regarding dissemination issues differed a lot. Some assured that topics raised are being followed-up while others do not think this does happen at all: *"…those who participated have taken something new away…but there is no further communication or distribution of experiences… it is completely up to the single person what he takes away from a PPR and what he is doing with it…"* (Interviewee 5). If minutes of a PPR are written, they are hardly ever disseminated outside of the project team. Again, this practice was described differently by the interviewees. Some were glad not to be bombarded with documents from projects they are not involved in. Yet, interestingly enough, all interviewees liked the idea of a database which would contain for example the three key lessons learnt of all Engineering Co. projects, provided by the respective project manager.

During the PPR observation, no particular evidence for the dissemination of the PPR results could be found. Consequently, the dissemination was strictly limited to the PPR participants of this particular PPR meeting.

7.3.1.13 Creation of Action Points

The creation of action points is not mentioned at all in the inspected guideline for PPRs, but the minutes showed that several action points were documented. These action points were always connected with a responsible person and sometimes also with an estimated due date until which the respective action point should be accomplished. However, the responsible people were usually not participants of the PPR meeting.

The practice of creating action points during PPRs was also confirmed by the interviewees. According to Interviewee 2, "*action points are always derived during the discussion and then documented in the minutes*", and Interviewee 5 stated that "*we sometimes miss out to agree action points, but in general we do so at each PPR*". These statements were also confirmed during the PPR observation, where very clear action points were discussed and noted by the project manager with responsibilities as well as deadlines.

7.3.1.14 Agreement on Improvement Suggestions

According to the guideline for PPRs, the PPR discussion should include the discussion of clear improvement suggestions. Also, the minutes of the PPR came up with a list of project specific and more general improvement suggestions. While most of these improvement suggestions were allocated to a specific person, they had no deadline added to it and the overall responsibility of the "post-PPR process" remained somewhat unclear.

All interviewees confirmed that improvement suggestions are discussed and usually also documented during the PPR meetings. In fact, Interviewee 4 even said that "*in my area there are so many projects one could use for improvement suggestions. If we have used all these you are already at a quality level of 80 or 90 % without even looking at the projects from the other areas*."

The same was mentioned several times during the observed PPR, i.e. five different PPR participants referred during the PPR discussion to the question if a specific point should be remembered as an improvement potential or not.

7.3.1.15 Recommendations Regarding PPR Practices

Overall, Table 7.3 illustrates that the guideline and practices regarding PPRs at Engineering Co. differ to some degree. This can partly be explained by the general PPR challenges or hurdles explained in Chapter 3. For example, PPRs tend to suffer from time pressures within the whole organization, which is also true for Engineering Co. Engineering Co. conducts PPRs generally fairly late, but often more detailed as considered necessary by most participants. In fact, Engineering Co.'s PPRs were considered as too long by most interviewees. PPR hurdles that were not confirmed at Engineering Co., though, were the reluctance to blame and the overall difficulty to communicate within the team. The atmosphere was always very constructive and friendly and even when criticism was raised, the discussion stayed objective and constructive.

This positive atmosphere was considered especially important by those interviewees at Engineering Co. who had to prepare their first PPR as the responsible project manager. The observation clearly showed that the PPR at Engineering Co. can be considered as an example for CoPs and expert networks which enable to grasp and share personal experiences more efficiently than written guidelines.

These junior project managers also mentioned that they prefer to prepare a PPR via their personal networks. The reasons for this are twofold: firstly, the guideline in its current form does not support the PPR preparation in a practical way. Secondly, and this refers back to the social learning theory, informal networks and team inherent processes are proven to be especially suitable for settings like PPRs where common experiences need to be gathered, analysed and discussed. Therefore, the individual reflection is only the first step in the preparation and is then followed up by a common reflection with the team. An aspect that could be improved apart from the dissemination of results and the details given in the guidelines, is the actual conduct of the PPR. It might be advisable to concentrate on only three or four key learnings which are then actually followed up with a detailed action list and also communicated to other project teams. This helps to prioritise improvement suggestions. In addition, the discussion could be facilitated by a neutral moderator, e.g. a project outsider but not an external consultant, who visualises the issues mentioned on a flipchart so that the repetition of issues as observed at Engineering Co. could be avoided.

The capturing of PPR results and their dissemination is a topic which still seems to be underdeveloped at Engineering Co. Firstly, minutes should be written for all PPRs conducted. Secondly, these minutes should not only be distributed to the PPR participants, but also to other project managers in the same business unit. Alternatively, the main results and learnings from the PPR could be presented during the project managers meetings, if this exists at all.

All project members should contribute to the PPR with a short report. This is often complied to in practice by the Engineering Co. project leader who calls for feedback reports from the project team as part of the PPR preparation. This goes hand in hand with claims that as many different perspectives as possible should be gathered during a PPR so that the result can be considered as objective knowledge (Cusumano & Selby, 1997; Duarte & Snyder, 1997)

7.3.2 Perceptions of PPRs at Engineering Co.

This section concentrates on Research Question 2: "*How are PPRs perceived by participants and R&D managers?"*. The main data source for analysing Engineering Co.'s R&D managers perceptions regarding PPRs were the semi-structured interviews in the semi-structured part of the interview (see Appendix 4.4). These findings were then compared and verified with the PPR observation notes as previously shown in Figure 7.2 and both aspects will be discussed in the following. Overall, perceptions regarding PPRs at Engineering Co. are summarised in Appendix 4.9, which also shows the code to which the different quotes from the interviewees were allocated to as explained in Chapter 6.

All six interviewees confirmed that PPRs are not a relatively new concept at Engineering Co. Previously, experience exchange happened on a more informal basis and very often during the weekly management meetings. "*Not many projects went through this gate up until today, but we have done something similar before as well. It was the same sort of thing, similar sort of meeting, we also exchanged our opinions on a previous project, it was just not formalised*" (Interviewee 4). This confirms claims from existing PPR literature (e.g. Weinberg & Freedman, 1982) which states that the idea that people need to exchange experiences with project colleagues is old, it is just the establishment of formal PPRs as such that is comparatively new.

When asked if they would conduct PPRs even if they were not compulsory, most interviewees confirmed that they fully support the idea of PPRs and are personally convinced of their advantages. Five out of six interviewees stated that the new and more formal way to conduct PPRs and to have them as a compulsory project milestone at Engineering Co. is very helpful. "*... there are things that go wrong in development projects and you can and have to learn from your mistakes. Only if you do it in a very open manner and discuss these issues with some sort of detachment from the project, you can learn for the next project*" (Interviewee 6). Only one interviewee is not at all satisfied with the current PPR practices at Engineering Co. "*...if we do them* [PPRs] *the way we do them today at Engineering Co., we might as well stop doing them...*" (Interviewee 5). His criticism was mainly on the point that no actions resulted from PPRs, although important suggestions for improvement are usually identified. Therefore, he perceives that the follow-up of PPRs is unsatisfactory and questions if the time spent on PPRs is justified.

The objective of PPRs is generally explained with the possibility to draw conclusions on special experiences with peers, to learn for future projects, to continuously develop the R&D processes at Engineering Co. and to solve problems. Similar quotes can also be found frequently in the transcript of the PPR observation, e.g. "*... we have to focus on what we could do differently in the next project...*", "*...it might be useful to discuss this in a bit more detail so that we can draw our conclusions from the experience and not do the same thing in future*" (PPR Engineering Co.). This was also stated in a similar way at the opening speech of the PPR meeting observed.

Regarding PPRs and learning, data from Engineering Co. confirmed that it is the PPR meeting as such, i.e. the face to face discussion itself that facilitates learning, especially concerning issues that are difficult to express or which are of a more tacit nature. "*Me as project manager might see things different than someone from documentation. The focus is always different, each one has different points of view what went wrong during the project, this is why it is important to exchange these views and to hear different opinions*" (Interviewee 3). This can be referred to Lave & Wenger's (1991) Communities of practice, which view learning not as narrow situated learning where instances of practice are simply replicated, but as something that happens in a group and "in situ", i.e. learning is seen as an integral part of practice (Hildreth et al, 2000).

Regarding the question how the PPR effect could be achieved in a different way, answers mainly focused on social interactions and included godfather project managers, exchange between senior and junior staff members as well as personal discussions. However, it was also made clear that PPRs are very difficult to replace if the same effect is intended. *"Personal discussion, but this is by far not as efficient, because it is always only one person. And I would not really get the information I want…if I only talk with single colleagues I would never get the overall picture and this only works if you sit together*" (Interviewee 6). "*Before it was called officially a PPR, the most effective communication was the round of department managers that happened regularly. There we talked real detail, nothing stayed on the superficial issues, and we are all experts in our field and know what the others are talking about when discussing a finished project…"* (Interviewee 1).

Further personal feedback from R&D managers at Engineering Co. confirmed but also refuted some of the frequently quoted challenges for PPRs. For example, it was confirmed that the length for PPRs was a very important feedback issue. According to Engineering Co.'s R&D managers, a PPR should be so well prepared and structured, that it can be done within an hour and a half maximum. This issue was also confirmed during the PPR observation, where it was visible during the observation that people became increasingly impatient after the first two hours of the PPR (people repeatedly looked at their watch, left the room for short telephone calls, etc.). Secondly, three people left the PPR at different times before the official end due to more pressing meetings they needed to attend. This proves that PPR generally suffer from time constraints, which is also perceived by R&D managers in practice. That means time is not only a constraint that might prevent a PPR from taking place at all, but also one which might hinder the efficient conduct of a PPR (see Kotnour, 1999).

Summarising the above discussion, it can be stated that PPRs are perceived very positively by R&D managers at Engineering Co. Although they analyse current PPR practices very critically and expressed various ideas for their improvement, they do not regard PPRs as a bureaucratic tool for the project termination, but as an active learning event made possible by having the projects experts around one table.

7.3.3 Learning and Knowledge Creation due to PPRs at Engineering Co.

This section aims at answering Research Question 3: "*What are the typical lessons learnt and can PPRs promote the creation and dissemination of both explicit and tacit knowledge?"* and looks at two different aspects:

- the experiences and lessons learnt stated in minutes of PPRs compared to those mentioned by project members (interviewees) and discussed during PPRs;
- the evidence for knowledge creation and dissemination that happens during PPRs by looking at metaphors and stories.

7.3.3.1 Repertory Grid Constructs from Engineering Co.

During the six repertory grid interviews, a total of 56 constructs - *lessons learnt* - were elicited. Table 7.4 illustrates the total list of constructs per interviewee and also shows which constructs were mentioned by more than one interviewee. For example, Interviewee 3 and Interviewee 4 both commented on the information flow within the projects they participated in (COM1 - Intra-team communication). Since various constructs referred to the same aspect of learning, the number of different constructs elicited at Engineering Co. was 34.

Table 7.4 is sorted according to the frequency a construct was mentioned across the six interviewees and then according to the averaged normalized variability of these constructs (the calculation method has been explained in Chapter 6). The average variability of constructs within Engineering Co. was 9.33% (the total of 56 constructs divided by 6 interviewees), and all constructs with an averaged normalized variability higher than these 9.33% are displayed bold in Table 7.4.

Table 7.4: Summary of Repertory Grid Constructs at Engineering Co.

TYPE	CONSTRUCT	1	2	3	4	5	6	Variability	Frequency
ORG3	**Complexity of project organization**	x	x	x	x	x	x	**13.72%**	**6**
TIME1	**Development time needed**	x		x	x	x		**11.04%**	**4**
TIME2	**Meeting of milestones and deadlines**		x		x			**17.75%**	**2**
PM10	**Quality of project planning**					x	x	**15.13%**	**2**
PM7	**Quality of market launch**			x	x			**14.94%**	**2**
ORG2	**Involvement of external parties**			x	x			**14.66%**	**2**
EXP1	**Experience of project manager**	x		x				**14.27%**	**2**
TEST2	**Length and depth of test phase**		x			x		**12.57%**	**2**
PM11	**Clarity of project structure**		x		x			**12.20%**	**2**
CAP1	**Necessary capacities and resources**			x			x	**12.19%**	**2**
BUR5	**Formality of project**	x				x		**11.80%**	**2**
PM1	**Allocation of responsibilities**		x			x		**11.11%**	**2**
ORG1	**Project matrix organization**	x					x	**10.38%**	**2**
TECH9	Complexity of technical requirements	x	x					9.28%	2
TURN1	Turnover achieved after market launch	x					x	7.41%	2
COM1	Intra-team communication			x	x			3.52%	2
PM2	**Project closure with PPR**				x			**28.08%**	**1**
TECH2	**Project iterations due to technical problems**		x					**20.07%**	**1**
COM4	**Communication of project objectives**						x	**16.16%**	**1**
TECH7	**Changes of specification**					x		**12.65%**	**1**
TECH3	**Innovation degree of project**						x	**10.77%**	**1**
TECH4	**Quality of transfer to customer**				x			**10.01%**	**1**
EXP4	**Networking between departments**			x				**9.41%**	**1**
COM3	International communication					x		9.01%	1
TECH1	Post-launch problems				x			8.90%	1
COST1	Meeting of targeted project costs			x				7.35%	1
COST2	Meeting of targeted product costs			x				7.35%	1
PM4	Quality of project management			x				6.65%	1
BUR1	Bureaucracy of project organization	x						6.56%	1
EXP7	Process improvement during project					x		6.48%	1
BUR2	Use of bureaucratic guidelines						x	5.58%	1
TECH8	Quality of technical project output						x	5.58%	1
PM8	Quality of transfer between diff. development phases				x			4.73%	1
EXP6	Satisfaction of project managers		x					4.58%	1
	Total number of constructs	**8**	**8**	**11**	**11**	**9**	**9**		**56**

Out of the 34 constructs there are several interesting conclusions that can be drawn, but only two constructs will be discussed in some detail at this stage. One construct is outstanding, because it was mentioned by all six interviewees and also carries a high average variability: *ORG3 - complexity of the project organization.* Overall, R&D projects at Engineering Co. differ very much in terms of their complexity. This includes not only the complexity in terms of how many people, departments or locations are involved in the project, but also how complex the actual project objectives are. Real new developments or "technological jumps" are considered particularly useful for lessons learnt and experience transfer. Other development projects are seen as routine business which should be managed with less bureaucracy and administrational requirements. "*Our laser projects are less complex, for a machine there are much more people involved which makes the project much more complicated, with more individual parts and more suppliers*" (Interviewee 1).

Another key construct that is listed in Table 7.4 is TIME1 - the development time needed. The absolute length or duration of projects is a key learning as many projects run longer than originally planned, due to poor planning at the product definition phase or bad scheduling of “bottleneck resources” like test departments. “*This project took longer than planned, because the capacities were planned unrealistically. We should have known this right from the start*” (Interviewee 5). In addition, two respondents mentioned that in the beginning the pressure to start on a particular development could be stronger. Often, there is a time cushion of several months until the first milestone. Consequently, the project starts very slow and time then runs out in the end.

7.3.3.2 Triangulation of Lessons Learnt at Engineering Co.

Not only the constructs from the repertory grid interviews represented lessons learnt from completed projects. Minutes of PPRs and the transcript from the PPR observation also contained lessons learnt and these three data sources were compared (see Appendix 4.10). Table 7.5 gives an overview of the number of lessons learnt found for each category in each of the three data sources.

Table 7.5: Categories of Lessons Learnt from Different Data Sources

Category	Minutes of PPRs	Repertory grids	PPR observation
BUR	1	3	4
CAP	1	1	1
COM		3	5
COST	1	2	1
EXP	2	4	6
MARK	1		3
ORG	1	3	8
PM		7	1
PROD	1		1
SOC			2
SUPPLY			1
TECH	1	7	5
TEST	1	1	2
TIME	1	2	2
TURN		1	1
	11 constructs	**34 constructs**	**43 constructs**

The problem with the overview given in Table 7.5 is that this comparison cannot be directly compared for validity reasons. The 11 constructs from the minutes of the PPR are based on one set of minutes only and the constructs from repertory grids stem from six interviewees. If more minutes of PPRs were analysed and coded, if more interviewees had been questioned and if more than one PPR would have been observed, it is very likely that more constructs would have been found. Therefore, the total number of constructs only provides a very rough indication of the knowledge creation potential of PPRs. Yet, Table 7.5 clearly shows that regarding the single categories, more lessons learnt are drawn by the project members and during the PPR discussion than reflected in the minutes of PPRs. For example, the minutes do not contain a single lesson related to communication or project management, whereas the other two data sources provide a whole variety of lessons learnt in these two categories. This leads to the first conclusion that the learning effect from a completed project is much lower for those who only read the minutes compared to those who participate at the PPR.

As illustrated in tables 7.4 and 7.5, a wide variety of issues was discussed when interviewees reflected on lessons learnt from specific projects. However, when being asked what specifically is being discussed during PPRs at Engineering Co., answers focused on technical issues and quantitative facts. Interviewee 3, for example, stated that *"we look usually in detail at project timings and all other areas like production, construction, service, development, documentation, etc."* Interviewee 2 mentioned that *"we usually talk about the same things, i.e. was it well planned, were the technical details o.k. Often the time is being discussed, because usually everyone complains about not having enough time and they just need to get rid of this point*." Interviewee 6 supports this by saying that *"PPRs concentrate on the factual or technical issues - other conflicts or problems should not be discussed."* Yet, the data analysis shows that issues mentioned during the repertory grid interviews and the PPR observation cover a much wider range. There are three possible explanations with respect to Engineering Co:

- Interviewees are not aware of these non-technical issues because they are not stated in the minutes and minutes are only distributed to a very small number of people in the R&D departments;
- Interviewees are not aware of these non-technical issues because guidelines for PPRs do not recommend these categories and are also not mentioned by experienced colleagues when being asked about the main lessons learnt;
- Interviewees are not aware of these non-technical issues because they represent tacit knowledge, which is difficult to document and express.

It can be claimed that the Engineering Co. guideline covers only parts of the practical PPR discussions and potential learnings, namely the part that concentrates on those issues that are easy to document. This means that these documents show the potential of PPRs for the creation and transfer of knowledge to only a limited degree. Their full potential is reflected by the issues highlighted during the observation of one PPR and elicited during the repertory grid interviews. But this wider set of lessons learnt are never officially documented. Either because they are difficult to document or because they are not consciously in the PPR participants' minds when writing the minutes. This became evident during the PPR observation when the project manager very often struggled to write down the result from the discussion: *"How can I write this down, I know we* *understand it here in the team without any discussion, but for outsiders this might not be that clear at all."* This difficulty in documenting results was also stated as one of the reasons why the dissemination of minutes of PPRs to a wider audience was not considered a high priority. All interviewees confirmed that project outsiders who did not participate to the PPR would struggle to pick up the experiences discussed without in depth explanations. *"The main thing is that it stays in the heads of the project team and it might happen that the same things happen again in the next project."* (Interviewee 5). This can be considered as evidence that not only pure explicit and easy to document knowledge is generated and exchanged, but also more implicit knowledge aspects which requires active participation in the project and the PPR so that it can be understood and eventually re-applied. Interviewee 1 for example, stated that *"...I learnt that you do not always have to fill huge files after a PPR. If you have a good team and reflect collectively on each topic, it works just by the common understanding of these people..."*

Another point that needs to be highlighted is that the focus during Engineering Co.'s PPR discussions lies mainly on negative aspects. This fact was not only mentioned by all six interviewees, but is also reflected in the minutes of the PPR and confirmed by the observation of a PPR. The minutes list ten different topics and only once a positive aspect was stated. Also during the observed PPR, there was only one short incident where the teamwork was described as "*not that bad at all"*. All interviewees shared the opinion that it makes no sense to mention positive things at all. In fact, three interviewees used the same expression: "*no blame is praise enough"*[23].

7.3.3.3 Metaphors and Stories at Engineering Co.

Until now, data from Engineering Co. showed that PPRs create tacit and explicit knowledge and also facilitate the transfer of lessons learnt based on the common understanding of participants and their mutual reflection. Further evidence can be based on Nonaka's (1994) claim that the use of stories and metaphors can be treated as evidence for tacit knowledge being shared and transferred. Therefore, the different data sources were analysed regarding metaphors as well following Analysis Instrument 4.

Table 7.6 reflects the construct categories in connection with which the metaphors were used. The first finding from this was that the minutes provided did not contain a single metaphor or story. Yet, the interviewees as well as the participants of the PPR provided a certain number of metaphorical examples which are presented in detail in Appendices 4.11 and 4.12.

[23] Direct translation of the well-known Swabian term "*ned gschumpfe isch gnug globt*" which describes a famous stereotype of the Swabian company culture to focus on the work and not to waste too much time on gratifying people.

Table 7.6: Number of Metaphors & Stories per Category

No	Category	Metaphors from minutes	Metaphors from interviews	Metaphors from PPR observation	Total
1	Bureaucracy		1		1
2	Capacity & resources			3	3
3	Communication		1		1
4	Costs and budgets				
5	Experience			2	2
6	Marketing aspects				
7	Organization			2	2
8	Product aspects				
9	Project Management		2		2
10	Supply chain				
11	Social aspects				
12	Technology		1	4	5
13	Testing aspects				
14	Timing aspects			1	1
15	Turnover aspects			2	2
	Total	**0**	**5**	**14**	**19**

It shows that metaphors & stories range across a number of different subject areas. Examples are the documentation expert who repeated various times his biggest problem is that "*...we are always at the end of the food chain...*" or another participant stating that his "*...test area was constantly with their backs to the wall*". Apart from that, the PPR discussion contained many instances of expert stories that were mentioned when a solution for a specific problem was looked for or when criticism about current procedures was expressed. Experienced members of the Engineering Co. project team often responded with in-depth stories about previous projects during the PPR. For example, one of the senior members during the PPR stated that "*I think I can put your mind at rest: I am now more than 30 years with Engineering Co. No matter which product was introduced, even very simple ones, had problems when they were launched and there were an awful lot of changes done. C' est la vie my friends*" (PPR Engineering Co.).

7.4 FIRST CONCLUSIONS

Although the pilot study was only the first step in this research, it provided valuable insights into PPRs in general and at Engineering Co. in particular. Apart from being able to give details on PPR practices and perceptions at Engineering Co., a variety of findings were gathered which illustrate that PPRs can facilitate and support the creation and transfer of explicit and tacit knowledge.

The data on PPRs at Engineering Co. confirm the claim that learning within a team after a project has been finished is of particular value to the individual member, but also to the organization as a whole. Since learning takes place on the basis of real practical context instead of artificial seminars or workshops outside of normal working routines, PPRs profit from the common understanding and mutual objectives of the team.

Although it is not possible for respondents to describe their tacit experiences or for researchers to actively observe learning in connection with PPRs, data gathered enables to illustrate the learning potential of PPRs as found in Engineering Co.'s R&D unit. In addition, evidence found confirmed that PPRs can only be apprehended when basing them on the social learning theory. The core aspect of this theory and the more specific applications of Communities of Practice claim that individuals with a common objective, understanding and sense of purpose are ideally suited to create, share and disseminate tacit knowledge that might otherwise not be accessible. Therefore, PPRs provide perfect environments for the creation and dissemination of implicit project experiences within a network of experts.

As the dissemination of PPR results and personal experiences seems to be a point which is not sufficiently managed during PPRs at Engineering Co., the researcher queried if there are any other practices for experience transfer. Three interviewees mentioned a so-called "godfather" system, where junior project managers can refer to senior ones for ad-hoc advice if necessary. In other words, the phenomenon of situated learning, where learning is dependent on the context and practical setting is actively promoted by PPRs at Engineering Co.

Contrary to existing literature in the field of project management, there were many PPR challenges or hurdles that were not confirmed by Engineering Co.'s R&D managers:

- The inability to reflect as well as the difficulty to generalise from one project to the whole organization could not be observed at Engineering Co. at all. Especially during the PPR observation it was obvious from the specific questions and the interest shown by all participants that the whole project team is used to a deep reflection and analysis of the project phases. Interviewees mentioned often the R&D director and his focus on learning from the past. "*...you know that he wants us to look back in a very critical manner. Not only because this is a strategic project, but because he* [the R&D director] *wants to profit from our experiences - otherwise this session here would not make any sense and we could use our time for something else..."* When discussing the study results with the group of interviewees, it was also stressed that for managers with some experience at Engineering Co., it is not difficult at all to identify general lessons valuable for the whole R&D unit. However, this might be due to the relatively small size of Engineering Co. and is getting more complex now due to the internationalisation of the R&D function;

- Not only in the eyes of the researcher when observing a PPR, but also according to all six interviewees and the minutes of PPRs, PPR discussions at Engineering Co. can be described as very open, direct and critical. That means, a reluctance to blame cannot be confirmed. There is definitely a focus on negative experiences and problems, but all six interviewees perceived this as logical and as the right approach. "*We should not use the PPR for general shoulder clapping, that does not help*" (Interviewee 6).

Overall, PPRs at Engineering Co. provide evidence for the application of Nonaka's theory of knowledge creation and the theory of Communities of Practice for three reasons (Mc Dermott 1999):

- Engineering Co.'s R&D managers shared different kinds of knowledge, although they were only consciously aware of the more explicit aspects;
- Engineering Co.'s R&D managers confirmed that common learning and experience transfer depends critically upon how well the team works together and how well the informal networks function;
- Engineering Co.'s R&D managers illustrated that new knowledge is only accepted and valued if it is linked with practical experience. If this is the case, it is easily transferred within a project team during a PPR.

First insights into PPR perceptions from Engineering Co.'s managers imply that the advantages of PPRs are very clearly appreciated by R&D practitioners. Although it is often stated in the literature that PPRs are hardly ever conducted and also not missed if they do not take place, data from Engineering Co. illustrates that this is not the case. However, current PPR practices are observed very critically by the interviewees and potential for improvement was openly discussed.

Overall, all findings need to be compared with those from further case studies. These future case studies, however, should also profit from experiences gathered regarding the research methodology applied at the Engineering Co. site, i.e. data collection and analysis.

7.5 REFLECTIONS ON RESEARCH METHODOLOGY

The data collection at a pilot case is often broader than the final cases and the experience gained in the pilot should be recorded carefully (Yin, 1994). The chosen research methodology proved to be suitable to answer the research questions, to investigate the phenomenon of PPRs, and also validated the basic choice for using the case study method. However, various aspects of the research methodology should be reconsidered.

7.5.1 Documents

As mentioned earlier, it became clear during the analysis phase that a huge amount of project specific paperwork did not add to the quality of insights one derived from them. Especially so-called background information was considered much too important in the beginning and a lot of time was spent on understanding the basics of the selected R&D projects. Consequently, these documents were not collected for future case studies.

7.5.2 Repertory Grid

When reflecting on the repertory grid interviews, there are some issues which needed to be amended for the following case studies:

- It was decided to change the repertory grid question to "*Looking at the three projects written on the cards - how are two of these projects similar and different to the third in terms of what you would do differently if you were doing the same projects again.*" The reason is that direct questioning of learnings as done during the pilot study is not suitable if one wants to elicit personal lessons learnt which might be of a tacit nature;
- The length of the repertory grid and semi-structured part of the interview should be divided more evenly. Experience from the pilot case showed that interviewees struggled to find new constructs after about 30 minutes. In addition, the time for the semi-structured questionnaire on PPR practices and PPR perceptions was usually too short to cover all details in depth. Thus, the time of the repertory grid section in the main case studies was reduced to 30 minutes, so that about 25 minutes were available for the questionnaire part;
- Technical issues were included in all future repertory grid interviews as experience during the pilot study showed that these might provide important insights into lessons learnt during a R&D project. Therefore, technical issues were already included in the second set of interviews conducted at Engineering Co.;
- The ranking of constructs needed to be clarified better in the beginning. The majority of interviewees at Engineering Co. took 1 as the positive end of the spectrum and 5 as the negative one, based on the German marking system. However, this was not the common approach and therefore caused extra work for the researcher when analysing the repertory grids;
- After the first four interviews, it was discussed if the constructs quality, time & costs should be provided in the beginning of the interview. However, after careful reflection, the researcher did not want to do this for future cases as it became clear that these three issues were not at all automatically mentioned by all interviewees. If these three constructs are mentioned at all and how often is also an important insight for the researcher based on the fact that it is usually the focus of most PPR discussions according to the literature.

7.5.3 Semi-structured Interviews

Although the semi-structured part of the interviews was comparatively short, it became clear fairly soon that the prepared questionnaire does help only partially to guide the communication. For future cases it might be more appropriate to prepare a matrix with the main topics to be covered on the left side vertically and the interviewees name on the right horizontally. This focuses the discussion much more on the relevant PPR aspects that the researcher wants to cover and also helps in a comparative analysis of the answers. If interviewees add anything on top of the matrix, this does not create any problems, but such a focused approach is more likely to guarantee that the main key questions will be answered from all interviewees.

In addition, it was not always possible to receive answers to all questions from the interviewees. This was mainly due to missing time, so that future interviews should concentrate to keep the repertory grid part at a maximum length of 30 minutes.

7.5.4 PPR Observation

No changes were made in the technique chosen for the observation of the PPR. However, if permitted by the case companies, it was perceived to be important to continue having two researchers during the PPR observation as this is vital for validating transcripts.

7.5.5 Improvements to Methodology

As the data for Engineering Co. was collected and the initial analysis was made, it became clear that more emphasis needed to be placed on metaphors and stories as evidence for knowledge creation. Based on the insights from the literature and the data collected, an Analysis Instrument 4 was developed. This was used to retrospectively analyse Engineering Co. It should be noted that this improvement was to the analysis but did not affect data collection at all, because metaphors and stories were automatically collected via the transcripts of interviews and PPR observations.

7.6 SUMMARY

This chapter presented the pilot case study of this thesis which aimed at probing the overall research design as well as illustrating the first research findings based on one case company only. The discussion started with a short introduction on how access was negotiated and some historical background on the pilot case company and their R&D activities.

The data collection based on the three data sources documents, interviews and observation was discussed in detail and the collection process was presented and explained covering the whole process during the four site visits. In addition, the analysis of individual data sources as well as the triangulation of the evidence found was done with the help of the four Analysis Instruments introduced in Chapter 6.

The discussion then centred on the main findings and first conclusions regarding the three research questions. In other words, it was described how PPRs at Engineering Co. are currently conducted, how they are perceived by R&D managers and their learning potential was investigated on the basis of typical lessons learnt and metaphors found.

The chapter concluded with reflections on the research methodology after the first study was conducted at Engineering Co. Some minor changes were necessary which were applied to all future case studies. These four case studies are discussed and presented in the following chapter.

CHAPTER 8 CASE STUDY OVERVIEW

"The joy of having finished a project provides the right climate for open discussions within the team. You should use this chance for a review on common learnings."
(Extract Project Management Handbook MedCare Co.)

8.0 INTRODUCTION

This chapter presents basic but important information on the four case studies which were conducted after the pilot case study. The discussion of these case studies will not be done in the same detail as for the pilot case study (compare Chapter 7), but will serve to explain specific characteristic facts of each company before starting the cross-case analysis in Chapters 9, 10 and 11. Thus, the following topics will be discussed:

- Background information on the four case studies;
- Details regarding the availability of data for all case studies;
- Basic discussion about the different data sources for each of the four case studies.

8.1. BACKGROUND INFORMATION

Following the overall sampling logic, all four case companies chosen after the pilot case are located in Baden-Württemberg, i.e. in Southern Germany. As discussed previously, the selection of these companies was based on the top 50 list of the biggest companies according to turnover in Baden-Württemberg. Only Publishing Co. was not within the list of the Top 50, but provided easy access due to personal contacts of the researcher.

Each one of the case companies is market leader in Germany or Europe in its particular industrial sector and looks back on a company history of at least 100 years. Available information regarding the companies varies very much because of their different situations in terms of ownership. For example, while Appliances Co. is a strictly family owned business, where available information is very limited and any information on R&D ratios or profit figures is strictly confidential, publicly quoted companies like MedCare Co. have to publish very detailed quarterly and annual reports. To give a general overview, Table 8.1 lists the main characteristics of all four companies and also highlights where they conduct their R&D activities[24].

[24] Information regarding the pilot case company is added to the table in italics in order to display all case studies in one table.

Table 8.1: Main Characteristics of Case Companies

No.	Name	Sector	Founded	Turnover	Employees	Ownership	Place of R&D activities
1	*Pilot: Engineering Co.*	*Machinery*	*Early 20th century*	*1.0 Bn Euro*	*5,000*	*Family owned*	*Headquarter and subsidiaries*
2	Appliances Co.	Tools	20th century	1.5 Bn Euro	7,500	Family owned	Headquarter and national adaptation teams
3	MedCare Co.	Hygienic articles	19th century	1.3 Bn Euro	10,000	Stock quoted	Headquarter and subsidiaries
4	Machinery Co.	Automation	19th century	386 Mio Euro	2,600	Foundation	Headquarter and national adaptation teams
5	Publishing Co.	Entertainment	19th century	280 Mio Euro	1,400	Family owned	Headquarter and subsidiaries

All four companies conduct their main R&D activities in their headquarters in Baden-Württemberg, MedCare Co. and Publishing Co. also have R&D activities in their national and international subsidiaries. Since the consumer products which they develop and launch are subject to local requirements, they cannot always be centrally developed for all countries. For Appliances Co. and Machinery Co., who market technical products and machinery, R&D activities are clearly centralised, and national teams merely adapt these products to national requirements in terms of national safety, power or hygienic regulations. Therefore, for all case companies researched, only the company headquarters and central R&D units in Baden-Württemberg were visited.

8.2 DATA SOURCES AVAILABILITY

One of the typical characteristics of case study research is that not all data sources are available across all case studies. "*What is readily available in one case may be difficult to collect in another*" (Harrison, 2002). This reality also applies to this research. Table 8.2 gives an overview about the available data sources at each of the case studies.

The reasons for missing data range from limited availability of data sources at the point of time of the research (e.g. no PPR took place during the research at Publishing Co.) to confidentiality reasons (e.g. minutes of PPRs at MedCare Co. and Machinery Co. could not be copied, but could only be inspected during a on-site visit).

Table 8.2: Overview of Available Data for Each Case Study

No	Case	Guideline for PPRs	Minutes of PPRs	Interviews	PPR Observation
1	*Pilot : Engineering Co.*	*Yes*	*Yes*	*Yes*	*Yes*
2	Appliances Co.	Yes	Yes	Yes	Yes
3	MedCare Co.	Yes	On-site inspection	Yes	Yes
4	Machinery Co.	Yes	On-site inspection	Yes	Yes
5	Publishing Co.	Yes	Yes	Yes	No

Therefore, certain data sources could not be analysed in the same depth across all cases. However, it has to be stressed that the lack of some data did not seriously limit the research.

8.3 APPLIANCES CO.

8.3.1 General Information on PPRs

Although PPRs were always conducted in some informal way at Appliances Co., their official introduction started around the year 2000 supported by the current CTO, who put more emphasis on continuous improvement of NPD processes than his predecessors. One very pragmatic and personal motivation for the CTO to install PPRs was their use as a reason to instigate small celebratory events for the NPD team (which would have not been possible without a PPR due to budget constraints). Although this may appear an unusual motivation for PPRs, it was confirmed by most interviewees as one of the main reasons to introduce PPRs, and led to them being welcomed by all NPD staff members.

8.3.2 Documents Provided

No official guidelines for the management of NPD projects in general or PPRs in particular could be found at Appliances Co. Instead, information regarding current PPR practices was found in a short checklist for small scale projects and in a training document for junior project managers. Both were rather limited in length and content as illustrated in Table 8.3.

In addition, three different sets of minutes from recently completed projects were provided which enabled the researcher to get detailed insight into the topics of the PPR discussion, the documentation of PPR results and the way these particular PPRs were conducted. Table 8.3 provides an overview of all documents used for this research.

Table 8.3: Documents Provided by Appliances Co.

No	No of pages	Document	Characteristics	Comments
1	1 page	"Criteria for project review"	Checklist used by internal PPR moderators and project managers covering 11 different project aspects and their potential improvement suggestions	Only used for small projects.
2	2 pages	"Kick-out meeting: content & framework"	Training document in the form of PowerPoint slides covering some details regarding the content and organization of PPRs	Contains mainly information on the organization, less on the intended discussion focus.
3	4 pages	"Minutes of PPRs"	Standard minutes form sheet at Appliances Co. covering strengths & weaknesses discussed during the PPR	Detailed reflection of PPR discussion with a very long distribution list.
4	4 pages	"Minutes of PPRs"	Standard minutes form sheet at Appliances Co. covering strengths & weaknesses discussed during the PPR	Detailed reflection of PPR discussion with a very long distribution list.
5	14 PowerPoint slides	"PPR final analysis"	10 pages technical hard facts and 4 pages potential improvement suggestions	Document was also used for presentation in various meetings.

8.3.3 Interviews Conducted

The interviewees at Appliances Co. were selected by the CTO and the head of the project management and planning department who is also in charge of the NPD processes. All interviewees were members of the department mechanical design, which is the sole area designating project managers for new product development projects at Appliances Co.

Table 8.4: List of Interviewees at Appliances Co.

Interviewee No	Position	Department	Company experience	PPR experience
1	Project manager	Mechanical design	16 years	Medium
2	Co-project manager	Mechanical design	4 years	Low
3	Team manager	Mechanical design	14 years	Medium
4	Project manager	Mechanical design	12 years	Medium
5	Main head of department	Mechanical design	24 years	High
6	Main head of department	Mechanical design	22 years	High
7	Project manager	Mechanical design	13 years	Low

Table 8.4 lists all interviewees and also shows the different levels of experience of the interviewed engineers. Contrary to all other case studies, seven instead of six interviews were conducted. However, the repertory grid part was only done with six interviewees, as one of them (Interviewee 2) did not yet have experience of six completely different projects, but was asked to participate by the CTO in order to include feedback on PPRs from younger staff members.

8.3.4 PPR Observation

The observed PPR at Appliances Co. took place in the external training centre and lasted a full day, i.e. 7.5 hours pure meeting time plus breaks for coffees and lunch. One week before the PPR took place, the researcher was also invited to take part at the preparation meeting between the project manager and the PPR moderator from the internal training department.

The PPR was selected by the CTO because the project was not only of strategic importance to Appliances Co., but was also the first one to incorporate and follow a new development process for testing series. Therefore the PPR was not only a review of the project success, but also a reflection on the suitability of the new process.

Before the PPR started, the PPR moderator introduced the researcher to the participants of the PPR together with the project manager. Permission to tape record the meeting was granted after several questions from PPR participants regarding confidentiality reasons were answered. The researcher was seated during the PPR workshop within the U-shaped tables together with the regular participants. During the final part of the PPR, when the results from the day were presented to senior managers and board members, the researcher was seated in a corner of the room in order not to disturb the presentation.

During the PPR discussion, a great variety of visual aids and brainstorming techniques were used. Examples included wish lists for the outcome of the PPR from all the participants on the blackboard, personal satisfaction curves based on the project life cycle and frequent use of metaplan cards[25] to display and classify lessons learnt.

8.3.5 Main Findings

Overall, it is important to note that Appliances Co. devotes a full day to the PPR meeting and uses members from the internal training unit as moderators for the PPR. This might be due to the strong support from the CTO who introduced the way PPRs are conducted today and who also takes

[25] Metaplan cards are frequently used in German companies. These are cards made of thin cardboard in different colours on which participants write their ideas during a brainstorming session. Afterwards, these cards are usually pinned to a specifically prepared board so that they can be grouped and discussed. (See www.metaplan.com).

part at the final presentation part of the PPR together with other senior managers in order to grasp the main experiences gathered from the completed project.

Looking at the way PPRs are perceived by project managers and project members at Appliances Co. it stands out that the event as such is very well accepted and perceived as helpful and positive. "*The idea is to communicate the good and negative things and to give others a chance to learn. The aim is to become a learning organization. Not to repeat experiences all the time, but to give one the chance to profit from the experiences of the colleagues"* (Interviewee 7, Appliances Co.).

Due to the length of the PPR event, the PPR discussion observed was very detailed and investigated the main aspects in-depth. During the discussion, positive and negative lessons learnt were gathered via personal brainstorming and then discussed in the group using a wide variety of metaphors and stories. For example, the quote "w*e do not want to sit on an island and plan this completely alone"* stems from the discussion regarding the planning necessity of materials and prototypes which cannot be done without input from all involved departments.

8.4 MEDCARE CO.

8.4.1 General Information on PPRs

MedCare Co. started the formal introduction of PPRs in connection with establishing a new product launch process in 2002. Before, PPRs were conducted informally and only for those NPD projects where the project manager himself or senior managers initiated the PPR event.

The contact person for the researcher was the head of the internal audit unit of MedCare Co. The reason for this was the very recent introduction of the above mentioned new product launch process (PLP) and that the internal audit unit had the task to audit this process after one year running in practice. Therefore, the process for PPRs was also under investigation.

8.4.2 Documents Provided

The guidelines provided by MedCare Co. were by far the most detailed across all case companies. One was the overall handbook for project management which referred to PPRs in a very general way and targeted at the whole organization and any kind of organizational projects. The other one was the detailed description of the product launch process in the product development area. However, although these documented guidelines were recent editions, PPRs were only referred to in a marginal way.

The minutes of PPRs were inspected during the second on-site visit due to confidentiality reasons. Overall, three different sets of minutes from PPRs were analysed by the researcher. The full list of documents provided is listed in Table 8.5.

Table 8.5: Documents Provided by MedCare Co.

No	No of Pages	Document	Characteristics	Comments
1	89 pages	“Handbook for project management”	Contains a one page summary of tasks that the project manager has to accomplish at the end of every project, which also includes the safeguarding of experiences and their transfer to other projects. Checklist in the appendix also refers to the final project meeting and final report.	Focus is very much on organizational and bureaucratic issues.
2	52 pages	“Product launch process guideline”	The PPR meeting is mentioned in the check list for the final phase of market introduction.	No details at all are provided regarding PPR meetings.
3	3x10 pages	“Minutes of PPRs”	Different formats of action minutes focusing on market figures after the launch and comparing these to original business plans.	No evidence of reflection can be identified as the documents are restricted to turnover and margins achieved.

8.4.3 Interviews Conducted

The selection of interviewees was done by the head of the internal audit department together with the CTO. Focus was placed on choosing interviewees from different business units so that the PPR information gathered could be considered as representative for the whole MedCare Co. organization. Table 8.6 shows details of all interviewees.

Table 8.6: List of Interviewees at MedCare Co.

Interviewee No	Position	Department	Company experience	PPR experience
1	Project manager	Development	5 years	High
2	Project manager	Development	3 years	Low
3	Technical manager	Technical NPD	4 years	Low
4	Project manager	Development	9 years	High
5	Project manager	Medical Development	9 years	Low
6	Project manager	Medical Development	9 years	Medium

One of the peculiarities at MedCare Co. was that the contact person asked to participate at all interviews. The reason for this was his personal interest in the details of several completed projects. In addition, he was also interested to observe the application of the repertory grid technique. In order to make sure that his presence did not influence the interview results, the researcher asked every interviewee before the interview if the participation of the internal auditor can be granted.

8.4.4 PPR Observation

The PPR selected by MedCare Co. for the observation was a conscious choice by the case company. It was not a regular team PPR but a PPR of three different projects combined with an audit about the general project management processes and the way PPRs were conducted. Therefore, the agenda of the meeting as well as the moderation was done by the audit managers and the different project managers each brought along some project specific issues to be discussed during the PPR.

The whole meeting took place in a normal meeting room and lasted about four hours. A specific characteristic of the PPR at MedCare Co. was that the PPR included not only the review of several NPD projects, but at the same time the internal quality audit of how the product launch process guideline was applied in practice. Therefore, the participants included two members of the quality department, the director for R&D and the responsible person within R&D for the project management procedures. Apart from that, various project managers and their key team members joined the meeting one after the other in order to report on their completed projects.

The researcher was presented to each of the participants before the meeting and permission was granted by all of them to tape record the meeting. During the PPR discussion, the researcher was seated next to the U-shaped table. Apart from an overhead projector to display the agenda of the PPR, no other visual aids were used.

8.4.5 Main Findings

Overall, MedCare Co. provided the most professional handbooks and checklists for the management of their R&D projects. However, these did not include many details regarding PPRs. The PPR event as such is perceived positively by most interviewed project managers, but at the same time it is also perceived as a bureaucratic and formal project closure which signifies the official project end for everyone involved. *"It is important to show all members of the project team that the project is now finished"* (Interviewee 1, MedCare Co.).

Based on the minutes of PPRs and the PPR observation, it was clear to see that the focus of the PPR discussion at MedCare Co. are the market figures, the turnover achieved directly after the market launch as well as the financial aspects like gross margins, advertising contributions, etc. In other words, the discussion of personal experiences and lessons learnt was not visible from the inspected minutes and only happened to a limited extent during the observed PPR. This is also reflected in a limited use of metaphors and stories compared to other case companies.

8.5. MACHINERY CO.

8.5.1 General Information on PPRs

The practice of conducting PPRs at Machinery Co. is comparatively old, although they only became formalised around 1998 when project management as such was documented and implemented in an official way. Before, PPRs were done in a very informal way and their character depended very much on the project manager and his preferences.

Currently, PPRs are part of all new product development projects and the results from these meetings are obligatory to be documented in the final project reports. Thus, the results of each PPR are automatically part of every project archive. The contact person for the researcher was a main head of department in the development unit who stated that mainly customer related projects are subject to PPRs. Internal R&D activities are running for longer time periods and there is no external pressure from customers to review on the project in hindsight.

8.5.2 Documents Provided

The inspection of documents at Machinery Co. took place during the first site visit, i.e. after the first set of interviews. The PPR event as such is mentioned in the internal “product creation process” which is summarised in a short document covering the whole process.

Regarding the minutes of PPRs, two different kinds of documents were inspected. First of all, official form sheets exist for the final report to the senior management which is then included in the project archive and in these form sheets the results from the PPR - mainly the three most important improvement suggestions - are listed. Apart from that, regular minutes of PPRs which are only disseminated to the team in terms of very short “action minutes” are produced after each PPR at Machinery Co. Table 8.7 shows an overview of all documents which were inspected by the researcher on-site.

Table 8.7: Documents Provided by Machinery Co.

No	No of Pages	Document	Characteristics	Comments
1	2 pages	"Product creation process"	Mentions project termination phase including final meeting	No details at all are provided regarding PPR meetings.
2	1 page	"Project management form sheet for final milestone"	Contains different boxes to be ticked regarding project results plus improvement recommendations	Mainly used for the official project archives and distribution to senior management.
3	4x1 page	"Minutes of PPRs"	Short summary of main aspects discussed during the PPR focusing on team aspects and project organization	Very short summary which is targeted at project participants and not senior management.

8.5.3 Interviews Conducted

The selection of the interviewees was done by the contact person in cooperation with the researcher. Care was taken to select members of staff with different levels of project and PPR experience. In addition, members from different development departments were chosen. Table 8.8 gives an overview of the six interviewees at Machinery Co.

Table 8.8 List of Interviewees at Machinery Co.

Interviewee No	Position	Department	Company experience	PPR experience
1	Project manager	Mechanical design	13 years	Medium
2	Project member	Mechanical design	11 years	High
3	Project and team leader	Development	15 years	High
4	Team leader	Software development	9 years	Low
5	Project manager	Mechanical design	15 years	Medium
6	Project controller	Controlling	13 years	Low

8.5.4 PPR Observation

The PPR observed was chosen by the contact person at Machinery Co., because it was a representative project in terms of complexity and participants. The PPR itself took place on a late Friday afternoon in the beer garden of a pub located next to a technical museum around 80 km north of Machinery Co.'s headquarters. The reason for this location was the fact, that the project manager decided to combine the PPR meeting with a social event for the team, i.e. a visit to the technical museum.

The researcher joined the PPR event after the visit to the museum and was seated amongst the team members in the beer garden. The PPR discussion of the project took about two hours in total and was tape recorded after permission was granted from all participants. The first hour concentrated on personal feedback from all participants and the discussion of the encountered problems, the second hour (the food and beers had been served in the meantime) was characterised by personal anecdotes, story-telling and bonding of the team based on the mutual experiences. No visual aids were used, but the project manager took detailed notes of the discussion.

8.5.5 Main Findings

Overall, one of the practical reasons at Machinery Co. to conduct PPRs is that the official final project report asks for three improvement suggestions derived by the team on the basis of the common experiences. "*As far as this conclusion meeting is concerned, the project manager is supposed to present three recommendations how the project should contribute… in order to conduct projects better in the future*" (Interviewee 5, Appliances Co.). However, the way the PPR is conducted is the project managers choice alone. Since no detailed written guidelines exist, this means that the way PPRs are conducted can vary.

Judging from the different interviews, PPRs are positively perceived at Machinery Co. although it was also frequently mentioned that they are not conducted for all projects. However, they were often regarded as the informal counterpart to the reporting requirements with the added value of being able to socialize with colleagues.

The observed PPR, for example, was combined with a social outing and took place in the beer garden of a pub. Consequently, the atmosphere during the PPR discussion was very open and personal and gave rise to the exchange to personal stories. "*Japan was a special experience for everyone really. It was muddy, cold, wet, we did not have a proper toilet or room to have our meals or a coffee" (PPR Machinery Co.).*

8.6 PUBLISHING CO.

8.6.1 General Information on PPRs

Officially, PPRs at Publishing Co. are conducted only once a year in March for all new products which were launched the year before. These PPR meetings are called "business reviews" and last about two days because they include the discussion of all new products launched and not just one project alone. These business reviews are prepared by the project managers, but only the senior management and board members are present at the meeting.

Apart from these business reviews, some project managers also conduct team PPRs, but these are not officially documented or asked for in the process guidelines. Therefore, the different interviewees had very differing opinions regarding the question if PPRs are conducted at Publishing Co. or not.

8.6.2 Documents Provided

The inspected documents at Publishing Co. are listed in Table 8.9. The official "operating manual" for all new product development processes only include guidelines for the annual business reviews and do not mention regular team PPRs at all.

The different sets of minutes which were provided gave insight into both the official business reviews as well as the regular PPR meetings which are only conducted if the project manager decides to do so for his own purposes. Therefore, the character of these minutes as well as their format differ very much and do not follow a general format or pattern as illustrated in Table 8.9.

Table 8.9: Documents Provided by Publishing Co.

No	No of Pages	Document	Characteristics	Comments
1	113 pages	"Operating manual"	59 page process description plus 54 pages appendix covering the whole product development process. PPRs are mentioned in a one page summary checklist in a so-called "business review".	PPRs in a classical sense, i.e. within the project team after the product launch are not mentioned.
2	4x1 page	"Minutes of PPRs"	Short summary of main aspects discussed during the PPR focusing on team aspects and project organization.	Very short summary which is targeted at project participants and not senior management.
3	1 page	"Minutes of PPRs"	Summary of a PPR with a focus on the cooperation with an external supplier.	Very much focused on communication between the project manager and external suppliers.
4	2 pages	"Minutes of PPRs"	Detailed minutes on international product development project including improvement suggestions.	Focus lies on most problematic areas encountered during the project.
5	3 pages	"Minutes of PPRs"	Minutes of a business review covering different products and projects.	Only targeted at senior management who is conducting the business review.
6	1 page	"Minutes of PPRs"	Minutes of a business review covering different products and projects.	Only targeted at senior management who is conducting the business review.

8.6.3 Interviews Conducted

The selection of interviewees was done by the NPD director combined with a limited input of the researcher because of her detailed insight into the projects and processes at Publishing Co. Interviewees represented a conscious mix of company experience and also differed in their experience with PPRs. Table 8.10 provides an overview of all interviewees from Publishing Co.

Table 8.10: List of Interviews at Publishing Co.

Interviewee No	Position	Department	Company experience	PPR experience
1	Senior R&D editor	NPD	19 years	Low
2	International project manager	NPD	19 years	Medium
3	Project manager	NPD	5 years	Low
4	International project manager	NPD	15 years	Medium
5	Project manager	NPD	12 years	High
6	Managing director NPD	NPD and marketing	24 years	High

8.6.4 PPR Observation

Due to the fact that regular PPRs are not officially asked for, no PPR took place during the period of this research. Unfortunately, it was also not possible to attend to the annual business review in March since the meeting is exclusively for the top management. Therefore, it had to be accepted that a PPR observation at Publishing Co. was not possible to integrate into the results of this thesis.

8.6.5 Main Findings

Overall, Publishing Co. knows in practice two different forms of PPRs. First of all, the official annual business reviews where the senior management looks at all completed projects and product launches of the previous year. These are also well documented in the guidelines. Secondly, however, there are also the regular team PPRs which are not mentioned in the guidelines at all and which only take part if the project manager decides to do so. As a consequence, many project managers at Publishing Co. perceive PPRs as something that is not really supported by the senior management. *"If I go to my boss and say I want to do a PPR he will say, well if you have nothing better to do and some spare time, I will not hinder you from doing it"* (Interviewee 1, Publishing Co.).

The official business reviews are also different from the regular team PPRs because they focus more on market figures, turnover and sold quantities than on lessons learnt and improvement suggestions for the general product development process. This was evident when looking at the different minutes of PPRs. Unfortunately, though, it was not possible to observe a PPR at Publishing Co.

8.7 SUMMARY

Summarising the case study overview, it is important to stress that all companies chosen are located in the same geographic region and share the characteristic of being German or European market leader in their specific industry sector. Across all companies, the availability of data sources was very high and thus represents a good basis for a thorough cross case analysis which will be discussed in the following chapters.

The list of interviewees shows that a well-balanced mixture of experienced and junior R&D managers was interviewed. The minimum work experience at the company studies was three years and the maximum was 24 years which also illustrates the range of experience.

Overall, the specific characteristics of each case company were briefly discussed and will now be compared across the five case studies when looking at the three research questions. The main differences which were already highlighted in this chapter were the levels of support for PPRs from the top management, i.e. the CTOs, the time dedicated for PPRs, the use of project external moderators as well as the location for PPRs. Based on this, the perceptions regarding PPRs also varied across the 30 interviewees.

CHAPTER 9 CURRENT POST-PROJECT REVIEW PRACTICES

"A PPR should be a final project meeting where all the project participants are sitting around one table and discuss the positive as well as the negative things."
(Interviewee 2, MedCare Co.)

9.0 INTRODUCTION

This chapter is based on data and evidence from all five case studies and presents the findings related to the first research question: *"What are the current practices of R&D organizations for conducting PPRs?"* The structure of this chapter is based on 14 characteristics of PPRs which were identified based on the literature and an inductive process of analysis of the different data sources.

In detail, this chapter focuses on the following issues:

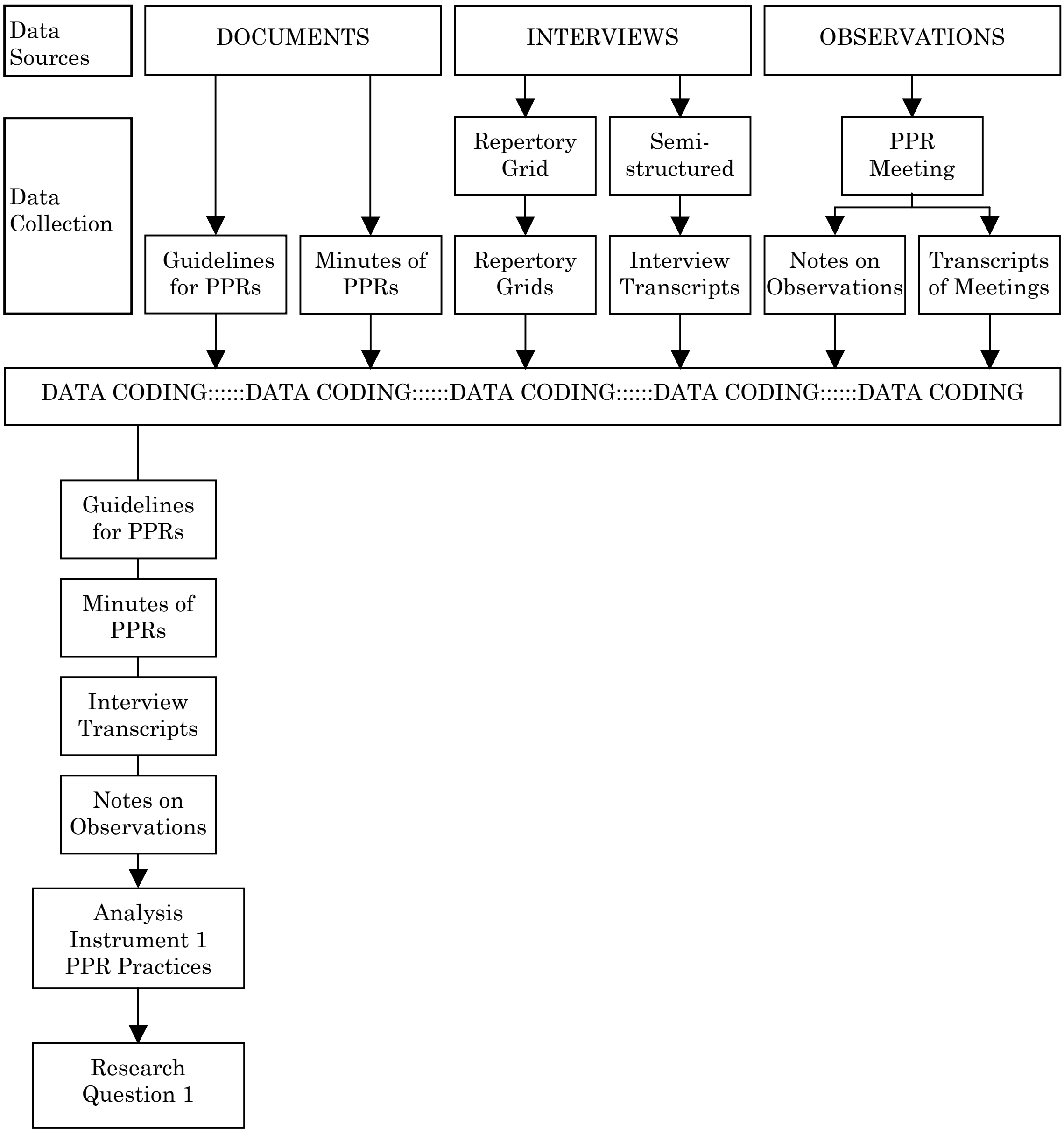
- Explaining the data sources used for investigating current PPR practices;
- Discussing the fourteen different PPR characteristics across the five case study companies including the implications of these findings;
- Deriving recommendations for PPR practices based on the empirical results.

9.1 DATA SOURCES USED

In order to extract the relevant data from the five case studies, it was necessary to look at all three data sources documents, interviews and observations. Figure 9.1 illustrates the data sources which form the basis of this cross-case analysis: guidelines for PPRs, minutes of PPRs, interview transcripts from the semi-structured interviews and notes taken during the PPR observations.

All these data sources were then coded on the basis of Analysis Instrument 1 (Appendix 3.2) as explained in Chapter 6 Research Methodology, with a detailed explanation of the analysis method in Chapter 7 Pilot case study (Section 7.3.1).

Figure 9.1: Data Sources Used for Research Question 1



9.2 FINDINGS ON CURRENT PPR PRACTICES

In order to present the findings of the analysis, the structure of this chapter is based on the 14 different PPR characteristics in Analysis Instrument 1. For each PPR characteristic a cross-case table is discussed and the similarities and differences across the case companies identified.[26]

[26] The entries in the following cross-case tables for Engineering Co. are based on those presented in Chapter 7 (Table 7.3). However, they have been enhanced through the further analysis and the results were slightly adapted for the cross-case analysis.

9.2.1 Objective of PPRs

Across the five case companies, several different objectives of PPRs were identified as illustrated in Table 9.1. It is clearly evident from the empirical data that for all companies, the analysis of strengths and weaknesses, the generation of lessons learnt as well as the agreement of improvement suggestions for future R&D projects represent the main objectives of PPRs. In fact, all data sources available for the five companies refer in some way or another to the fact that PPRs are conducted in order to reflect on experiences and lessons learnt.

Connected to the objective to gather experiences and lessons learnt, is the conscious effort and wish to transfer these learnings to future projects. This project-to-project learning aspect can be supported with various examples from the data. At Engineering Co. the objective to apply experiences to future projects is clearly stated in the guideline for PPRs ("*gather experiences and apply these to new/subsequent projects"*) and in the minutes of a PPR ("*the aim was to learn from the mistakes as well as from the successfully completed project phases in order to apply the findings and improvements to the next machinery projects*"). Furthermore, at Appliances Co. it was expressed very clearly by Interviewee 7 since *"…the idea behind is of course to communicate the good and negative things and to give others a chance to learn - the aim is to become a learning organization."* In addition, during the observed PPR at Appliances Co. the objective of the day was stated in a similar way: *"The objective of this day is to summarise what we did good and what we could have done better. Also in terms of what can we transfer to other projects and what should we do differently in the future."* During the PPR at Appliances Co. it was observed that one of the main tasks of the meeting was to document clear improvement suggestions on a blackboard with deadlines and responsibilities. At Engineering Co. and Publishing Co. these improvement suggestions should be specifically targeted at the development processes as stated by Interviewee 5: *"My personal objective for PPRs is the continuous improvement of our development processes."*

An important insight from Table 9.1. is that formal objectives like PPRs as the official project end or to release the project manager from his responsibilities are mentioned less often. In addition, only at MedCare Co. it was stated as an objective to thank the project team and to credit the team for the achievements. "*As the project manager you have generally the role to motivate and thank the people involved*" (Interviewee 1, MedCare Co.).

It was also interesting to note that in all four PPRs that were observed, the objectives were verbally presented in the beginning by the project manager and/or moderator. In none of the companies, though, were these objectives written down on flipcharts or white boards. They were also not referred back to at the end of the PPR. In addition, the objectives stated in the guidelines were not referred to in any of the observed PPRs.

Table 9.1: Objectives of PPRs

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	- Analyse experiences - Apply experiences to future projects	- Objectives for PPRs are not mentioned in the inspected guidelines	- Official project end - Manoeuvre critique - Thanks to project team	- Objectives for PPRs are not mentioned in the inspected guidelines	- Starting point for strategy process - Common reflection	Main objective across the cases is to commonly reflect on the project, to analyse the gathered experiences from the project and to apply these to future projects via improvement suggestions. Formal objectives like the release of the project manager for PPRs as the official end are mentioned less often.	Clear and frequent communication of the objective for PPRs is critically important. Objectives need to be stated in the guidelines and should ideally be the start of each PPR discussion as well as the first sentence of minutes of PPRs. The focus should be placed on common reflection and learning targeted at future improvement of the organization.
Minutes of PPRs	- Analyse experiences - Apply experiences to future projects	- Collect strengths & weaknesses - Find improvement suggestions - Common reflection	- No evidence regarding the objectives for PPRs was found	- No evidence regarding the objectives for PPRs was found	- Improve NPD process - Common reflection		
Interviews	- Make processes reproducible - Draw conclusions and learn - Document mistakes - Avoid repetition of mistakes - Improve NPD process - Solve problems	- Official project end - Analyse problems - Learn from problems - Conserve experiences for the future - Become a learning organization - Avoid repetition of mistakes - Profit from colleagues' experiences	- Official project end - Show result to steering committee - Common reflection - Release the project manager - Find improvement suggestions - Analyse project outcome - Thank project team - Learn from pros and cons	- Put everyone on same level of information - Find improvement suggestions - Common reflection - Analyse project outcome - Release the project manager	- Learn from mistakes - Avoid repetition of mistakes		
PPR Observations	- Discuss pros and cons - Find solutions to problems - Find improvement suggestions	- Gather lessons learnt - Discuss pros and cons - Find improvement suggestions - Apply experiences to future projects	- Improve NPD process - Check where problems exist	- Analyse experiences - Analyse project outcome	- Data source not available		

-

Reflecting on the empirical evidence, the clear communication of the objectives of PPRs in the whole R&D organization appears to be of critical importance to ensure that PPRs are actively used as learning events. One possibility is to clearly state them in the internal guidelines for PPRs (compare Engineering Co. and MedCare Co. in Table 9.1 where the objectives are given in detail), another possibility is to start each PPR meeting with a discussion as to what the objective of the meeting should be. Such an approach assures that not only the project manager or moderator, but also the PPR participants are absolutely clear as to why the PPR is conducted and also what is expected from them during the discussion. The agreed objectives should be documented on flipcharts or other visual aids and should be referred to again at the end of the PPR in order to double check if all objectives have been met. Furthermore, the minutes of PPRs should also state the agreed objectives for those people who did not participate to the meeting.

9.2.2 Timing of PPRs

Table 9.2 clearly reflects that all five companies schedule PPRs after the market launch of the newly developed product, because this allows for feedback from the market to be part of the PPR discussion. For three companies (Engineering Co, MedCare Co., Publishing Co.), this timing for the PPR is particularly important because their PPRs include a review of turnover and units and a check that these correspond to the original business plans. "*I think roughly six months after the official project end and when you have measurable indicators about what the product resulting from the project achieved on the market, then you do a PPR*" (Interviewee 6, MedCare Co.).

In general, the guidelines for the timing of PPRs range from some weeks after the serial release up to six months after the market launch. An exception to this are general business reviews at Publishing Co. which always take place in March after the Christmas season is over. Yet, it is clear to see that in practice, PPRs might take place at other times. In fact, in each of the four PPRs observed, the actual timing was much later than originally planned. For example, at Engineering Co., the observed PPR took place before the serial release instead of some months after the serial release, because there were already enough machines in the field to reflect on the results. At Appliances Co. the PPR took place one year instead of six months after the market launch because it was difficult to find a suitable date for all participants. At MedCare Co. the actual PPR data was roughly as stated in the guideline, i.e. it took place five months after the market launch instead of six months for the simple reason that the internal auditors who were planning the PPR wanted to conduct several PPRs at the same day and did not want to schedule another one a month later for one project only. At Machinery Co. the PPR took place later than planned because of holiday seasons and other pressing problems in current projects.

Table 9.2: Timing of PPRs

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	After the launch of first serial products	One or two months after market launch	Six months after market introduction	After "factory acceptance test" and before "site acceptance test"	Business reviews in March regarding products launched in previous year	All companies schedule the PPRs one or several months after the market launch. Contrary to that, all minutes of PPRs and observation show that the timing of PPRs in practice is much later than that.	PPRs should be part of the original project plan with a firmly established delay of several months between market launch and date of PPR.
Minutes of PPRs	Six months after serial release	Several months after market launch	Timing of PPR could not be identified in the minutes	Timing of PPR could not be identified in the minutes	- Nine months after proceeding Christmas season. - Three months after first production run - Directly after first prototype was delivered		
Interviews	Two months after serial release	Three to six months after the market launch	Six months after the market launch	- After the "factory acceptance test" - Before the "site acceptance test"	- During the regular business reviews in March - After the first season with sales, i.e. in March - Directly after market launch		
PPR Observations	Before serial release, but with 60 machines in the field	One year after the market launch	Five months after market launch	Six months after project end	Data source was not available		

The difficulties in arranging a PPR within the required time frame can in extreme cases even lead to the situation that no PPR at all is being conducted. Thus, one of the issues mentioned in the literature, i.e. PPRs are not conducted or conducted only from time to time due to internal time constraints, is clearly confirmed by the empirical evidence from this thesis.

Consequently, in order to avoid the practical problems of conducting the PPR at the ideally scheduled time, the PPR should be already considered when doing the original time plan of the project. In order to avoid that the PPR event as such is missed due to time pressures, a fixed time period between market launch and PPR meeting should be established, so that not the market launch, but the PPR represents the last milestone in the project plan. If market launch dates change during the project lifecycle, the PPR date would move accordingly, but the visual presence of the PPR on the project time plan could most probably reduce the risk that the PPR is not conducted at all or not much later than originally planned.

9.2.3 Duration of PPRs

How long a PPR lasts varies a lot across the five companies, but is very consistent within the data sources for each case company as illustrated in Table 9.3. At Engineering Co., MedCare Co., Machinery Co. and for the team PPRs at Publishing Co., a typical PPR meeting takes about two hours. It was frequently stated that anything less than two hours would not allow a deep enough discussion. Nevertheless, long PPRs are not necessarily better, because PPR observations showed that after two hours, the PPR discussion can suffer. At Engineering Co, for example, participants started to leave the room, answered their mobile phones or frequently looked at their watches. At Machinery Co., PPR participants were eager to start the "social part" of the PPR after about two hours. This became evident because one after the other changed their drinks from water to beer and the discussion included more and more personal anecdotes which were not any longer connected to the project in question.

A very clear exception is Appliances Co. which invests a full day (if the project exceeded a certain budget level or strategic importance). Although Appliances Co. recognises the significant cost for a one-day event with all project members being present, it is perceived by the CTO that the results outweigh the costs. Yet, not all PPR participants at the observed PPR at Appliances Co. agreed that a full day is always necessary for the discussion. The project controller stated: "*Me personally I do not profit that much, each time I witness the same thing, although the details differ between projects, but no real new insights, so for me half a day would be sufficient*." The potential reason for this is that finance people like controllers are involved in many different development projects. This can mean that they have less insights compared to their colleagues from the technical areas. They are also not that deeply involved in every single project in order to have the necessity to do a full day review of the project in hindsight.

Table 9.3: Duration of PPRs

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	No details provided	One day workshop	No details provided	Between 1 and 2 hours	One day for business review, regular PPRs not mentioned	Practice ranges from one hour to a full day, but the average seems to be half a day, which is also the length preferred by most project members.	Duration needs to be adjusted to the project size and its strategic importance. For meetings longer than 2 hours, good moderation is needed to keep the interest and stimulate learning.
Minutes of PPRs	2 hours	One day workshop	No details provided	No details provided	Ranges between 2 hours to one full day for the business review		
Interviews	- On average half a day, i.e. 3 to 4 hours - As short as possible, i.e. one hour - 2 hours	One full day	- Less than half a day - About 1 or 2 hours	About 1 hour, usually followed by a social event	- About 2 hours - Not more than 1 hour - From 1 hour to one full day - 15 minutes up to 3 hours depending on importance of project		
PPR Observations	2.5 hours	One day workshop	Half a day	2 hours	Data source not available		

Similarly to Appliances Co., Publishing Co. invests a full day for their annual business reviews in March. This is due to the fact that they do not only look at one newly developed and launched product, but at all products launched in the season before. Only in very exceptional cases like entering a completely new market segment with a new product, a separate business review in form of a PPR is done. However, this only happens every three to four years and then the PPR lasts up to three days. As Publishing Co. refused access, the effectiveness of their approach to PPRs cannot be judged directly.

Consequently, it can be concluded that an ideal duration for PPRs appears to be about two to three hours, as it allows an in-depth discussion but does not block a whole day of all participants. However, if the objective is to reflect on certain points in great detail in order to derive improvement suggestions for the companies' development processes, it can make sense to spend a whole day on these questions. Furthermore, the length should always depend on the complexity and strategic importance of the project to be reviewed as well. Therefore it makes sense to apply a flexible approach regarding the length of PPRs instead of following a strict guideline. Also for longer PPRs the importance of good moderation increases.

9.2.4 PPR Participants

It is clearly shown in Table 9.4 that across all five companies the core project team members usually participate in the PPR. This core team typically consists not only of R&D team members, but also includes other involved departments like construction, documentation, other technical experts, purchasing, production, sales, product managers, finance and controlling staff, customer services and sometimes also legal experts on patenting issues. This practice can be highly recommended as only the whole project team can effectively discuss and review the project with all its different facets.

The project team members can be either from one company site, from various sites or even a mixture of national and international colleagues, depending on the project structure and the degree to which the product is launched in international markets. For example, Engineering Co. used a video conferencing link to include Swiss colleagues in the PPR observed. In some cases, for example for the minutes of PPRs analysed from Publishing Co. also external suppliers were involved because a high number of project tasks were outsourced to this external supplier and a PPR without his contribution would not have made any sense. Apart from that, further cooperation with this external supplier required him to be part of the discussion about how the cooperation and communication should be improved in future projects.

It was interesting to find that senior management or members of the steering committee were sometimes also mentioned as regular PPR participants. For example, at Appliances Co,. senior managers are invited to the last hour of the PPR. Then, the team presents to their managers the results of the workshop and have the chance to discuss these results directly with them. Secondly, the presentation enables the senior managers to provide direct feedback to their staff and also comment on the improvement suggestions. Afterwards, the senior managers also take part at the social event after the PPR in order to express their appreciation for the achievements of the project team. The senior management of MedCare Co. and Machinery Co. takes part exclusively in selected PPRs which are of particular strategic importance. In these cases, there is usually a steering committee in place for the project which consists of the CTO and other board members who are then also present during the PPR in order to release the project team and witness the discussion of the most important aspects.

In contrast to this, during the special annual business reviews at Publishing Co. only the board members and the senior manager for product development meet without representatives of the various project teams whose products are being reviewed. This was explained with the fact that the business review PPR looks specifically at the implications for the future strategic direction of the company instead of project specific learnings which is done in the normal team PPRs where only the project team is present. Although direct observation of this approach was not possible, it appears that this approach will not be effective at generating project-to-project learning.

One of the most important insights gathered from the data was that interviewees provided conflicting evidence whether senior managers support or disturb an open discussion in the team. Consequently, the practice observed at Appliances Co. seems to be a suitable and sufficient compromise which can be recommended to other companies. If senior managers are invited to the final section of the PPR, they can get a short verbal presentation of the PPR results and are thus already able to give their feedback to the whole project team without disturbing or influencing the PPR event as such. Another positive aspect of such a short presentation is that it serves also as a dissemination tool for the PPR results. Therefore, R&D organizations could also invite other staff members external to the PPR to attend the final presentation, for example junior project members who are about to start their first project or other project members from the same unit in order to profit from the lessons learnt. Such an experience transfer via a short presentation is likely to be of higher value for the project external people than reading the minutes of the PPR. One reason for this is undoubtedly, that the stories during the presentation are more likely to be remembered than written documents.

Table 9.4: PPR Participants

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	All responsible project members from the involved departments	Core team members plus management for final presentation	No details provided in the guideline	Core project team	Only management board for business review, no project team members	Across all companies, the core project team members participate to the PPRs. Senior managers or the steering committee is present in some cases for a final presentation or for strategically important projects. Only exception is Publishing Co. where only the management board attends the annual business reviews.	Although the number of participants should not be too high, dissemination of lessons learnt can be facilitated by having project-external staff members as participants. (Partial) participation of the senior management allows direct transfer of lessons learnt and also shows appreciation of the teams achievements.
Minutes of PPRs	Core team members from involved departments	Core team members, partially also management board	No details provided in the minutes	No details provided in the minutes	- Management board for business reviews - Project team and if needed also external suppliers for team reviews		
Interviews	- Core project team from involved departments - Usually not more than 10 people	Core team members, joined later by management board	- Project team - Sometimes also steering committee and management	- Core team members - Sometimes directing committee	Management board for business reviews, all involved departments for PPR		
PPR Observations	Core project team with representatives from all involved departments	Core team members, for final presentation also senior managers and CTO	Auditors, senior management and project managers	Core project team	Data source not available		

9.2.5 Moderation of PPRs

Looking at Table 9.5, a high degree of commonality can be found across the companies regarding the moderation of PPRs. Four out of five case companies give the responsibility to moderate the PPR to the project manager. Triangulation of the data showed that the normal practice is that the project manager moderates and leads the discussion, and also takes part in the discussion itself. Appliances Co. is the only exception and uses a different approach. Since Appliances Co. feels that the personal input of the project manager to the PPR is very important, they use moderators from the internal training unit, who are usually specialists in project management. Interviewee 4 at Appliances Co. stated that: "*A good moderator can cope better with people who disturb for example or go on about the same thing for ages. The ones we have are really good, know what they are talking about, but surely it could also be done by the project manager.*" Another reason for this practice is the impression that a more neutral discussion is possible if the moderator is not part of the project team and has no personal opinions regarding any of the topics being discussed. "*The moderator can help with the method, that sort of support. So this person from the training department joins the meeting, follows the day and might help if the discussion and dialogue dies*" (Interviewee 6, Appliances Co.). Overall, the use of moderators was very well accepted at Appliances Co. and was also considered as normal practice. The only criticism voiced during the interviews was that the moderator sometimes spends too much time on an individual discussion point, because he lacks the project-internal know-how to set the priorities. For the observed PPR at Appliances Co., though, this was avoided because the project manager prepared and briefed the moderator accordingly a few days in advance.

Another peculiarity found during the data triangulation was the annual business reviews at Publishing Co. Here, the director for new product development is responsible for the moderation. The project managers of the different projects discussed during these business reviews do not take part at the meeting, but provide their input in advance to the NPD director.

As a consequence, it is highly recommended for bigger and strategic projects to use a project-external moderator, because such a person enables a neutral guidance of the discussion and thus contributes a lot to the discussion quality. Although a moderator is not a guarantee for a better PPR outcome, he enables the project manager to participate more actively in the discussion. Apart from internal trainers as used by Appliances Co., other project managers, project management specialists or external consultants specialised in moderation, could also act as moderators.

Table 9.5: Moderation of PPRs

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	No details provided in the guideline	Moderator from internal training unit	No details provided in the guideline	Project manager	For business review PPR NPD director	Generally the project manager is the moderator. Only Appliances Co. uses moderators from the internal training unit.	Although not mentioned in company guidelines, the ways of stimulating discussion appear particularly important. Moderators external to the project are advisable. They can facilitate the discussion, and are objective to the project. In addition, they can relieve the project manager from moderating and taking notes which then enables a more lively discussion to which the project manager can contribute more actively.
Minutes of PPRs	Project manager	Moderated by internal trainer	No details provided	No details provided	Project manager for PPRs, for business review no evidence provided		
Interviews	Project manager	Moderator from internal training unit	Project manager	Project manager	Project manager, for business reviews NPD director		
PPR Observations	Project manager	Moderator from internal training unit	Internal auditor	Project manager	Data source not available		

9.2.6 PPR Discussion Method

All five case companies conduct their PPRs based on team internal discussions as illustrated in Table 9.6. The PPR discussions were always structured on the basis of a previously distributed agenda which was then supplemented by further topics during the PPR. For example, during the PPR observed at Engineering Co. the project manager started the meeting by referring to his invitation in which he already stated some of the points to be discussed. He then asked for feedback from the PPR participants.

Generally, the observed PPRs were often unstructured, jumping from one aspect to the next and also repeating many discussion points several times. The reason for this is most likely the importance of these particular points e.g. the frequently mentioned capacity problems at Engineering Co. or the new product launch process at MedCare Co. Another possible explanation might be that the moderator/project manager lost track when leading the discussion and at the same time contributing to it.

At Appliances Co. various techniques which go beyond an unstructured team discussion could be identified. The moderator started the discussion saying *"…we can now start with our analysis phase. I have prepared two groups of questions. One goes into the direction of what was particularly helpful in the project and what should be transferred to other projects or what were the particular strengths of the project. And the other one is what should be improved in other projects, what needs to be changed, where are the weaknesses. So you see these are two completely different objectives and questions. I suggest that we collect points for both aspects. I will give you some cards with two different colours to keep the positive and negative aspects apart. In addition, I also have the question if you could draw a so-called "satisfaction curve" on this big flipchart here. The x-axes is the time and the y-axes is the degree of your personal satisfaction.*" The collected cards from the brainstorm were then put on separate walls for positive and negative aspects which were grouped and used to visualise certain topics during the whole meeting. In addition, the "personal satisfaction curves" drawn by all participants were often referred to during the discussion in order to visualize and highlight personal experiences and feelings which occurred during the project.

The discussion method used during a PPR is important, because it might influence the overall atmosphere and consequently also the findings from the exchange of opinions and experiences. Consequently, it seems important to consciously think about the discussion method for PPRs, because the unstructured ways observed in four companies do not seem to be optimal to achieve a fruitful conversation.

Table 9.6: PPR Discussion Method

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	No details provided in the guidelines	No details provided in the guidelines	No details provided in the guidelines	No details provided in the guidelines	For business reviews structured discussion on basis of market figures	No details provided in guidelines and minutes. Only Publishing Co. mentions market figures for discussion in their operating manual. Apart from team discussion and reflection, only Appliances Co. uses visual aids.	If the location allows the use of visual aids and special discussion techniques, these should be applied. Especially the beginning of a PPR can profit from a triggering effect from such approaches and it might also help to select the most important aspects to be discussed in the team during the PPR.
Minutes of PPRs	No details provided in the minutes	No details provided in the minutes	No details provided in the minutes	No details provided in the minutes	No details provided in the minutes		
Interviews	- Team discussion - Common reflection	- Team discussion - Common reflection - Metaplan cards	- Team discussion - Review of project phases	- Team discussion - Common reflection	- Business reviews clearly structured - Unstructured discussion for team PPRs		
PPR Observations	- Team discussion - No visual aids	- Visual aids like metaplan cards - Experience curves - Cause & consequence analysis	- Team discussion - No visual aids - Strictly following agenda from auditors	- Unstructured discussion - No visual aids	Data source not available		

Especially the use of visual aids to highlight and focus the discussion seems to be important. Visual aids should always be used to aid the PPR participants and to make sure not to lose important aspects which have been mentioned. The use of metaplan cards at Appliances Co., for example, avoided the discussion jumping backwards and forwards several times as happened at the other case companies. In addition, it is much easier to visualise causes and consequences than explaining them only verbally. It was also very clear to see that metaphors and stories were frequently mentioned when PPR participants at Appliances Co. presented their cards to the group or explained the form of their satisfaction curve. Thus, visual aids also seem to support the creation of tacit knowledge more than a normal unstructured discussion.

9.2.7 Location for PPRs

The general approach identified for the place of PPR meetings are normal meeting rooms within the company building, which is also reflected in Table 9.7. Only Appliances Co. uses their internal training centre, which is about 15 km away from where the team members work and regularly meet. The location is chosen on purpose so that daily routine cannot disturb the discussion and none of the members is tempted to use any breaks to check e-mails or for important phone calls. During the observation of the PPR at Appliances Co. it was clearly noticeable that due to the external location the discussions continued during the coffee and lunch breaks and also contributed to a more relaxed atmosphere between the PPR participants.

In two cases, PPRs are followed by a meal for all team members and the management in order to celebrate the end of the project (Appliances Co., Machinery Co.). At Machinery Co. even the actual PPR discussion itself is often conducted at a bar or restaurant, following a common "outing" of the project team, for example to a technology museum. The PPR is then held in a restaurant close to the museum, so that the PPR is part of the social event to celebrate the project end. Such an approach stimulates interaction and intra-team learning.

It is interesting to note that interviewees from all five companies expressed their concern that no budget for social events during the project life cycle exists and that the PPR represents the only possibility for a project manager to invite this team members for a meal. Some companies (Appliances Co., Machinery Co.) even stated that one of the reason for the introduction of PPRs was that they were looking for a possibility to organize a social event of some sort after the official project end. "*We always try to invite the team for dinner in connection with the PPR. This is usually outside of the normal working hours, but the company then accepts to pay the meals. In fact, this is one of our reasons to conduct the PPR. Not the only reason, but an important one*" (Interviewee 5, Machinery Co.).

Table 9.7: Location for PPRs

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	No details provided in the guidelines	Meeting room in external training centre, afterwards local pub or restaurant	No details provided in guidelines	Meeting room, often followed by common dinner in a restaurant	Normal meeting room	General practice are normal meeting rooms, sometimes followed by a common dinner. External training centre is used by Appliances Co. to have a real day off and some PPRs at Machinery Co. take place in pubs to stress the social character of the meeting.	Different location from normal meetings are advisable to stress the different character of PPRs. Social locations are advisable to support the team building during the PPRs as well as the emergence of metaphors and stories.
Minutes of PPRs	Location not mentioned in the minutes	Room in external training center	Location not mentioned in the minutes	Location not mentioned in the minutes	Normal meeting room		
Interviews	Normal meeting room	External training center or seminar hotel	Meeting room	- Informal setting - Dinner or something similar - Meeting room or pub	Normal meeting room		
PPR Observations	Meeting room at headquarter	Room in external training center	Normal meeting room	Beer garden	Data source not available		

Choosing the location for a PPR almost certainly has an influence on the atmosphere as well as on the topics that come up during the discussion. While the observed PPR at Machinery Co. showed that the PPR discussion profited from the informal atmosphere in the pub, it also has the disadvantage that visual aids like flip charts or metaplan cards cannot be used. Overall, though, it seems to be useful to chose a room which is different from those for normal project meetings in order to differentiate the PPR from a normal meeting and also in order to clearly indicate that a detailed and in-depth discussion of the project is intended. In addition, a more relaxed and social location might trigger a more personal discussion which can eventually lead to the emergence of topics which do not come up when meeting in a normal meeting room.

9.2.8 Use of Guidelines for PPRs

It is very clear from Table 9.8 that in none of the five companies was there evidence in the documents analysed that guidelines for PPRs were used and followed. The guidelines for PPRs do not specify checklists that are supposed to be used in preparation, nor did any of the analysed minutes of PPRs contain any evidence that the guidelines were used or applied. Evidence of the use of guidelines was observed only at Engineering Co. The guidelines for PPRs were not mentioned during the PPR, but the project manager and moderator confirmed after the meeting that the guidelines had been referred to in preparation of the meeting.

At Publishing Co. it became clear that guidelines only exist for the annual business review, but not for PPRs. "*The new operating manual is definitely useful, but it does not include anything regarding PPRs"* (Interviewee 4, Publishing Co.). At Engineering Co. and Appliances Co. Interviewees gave conflicting information on whether guidelines are really used, but the majority of interviewees stated that they are not used. *"I did not use the guideline for PPRs at all before the meeting - it was done completely informal*" (Interviewee 4, Engineering Co.). "*The guideline for PPRs is in the project management handbook I think, but that is more like the bible, something you know that exists, but does not always help in real life*" (Interviewee 4, Appliances Co.). Probably the main reason why the guideline for PPRs is not used at Appliances Co. is that their existence is not known. "*No, a guideline does not exist on any of our servers*" (Interviewee 5, Appliances Co.). Another explanation is that personal networks and discussions with colleagues about how a PPR should be conducted are much more efficient and helpful than any company guideline. At Machinery Co. only the general project management handbook is used and known. The only official form sheets that were mentioned by the interviewees are the official documents that need to be filled in before and after the PPR.

Table 9.8: Use of Guidelines for PPRs

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	Use of guideline is not mentioned	Use of guideline is not mentioned	Use of guideline is not mentioned	Use of guideline is not mentioned	Use of guideline is not mentioned	No evidence regarding use of guidelines for PPRs could be found in documents. Interviews confirm focus on informal networks and team reflection, while observation shows that guidelines for PPRs are not used at all or only to double check formal issues.	Quality of guidelines for PPRs needs to be ensured and their applicability to managerial practice should be tested in advance. Simple practical guidelines are needed.
Minutes of PPRs	Use of guideline is not mentioned	Use of guideline is not mentioned	Use of guideline is not mentioned	Use of guidelines is not mentioned	Use of guideline is not mentioned		
Interviews	- PPRs are integrated into the general guidelines - Limited use of guidelines, because they are not useful	- Sometimes used for preparation - Not sure if guideline exists and where it is stored - Handbook is more a bible than a working help	- Checklists are used - Handbook is useful - Formerly different guidelines with roughly the same content	- Project management guidelines not used - Only certain official form sheets are used	- Guidelines for normal PPRs do not exist - No guidelines are used		
PPR Observations	Used by the project manager in advance to double check the rules	Use of guideline was not observed	Guideline was not used for the observed PPR	Use of guideline was not observed	Data source not available		

The analysed data showed clearly that guidelines for PPRs - if they exist - are not heavily used by project managers or PPR participants, either because they are not known or because the guidelines are not considered to be useful. As personal networks within the company are preferred to collect information regarding the PPR practices, one recommendation has to be to gather this informal information from experienced project managers and include it in the official guidelines and handbooks. This would ensure the quality and practical applicability of the guidelines for PPRs and also increase the probability that PPRs are used. This does not mean that internal networks should not be used again, but assures that similar information can also be found if no personal networks exist, for example for new members of staff. In addition, the integration of recommendations from experienced practitioners might also increase the acceptance and usage of the guidelines and handbooks for PPRs within the whole R&D organization.

9.2.9 Preparation of PPRs

Table 9.9 shows very clearly that existing guidelines for PPRs are rarely used in the preparation of a PPR and hardly any evidence regarding the preparation of PPRs could be found in the guidelines and minutes of PPRs. A frequently applied practice detected was that project managers asked participants to prepare the main issues in advance of the PPR meeting, for example the positive and negative aspects they consider as most important for the discussion (Engineering Co., Machinery Co.). At Appliances Co., the project manager prepared the PPR together with the moderator from the internal training department in a separate meeting. During this meeting not only the most important points from the project manager's point of view were discussed, but also the PPR participants role in the project was explained to the moderator. It has to be stated, though, that in none of the five companies was preparation necessary in order to be able to actively participate at the PPR.

There are some issues which were mentioned several times by interviewees and which are thus considered as valid evidence for the practical preparation of PPRs. For example, the drawing up of an agenda as a preparation for the PPR was mentioned by interviewees at MedCare Co. and Machinery Co. The analysis and preparation of figures and data for the PPR discussion was stated by three different interviewees from Appliances Co. and MedCare Co. Evidence across three different companies (Engineering Co., Appliances Co., MedCare Co.) showed that project managers very often base their planning of a PPR meeting on ideas from older experienced colleagues in order to get some advice as stated by Interviewee 3 at Engineering Co.: *"I would ask my colleagues how they did it."*

Consequently, it can be stated that all five case companies focus on the individual reflection of project team members before the PPR meeting, which can be considered as a very useful practice. For example, Interviewee 6 at Engineering Co stated that: *"I always try to reflect on what has happened in the project."* Another example is given by Interviewee 3 at MedCare Co.: "*I think the most important issues I would have in my head, especially those things that went wrong. That is always very easy to remember and I would then reflect on these."* This practice can also be recommended, because it avoids the PPR discussion starting with a long silence, because the participants have already reflected on the most important aspects in advance. The PPR meeting as such can then concentrate exclusively on the exchange of the individual experiences. Another recommendation is based on the observation at Appliances Co., where the responsible sales manager prepared and presented feedback from the different markets where the product has been launched. This was not only interesting information for all team members, but also triggered new aspects in the PPR discussion.

Overall, in order to generate maximal learning from a PPR the location, moderation and good preparation all appear to play key roles. Managers organizing PPRs need to make them a "special event" rather than "yet another meeting" - this needs skill and original thinking and Appliances Co.'s use of a professional moderator and Machinery Co.'s visits to a museum seem appropriate mechanisms for making the PPR a "special event".

Table 9.9: Preparation of PPRs

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	Should be done with the help of project documents, action lists, test reports, service reports & risk lists	No details provided in the guidelines	No details provided in the guidelines	Team members prepare positive and negative project aspects	Business reviews prepared by project managers	Variety of evidence: ranges from review of documents, reflection of team members to presentations of project managers and the networking with experienced colleagues. This evidence is mainly based on interview data and observation, because documents did only provide very limited evidence regarding preparation of PPRs.	It seems to be advisable to encourage individual or team reflection on the project before the PPR takes place. This can be done informally or triggered by the project manager. Senior colleagues can be used to reflect on previous PPR experiences. Original thinking (to make the PPR a "special event") is needed on the part of the management or moderator responsible for the PPR.
Minutes of PPRs	Reflection of individual team members on the basis of project documents and phases	Participants prepared positive and negative aspects in advance	No details provided in the minutes	No details provided in the minutes	No details provided in the minutes		
Interviews	- Ask experienced colleagues - Team reflection - No preparation necessary - Individual reflection of participants	- Look at figures, milestones, technical details and organizational issues - Team reflection - Reflection with moderator - Ask experienced colleagues - Look at previous minutes of PPRs	- Project manager prepares key issues and agenda - Team reflection - Use common sense - Look at training documents - Ask experienced colleagues	- Look at project sheets - Project participants know the main topics automatically - Project managers draw up an agenda	- Team reflection - Draw up agenda - For business review individual reflection of project managers - Look at process steps		
PPR Observations	Project members provided discussion topics to project manager for the PPR agenda	Preparation between project manager and moderator in a separate meeting	Auditors prepared agenda	Project manager asked participants to prepare three pros and three cons for the discussion	Data source not available		

9.2.10 Atmosphere during PPRs

Table 9.10 illustrates that all five case companies provided sufficient data to allow a general judgement regarding the atmosphere of PPRs. For example, the short guideline for PPRs at Appliances Co. mentions the idea of a social event after the meeting and MedCare Co. stresses that the PPR should be characterised by the "*joy to have finished the task*". Another example stems from the minutes of PPRs at Engineering Co. which describes the atmosphere as factual, fair and open.

A positive and open atmosphere was clearly present during the observed PPRs at three companies. At Engineering Co. the meeting was clearly characterized by a very good relationship between the team members and the project manager who moderated the PPR. This became clear because the project manager asked the participants very often directly for their feedback and also different PPR participants expressed their opinions but very frequently then asked another team member if they share this opinion, if their view is correct or not, etc. For example, questions like: *"How do you feel from the other areas regarding time planning?"* or *"How does the group feel about this?"* were used very frequently. At Appliances Co., the observed PPR was also characterized by a very open and friendly atmosphere. The verbal contribution was distributed very evenly between the participants, i.e. there was no one who dominated the meeting, but also no one who did not actively participate. At Machinery Co., where the PPR meeting took place in a local pub, the atmosphere was the most informal and social one. The project team resembled very much a football or tennis club where everyone knows each other very well. This was demonstrated for example by the fact that everyone used the informal "Du"[27] when talking to each other.

A very different kind of atmosphere was found at MedCare Co. and Publishing Co. Interviewees from MedCare Co. described the PPR mainly as "professional". This was also observed during the PPR, where it was clearly visible that the PPR participants did not feel at ease when asked to explain certain problems which they encountered during the project life cycle. One of the project managers also mentioned to the researcher afterwards, that the PPR is always very nerve-racking because even the tiniest details need to be explained and documented for bureaucratic reasons. "*In extreme cases, our PPRs are pure stress because we only think about the form sheets that need to be filled in instead of discussing our experiences"* (PPR at MedCare Co.). At Publishing Co., the atmosphere clearly depends on the presence of senior management. It was stated by four out of six interviewees that an open and positive discussion is only possible if no senior manager is present.

[27] In German, the equivalent of "you" has two forms: "Sie" (formal, respectful) and "Du" (informal, used with close associates, family and friends).

Table 9.10: Atmosphere during PPRs

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	No details provided in the guideline.	Workshop ends with common dinner and social event	- Joy to have finished the task - Good climate for open discussion	No details found in the guidelines	No details found in the guidelines	Evidence ranges from very informal events where everything can be mentioned to formal professional meetings, where social and team aspects are not the focus.	Ideally, PPRs should take place in an open, constructive and informal atmosphere. Otherwise, the learning effect of PPRs will not surface, as the individual team members are reluctant to express their personal experiences.
Minutes of PPRs	Factual, fair and open	Project manager thanks project team	No details found in the minutes	No details found in the minutes	No details found in the minutes		
Interviews	- Very open - Informal	- Open experience exchange followed by beers and dinner - Relationship between colleagues is very open - Informal and enjoyable	- Normal professional meeting - More professional than team building	- Open - Any topic can be mentioned - Relaxed - Without protocol, especially if done during a dinner	- Business reviews professional meetings - Team PPRs very amicable - Possible to mention everything during team PPR if bosses are not there		
PPR Observations	Open and positive	Open and constructive, followed by common dinner and social event	Professional and constructive	Very informal and relaxed, lots of laughter, lots of “Prost”	Data source not available		

Although it is difficult to collect clear evidence regarding the atmosphere of PPRs, this PPR characteristic appears to be relevant for profiting from the learning potential of a PPR. It is highly recommended to support an open and constructive atmosphere where all participants feel to be at the same level and where an open exchange of opinions and experiences is possible without having to expect sanctions or other negative consequences. If this is not achieved, the flow of the PPR discussion as well as the learning effect from the PPR are clearly hindered.

9.2.11 Results of PPRs

Table 9.11 reflects that all companies document the outcome of PPRs in official minutes written by the project manager. However, it became clear that these minutes are not always written within a short time frame or sometimes not written at all. For example, the minutes from the observed PPR at Engineering Co. were never finished because the project manager did not find the time to do so within the four weeks after the PPR and was then relocated to the US subsidiary. Consequently, the issue of minutes of the PPR lost its importance for everyone involved and no one asked for the minutes more than a month after the meeting. This stands in sharp contrast with the clear aim of all five companies that the essence of the PPR discussion should always be documented shortly after the meeting by the project manager. In addition, the minutes of PPRs which were inspected at the different companies varied very much in their length and detail. Some of them gave a lot of background information which was not directly connected to the PPR discussion, others were typical action minutes, where only the open tasks were listed. For example, the final report at Machinery Co. asks for three improvement suggestions from each PPR.

At two companies (Appliances Co. and Machinery Co.) it was also stated and in one case observed that the PPR discussion resulted in a short presentation to the senior management. Appliances Co. conducts such presentations after each single PPR, while Machinery Co. only uses it for strategically important projects. Overall, all interviewees from these companies rated this approach very highly and were convinced that it is a vital element for the dissemination of the results.

Overall, the five cases showed that a verbal summary of the PPR results is always preferred to the minutes of PPRs alone. Based on this empirical evidence, it is clearly recommended that PPRs should not exclusively result in written documents, because important insights and know-how cannot be documented as highlighted by the literature on tacit knowledge. Important aspects, which are relevant to other project teams or the whole organization, should also be presented in senior management meetings, in circles of project managers or similar meetings. This is closely connected to the aspect of dissemination of PPR results, which will be discussed in the following section.

Table 9.11: Results of PPRs

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	Refers back to objectives, i.e. application of experiences in future projects	No details provided in the guidelines	Final project report	Release of project manager when steering committee signs the official report	No details provided in the guidelines	Clear focus on written results like minutes, final reports or documenting improvement suggestions. Limited use of presentations to senior management.	Each PPR should provide two different results: Firstly action minutes containing the most important lessons learnt and recommendations for future projects, and secondly a verbal presentation of these results.
Minutes of PPRs	Minutes of PPR	Documentation of discussion topics and improvement suggestions	Minutes of PPR	Minutes of PPR	Action minutes		
Interviews	- Minutes, but these are not always done - Results are derived during the discussion	- Minutes - Group discussion with the board members - Presentation to the board	- Final project report - Minutes of PPR	- Minutes of PPR - Three lessons learnt for board members - Presentation to the directing committee	- Report or minutes of business review - Action minutes - Presentation slides from business review		
PPR Observations	Minutes were announced during the PPR but finally not written because of the project managers relocation to the US subsidiary	- Minutes - Action points - Improvement suggestions - Presentation to the board members	Minutes of the PPR	- Minutes of the PPR - Three improvement suggestions for future projects	Data source not available		

9.2.12 Dissemination of PPR Results

As demonstrated by Table 9.12, the results of PPRs in all five companies are disseminated in the form of minutes or reports which are distributed to the project team (usually the PPR participants), as well as relevant higher level managers. This can either be the steering committee (MedCare Co.) or R&D directors (Engineering Co., Appliances Co., Machinery Co.) and main department heads (Publishing Co.). It is interesting to note that dissemination activities do not cover other project teams in the R&D unit. The reason for this is either because it was never done or because of the opinion that the findings of the PPR are only interesting for those people directly involved in the project. Interview results showed that most R&D team members are actually interested in other PPR results, but organize access to these informally, i.e. via their personal network. An automatic distribution of these reports is considered as negative as it would only increase the information overload.

Apart from the distribution of the minutes, a variety of different mechanisms to disseminate results could be found. At Engineering Co., the main findings are presented to other business units if the topics are of general interest. Engineering Co. also has a central documentation unit who is active in integrating general PPR findings documented in the minutes into the overall guidelines and handbooks. Both Engineering Co. and Appliances Co. also conduct regular R&D meetings, where the PPR results are discussed amongst the different project managers and R&D department heads. As already mentioned several times, Appliances Co. also uses the PPR meeting as such as a dissemination tool, because the directors for R&D and sales as well as other senior managers are invited to the last part of the PPR discussion and get the PPR results presented. Thus, the minutes of PPRs already contain the feedback from these managers. Another important finding was that several interviewees mentioned that the PPR participants represent a dissemination tool as well. *"The PPR results stay in the heads of the project team and it might happen that the same things happen again in the next project, but then these people will remember what was discussed*" (Interviewee 5, Engineering Co.).

Overall, the dissemination of PPR results is one of the main points for criticism by most interviewees, because they do not feel that the positive learning from PPRs is properly distributed in the whole company, so that the value of a PPR is automatically reduced. Thus, apart from minutes, it is highly recommended to use people-based approaches like project managers meetings or other informal ways of passing on the personal learnings from PPRs to other colleagues and project teams. In addition, it appears to be absolutely critical to support personnel rotation and a changing mixture of project team. This might stand in contrast to the saying "never change a winning team" which is frequently adapted in R&D organizations, but automatically hinders the dissemination of new insights and know-how.

Table 9.12: Dissemination of PPR Results

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	Use of experiences in subsequent projects	- Presentation to board members during the workshop - Minutes of PPRs to participants and wider distribution list	- Minutes of PPR are sent to project team and steering committee or main department heads	- Official form sheets in project archive - Minutes of PPR to project team and board members	No details found in the guidelines	Dissemination usually centres around the distribution list of minutes of PPRs or the integration of gathered experiences in official guidelines. Dissemination via participation to future projects is hardly mentioned, but presentation of results to senior managers or other project externals seems to be occasionally used as well.	Clear focus on dissemination of documents within a very tight circle of the project. Wider dissemination needs to be a mixture of document, personal, informal and presentation approaches. If not, the PPR results will not lead to an improved R&D organization. Innovative approaches such as video interviews of the project manager being interviewed about the project could be useful. Anecdotal evidence of this practice at Hewlett Packard emerged during the pre-pilot phase of the research.
Minutes of PPRs	Present general improvement suggestions to other business areas and R&D managers; include aspects in the official guideline	- Presentation of workshop results to senior management at board members - Distribution list of minutes	No evidence found regarding the dissemination of PPR results	Minutes are distributed to project members and PPR participants	Minutes are distributed to participants of the meeting		
Interviews	- Minutes are disseminated to core team and also stored in heads of participants - No transfer to other business units	- Presentation to the board members - Distribution of minutes down the hierarchy - Presenting results during project committee meeting	- Distribution of minutes to project team - Relevant points are integrated into the company guidelines	- Distribution of minutes to project members - Presentation to the directing committee	- Participants plus some high level managers receive minutes - Participants take away a lot of experiences		
PPR Observations	Limited to PPR participants	- Distribution list of minutes - Presentation of workshop results to management	Participants and main department heads receive the minutes	Minutes of PPRs are distributed to team members	Data source not available		

9.2.13 Creation of Action Points

Although the guidelines for PPRs do not provide a lot of specific instructions for the creation of action points, it is clearly visible from Table 9.13 that action points are derived by all five case companies. Furthermore, evidence from all companies shows that the action points are always documented and distributed via the minutes of PPRs. In most cases, these action points are also supplemented by deadlines and responsible people who are supposed to look after these open issues until a specific point in time. Yet, it was observed at Appliances Co. that no deadline could be allocated to a great number of action points due to the fact that a realistic time frame could not be estimated by the PPR participants. At MedCare Co. and Machinery Co. the issue of action points is understood very much in terms of remaining tasks from the project as such instead of new actions discussed during the PPR, which can also be of a very general nature and process-related.

One of the most frequent criticisms voiced by interviewees is that action points are not always followed up - either not at all or not in an efficient way. There are several reasons for this. At MedCare Co. and Machinery Co. the responsibility for the follow-up of the documented action points is always and exclusively allocated to the project managers. In other words, any open actions connected to the project remain his responsibility, even if he is already involved in new projects and the team is already dissolved. "*The follow-up is very clearly done by the project manager. It is also his responsibility to set the priorities. I guess if we finish the project it means that the product is good and fit for the market, but if the recommendations of the project team are followed up is the decision of the project manager*" (Interviewee 5, MedCare Co.). Consequently, it is not surprising that the follow-up of action points of a completed project has a lower priority for project managers than solving current problems of a running project.

Another problem regarding the follow-up of action points is that general action points can only be followed up by the top management. This means the project team delegates certain tasks to their bosses, but apart from Appliances Co., where the top management can comment on these points during the PPR, the top management knows about these action points only once they receive the minutes of PPRs. The same problem exists if the people who are responsible to follow up certain action points are not participants of the PPR (Engineering Co., Machinery Co., Publishing Co.).

Consequently, it is vital to differentiate between project related action points under the responsibility of the project manager and general action points, for which a specific person or department should be responsible. This person or department could then gather action points from all PPRs, find synergy effects and also communicate once certain action points are ticked off.

Table 9.13: Creation of Action Points

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusions	Recommen-dations
Guidelines for PPRs	No details provided in the guidelines	No details provided in the guidelines	Clarification of responsibilities for open action points	Open issue list is part of official final project reports including deadlines and responsible people	Business review minutes contain next 5-10 steps to be tackled	Action points are derived and documented, sometimes also with responsible person and deadline. Frequent critique of interviewees that the follow up of action points is missing.	Clear allocation of responsibility for the follow-up of action points. General action points need to be differentiated from project-specific ones, which have to be followed up by the project manager.
Minutes of PPRs	Documented including deadline and responsible person	Documentation with responsible person	Action points are listed with responsible person	No data found for action points	Included in action minutes		
Interviews	Documented in minutes, but follow-up often missed out	- Action points for team and board are derived with deadlines, but not always followed up - Included in minutes - Solution and action to each problem is derived	- Fixed in minutes with responsible person and deadline - Follow up done by project manager	- Project manager follows the open item list - Documented in the minutes with responsibilities and deadlines	Included in action minutes		
PPR Observations	Agreed during the discussion and documented by project manager	Documentation with responsible person	Only done for specific outstanding tasks from the project	Some open issues and action points were discussed, but were already on the way to being solved	Data source not available		

9.2.14 Agreement on Improvement Suggestions

Although Improvement suggestions are mentioned in all guidelines apart from Publishing Co. as clearly set out in Table 9.14, no details are provided about what kind of improvement suggestions should be derived during the PPR discussion. Only Machinery Co. stresses that at least three improvement suggestions need to be documented after the PPR on the official form sheet which is part of the project archive. Yet, during the inspection of the different minutes of PPRs, a wide range of improvement suggestions could be found, which ranged from technical changes over communication processes to the improvement of internal routines. Only the minutes at MedCare Co. and Machinery Co. did not provide any details on agreed improvement suggestions.

Similarly, interviewees from all case companies confirmed that improvement suggestions are discussed within the team during the PPR discussion. This was also verified by the different PPR observations. For example, during the observed PPR at Appliances Co., the documentation of improvement suggestions was a separate discussion in the final part of the PPR. Generally, all improvement suggestions are documented by the project manager in the minutes of PPRs, often also with responsible people allocated to the single issue. The problem in following up these improvement suggestions goes in line with those discussed in the previous section for the action points, because controlling how these improvement suggestions are actually implemented is very seldom done. The reason for this is usually that even central project management units do not see these controlling aspects as their responsibility, and project managers are already released from their responsibilities.

As a result, the improvement suggestions derived during the PPR discussions as well as the action points should not only be documented in the minutes, but also presented to the responsible people verbally, so that no misunderstandings are created as to what sort of actions were agreed upon. Since all case studies showed that the follow-up of action points and improvement suggestions demands a clearer allocation of responsibilities, a specific person or department needs to be allocated to this task. In other words, each company needs to establish absolutely clear rules who carries the overall responsibility that the improvement suggestions from PPRs do not get lost in the daily business or because of new active projects. If no department can be found to accomplish this task, the responsibility should be allocated to the R&D director.

Table 9.14: Agreement on Improvement Suggestions

Data source	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Conclusion	Recommen-dations
Guidelines for PPRs	Improvement suggestions are discussed and documented	Recommendations for internal purposes	Discussion of recommendations for the future	At least three improvement suggestions need to be derived from the team	No details found in the guidelines	Improvement suggestions for future projects are derived by all case companies and usually included in the minutes of PPRs.	Same approach needed as discussed for the follow up of action points, i.e. clear allocation of responsibility needed. Separate responsibility for project specific and more general improvement suggestions.
Minutes of PPRs	General improvement suggestions are listed	Documentation of a wide variety of improvement suggestions	No data found in the minutes	No data found in the minutes	Improvement suggestions are documented in the minutes		
Interviews	- Agreed during discussion - Documented in minutes	- Intense group discussion during PPR - Team gives recommendations for future	- Intense discussion, but not always documented - Critical reflection in terms of future projects	- Often of technical nature - Three improvement suggestions are discussed in the team	- Derived on the basis of bad experiences - Sometimes general process improvements are discussed.		
PPR Observations	- Agreed during discussion - Documented by project manager	Discussion derived 5 most relevant topics for improvement and their individual components	Short list was discussed and documented in the minutes	Many improvement suggestions discussed in the team and noted by the project manager	Data source not available		

9.3 RECOMMENDATIONS BASED ON THE RESULTS

The depth of data collected on the PPR practices of the five case companies allow clear recommendations to be developed, which were already mentioned in each individual section based on the empirical evidence. Table 9.15 summarises the empirical evidence and the practical recommendations following from the analysis of all data sources across the five companies.

In the following, some representative recommendations included in Table 9.15 and how they interact will be discussed in more detail. First of all, it became clear that the communication of the PPR objective is a critical point to be addressed by the R&D top management. If project managers and PPR participants are not clear about the objectives of the PPR event as such, it is highly unlikely that learning will result and the risk is high to turn the PPR event exclusively into a formal closure of the project. Therefore, it is absolutely vital, that not only the guidelines for PPRs, but also project management handbooks and training documents for junior project managers highlight the reflection and learning objective of PPRs. This is also closely connected to the atmosphere during PPRs. If PPRs are expected to derive objective lessons learnt and a critical discussion of the gathered experiences, the company culture and most importantly the top management needs to support such an open discussion. If PPR participants do not feel that they can express their personal opinion without risking penalties or negative consequences (see Publishing Co.), the PPR meeting will not be able to contribute to a learning R&D organization.

Another important point to mention is that in the literature, it is well recognized that a moderator is important for the quality of PPRs. However, few ideas are given about how a moderator can stimulate the PPR discussion and knowledge generation. From Appliances Co. it can be learnt that a moderator provides not only a more objective discussion, but also helps to structure the discussion and relieves the project manager from participating and leading the discussion at the same time. In addition, moderators are more likely to place particular focus on special discussion methods and approaches which are more likely to result in storytelling and know-how transfer (such as the use of “satisfaction curves” at Appliances Co.). Therefore, these approaches represent an efficient way for the creation and transfer of tacit knowledge (see also Chapter 11). If external moderators are used, these can also re-use experiences from previous PPRs they moderated within the same company, so that the moderator himself acts to some degree as a dissemination tool of lessons learnt as well.

Table 9.15: Key Recommendations Based on Empirical Evidence

	PPR issues	Empirical conclusions	Practical recommendations
1	Objective of PPRs	• Common reflection • Analysis of gathered experiences • Application of experiences to future projects	• Clear communication of the objective for PPRs by top management • Focus should be placed on common reflection and learning targeted at future improvement of the organization
2	Timing of PPRs	• PPRs take place much later than originally planned, i.e. not 3-6 months after market launch	• PPRs should be part of the original project plan with a firmly established delay between market launch and date of PPR
3	Duration of PPRs	• On average half a day	• Duration needs to be adjusted to the project size and its strategic importance • Particularly if PPR is scheduled for more than 2 hours, good moderation is very important
4	PPR participants	• Core project team members • In some cases steering committee or senior management	• Dissemination of lessons learnt can be facilitated by having project-external staff members present • Participations of senior management allows direct transfer of lessons learnt and shows appreciation of the teams achievements
5	Moderation of PPRs	• Generally the project manager is the moderator • External moderators are less frequently used	• Moderators external to the project are advisable as they can facilitate the discussion • Ways of stimulating discussion are important and should be integrated into the guidelines
6	PPR discussion method	• Unstructured team discussion and reflection • Visual aids only seldom applied	• Use of visual aids and special discussion techniques is recommended if the location allows this
7	Location for PPRs	• Normal meeting rooms, sometimes followed by a common dinner • External meeting rooms seldom used	• Different location from normal meetings are advisable to stress different character of PPR • Social locations are advisable to support the team building during the PPR
8	Use of guidelines for PPRs	• Guidelines for PPRs very seldom used	• Quality of guidelines for PPRs needs to be ensured and their applicability to managerial practice should be tested in advance
9	Preparation of PPRs	• Review of documents, reflection of team members to presentations of project managers and networking with experienced colleagues	• Encourage individual or team reflection on the project before the PPR takes place • Original ideas for "social event" are needed
10	Atmosphere during PPRs	• Ranges from very informal events to formal professional meetings	• PPRs should take place in an open, constructive and informal atmosphere
11	Results of PPRs	• Written results like minutes and final reports • Limited use of presentations to senior management.	• Each PPR should provide action minutes as well as a verbal presentation of results

Table 9.15: Key Recommendations Based on Empirical Evidence (ctd.)

	PPR issues	Empirical conclusions	Practical recommendations
12	Dissemination of PPR results	• Distribution list of minutes of PPRs • Integration of gathered experiences in official guidelines • Dissemination via participation to future projects is hardly mentioned • Presentation of results to senior managers or other project externals only used occasionally	• Dissemination needs to be a mixture of document, personal, informal and presentation approaches • Innovative approaches (e.g. video interviews of project managers containing main lessons from project) could be useful
13	Creation of action points	• Action points are derived and documented • Follow up of action points is often missing	• Clear allocation of responsibility for the follow-up of action points • General action points need to be differentiated from project-specific ones
14	Agreement on improvement suggestions	• Improvement suggestions for future projects are included in the minutes of PPRs	• Clear allocation of responsibility needed • Separate responsibility for project specific and more general improvement suggestions

The point of dissemination of the results of the PPR discussion was most frequently mentioned by the interviewees across all five companies. It is clearly evident that currently too much focus is placed on the written documentation and dissemination of minutes. Verbal or personal approaches are only used to a very limited degree. However, dissemination could ideally start with the list of PPR participants, because junior project managers about to start their first R&D project or project managers from other business units could be invited to the whole or a part of the PPR in order to profit from the discussion, because minutes only contain a limited amount of know-how derived during the meeting. Such an approach would follow the example of Appliances Co. where the project team presents the main results to the senior management in the final part of the PPR. The number of participants of this round could easily be extended to other R&D managers as well, because it could facilitate the verbal dissemination to a wider audience. In addition, the over-reliance on written minutes which contain explicit knowledge only, could be reduced. Yet, this recommendation is not reflected in any of the existing guidelines for PPRs.

Another very critical point found across all five companies is that action points as well as improvement suggestions are not followed up in a professional way. Consequently, at least a certain part of the PPR results is lost and the PPR is automatically limited in its potential to support knowledge creation and learning for the whole R&D organization. No evidence from the existing PPR literature and none of the five case companies provide any guideline as to how follow up activities should be organized. Therefore, it is recommended to strongly differentiate between project-specific actions and improvements (these are clearly the responsibility of the project manager) and general all-encompassing issues which should be looked after by a dedicated person or department established by the R&D director.

9.4 CONCLUSIONS

Reflecting on the detailed discussion of the current practices, it is clear to see that current PPR practices vary a lot across the five case companies. Nevertheless, it was possible to derive a number of practical recommendations for R&D managers, which can be adapted to the needs of their specific R&D organization accordingly.

These recommendations do not intend to add to the variety of existing guidelines and checklists for PPRs, but want to provide a flexible framework useful for R&D managers who are not yet conducting PPRs or are not yet satisfied with the quality of their PPR process. It is clearly evident from the inspected data that particular attention needs to be placed on the dissemination of the PPR results and the follow up of the agreed actions and improvement suggestions after the PPR has happened. If this is not done in an efficient way, the learning potential of PPRs will always stay exclusively with the participants of the PPR and cannot be extended to the rest of the R&D organization.

9.5 SUMMARY

This chapter presented the cross-case analysis of current PPR practices found in the five case companies. The discussion was based on the triangulation of evidence from documents, interviews and PPR observations. Overall, 14 different characteristics like for example PPR participants, moderation of PPRs or PPR results were inspected and discussed in detail.

Based on these findings, clear practical and managerial recommendations concerning each of the 14 characteristics were presented. These are either best practice examples from one of the five case companies or are based on obvious shortcomings from the inspected practices. It is also important to mention, that these recommendations frequently overlap with each other. For example, the choice of PPR participants has a clear impact on the dissemination of PPR results, and the presence of senior management during the PPR might influence the atmosphere as well as the follow up of the agreed improvement suggestions.

CHAPTER 10 PERCEPTIONS OF PPRs

"The aim of a PPR is to become a learning organization."
(Interviewee 7, Appliances Co.)

10.0 INTRODUCTION

This chapter focuses on the second research question: "*How are post-project reviews perceived by participants and R&D managers?"* The intention is to highlight the personal perceptions of PPR participants and R&D managers. Personal perceptions are important in that they give an indication to the level of acceptance of PPRs and provide clues as to how they can be more effectively utilized.

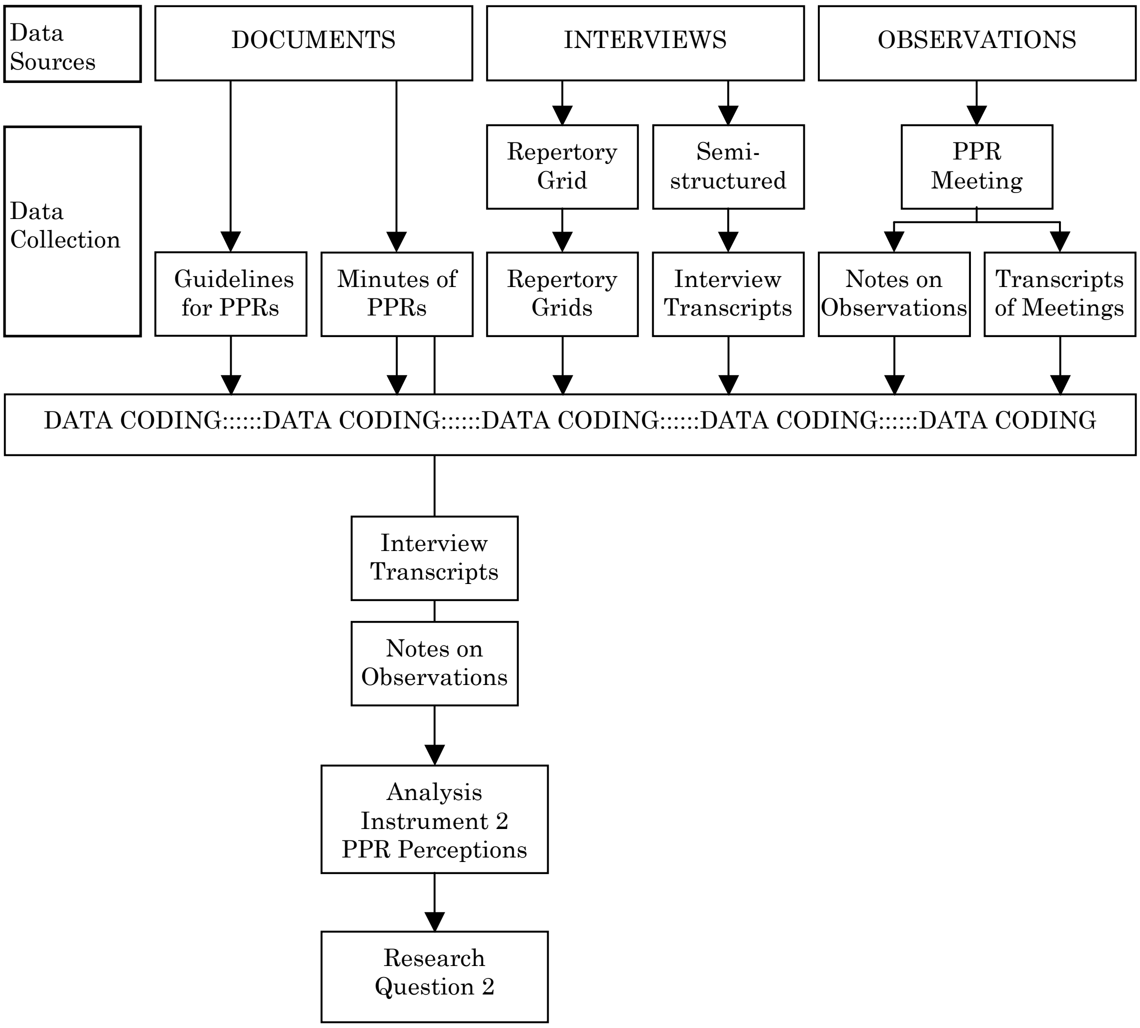
The main sections of this chapter cover:

- The data sources used for analysing PPR perceptions;
- Judgements of PPRs in general;
- Participants' personal objective for PPRs;
- The role of PPRs for a learning organization;
- The outcomes of PPRs;
- The dissemination of PPR results;
- Alternative ways to exchange experiences and lessons learnt.

10.1 DATA SOURCES USED

The main data source used for investigating perceptions of PPRs were the semi-structured interviews (see Figure 10.1). This was because perceptions are very difficult to observe and are normally not documented in minutes or other reports, although - as shown in Figure 10.1 - some comparisons were made with the data from the PPRs observed.

Figure 10.1: Data Sources Used for Research Question 2



In total, 31 interviewees expressed their personal views in the interviews. Although the same semi-structured questionnaire was used for all 31 interviews, a certain degree of missing data had to be accepted. Table 10.1 illustrates the number of answers from each company for the six different categories of perception investigated. It shows that for each of the questions between 23 and 29 (maximum) answers from the 31 interviewees could be derived. There are two main reasons for this: firstly, the limited amount of time available for the interviews (a maximum of strictly one hour was agreed) led to some interviews being terminated before all questions had been discussed. Secondly, some interviewees answered several questions within one answer and it was then sometimes difficult to allocate such answers clearly to the categories. However, some answers given by individual interviewees contained two aspects and thus received two codes during the analysis, which means that the overall total of allocated codes can sometimes be higher than the total of interviewees who answered a particular question.

Table 10.1: Available Data Regarding PPR Perceptions

Category No	Aspect	Engineering Co.	Appliances Co.	MedCare Co.	Machinery Co.	Publishing Co.	Total
1	Judgements of PPRs	5	7	5	5	6	28
2	Personal objectives of PPRs	5	5	6	5	2	23
3	PPRs and learning	4	7	5	6	6	28
4	Outcomes of PPRs	5	6	6	5	5	27
5	Dissemination of results	6	6	6	5	5	28
6	Alternatives to PPRs	6	7	4	6	6	29
	Number of interviewees	**6**	**7**	**6**	**6**	**6**	**31**

Individuals' perceptions will be presented separately per category in the following sections. All answers were coded following an inductive logic, i.e. the codes were derived on the basis of the quotes and had not been determined before the data collection. To demonstrate the full trail of evidence, Appendices 5.1 to 5.6 list the full quotes from the interviews and the codes for each of the six categories (between each of which there is a degree of overlap). All of the quotes have been translated into English.

10.2 JUDGEMENTS OF PPRs

Interviewees were asked *"What do you personally think of PPRs in general?"* Judgements varied a lot across the interviewees and also across the different case companies. Several statements could be identified (see Appendix 5.1 which is ordered by "positive", "neutral" and "negative" judgements) which will now be discussed in more detail.

There were 15 "positive" comments across the 28 interviewees. From these, six interviewees mentioned that they value the importance of the PPR discussion very highly. The reasons given for this ranged from "*common reflection*"[28] over "*expert communication*"[29] to "*gathering and discussing project knowledge*"[30] and "*good investment of time*"[31]. In other words, the PPR is perceived as an ideal event at which to discuss what happened in the project, because all experts are present. PPRs were also perceived positively, because they allow projects to be considered from different viewpoints with the help of colleagues. PPRs were considered as a

[28] e.g. Interviewee 5, Appliances Co.
[29] e.g. Interviewee 2, Engineering Co.
[30] e.g. Interviewee 3, Appliances Co.
[31] e.g. Interviewee 2, Machinery Co.

good investment of time, because they can help to avoid problems and the repetition of mistakes from previous projects (project-to-project learning). PPRs were also perceived as a source of ideas for future projects.

Another positive aspect which was mentioned three times was that PPRs represent the official end of a project. This was not perceived in a negative or bureaucratic way by the interviewees, on the contrary it was perceived as positive and a clear signal of the end of a project (which avoids that a project "fizzles out" and is never officially terminated). The main advantage of such an official end to projects was described as the release of the project manager and his team from all the responsibilities connected with that project. Three other interviewees stated that PPRs are an ideal event at which to recognize and reward the performance of the team for the overall outcome of the project.

Across all interviewees, there were four "neutral" statements regarding PPRs in general. Two interviewees mentioned that official PPRs should only be recommended for bigger projects. On the one hand, the effort is too high for smaller projects, on the other hand the formalism of PPRs is not efficient for smaller meetings, where PPRs are probably better done in an informal way, instead of scheduling a separate meeting.

Another neutral viewpoint was that the PPR itself is very much dependent on the culture of the NPD team. It was stated twice that if the atmosphere within the team and within the R&D organization is not open to constructive criticism, then the output of a PPR will definitely suffer. Therefore, it is vital that all PPR participants are honest and discuss openly the positive as well as the negative aspects of projects. This is a prerequisite if a team is to make a constructive analysis of a project.

Amongst the interviewees, there were nine "negative" views expressed regarding PPRs. Five interviewees stated that PPRs are not conducted at all, or are not supported by the top management (and are therefore highly dependent on the project manager's own efforts). From these five negative statements, four stem from Publishing Co., where PPRs on the project team level are not officially asked for. It was even stated that at Publishing Co. the management might consider a PPR as a "waste of time", which is why the project managers are often reluctant to conduct PPRs on their own initiative.

Another negative aspect mentioned twice, was the problem of time constraints. As R&D organizations generally face increasing pressure to come up with new innovative products, several interviewees mentioned the high pressure to finish a project and to move quickly on to the next. Consequently, two interviewees considered it to be more important to kick off new projects than to reflect on completed ones.

Only two out of 31 interviewees mentioned that they see no personal benefit from PPRs at all. The first one, a project controller, finds no real new insights emerge from PPRs. For him, the discussion of technical and team-internal aspects is not relevant, because he is involved in many different projects in parallel. The second, from R&D, views PPRs as too bureaucratic and thinks that his work does not depend on the work of the other project members.

Overall, the perceptions of PPRs were found to be generally positive - except in the case of interviewees from one company (Publishing Co.) that appears not yet to have successfully introduced PPRs into its R&D organization. Obviously, PPRs take time and this is at a premium in R&D organizations today. Only two interviewees perceived there to be no value in PPRs - although this part of the research is not aimed to quantitatively significant, this appears to represent a small minority of respondents in the case companies.

10.3 PERSONAL OBJECTIVES OF PPRs

The second question was: "*What do you personally want to achieve with a PPR*?" As illustrated in Table 10.1 only 23 out of 31 interviewees provided an answer to this question. The main reason for this was that the interviewees at Publishing Co. had difficulties to identify meaningful objectives for PPRs, since they felt that PPRs on the project team level will never be effectively used by their organization. For example, Interviewee 1 at Publishing Co. stated: "*You want to know my personal objectives for PPRs? Good question, but a waste of time to think about, because it will never properly happen here - I promise you.*"

Aside from Publishing Co., many interviewees gave several personal objectives for PPRs. Appendix 5.2 lists the quotes from the interviews and also illustrates the allocated codes. Overall, the objectives that interviewees want to achieve from PPRs can be grouped under six different codes: "evaluation", "learning", "improvement", "discussion", "team" and "formal". Some interviewees also referred to two different objectives in their answer and were allocated two codes.

The objective most frequently mentioned (in total 13 times) was that a PPR enables an evaluation of a project after the product has been launched in the market. Shared reflection is considered to be important because all project participants are present and because all aspects can be looked at from different viewpoints. In addition, feedback regarding these viewpoints can be exchanged there and then. Out of the 13 interviewees referring to evaluation, three interviewees also mentioned that they personally would like to evaluate the project fully during the PPR. This means not only looking at the project outcome and its quality, but also referring back to the original objectives of the project and analysing if these were met and to what degree. (These comments indicate that some PPRs are perceived to focus too tightly on project outputs, rather than the process.)

An objective which was mentioned nine times across the interviewees was to learn on the basis of the experiences gathered during the completed project. It was perceived that learning can result from either positive or negative experiences, from mistakes or from successful practices which were applied. Often, the objective is not only to learn, but to learn for the future, i.e. in order to apply the experiences and lessons learnt to future projects (thus contributing to a learning R&D organization).

An objective to identify suggestions for improvements in projects based on the experiences gathered was mentioned by seven interviewees. Such suggestions could then be applied to future projects and also integrated into official guidelines and handbooks.

Two interviewees stated that PPRs should ideally be a forum for discussion and the exchange of information within a project team. This objective is different to learning in that it merely refers to that fact that all PPR participants are put on the same level of information. Yet, it does not automatically imply that evaluation or learning takes place at the same time. Another personal objective mentioned twice was the recognition of the team achievements, to thank everybody involved and also to motivate the project team for the coming projects.

One interviewee stressed that his personal PPR objective would be to officially close and finish the project so that all responsibilities are then assigned to the line departments and the project manager and his team are relieved from the project tasks.

An interesting aspect from the personal objectives identified, is that the majority of interviewees are focused on the project team, as opposed to project-to-project learning. It appears that participants could and should be made aware during the PPR introduction of the potential for project-to project learning and individuals' roles in this.

10.4 PPRs AND LEARNING

This section discusses interviewees' answers regarding a question which was targeted at the role of PPRs in supporting a learning organization: *"How do post-project reviews support the learning from projects from your point of view?"* Appendix 5.3 lists the most relevant quotes from the interview transcripts and groups them into "positive", "neutral" and "negative" statements.

The majority of responses (23 from 28 interviewees) were "positive" about the role of PPRs in supporting learning. First of all, PPRs were perceived to facilitate the exchange of experience, because the discussion exposes different viewpoints which individuals may not have recognized. *"Of course there are always some issues that everyone is surprised about how they develop into big problems during the PPR discussion or vital elements without anyone realizing this before"* (Interviewee 4, Appliances Co.). This is helped in that a PPR usually brings together the whole project team, and not only the core team. Thus, the pool of experience available is higher than in many project meetings where certain sub-teams discuss specific issues. It was also mentioned that staff outside of the core project team (e.g. purchasing, controlling, etc.) gain a lot of insights during a PPR since they are not always closely involved in all aspects of the project. However, this was stated by R&D mangers only and has to be acknowledged as speculation, because it was not at all supported by representatives from the purchasing or controlling departments and stands in sharp contrast to the viewpoint from the project controller at Appliances Co.

Another positive aspect was that PPRs trigger personal reflections and lead to brainstorming within the team which does not happen during other meetings. *"There are certain issues that only come up at the end in the review, because only then you have the time and quietness to actually think about causes and consequences"* (Interviewee 2, Appliances Co.). The reason for this is that the individual members look at all events in hindsight and have already accomplished their task, i.e. they feel already more detached from the project work and therefore also less stressed to find solutions to specific problems within a short time frame. It was also mentioned that the discussion during a post-project review enables more transfer of know-how within the team than anything that might be formally documented and stored in databases. *"During the discussion the real important points emerge within the team - you will never find these points in minutes or databases"* (Interviewee 7, Appliances Co.).

Three interviewees in total voiced "neutral" opinions regarding the supporting role of PPRs. For example, one interviewee said that the contribution of a PPR to learning can only be differentiated when looking at the effectiveness of future projects. Two other interviewees stated that a learning during PPRs is only possible for people from departments which are further away from the daily project work. *"I think the effect that you learn something during the meeting only happens with departments which do not deal closely with development, such as controlling, marketing, these kinds of departments"* (Interviewee 2, Engineering Co.). However, the two interviewees who voiced this opinion are both R&D managers who only suppose that colleagues from non-R&D departments can learn more. (In addition, their view is in direct contrast to the view of a financial controller discussed in the previous section.)

Only two interviewees expressed clearly "negative" perceptions regarding the role of PPRs in supporting learning. One said that PPRs have limited utility in that they discuss problems and potential improvements but action issues are very seldom followed-up in a professional way. The second negative view was that PPRs are only effective if the company culture supports open discussion. Without a company culture which is open for honest discussion, PPRs were perceived as not being able to contribute to a learning organization at all.

Overall, it is fair to conclude that the positive role of PPRs for learning has been confirmed by the majority of interviewees. Yet, it is also important to stress that this learning depends to a high degree on the way the discussion is structured and moderated, and the time a company invests for in-depth reflection during a PPR.

10.5 OUTCOMES OF PPRs

The next aspect looked at with the interviewees was the ideal outcome of a PPR. This was based on the question: "*What should ideally be the outcome of a PPR*?". Appendix 5.4 illustrates the relevant quotes regarding this aspect and allocates each quote to one of the three following quotes: "action-based", "document-based" and "social interaction".

Overall, the interviewees had some interesting views on what they perceived as the ideal results of a PPR. In total, 15 interviewees out of 27 thought that written summaries were an ideal outcome. This can be either the official final project report, the official minutes of PPRs or internal guidelines and checklists. Both are usually written by the project manager after the PPR has taken place and should include the main points discussed. It is interesting to note that three of the 15 interviewees mentioned a document-based approach, because they did not think that any other method would work in their organization. For example, at MedCare Co. only documents can be transferred to other business units, because there are no personal relations to the colleagues from the other business units. A project manager at Publishing Co. recommended documents as the preferable PPR result, because the company culture does not support personal ways of capturing the outcome of a PPR. The remaining 12 interviewees very frequently stated the status quo regarding the results of PPRs in their organization instead highlighting their personal preferences. For example, Interviewee 2 at Machinery Co. stated: *"Well, we do a protocol for every meeting, so also for the final meeting. The project manager has to do that."*

It is interesting to speculate that the 15 interviewees that identified minutes and other documents as the ideal result from a PPR may have not yet experienced more direct outcomes. Therefore, it appears important that a clearer link is made between PPRs and action, so that every PPR leads to specific improvements (which become known throughout the R&D organization). Additionally, it is interesting that the 15 interviewees have not recognized that documents have limitations. For example, tacit knowledge cannot be disseminated by documents. This means that many interviewees do not have a clear understanding of the different types of knowledge that can be created.

Ten interviewees out of 27 went further than mentioning documents and expressed the view that achieving action points is important. Such action points should be accomplished by a specific person until a specific point in time. The action points can be general improvement suggestions, the most important aspects to be considered in future projects or a checklist of remaining actions – all these are also considered to be a vital result of PPRs.

In addition, eight interviewees recognized the problems of sharing results and suggested social interactions as the optimal outcome of a PPR. *"I always prefer to do personal presentations after the PPR took place, because only the interaction between people can really transfer the knowledge gained during the meeting"* (Interviewee 4, Machinery Co.). They emphasised that the result of PPRs cannot be documented in an efficient way and that the exchange of information, the team-internal discussion and the solving of problems right there during the PPR is for them the most important result. This was highlighted by Interviewee 2 at Publishing Co in the following way: *"You cannot really write down experiences, even if you try. This is almost impossible and it would be a huge book."* Approaches based on social interactions also include the verbal and visual presentation of the results to the board members as practiced at Appliances Co., since only verbal communication is able to carry across the results from the PPR.

10.6 DISSEMINATION OF PPR RESULTS

Interviewees were asked "*How should PPR results be disseminated*?" Appendix 5.5 lists all relevant quotes and separates between "document-based" and dissemination approaches based on "social interactions".

A majority of interviewees (19 out of 28) stressed that results should ideally be disseminated through social interactions, i.e. in an informal way. It was stated by four interviewees that it is easier and more efficient not to read the minutes from other PPRs, but to communicate informally with colleagues who took part in the PPR meeting as such. *"I hope that we will find a way that replaces the written minutes, because they are useless. We probably have to do it more on an informal personal level to make it happen"* (Interviewee 2, Appliances Co.). This of course depends very much on the existence of a functioning personal network of the PPR participants, which was put forward by three interviewees as the ideal way to disseminate PPR results. It was stressed by six interviewees that the best dissemination of PPR results takes place via the participants as they will apply their learnings from the previous project and PPR automatically to future projects in which they take part. For example, Interviewee 5 at Engineering Co. phrased it in the following way: *"Those who participated have taken something new away and if they are in the next project they might get up and say - attention please - we had this before."* Two of the R&D managers interviewed suggested that important lessons from PPRs can be disseminated verbally on the hallways or via the grapevine of the R&D organization or different departments. Alternatively, the results could also be presented and delegated to the steering committee, so that it is their responsibility to disseminate the results within the wider organization.

Three interviewees proposed to organize specific presentations where PPR results could be verbally presented by the project manager or team members to other members of the R&D organization or the management board. Since many of the experiences gained from a project are very difficult to write down, this was suggested as a better way to get across the "story" of the project.

In addition to the 15 interviewees who suggested documents as the ideal outcome of PPRs, 10 interviewees suggested to use documents as well in order to disseminate the results of PPRs. Usually, the project team plus senior managers should receive the minutes of PPRs from the project manager. It was emphasised by four interviewees that minutes from all PPRs can be accessed and read because the networking between different project teams functions. For example, Interviewee 6 at Appliances Co. mentioned: *"I get the minutes of PPRs in order to learn from it. I insist on getting them. It is very important even if I only know the projects from the far."* This means, that even if a specific person is not on the distribution list of the minutes of PPRs, it is not difficult for this person to get hold of the documented results. One of the critical success factors of such a document-based approach, though, is that minutes are not too long, because the problem of information overload was mentioned four times in total. *"Our minutes are not so bad at all, assuming that they have not more than one or two pages - we really suffer from information overload in this company"* (Interviewee 1, Machinery Co.). Finally, another document-based method of dissemination suggested by three interviewees was to integrate PPR results into the official guidelines and handbooks. Such an approach makes it highly likely that the experiences are applied in future projects assuming that these future project teams actually refer to the checklists and handbooks available.

10.7 ALTERNATIVES TO PPRs

In order to analyse how PPRs are perceived, the comparison of PPRs with other internal mechanisms to transfer experiences and lessons learnt appeared to be relevant. Therefore, one question was: "C*an you think of any other mechanisms to share experiences and lessons learnt in your organization?*" Appendix 5.6 displays the quotes regarding this question and groups them into the codes "social interactions", "meetings", "IT-based" and "document-based".

The mechanism most often mentioned as a potential alternative to PPRs was social interactions (15 interviewees from 29). Such mechanisms are any kind of personal relationship within a department, project group or company which enables the informal exchange of ideas and experience. For example, senior employees in a company often gain a reputation to have their know-how in a very particular area and are consulted by colleagues if questions in this area arise. However, these networks are always informal and not supported by the organization in any way. One factor that supports these informal networks is the co-location of experienced colleagues with younger members of staff. Examples are a common project office where discussions are automatically facilitated and no "closed doors" or "walls" exist to hinder access to know-how carriers. *"What I usually do is to ask the person who sits opposite of me…this informal way works good enough, it does not need to be introduced formally"* (Interviewee 2, Appliances Co.)

Informal networks and personal discussion can work well and it was mentioned that they provide the easiest and quickest way to find answers to complex questions within an organization. However, as the number of experienced employees with real know-how is usually limited, it was recognised that it is sometimes necessary to "pester" these colleagues in order to obtain the relevant information. In addition, it was mentioned that one-to-one discussions are on the one hand very focused, but on the other hand they do not provide the same kind of insight as a post-project review, because these combine insights from a wider group of people.

One mechanism which is used to transfer knowledge are "godfather" project managers at Engineering Co. These are experienced project managers assigned to meet weekly with junior colleagues in order to discuss their current issues and answer questions - a formal way to stimulate the creation of networks.

An alternative to PPRs which is closely connected to social interactions are meetings of project managers, which were mentioned by nine interviewees. *"A regular meeting of project managers every two or three months could be useful. That we look together at projects and say what does not work properly. This should be optimised really, because at the moment there is nothing formal yet"* (Interviewee 4, MedCare Co.). However, most interviewees thought that a regular meeting of managers from different projects makes sense and ensured that project managers take time to exchange knowledge. The frequency of these meetings, however, varied a lot between the case companies. Some have the practice to meet each week, some every two or three months and some only once or twice a year. It can be speculated that the frequency dictates to a certain degree the scope of the discussion. While weekly meetings are likely to focus on day-to-day operational points and less on strategic issues, organizations where project managers meet only once or twice a year probably place more emphasis on looking at their general internal processes and less on specific project experiences.

Interviewees also perceived coaching meetings to be useful. In these, an experienced project manager discusses example problems with a group of junior members of staff in an informal session. This can facilitate the transfer of lessons learnt and also develops the capacity to solve similar problems within the group. An important issue mentioned once (which also came up frequently in other parts of the semi-structured interview) is that informal networks depend on the time that an employee has worked in an organization. Also, informal networks depend to a high degree on a low turnover of employees within an organization, because employees' know-how usually is lost when they leave. Low employee turnover was observed in all five companies, which partly explains why the importance of informal networks was stressed by so many interviewees. At all companies except MedCare Co., it was often stated that you are only a company "insider" after about 15 years and not earlier.

According to the statements from seven interviewees, three out of the five case companies actively use databases to store project information and experiences. However, it was perceived that the information in databases is not only comparatively difficult to access, but also not suitable to answer specific questions which might arise during a R&D project. Another criticism of databases was that the stored information is either out of date or subject to censoring by various departments. Due to the increasing time pressure that most companies face in product development, often the input of project experiences is simply not done in order to save time and based on the thought that the real important aspects cannot be written down anyway. Therefore, databases are most often used to store technical features like quality problems and how they can be solved or the outcome of testing machinery components as explained by Interviewee 7 at Appliances Co.: *"We have a lot of databases, e.g. a database where you can look at occurrences when testing a component."*

Four interviewees mentioned official guidelines, checklists or handbooks as potential alternatives to PPRs. At Publishing Co. these guidelines are considered as helpful because until recently no such handbooks existed and especially new members of staff now use it as a reference book regarding the new product development process. At Machinery Co., on the other hand, the checklists are mainly used to report to the higher management. In addition, the document was identified as a potential replacement, but the interviewees were not always convinced if documents and guidelines are able to trigger the same learning as a PPR meeting.

10.8 CONCLUSIONS

Table 10.2 summarises the main empirical results on perceptions of PPRs discussed in this chapter and also provides corresponding recommendations how these findings should influence managerial practice in R&D organizations. Overall, the majority of interviewees expressed a positive personal attitude towards PPRs and confirmed that they would most likely conduct PPRs even if they were not a compulsory step in the development process of their company. This is particularly interesting when considering that most R&D organizations do not conduct PPRs at all. Even at Publishing Co. where PPRs do not have top management support, some project managers invest the time and effort for PPRs (and would welcome a formal requirement for all development projects to have PPRs). The generally positive perceptions of PPRs mean that companies that have not yet introduced them should seriously consider to establish them as the final project milestone for each of their R&D projects. PPRs are extra work for project teams, but - used correctly - bring returns. Furthermore, the importance of PPRs also needs to be supported by the top management - ideally by their participation in parts of the PPR discussion and/or by combining the PPR with a social event to which the top management invites the project team.

It is also important to note that a high number of interviewees confirmed that the discussion during the PPR triggers a lot of personal insights and is of higher value than resulting documents or lessons learnt which are stored in intranets or databases. This can be clearly related to the theory of Communities of Practice (CoP) and the social learning theory identified in Chapter 4 as the basis of this research on PPRs. Especially the contribution of PPRs to learn and to find improvement suggestions for future projects was highlighted. Formal aspects of closing the meeting and team-related objectives to celebrate the end of the project in a social way were also mentioned, but only by a minority of interviewees. Thus, these findings clearly support the claim that PPRs do not only serve a procedural task of finishing off a project, but mainly support the learning processes within a project team. Consequently, it seems crucial to establish PPRs as a learning event (as opposed to a mere bureaucratic milestone) and to enable and foster an atmosphere during which open exchange of opinions is possible.

Very similar insights were found when looking at PPRs and learning. A clear majority of interviewees confirmed that the PPR discussion as such triggers the insights of a project team, so that it seems to be vital to organize the discussion in an optimal way, for example with the help of moderators or visual aids. Again, the realisation that PPRs can support the reflection within a R&D team can be referred back to the theoretical frameworks Communities of Practice (CoP) and Nonaka's spiral of knowledge creation. Both frameworks highlighted that a common stock of experience is needed to create and transfer knowledge - in particular tacit knowledge. Furthermore, the PPR needs to allow enough time for in-depth reflection of the team, which is also dependent on a company culture open to constructive criticism. The potential for project-to-project learning did not appear to have been recognized sufficiently by interviewees.

Regarding the results of PPRs, the interview data clearly showed that documents like minutes and final reports are still very dominant (although they are not always written and do not always contain all the aspects from the PPR). Therefore, some R&D managers mentioned social interactions as their personal preference when it comes to the result of PPRs, because experiences and tacit know-how cannot be documented. These people-based approaches are also clearly preferred by the majority of interviewees when it comes to the dissemination of PPR results. Since general access to minutes of PPRs can only support the transfer of explicit knowledge, it is especially important to foster the exchange of tacit know-how by giving room for informal networks, internal presentations and job rotation so that experiences are applied by project members to other projects. Their importance is based on the fact that discussions with fellow project managers or experienced senior colleagues is rated higher than reading minutes of PPRs by most interviewees.

The same applies to the suggested alternatives to PPRs. Some interviewees stated that databases and guidelines need to be updated on a regular basis in order to support the results from PPRs, but most R&D managers interviewed pointed towards informal networks, meetings and project management coaches. These are more effective than IT applications and documents, because they are more suitable to touch upon the tacit knowledge inherent within a project team. Consequently, it is recommended to support a close physical proximity between senior and junior members of staff and to think about the introduction of specific mechanisms for the transfer of tacit knowledge, like godfather programmes, coaching of junior project managers or organized "storytelling" during trainings or regular meetings. In many ways the suggestions can be viewed as opportunities to enhance the learning from PPRs and not strictly as "alternatives" only. These social interactions also follow the recommendations from Nonaka (1994) for the transfer of tacit knowledge within an organization.

Table 10.2 Summary of Empirical Results and Recommendations

		Empirical results[32]	Practical recommendations
1	Judgements of PPRs	• 15(of 28) positive perceptions that PPRs cause team reflection and learning • 9(of 28) negative comments that PPRs do not take place or are missing top management support	• Conduct PPRs for all projects • Communicate PPRs as the final and accepted project milestone • Extend the circle of participants outside the core project team and include all project experts • Support PPR importance with (partial) top management presence and combination of PPR with a social event
2	Personal objectives of PPRs	• 13(of 23) focus on evaluation and reflection • 9(of 23) emphasise learning • 7(of 23) suggest to find improvement suggestions	• Confirm PPRs as an important learning event • Enable open atmosphere and foster constructive criticism and learning culture within the R&D organization
3	PPRs and learning	• 23(of 28) view PPR discussion as a trigger for common insights and personal reflection • 2 (of 28) highlight that PPRs do not solve problems and are highly dependent from the company culture	• Prepare, structure and manage the PPR discussion in an optimal way, e.g. with the help of a moderator and visual aids • Allow sufficient time for in-depth brainstorming and reflection • Provide a supporting company culture that supports open discussions • PPRs are a clear opportunity to achieve project-to-project learning
4	Outcomes of PPRs	• 15 (of 27) highlight documents like minutes or guidelines • 10 (of 27) propose action based results like checklists and open action points • 8 (of 27) prefer social interactions	• Make sure that minutes are written for all PPRs • Highlight the need to document open actions and improvement suggestions • Recognize tacit results from PPRs and their value to the organization
5	Dissemi-nation of results	• 19 (of 28) prefer social interactions • 10 (of 28) mention documents as dissemination tools	• Support exchange of tacit knowledge and experience via informal networks, job rotation and internal presentations • Enable general access to minutes of PPRs and organized integration of PPR insights into guidelines and handbooks
6	Alternatives to PPRs	• 15 (of 29) suggest social interactions • 9 (of 29) mention different forms of meetings as alternatives • 7 (of 29) highlight database alternatives	• Ideas for other ways of sharing learning can augment PPRs – they do not have to be strict alternatives • Arrange regular meetings of project managers • Establish presentations of key experiences across projects and business units • Support close physical proximity between senior and junior staff so that vivid “stories” can be transferred • Introduce godfather programmes or coaching processes for junior project managers • Allocate clear responsibility for the update of databases and guidelines

[32] As mentioned earlier, some interviewees stated several different issues, so that the sum of responses listed in Table 10.2 is in some cases higher than the overall total of interviewees.

10.9 SUMMARY

This chapter concentrated at Research Question 2 and provided answers regarding the perceptions of PPRs expressed by PPR participants and R&D managers. The discussion was based on interview transcripts and was important as only if PPRs are widely positively perceived are they likely to be successful in practice.

A clear statement that can be given based on the discussion in this chapter is that PPRs are mainly perceived positively by R&D managers. Not only are PPRs generally seen as ideal events for team reflection and learning, but also the consequential improvement of future projects was frequently highlighted by the interviewees as their personal objective for a PPR. Thus, PPRs are clearly viewed as a mechanism that can support project-to-project learning in an R&D organization.

The positive role of PPRs for learning within a project team was also clearly proven, because their role for the triggering of insights and the individual as well as common reflection was frequently mentioned during the interviews. However, this positive effect of PPRs can only be achieved if the company culture allows an objective and open discussion which allows constructive criticism to be voiced. In addition, the team reflection should ideally be supported by a structured moderation and visual aids.

It is interesting to note that the interviewees perceived the best ways to disseminate the results of PPRs as via social interactions. These were also frequently mentioned as potential “alternatives” to PPRs, although these do not need to be strict alternatives, but could be introduced in parallel to the PPR process. The literature on knowledge management stresses the importance of such interactions for transferring knowledge. Therefore, the next chapter will look in detail at the knowledge generated in PPRs - the so-called lessons learnt - and the role of tacit knowledge.

CHAPTER 11 KNOWLEDGE CREATION & TRANSFER DUE TO PPRs

"I think a PPR is important because we gather in a structured way the pros and cons of the project.... A lot of these things are in everybody's head of course, but you also hear other peoples opinion and explanations. And that is in the end the added value of the PPR."
(Extract from the observation of a PPR at Appliances Co.)

11.0 INTRODUCTION

This chapter investigates the role of PPRs in the creation and transfer of knowledge both within a R&D project team and the potential transfer to other teams. Thus, it focuses on the third research question: "*What are the typical lessons learnt and can PPRs promote the creation and dissemination of both explicit and tacit knowledge?"* In many ways this chapter presents the most challenging part of the research. This is because this part of the research is not only probing aspects of knowledge in R&D that have not previously been investigated, but also because of the lack of proven methodological approaches. Therefore, this third and final empirical summary chapter is the most exploratory in nature.

This chapter discusses:

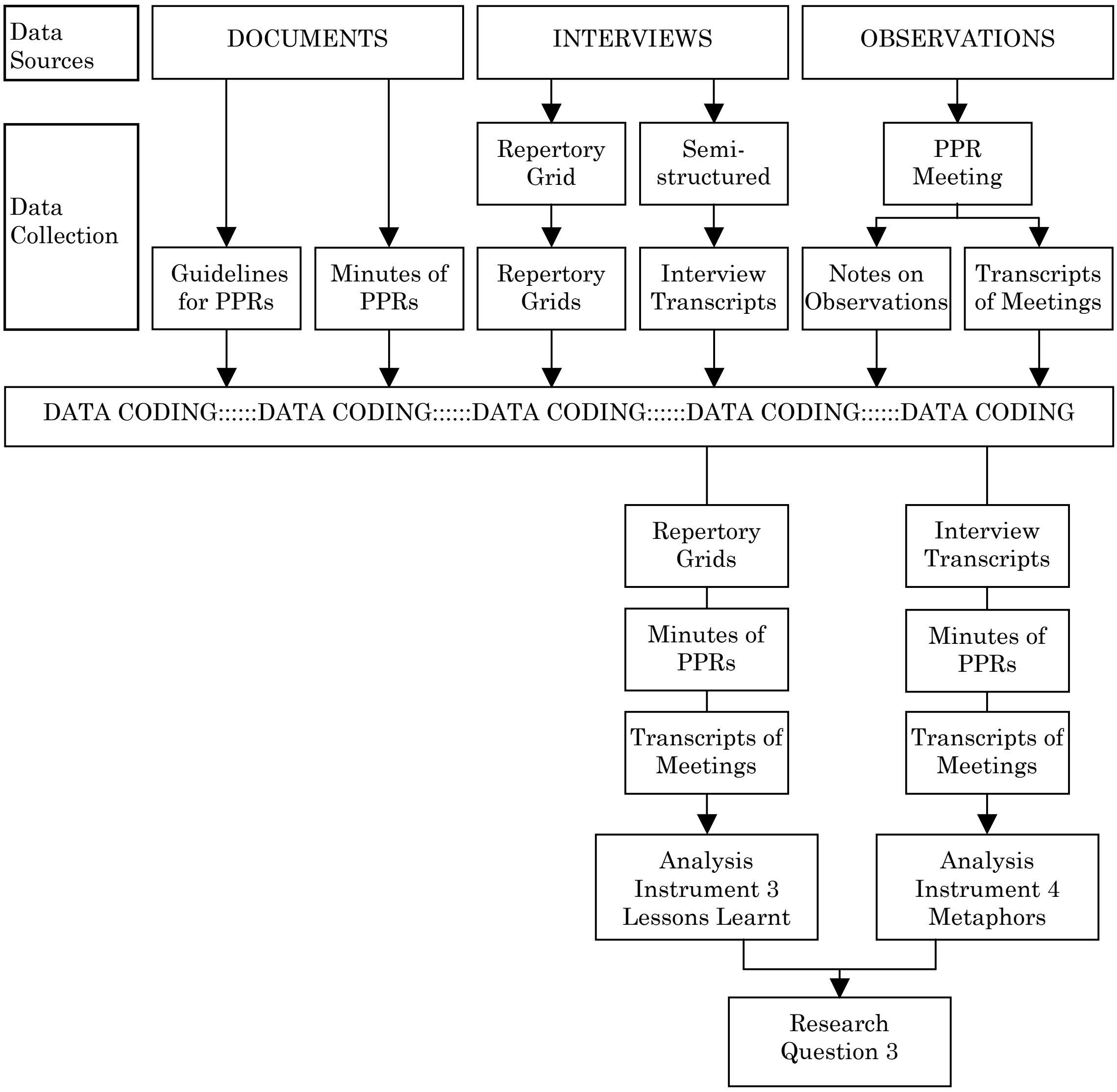
- The different data sources used for answering this research question;
- The lessons learnt from completed R&D projects derived from the repertory grid technique;
- The partial comparison of lessons learnt from the repertory grid interviews with those from other data sources;
- The analysis of metaphors and stories and how they were used.

11.1 DATA SOURCES USED

To answer Research Question 3, which addresses complex issues, a variety of data sources were necessary as illustrated in Figure 11.1 - minutes of PPRs, repertory grids and transcripts of observed PPRs. Since the third research question contains two different aspects about knowledge creation, data were coded on the basis of two different Analysis Instruments (3 and 4) as previously discussed in Chapter 6 on research methodology. Thus, extensive triangulation was used to ensure internal validity.

As previously discussed in Chapter 4, two central frameworks in the Organizational Learning literature applicable to PPR research are Communities of Practice (CoP) and Nonaka's spiral of knowledge creation. Unfortunately, as the operationalization of these frameworks is not specified in the literature, a novel approach had to be designed, which will be presented on the basis of the collected data in the following sections.

Figure 11.1: Data Sources Used for Research Question 3



11.2 LESSONS LEARNT FROM R&D PROJECTS

The first data source used to investigate the lessons that are typically learnt from completed projects were the repertory grid interviews. Across the five companies, the repertory grid interviews elicited constructs which were collated, in order to produce a comprehensive construct listing. From this listing, the key constructs were then identified.

11.2.1 Collation of Common Constructs

During the 30 repertory grid interviews in five companies, a total of 272 constructs, i.e. lessons learnt from completed projects, were elicited. Thus, each interviewee elicited on average 9.07 different constructs. While reading the interview transcripts and inspecting the repertory grids, it was evident that many of the elicited constructs were common, i.e. constructs that were mentioned by several interviewees. The challenge was to ensure that appropriate construct labels could be identified (as is always the case in repertory grid analysis). Sometimes the allocation of construct labels was simple and unambiguous. In some other cases it was necessary to refer to the different interview transcripts several times or to refer to the construct poles mentioned, in order to be sure that the correct label could be allocated to a construct. Table 11.1 illustrates how the constructs "communication" (COM1 - intra-team communication) and "experience" (EXP3 – technical experience of project team) were derived. It can be seen that for COM1, all six respondents actually used the word communication and so the allocation of the label was unambiguous. For EXP3, however, only one quote used the word "experience", while the other ones described the same factor with other words.

Table 11.1: Example for the Collation of Common Constructs

Construct code	Construct name	Poles	Example quotes	Frequency
COM1	Intra-team communication	Efficient / not efficient	• "W*ith every project, even if it is a very small one, there are communication problems.* (Int. 1, Appliances Co.) • *"Communication in the team cannot be efficient if part of the project team does not follow the rules."* (Int. 4, Engineering Co.) • *"Communication with the team when very many people participate is often not easy. Ideally, communication is not formalised, but very intense and objective oriented, otherwise it is not efficient.*" (Int. 3, Appliances Co.) • *"In this project the information flow was much better which means we communicated in the right way."* (Int. 3, Engineering Co.) • *"In the past there was no exchange of opinions and communication taking place between the sales and marketing colleagues."* (Int. 5, MedCare Co.) • *"I learnt that communication only helps if everyone in the team is actually honest and does not hide any gut feelings along the way."* (Int. 4, Publishing Co.)	6
EXP3	Technical experience of project team	High / Low	• *"The people in the team had not been given the necessary technical training"* (Int. 4, Machinery Co.) • *"It was a star project with a superb team and everybody had a lot of experience*." (Int. 5, Appliances Co.) • *"These two projects I took over and then realized that the guys did not know their jobs at all.*" (Int. 6 Appliances Co.)	3

11.2.2 Identification of Full Construct Listing

The full construct listing across the five cases can be found in Appendix 6.1. This shows that the total of 272 constructs was reduced to 65 different constructs. Appendix 6.1 not only shows the construct codes sorted alphabetically, but also the construct label and the construct poles as well as an example quote from the interview transcripts.

Once all the constructs had been collated, it was possible to identify the frequency of each construct. While the column frequency refers to the number of interviewees who mentioned this specific construct, the column frequency in % refers to frequency of mention across the 30 interviewees. In other words, if a construct was mentioned by six different interviewees, the frequency is 20%. (The last column headed "average weighted variability" will be explained in the next section when discussing the identification of key constructs.)

11.2.3 Identification of Key Constructs

The identification of key constructs was done in two different ways. Firstly, the frequency as illustrated in Appendix 6.1 was used. Since the repertory grid literature does not provide any widely accepted guidelines for the classification of constructs by their importance, it was decided that constructs which were mentioned by at least 20% of interviewees (i.e. by 6 interviewees or more) would be considered "important".

Apart from the frequency of mention of constructs, it was also necessary to look at the variability of constructs, because a high frequency could merely mean that a construct is so obvious that it is mentioned by most interviewees. Therefore, the analysis also included the average weighted variability of the full construct list.

Variability is a measure of the spread of ratings in an individual repertory grid and is automatically contemplated by GridLab[33] software. However, GridLab does not provide support in calculating variabilities for the same construct across multiple repertory grids. Therefore, a calculation method to determine the average weighted variability was adopted following the approach published by Goffin et al (2005).

Overall, the variability of a construct depends on the number of constructs in a grid. For example, if 10 constructs are elicited, the average variability is 10%, but if only 5 constructs are elicited, the average variability would be 20%. Consequently, when comparing variability figures from multiple grids, it is first of all important to correct for the different

[33] Gridlab software was created for the analysis of repertory grid matrices. It allows researchers to enter repertory grid data in a straightforward way into standardized templates. Based on these data, Gridlab then offers analysis modes like visual sample grids and variability calculations.

numbers of constructs. This normalization was done by multiplying the individual variability figure of a construct by the total number of constructs in the grid and dividing this by the average number of constructs mentioned across the 30 interviewees, i.e. 9.07. These normalized variabilities were then averaged across the different grids for those constructs which were mentioned several times.

Based on the average number of constructs of 9.07, the average variability of each construct was 11.03% (100 divided by 9.07). In other words, all the constructs which show a normalized average variability above 11.03% should be looked at in some more detail, because these are most significant in their spread of ratings across the different interviewees. Therefore, Table 11.2 lists all the constructs which have a normalized average variability higher than 11.03% and a frequency of 20% or more, sorted top down by their variability. This approach identified nine different constructs (i.e. lessons learnt from completed projects) that appear to be the most important. These nine constructs are distributed across seven different categories. The only category that occurs more than once is “technology”, which appears three times in Table 11.2.

The first lesson learnt displayed in Table 11.2 is that technical specifications of R&D projects are subject to very frequent changes (TECH7). This was described as highly disturbing for the project process, because it means that the project plan had to constantly be adapted. For example, Interviewee 1 at Appliances Co. described the disturbing influence of changing specifications in the following way: “*No matter which project it is, if you do not have an objective that is clearly defined or specifications which constantly change, you cannot help but end up in problems*.” The other two technical lessons learnt which were identified as key constructs are the innovation degree of a project (TECH3) and the number of technical problems (TECH2). Both have a great influence on the project work. While the first one determines the difficulties that might be encountered when entering a new technological field, i.e. a certain kind of black box is part of the project, the number of technical problems faced has a direct link to the number of loops and timing delays which might be dealt with during the project.

Another key construct identified were the project costs (COST1), i.e. the realisation that the total budget is very often not kept and additional costs occur. Reasons for this stated by the interviewees most often centred around the fact that the unit costs for the product to be developed has a higher internal priority. *“Here we had the huge problem that we missed by far the product costs. Project costs are not important for us, which has a logic. If you miss product costs it hurts a lot, because the products are sold with huge quantities and the deviations are then multiplied, but project costs are not so bad, you just have to report them once if you spent more. But if you* *have 10 Euro difference for 200.000 units it makes a lot of difference. Or you increase the price and then your units go down"* (Interviewee 7, Appliances Co.). Furthermore, additional technical components for which no additional budget is available are often added to the project, which also causes problems.

The degree of complexity of a project organization (ORG3) has also been identified as a key lesson learnt from completed R&D projects. Basically, the more departments and different company sites (national or international) are involved in the project, the more complex it is to manage the project for everyone involved. Yet, it is necessary to find the right balance here, because it is also important for the success of the project that representatives from all main departments are part of the project team. According to the interviewees, it is important to allocate enough time to the management of this inevitable complexity.

Six interviewees stated that the length and intensity of the testing phase (TEST2) is of critical importance for R&D projects. For example, Interviewee 3 at MedCare Co. mentioned that "*…market tests are usually done with a very big field which we only do with very new products or big projects, but in this case we decided to do a market test as well and to start earlier than usually with the tests. The results were of very high value for the project work and the test as such was done perfectly."*

The following quote from Interviewee 5 at Appliances Co. is representative for the key construct EXP1, i.e. experience of the project manager: "*The project manager here was a person who is extremely ambitious, loves to work, a real animal and he has the ability to motivate his team so his social capabilities are very good. And he managed despite this difficult phase and despite missing capacities to manage this project in a short time although he had nothing than problems and catastrophes each day. He did not have the time for lengthy team meetings, but did a lot through personal enthusiasm and this is what was the key success factor for the project."* Thus, not only the technical expertise of the project manager is of critical importance, but also the personal and social capabilities when managing the project team.

Table 11.2: Most Important Constructs

Construct code	Construct name	Poles	Example quotes	Frequency	Frequency in %	Average weighted variability
TECH7	Changes of specification	Frequent / seldom	"*It became sort of an illness that the specifications are changed on a regular basis.*" (Int. 2, Machinery Co.)	8	27%	15.09%
COST1	Meeting of targeted project costs	Project cost budget met / not met	"*Lets take project costs now, although it is only a marginal topic here. We do not really care about our project budgets.*" (Int. 3, Appliances Co.)	9	30%	14.28%
ORG3	Complexity of project organization	High / low	"*With more than one development site, it always becomes more difficult and complex for the project organization.*" (Int. 2, Engineering Co.)	9	30%	14.07%
TECH2	Project iterations due to technical problems	Frequent / seldom	"*There was a project where we needed an awful lot of iterations which was not expected.*" (Int. 6, Appliances Co.)	6	20%	12.88%
TEST2	Length and depth of test phase	Long and intense / short and superficial	"*Testing can actually never be long enough.*" (Int. 2, Engineering Co.)	6	20%	12.81%
EXP1	Experience of project manager	High / low	"*A good new project manager – a doer – with a lot of the right technical and interpersonal expertise.*" (Int. 5, Appliances Co.)	6	20%	12.61%
TECH3	Innovation degree of project	High / low	"*These two projects included a lot of real innovations which makes the project work more risky.*" (Int. 1, MedCare Co.)	10	33%	11.78%
TIME1	Development time needed	Short / long	*This took longer than planned, which is not really unusual in our company.*" (Int. 5, Engineering Co.)	9	30%	11.57%
CAP1	Necessary capacities and resources	Available / not available	"*Very often the necessary development capacities are just not available and we all know the consequences.*" (Int. 7, Appliances Co.)	7	23%	11.41%

The development time needed in total to accomplish the project task (TIME1) was also one of the key constructs derived from the interviews. The fact that projects often run longer than scheduled was most often connected by the interviewees to unexpected technical problems, additions to the project specifications or unrealistic time plans from the start (and established by the management without consultation with the project manager and team). The development time was also frequently connected to another key construct, i.e. the availability of the necessary capacities needed for the project (CAP1). It was evident from the seven interviewees who explained this construct, that very often not enough engineering capacity is available for projects. One reason is that the necessary capacity across parallel R&D projects are very often not considered in their totality, e.g. the prototyping team is allocated to three different projects at the same time. Consequently, two projects then have a capacity problem. Another reason mentioned for capacity problems are unrealistically planned projects, where there is no prior experience on which to base the capacity estimates.

Overall, the repertory grid interviews give some interesting insights into the type of lessons that R&D personnel can learn from different new product development projects. Repertory grid technique has a reputation for probing deeply and pushing respondents to identify issues that they may not even have been aware of previously. In addition, the technique allows key aspects to be differentiated. Therefore it should be noted that the list of lessons learnt in Table 11.2 distills what 30 R&D personnel identify as the main experience they have gained with working on different new product development projects.

11.3 PARTIAL COMPARISON OF LESSONS LEARNT

After the discussion of the lessons learnt elicited during the repertory grid interviews, it is important to compare these with the lessons learnt found in minutes of PPRs and identified during the PPR observations. This step of the cross-case analysis is consciously labelled as a partial comparison and not a full one, because several limitations need to be acknowledged.

The lessons learnt found in the three data sources are not fully comparable, because of the very different characteristics of the different data sources. The repertory grid interviews investigated 30 respondents' views on the lessons that they learnt from previous projects with which they had been involved. Repertory grid methodology is known to probe deeply and therefore exposes tacit knowledge. The minutes from a total of 19 PPRs were inspected across the five cases. By definition, documents such as minutes of PPRs record explicit knowledge (lessons learnt). Finally, observation of PPRs at four companies allowed the lessons learnt that emerged in discussions to be determined. In the observations, data were collected on both explicit lessons learnt and, in addition, evidence was collected on tacit knowledge generation and transfer.

It is highly likely that more lessons learnt could have been identified with the help of more interviews, minutes or observations. However, this is a typical problem to be faced with in qualitative research and it can be expected that at some stage saturation is likely to occur. The repertory grid methodology literature indicated that saturation is likely after 30 interviews and so this was the number conducted. The number of minutes inspected and PPRs observed was limited by access and confidentiality issues (the case companies were reluctant to share all of the minutes of previous PPRs with the researcher). As relatively few minutes and observations were analysed, it is likely that the number of different lessons learnt identified from these two data sources is lower than it would have been if more access had been possible. This is a limitation that will be considered in the following analysis.

Reflecting on the above limitation, it was decided not to simply compare the frequency of lessons learnt across the three data sources, but to compare the categories to which these lessons belong. This enabled the identification of clearly dominant categories in each of the data sources. Table 11.3 compares the three data sources. It gives the categories (e.g. bureaucracy, capacity & resources, etc.) and lists the number of lessons learnt found in each of the data sources. The details of this comparison can be found in Appendix 6.2, where each single construct code for the three different data sources is displayed.

The first thing to note about Table 11.3 is that the number of different constructs as well as the frequency mentioned, is lower for the minutes of PPRs than for the repertory grid interviews and the PPR observations. There are three possible reasons for this: firstly, it may depend on the number of data sources used, i.e. the number of constructs found in the minutes could have been higher if more sets of minutes could have been analysed as explained earlier. However, across the five cases a much higher number of minutes were analysed than PPRs observed, so that the limited number of minutes available cannot be the sole explanation. Secondly, it is highly likely that the minutes of PPRs do not always contain the full PPR discussion, i.e. not all lessons learnt are finally documented. For example, Machinery Co. only asks for three main lessons learnt to be included in the final project report and there are no compulsory minutes of PPRs at all. Thirdly, minutes record explicit knowledge and so tacit forms of knowledge generation and transfer are not included.

Table 11.3: Comparison of Lessons Learnt

No.	Category	Minutes of PPRs	Repertory grids	Observations of PPRs
1	Bureaucracy	2	4	5
2	Capacity & Resources	1	1	1
3	Communication	3	5	7
4	Costs and budgets	1	2	3
5	Experience	6	10	9
6	Marketing aspects	2	4	2
7	Organization	6	6	8
8	Product aspects	3	4	3
9	Project management	3	11	9
10	Supply chain	2	3	2
11	Social aspects			4
12	Technology	7	9	10
13	Testing aspects	2	2	2
14	Timing aspects	2	2	2
15	Turnover aspects	2	2	2
	Total	**42**	**65**	**69**

Another clear finding from Table 11.3 is the role of social interactions which was only detected during the PPR observations, but not in minutes of PPRs or during the repertory grids. Therefore, it seems reasonable to conclude that social interactions which come up during PPRs are usually not documented and were also not raised by interviewees. Overall, social interactions are the informal and personal issues that only occur because the project team members work closely together and share particular personal experiences. These personal experiences are often a result of the combination of different characters in a project team or the degree of familiarity between project members. Examples for these social aspects observed (see also Appendix 6.2) are the importance of respect within the team and the mutual trust between the team members. Furthermore, it was frequently stated that the project success depends to a high degree on the existence of social relationships in the team, particularly in extremely stressful situations (e.g. inter-cultural problems during a visit to Japan) or when unexpected problems occur.

Therefore, it appears that lessons learnt with a social background are necessarily dependent on a social setting like the event of a PPR where the interaction of different views takes place. The fact that they were only detected during the observation of PPRs also indicates that these lessons learnt mainly exist on a tacit level. In addition, since social aspects are very hard to define in a clear cut way, they are less likely to be documented in minutes of PPRs.

When analysing the content of Table 11.3, the dominance of the categories “experience” and “technology” is easy to see for all three data sources. Consequently, it is important to note that PPRs not only discuss the technological aspects of a project. Alongside of these technical issues, project teams use PPRs to reflect on their experiences, too, and a comparatively high number of typical experiences from completed projects are even documented in the minutes of PPRs. Especially during the repertory grid interviews, a high number of experiences gathered from completed projects were mentioned. There were also two lessons learnt - EXP8 (creative freedom for the project team) and EXP13 (learning from products which failed) - which only came up during the repertory grid interviews. From the nature of these constructs, it can be assumed, that these are examples for experience with a high tacit element, which is why they are not found in minutes of PPRs.

Another category which is important to look at in detail is “project management”, which emerges particularly from repertory grids and the PPR observation. This stands in contrast to the minutes of PPRs, where only three aspects of project management were found. This leads to the question why lessons learnt related to project management are less likely to be mentioned in minutes of PPRs than, for example, learnings from the technical side. The answer to this question might be that project management learnings are not officially considered to be a vital or important outcome of PPRs, although they were frequently mentioned by interviewees and PPR participants.

Although it is clearly shown in Table 11.3 that communication issues were found across all three data sources, it is interesting to refer to Appendix 6.2 and the construct COM4 (communication of project objectives). Here, it is visible that the importance of communicating project objectives appears to be rated particularly high for R&D managers, because exactly one third of the interviewees referred to this learning. Again, it can be assumed that this issue is closely connected to tacit knowledge possessed by many R&D managers, but is hardly ever mentioned during PPRs or documented in minutes of PPRs. Another insight from Appendix 6.2 with regards to the results from repertory grid interviews is that marketing issues were generally mentioned more often than in the other data sources. This might be possible to explain with the fact that marketing aspects are not always part of the agenda of PPRs, do often not come up naturally in the discussion and are thus also not part of the minutes of PPRs.

Furthermore, Table 11.3 reflects that only one lesson learnt was identified for the category “capacity & resources”. The issue that the necessary capacities are not always available was also discussed earlier as one of the key constructs from the repertory grids. It is thus also interesting to note that no other lessons learnt regarding capacities were mentioned in none of the three data sources.

Overall, the above discussion of lessons learnt clearly supports the role of PPRs for the creation and transfer of explicit knowledge. Following this, and in order to analyse the role of PPRs regarding tacit knowledge creation as well, it is now necessary to look at the cross-case analysis of metaphors and stories identified during the course of this research.

11.4 COMPARISON OF METAPHORS AND STORIES

One of the main conclusions from the literature review is that tacit knowledge is very difficult to observe and thus there are no established methods for its operationalization. However, the literature indicated that the occurrence and use of metaphors and stories can be used as a proxy and as evidence for the creation and transfer of tacit knowledge. Consequently, the data sources were analysed with a focus on metaphors and stories and the results from this analysis will now be discussed in detail.

11.4.1 Cross-case Analysis of Metaphors and Stories

Metaphors and stories were identified across the three different data sources for each case company and counted as illustrated in Table 11.4. Not surprisingly, the number of metaphors and stories is highest for the PPR observation and very low for the minutes of PPRs (in some case companies no metaphors could be identified at all in the inspected minutes). One reason for this is that metaphors are mainly used in verbal exchange and less in written documents.

The original metaphors and stories identified are listed in Appendices 6.3 (metaphors and stories in minutes), 6.4 (metaphors and stories in repertory grid interviews) and 6.5 (metaphors and stories observed during PPRs). The following list gives one representative example for a metaphor or story from each of the three data sources:

- "*We always had clear <u>playing rules</u> in our team*" (Extract from minutes of PPRs from Appliances Co.);
- *"In the past we had a <u>tower</u> marketing and a <u>tower</u> technical department and we have <u>thrown</u> our not very well defined wishes <u>over the wall</u> to the other <u>tower</u> and what we got in return was not what we wanted*" (Interviewee 5, MedCare Co.);
- *"If we had problems we had to <u>juggle with several balls</u>, but we always had a <u>safety net</u> as well"* (PPR at Appliances Co.).

Table 11.4: Identification of Metaphors and Stories

Case no	Case name	Metaphors found in minutes of PPRs	Metaphors used during repertory grids	Metaphors mentioned during PPR observations	PPR Length
1	Engineering Co.		5	14	2.5 hours
2	Appliances Co.	2	12	30	7.5 hours
3	MedCare Co.		5	6	2 hours
4	Machinery Co.	1	3	5	3 hours
5	Publishing Co.	1	10	n/a	n/a
	Total	**4**	**35**	**55**	**15 hours**

Based on Table 11.4 alone, it can be stated that PPRs support the exchange of tacit knowledge within a project team, because a number of metaphors and stories were identified in the four PPR transcripts and many more were observed in PPR discussions. Nevertheless, it is also important to identify the categories of metaphors and stories used. This is illustrated by Table 11.5 which shows how the total number of metaphors identified for each data source is spread across the fifteen different categories.

Table 11.5: Number of Metaphors and Stories per Category

No	Category	Metaphors from minutes of PPRs	Metaphors from repertory grid interviews	Metaphors from PPR observation	Total
1	Bureaucracy		2	3	5
2	Capacity & Resources			4	4
3	Communication		5	3	8
4	Costs and budgets			4	4
5	Experience	1	7	6	14
6	Marketing aspects		1		1
7	Organization	1	1	8	10
8	Product aspects	1		1	2
9	Project management	1	5	6	13
10	Supply chain		2		2
11	Social aspects			1	1
12	Technology		10	9	19
13	Testing aspects			5	5
14	Timing aspects		1	1	2
15	Turnover aspects		1	4	5
	Total	**4**	**35**	**55**	**94**

Overall, it is evident that metaphors are used by interviewees and in PPR discussions (as observed), but are almost entirely absent from the minutes produced. The category which is most often supported by the use of metaphors is "technology". The reason for this might be that technical issues are most difficult to explain to the other PPR participants and team members because the necessary know-how to understand the technical details is very specific and not necessarily possessed by all participants. For example, technical problems are often passed on from one development phase to the next so that the responsible people for the last phase end up with the problem of having the task to finally resolve the issue was described in the following way during the PPR at Machinery Co. by a representative of the final assembly team: "*We are always the second squadron in the war really.*" The same issue was mentioned during the PPR at Engineering Co., where the representative of the technical documentation department stated: *"All this is obviously because we hang at the end of the food chain."* It goes without saying that both sentences only make sense to those people who are project experts and also to those who participated in the PPR. Therefore, it can be regarded as evidence for tacit knowledge transfer.

Other categories which were frequently discussed with the help of metaphors and stories were the categories "experience" and "project management". Experiences were very often described with stories. For example, at Machinery Co., the project manager of the project being reviewed started his personal reflection on the project with the following story: "*If my wife would rate the project she would say it was a disaster. Because I was hardly at home and if I was at home I was tired or bad tempered or I was only there physically, so from her point of view it was a catastrophe really.*" The meaning of this reflection was to highlight the enormous workload that the project had created for everyone involved as well as the many hurdles that had to be crossed during the project, but this did not become clear before the discussion continued. However, the project manager then continued to explain that his overall personal experience during the project was a very positive one - and stands in sharp contrast to the opinion raised by his wife. Another example for a metaphorical story stems from the PPR at MedCare Co. where one of the senior managers present at the meeting tried to understand how the project was originally planned and scheduled. Since he did not manage to get a satisfying answer from the project manager he explained the importance of planning in the following way: "*Every task requires planning. If I go shopping on Saturday morning and do not have a shopping list then I buy a lot of things I do not need and I spend too much money. And finally I do not have the things I need in my kitchen, but my wife is definitely cross with me.*" From the related discussion it then became clear that the metaphor was used to highlight the importance of pre-established detailed plans for all projects, independent of their size or budgets.

There are also various examples of metaphors and stories observed during PPRs, which were automatically clear to all participants, but not to the researcher. In these cases, the discussion before or after a specific metaphor or story did not help the researcher to identify the topic being talked about with the help of metaphorical language. For example, during the PPR at Appliances Co. one of the participants mentioned that: *"He* [the project manager] *was almost like a shepherds dog and kept circling the project like a herd of sheep."* Some minutes later in the discussion, another participant of the PPR then referred back to this statement and said "*…yes, this is again the example with the herd of sheep."* Although a part of the metaphor was repeated, the researcher was not sure about the topic being discussed until one of the participants mentioned quietly to the researcher that the metaphors refer to the fact that the project manager was very much keen to concentrate on the project objectives and observed the work of the project team very conscientiously.

Another example for the difficulty of the researcher to fully understand the meaning of metaphors mentioned during PPRs is the following quote from the PPR at Appliances Co.: *"It was like this mole game. You hit one on the head and somewhere else appear four or five other ones."* Although this particular metaphor caused a lot of laughter amongst the PPR participants, it was not clear to which issue the statement refers and the discussion continued straight away with a different topic. Thus, the researcher needed to ask the project manager after the PPR about the background of this metaphor. He then explained that the moles were meant as a synonym for problems, i.e. once one problem was solved by the project team, they were suddenly faced with four or five new ones. Consequently, this metaphor is a suitable example for the fact that project teams have a specific common know-how which enables the transfer of tacit knowledge.

Certainly, one could list and describe metaphorical examples for all different categories at this point, but the main conclusion to emphasise is that PPRs very clearly demonstrated the use of metaphors and stories, which according to the OL literature means that tacit knowledge is being created and transferred.

11.4.2 Usage of Metaphors and Stories

An interesting aspect when analysing metaphors and stories during PPR discussions is the question when exactly these are used by the participants. The researcher realized during the four PPR observations, that metaphors and stories are mentioned at specific points when a particular topic is being discussed. This analysis is only based on evidence from the observations and cannot be supported or triangulated with other empirical evidence. It should be noted that this analysis is a new approach that emerged from the data, as opposed to being recommended in the literature.

Across all 55 metaphors identified during the four PPR observations, it was found that metaphors and stories are used at four distinct places in the discussion: at the beginning (i.e. initiating discussion on a new topic), in the middle, at the end (i.e. to round off a topic) and also as a stand-alone expression without any reference to the previous or subsequent discussion. Table 11.6 lists one example for each of these places at which metaphors and stories were typically used and the frequency of their use in the four observed PPRs.

Table 11.6: Examples for Places of Metaphors in the PPR Discussion

Data source	Metaphor and related discussion	Construct	Place of metaphor	Total number of this type
PPR Engineering Co.	***"We are on thin ice and still have quite a few problems."*** *Which consequences does all this have overall to our customers? Does thin ice mean we are able to deliver or do we need to postpone the market launch in most countries and are also forced to lower our sales expectations?...*	TURN1	Metaphor in the beginning	12
PPR MedCare Co.	*...We have discussed this question very long internally. I have also talked with our CTO and asked him what is for him the definition of a project?* ***"We are not able to find a rule that is 100% water proof."*** *This will never be possible. But what we did was with the colleagues from marketing and development we have developed indicators with which you can see if something is a task or a project. That helps at least to a certain degree and to avoid most of the confusion...*	BUR2	Metaphor in the middle	10
PPR Appliances Co.	*...Everything apart from the project costs is in the green area, the costs are the only red point in the whole project.* ***"Well then, red traffic lights crossed - one point in Flensburg - and 4 weeks no driving licence."***[34]	COST1	Metaphor at the end	20
PPR Appliances Co.	***"For the moment we only play here a bunch of "Reichsbedenkenträger"*** *(no direct translation possible, similar to "minister of doubt" meaning people who only have doubts, pessimistic thoughts and problems)*	PM18	Metaphor alone	13
	Total			**55**

Overall, a majority of metaphors and stories (20 of 55) was used at the end of discussing a particular topic, i.e. to summarise and highlight again the preceding discussion. The example given in Table 11.6 reflects such a summary, because the issues of costs and budgets were discussed for a very long time during the PPR at Appliances Co. and re-started several times without achieving any new insights. It was only when a younger

[34] The German traffic ministry has an office in Flensburg, where all major traffic related offences are registered. Depending on the gravity, a certain number of points is allocated to the offenders' driving licence. After a certain number of points gathered during three years, the driving licence can be lost for a specific period of time.

member of staff mentioned the above "Flensburg" metaphor that the project team agreed to move on to the next topic on the agenda. Metaphors in the beginning of the discussion (12 of 55) and as stand-alone metaphors (13 of 55) occurred almost with the same frequency. The metaphors and stories mentioned in the middle (10 of 55) were less frequent.

It is also important to mention that the moderator at the PPR observed at Appliances Co. regularly referred back to metaphors from the participants in order to trigger the discussion or to support a more in-depth analysis. Thus, these metaphors were usually at the beginning of the discussion of a particular issue, but were also used to make the team change the topic.

Reflecting on these examples and the place at which they are used during the PPR discussion leads to the conclusion that metaphors and stories play a specific role in PPR discussions. While stand-alone metaphors are clear statements which can only be understood by participants and would not be clear to anyone reading the minutes of the PPR (if the metaphor would be documented in these minutes), metaphors are also used to start a particular topic in an informal way or as a trigger for changing the subject. If metaphors and stories are used in the middle of a discussion, it was often to strengthen an argument or to repeat an earlier argument in other words which might be easier to understand for other participants of the PPR. Finally, metaphors were also used at the end of specific discussion points in order to summarize the previous discussion and to conclude the arguments mentioned.

Overall, 55 metaphors were identified across the 15 hours of observed PPRs - on average one metaphor every 20 minutes. As the current research is the first time that the frequency of usage of metaphors and stories has been documented for PPRs, it is difficult to draw conclusions based on this frequency. No "benchmarks" were found in any of the relevant literatures. However, within the limitation of the exploratory current research, one can draw some important conclusions:

- Metaphors and stories form an important part of PPR discussions;
- They can be used to stimulate or summarize key points;
- Metaphors and stories enable the transfer of knowledge on complex technological points by making the discussions understandable to those without detailed knowledge;
- They offer a useful approach for moderators to improve PPR discussions.

11.5 CONCLUSIONS

Looking back at the findings discussed in this chapter, it is important to distinguish between the two different aspects covered by Research Question 3. The first aspect to look at are the typical lessons learnt from completed projects. From the repertory grids, a great variety of lessons learnt were identified and nine key constructs were discussed in more detail. For example, the repertory grids showed the importance of dealing effectively with the inevitable changes in specifications, solving technical problems, and mitigating for complexity (from both a technological and organizational standpoint). Overall, the constructs in Table 11.2 provide a useful checklist of factors to be carefully considered in project planning.

Across the three data sources, a comparison of lessons learnt was subject to a number of limitations. Nevertheless, it was evident that social interactions were only mentioned during the PPR observations and were not documented in minutes of PPRs or mentioned by the interviewees. All other categories of lessons learnt could be identified across all three data sources, but metaphors and stories (evidence for tacit learning) appear to be a very important aspects of PPR discussions.

The second aspect of Research Question 3, i.e. the question if PPRs can promote the creation and dissemination of both explicit and tacit knowledge was investigated using metaphors and stories as a proxy for tacit knowledge generation. While explicit knowledge is clearly observable and easy to document and was thus clearly identified during the observations of the four PPRs, tacit knowledge could only be measured in terms of the frequency of metaphors and stories that occurred during PPRs, because no other accepted method for its operationalization is currently known. Yet, it clearly emerged that metaphors and stories are frequently used in PPR discussions and also when lessons learnt from completed projects are explained by interviewees, but that hardly any could be identified in minutes of PPRs. Thus, it was shown that the PPR event as such and the participation to this event supports the creation and transfer of tacit knowledge and cannot be replaced by document based approaches like minutes.

In addition, first evidence was found that metaphors and stories are used in particular places for different reasons during a PPR. Consequently, the data strongly support the notion that PPRs create and disseminate tacit knowledge. Thus, the role of metaphors and stories was clearly recognized in the research and this is demonstrated by the variety of metaphors or stories listed in Appendix 6.5.

This also supports the theoretical frameworks established in Chapter 4. Firstly Communities of Practice (CoP) and their common characteristics with project teams highlighted that members of these communities or project teams share a specific language which is not always clearly understandable for external people. This was clearly the case at several instances during the PPR observation when the researcher had to ask about the meaning of a particular metaphor or story. Secondly, Nonaka stressed the importance of metaphors and stories for the transfer of tacit knowledge, and the frequency of metaphors during PPRs alone can be viewed as evidence for knowledge creation during the observed PPRs.

A summary of the empirical results and the resulting practical recommendations is listed in Table 11.7. Overall, the conclusions are mirrored in a striking way by the following quote from McMasters (2000): "*The most valuable learning about past projects often comes from listening to those few individuals that assume the role of story teller. One absorbs the context, nuances, and rationale (or lack thereof) behind the project documentation from them…combining objective project documentation with subjective perceptions about a project is the leap between historical data and historical information.*"

Table 11.7: Summary of Key Empirical Results and Recommendations

	Empirical conclusions	Practical recommendations
1	PPRs create a great number of lessons learnt supported by the common reflection in the team.	• PPRs should be scheduled for all completed projects with sufficient time allocated to allow in-depth reflection.
2	Minutes of PPRs do not contain all lessons learnt derived from PPRs.	• Dissemination of PPR results and lessons learnt must not be restricted to documents, but needs to be extended by informal networks and people-based approaches like presentations, internal trainings and project manager meetings. • Participation to PPRs is vital to contribute to knowledge creation and to receive learning.
3	Metaphors and stories are frequently used during PPR discussions, but hardly mentioned in minutes of PPRs.	• Metaphors and stories should be consciously triggered during PPRs, e.g. with the help of moderators. • Metaphors and stories should be documented in minutes as far as possible and established as synonyms for typical lessons learnt with the R&D organization.

11.6 SUMMARY

This chapter discussed the evidence for the creation and transfer of explicit as well as tacit knowledge with the help of PPRs. First of all, the data sources used for the analysis were presented. Following this, the typical lessons learnt from completed projects elicited during the repertory grid interviews were grouped, collated and the frequency as well as the averaged weighted variability of these constructs was derived, before the nine key constructs identified were discussed in detail. Across the 30 interviewees, most lessons learnt were allocated to the categories "technology", "project management" and "experience".

The comparison of the lessons learnt across the three different data sources showed that the number of lessons learnt is much higher for the interviews and PPR observations than for the minutes of PPRs. It was found that not all lessons learnt discussed are documented in the minutes of PPRs, so that only participants have the chance to share in this learning.

Finally, the analysis of metaphors and stories found in the three different data sources was presented. Again, it was found from observation that PPRs provided the highest number of metaphors, and that these metaphors were connected to a great variety of different lessons learnt. In addition, it was shown that metaphors and stories are used in different ways during PPR discussions. Thus, the data provides evidence that tacit knowledge is created and transferred by PPRs and also clearly supports the statements from the theoretical frameworks Communities of Practice and Nonaka's spiral of knowledge creation. The overall implications of the findings of this chapter will be discussed in the following and last chapter of this thesis.

CHAPTER 12 RESULTS AND CONCLUSIONS

"PPRs should be a firm step in the development process."
(Interviewee 1, Engineering Co.)

12.0 INTRODUCTION

This final chapter builds on the discussion in the previous three chapters and highlights the overall conclusions from the research. When doing academic research it is not only important to look at the research findings, but also to consider the wider implications and how these might influence future research and practice. In addition, it is advisable to review the research process as such and to reflect on the lessons learnt (especially as this thesis is concerned with lessons that can be learnt).

Consequently, this chapter concentrates on the following topics:

- Summarizing the main results of the research;
- Discussing the overall contribution of the thesis;
- Reflecting the research design applied;
- Considering the limitations of the research;
- Suggesting topics and methodologies for further research.

12.1 SUMMARY OF THE RESULTS

12.1.1 The Role of PPRs

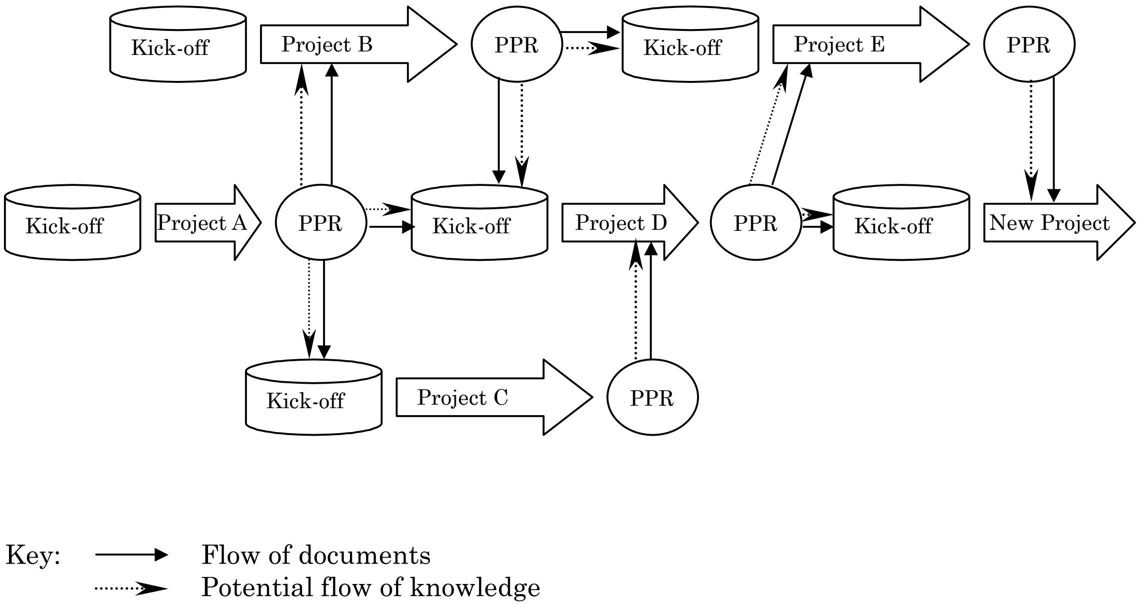
As discussed in Chapter 3, this thesis views PPRs as "*the final meeting of a project team in order to jointly reflect on lessons learnt and thus creating the setting for detailed exchange of experiences and stories.*"[34] Thus, it is important to stress at this point that they are not merely a final milestone to meet bureaucratic guidelines for completing a project. Instead, the importance of PPRs is high and one of the most important things to mention is their potential to support team reflection and learning. This learning resides not only in the PPR itself, but can also influence future projects within the R&D organization. Consequently, PPRs can have a positive impact for project-to-project learning and continuous improvement based on the explicit and tacit knowledge that emerges during the PPR.

This potential impact of PPRs for project-to-project learning in an R&D organization is illustrated in Figure 12.1. It shows that a PPR is held upon the completion of Project A. The output of Project A's PPR is both documentation (e.g. minutes of the PPR and/or database entries) and, potentially, the flow of knowledge between different project teams. A specific

[34] This definition was established in Chapter 3 and is a working definition from the researcher which combines existing definitions for PPRs with a clear emphasis of their learning potential.

example for the flow of documentation and knowledge could be the integration of insights from PPRs into the kick-off meetings of new projects in order to avoid the repetition of mistakes. Project-to-project learning is crucial and a PPR can be an important (but not the sole) mechanism for such knowledge transfer.

Figure 12.1: Project-to-Project Learning with PPRs



Consequently, PPRs and their results have a potential influence on the conduct of subsequent projects, and lessons learnt from a completed project should be applied to all future projects. The wish to understand how PPRs can enhance project-to-project learning was one of the motivations to conduct the research in the first place. Ideally, PPRs can support a culture of continuous improvement in a R&D organization.

12.1.2 Key Findings

Now that the role of PPRs in project-to-project learning has been explained, the results of the research questions will be summarized. Based on the research objectives outlined in Chapter 1, three different research questions were investigated using a selection of methods and multiple data sources under the umbrella of case study research at five companies. Table 12.1 summarizes the Research Questions and key findings.

Table 12.1: Overview of Research Findings

No	Research Question	Key findings
1	*"What are the current practices of R&D organizations for conducting PPRs?"*	The cases identified 14 characteristics of how PPRs are planned, run and the lessons disseminated. These 14 characteristics give insights into how PPRs can be managed to ensure the optimal generation and dissemination of knowledge between R&D teams.
2	*"How are PPRs perceived by participants and R&D managers?"*	Six aspects of R&D employees' perceptions on PPRs were investigated. These show that PPRs are generally viewed very positively and that especially social interactions appear to be relevant for the transfer and dissemination of PPR results.
3	*"What are the typical lessons learnt and can PPRs promote the creation and dissemination of both explicit and tacit knowledge?"*	The three data sources provided insight into typical lessons learnt from completed projects and confirmed the promotion of explicit knowledge via PPRs. Metaphors and stories are frequently used during PPRs so that tacit knowledge creation and transfer during PPRs was clearly observed.

12.1.2.1 Research Question 1 - PPR Practices

Investigating PPR practices in five companies using multiple data sources provided a depth of understanding that was previously missing. It showed that PPR practices and their efficiency vary significantly, viewed through a framework of 14 key characteristics. This framework enables clear recommendations to be made about how PPRs should be organized and how effective discussions and learning can be stimulated. Although various guidelines for PPRs can be found in the existing Project Management and R&D literatures, their relevance to PPRs in practice is limited. Even company-internal guidelines were not considered as particularly useful by the interviewees compared to the informal ideas on how to conduct PPRs provided by experienced colleagues.

The research showed that top management interest is needed in order to support the effectiveness of PPRs. For example, PPRs are perceived as more helpful and important in those companies where top management is actively involved in the PPR process, or the dissemination of the PPR results. The interest of top management is also directly connected to the amount of time invested in PPR discussions. It was observed that the objectives of PPRs need to be clearly communicated in a company. The clearer these objectives are given in particular in project management handbooks and at the beginning of PPR meetings, the more effort is put into real experience exchange and away from documenting solely hard facts during the PPR.

It was also found that the barriers to learning from completed projects are dependent on the company culture. Those companies which do not focus on learning and reflecting during projects, are also unlikely to support reflection at the end of a project via a PPR. While a lack of time was clearly observed at all five case companies, other barriers such as the reluctance to discuss the experiences openly within the team and the difficulty to express personal insights, was only observed at those companies where the company culture does not support critical reflection.

Overall, in answering Research Question 1, a wealth of insights was generated on each of the 14 key characteristics of PPRs. These enable clear recommendations to be generated for both researchers and managerial practice - as will be discussed later in this chapter.

12.1.2.2 Research Question 2 - PPR Perceptions

Across the five case companies, a high proportion of interviewees perceived PPRs positively and saw them as events during which evaluation, reflection and learning should be the main objective. Thus, it is vital that PPRs are officially confirmed by the top management as an opportunity for learning and not merely as the final milestone of a project.

A clear majority of the interviewees also rated the potential learning effect of PPRs very highly. They saw PPRs as ideal for triggering insights on the personal and team level, because the in-depth discussion of the project experts can create valuable lessons learnt. This discussion could be optimised through suitable moderation and the appropriate use of visual aids.

A frequent criticism voiced regarding PPRs was the lack of follow-up on the suggestions for improvement and the (too) limited use of the gathered experiences in future projects. Interviewees suggested both social interactions and documents to disseminate the results of PPRs, but it was also clearly stated that this is hardly ever done in a professional way across the five case companies.

Another important insight was that interviewees suggested several alternatives to PPRs based on social interactions and meetings. The alternatives mentioned by the interviewees should not be seen as strict alternatives (i.e. they could also be used in combination with PPRs). The maximum impact of PPRs for the creation and transfer of knowledge can best be achieved through informal networks, senior project manager coaches or job rotation programmes. The amount of tacit knowledge generated during a PPR is high and these tacit aspects can only be disseminated and transferred through social interaction and not through documents or formal mechanisms.

12.1.2.3 Research Question 3 - Knowledge Creation & Transfer due to PPRs

It was found that lessons learnt during PPRs typically cover a range of issues much wider than the traditional project management factors “cost”, “quality” and “time” and include a lot of experiential and implicit aspects which are considered to be especially important in R&D project work. The key insight from the repertory grid interviews was the clear identification of what 30 R&D personnel perceive they have learnt from working on previous new product development projects (see Table 11.2). This list of lessons learnt demonstrates the role of experience in R&D and, in a sense, is the distillation of the interviewees' combined 385 years of experience in working on R&D projects. By knowing what managers and R&D personnel perceive they have learnt also provides ideas on how knowledge (experience) can be transferred through PPRs and other means.

Not only the number and range of constructs identified by the repertory grid interviews reflect the learning from projects, but insights were also gained from documents and by what was observed during the PPR meetings. The analysis of minutes of PPRs showed that these did not capture the richness of the type of discussions observed in actual PPRs. Similarly, R&D engineers and managers indicated during the PPRs that far more can be learnt from projects (such as the importance of social networks in a project team) than indicated by the minutes.

Evidence for the creation and transfer of tacit knowledge and experiences emerged during the PPR discussions based on the shared knowledge of the team. This confirms the claim of CoPs that social contexts are crucial to learning and that individuals often learn through social interaction within their group of experts. Furthermore, the frequency of metaphors and stories observed during the PPR meetings clearly show that the processes during a PPR can be related to Communities of Practice and Nonaka's spiral of knowledge creation. While the CoP framework stated that CoPs often develop specific language and jargon which are meaningless for outsiders, Nonaka claims that tacit knowledge is most often articulated via metaphors and stories and the spiral of knowledge creation is enabled by a common language and meaningful dialogue. Thus, evidence to support both frameworks was clearly found.

One aspect which also became very clear across all five companies was that the learning from PPRs is currently only disseminated effectively to the people who directly participated in the meeting. Although suggestions are often carefully discussed and documented, they do not seem to be followed up in an efficient way so that they cannot contribute to the continuous improvement of the R&D organization as a whole and action points do not seem to be followed up.

12.2 CONTRIBUTION OF THE RESEARCH

12.2.1 Contribution to Academic Theory

The main contribution of this thesis is to add to the knowledge on PPRs in R&D, where previous research has largely been lacking (often anecdotal and seldom systematic). No detailed description of current PPR practices existed apart from single case studies, let alone detailed investigations regarding the complex processes of knowledge creation and learning which might occur during and as a result of PPRs. Thus, this thesis does not only add to existing PPR knowledge, but also approached the topic from three distinct angles, ranging from PPR practices to PPR perceptions, to the learning potential of PPRs. These three topics are in themselves interesting aspects, but in combination provide insights that go beyond the existing literature on PPRs.

The academic contribution is also illustrated by the three bodies of literature which form the basis of this thesis: R&D management, Project Management and Organizational Learning. These three areas have not been sufficiently drawn together in any previous R&D management research, and certainly not on any investigation of PPRs. Therefore, a stronger link between selected theories of organizational learning and R&D management was established.

This research was based on a rigorous research design and in-depth empirical data on PPR processes and practices of R&D organizations. Thus, it goes beyond previous studies on PPRs as most of them are based on anecdotal evidence only. However, the research has known limitations, which will be discussed.

The study also investigated the fascinating gap between the importance of PPRs stated in the literature and perceptions of R&D managers regarding PPRs. Although it is widely recognized that PPRs are not conducted by many R&D organizations, or not in an ideal way, the perceptions of R&D managers themselves had previously not been considered. Such consideration is important as if managers do not perceive PPRs as useful, they are unlikely to be adopted.

The research also provides evidence for the utility of the theoretical concepts of Communities of Practice (CoPs) and Nonaka's spiral of knowledge creation, which are both related to the social learning theory. Although no established way to operationalize these two frameworks could be found in the literature, the research methodology chosen enabled empirical findings to be made which match the theory. Evidence from R&D managers and the observation of PPRs clearly showed that the participation in social communities - which CoPs and project teams are - can support knowledge creation and learning of individual members as well as the community as a whole. This was confirmed by a majority of interviewees when being asked about the role of PPRs for learning. Analysis of the use of metaphors and stories as evidence of the transfer of tacit knowledge was also made. The theoretical claim that knowledge and learning develop in specific social contexts appears to be the case for PPRs. Thus, the research demonstrated the role of social interactions and tacit knowledge for PPRs and project-to-project learning.

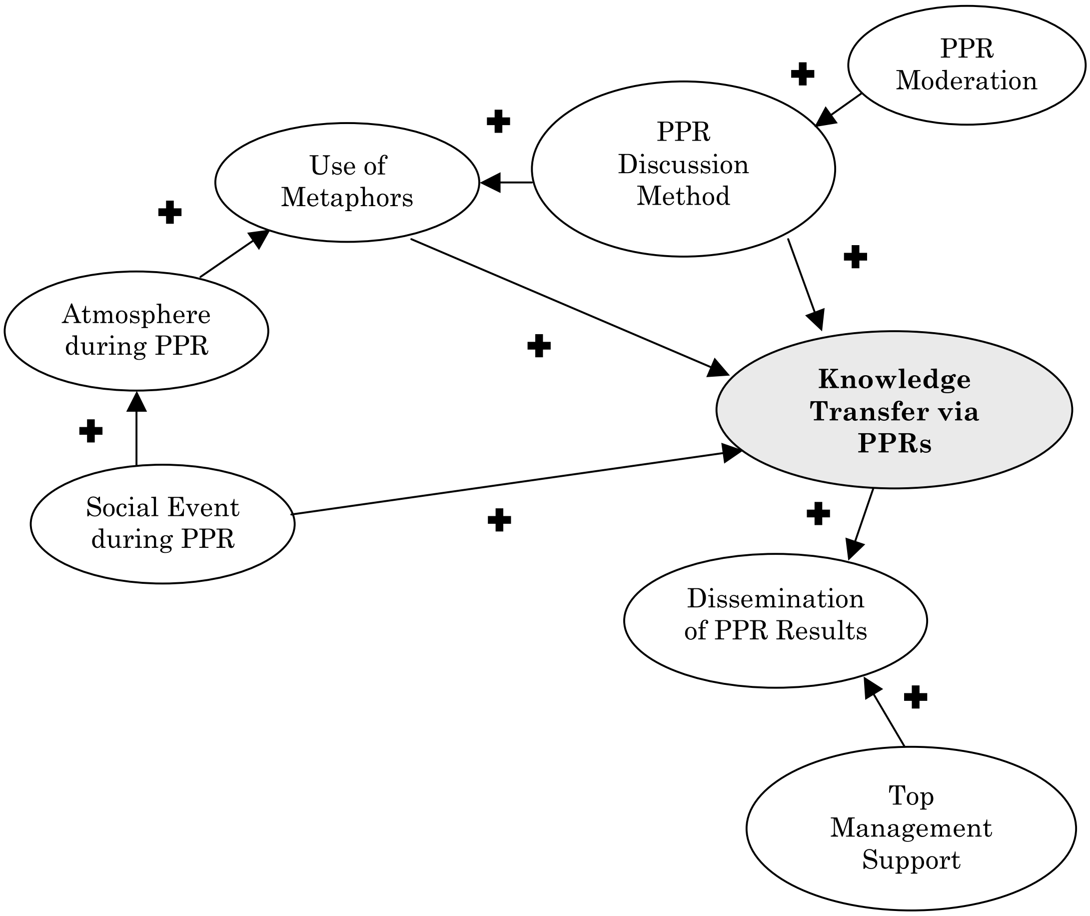
Finally, as the organizational learning literature lacks empirical data resulting from the application of its theories, this thesis provides the first detailed empirical evidence of the role of metaphors and stories in R&D discussions. It also made an exploratory investigation of the way in which metaphors and stories are used (in, for example, stimulating or summarizing discussion). Although the analysis of tacit knowledge generation and sharing was simplistic - using metaphors and stories as a proxy measure - it was innovative. It provided a small but potentially important step by attempting not only to analyse the frequency of metaphors and stories, but also by looking how they are used. It is hoped that these ideas will stimulate other researchers to focus on the operationalization of the concept of tacit knowledge and learning, because there is an urgent need to back our theoretical understanding of organizational learning with empirical investigations. Similarly, aspects like atmosphere or top management support need to be tackled in future research as well, although their operationalization is expected to be very difficult.

12.2.2 New Theoretical Insights Gained

Although the results of only five case studies cannot be generalized, the research does give enough insights to generalize to theory. The intensive contact with R&D organizations that the researcher enjoyed over the last five years allowed a number of ideas to be developed, which permit the theory to be developed further. Various factors appeared to be of significant importance for knowledge creation and transfer within and between R&D project teams. These factors were not the focus of the research and thus were not empirically investigated. However, the researcher feels it important to record these insights, because they appear to indicate interesting routes for further research.

Combining the results from the three literature reviews with the empirical findings of this research allows the researcher to propose a new theoretical understanding of how knowledge is generated and transferred during a PPR in a tentative conceptual model represented by Figure 12.2. It highlights the different aspects which appear to have a potential positive impact on knowledge transfer during a PPR. There are several aspects which are directly related to this knowledge transfer and others which appear to moderate it. For example, the combination of a PPR with a social event for the project team can have a direct positive effect, because of its motivating effect on the team. This was experienced first hand by the researcher during one of the PPRs observed which took place in a beer garden, but was also evident when another project team were looking forward to and frequently referred to the upcoming social evening that was planned following a PPR. Hence, the fact that a social event is planned has a positive effect on the atmosphere during the PPR which then might lead to the triggering of metaphors and stories during the discussion. These metaphors and stories – as discussed earlier – are important factors for the transfer of knowledge in PPRs, and can also be positively influenced by suitable moderation and the discussion method used during the PPR. From Figure 12.2 it can be seen that there is a complex interplay of factors.

Figure 12.2: Conceptual Model of Knowledge Transfer via PPRs

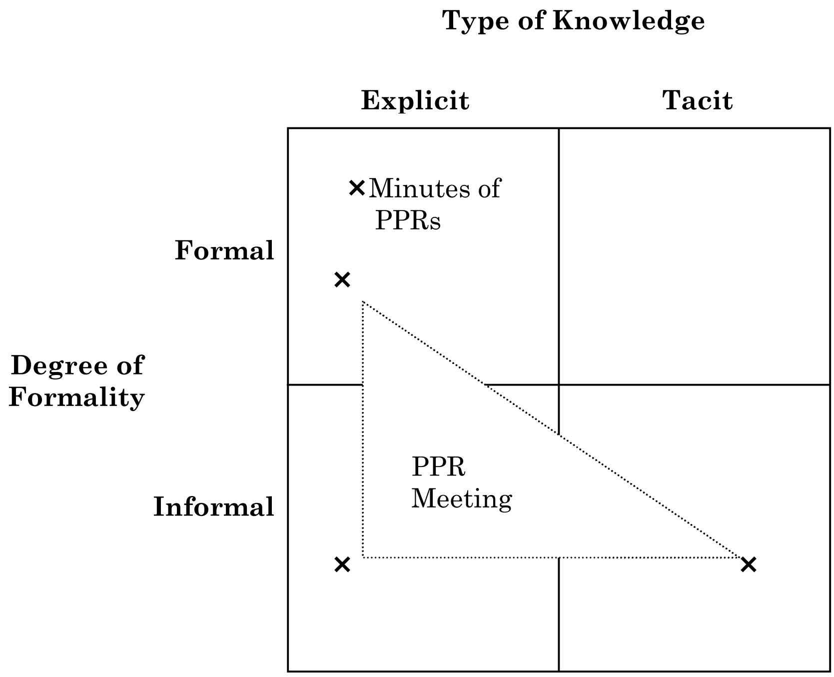


The knowledge transfer achieved during the PPR also impacts the wider dissemination of the PPR results. This can also be influenced by the degree of top management support. Such support is critical, because PPRs cannot take place without the interest from the management and the knowledge gained via the PPRs can only flow through the R&D organization if the top management enables a correspondingly open company culture.

Furthermore, the researcher believes that a key factor that influences how knowledge can be disseminated via PPRs is the degree of formality within which the PPR takes place. This is illustrated in Figure

12.3. It illustrates the knowledge transfer during PPRs in R&D organizations and categorizes it along two different axes. The x-axis represents the type of knowledge and illustrates the range from the explicit to the tacit extreme of the knowledge spectrum. Since purely explicit or tacit knowledge does not exist according to the established literatures, the x-axis intends to highlight the trend towards one of the extremes rather than separating explicit from tacit knowledge in a strict sense.

Figure 12.3: Matrix of Knowledge Transfer via PPRs



The y-axis illustrates the degree of formality during PPRs. Although formality is difficult to measure and operationalize objectively, its role for an efficient knowledge transfer during PPRs is crucial. Aspects which influence the degree of formality regarding PPRs, for example, are the location of the meeting, the moderation of the meeting, the common experiences of the team members during the project or the extent of the top management presence during the PPR.

Overall, Figure 12.3 illustrates that minutes of PPRs are more likely to transfer explicit knowledge resulting from PPRs. The knowledge that is transferred during the PPR as such, though, is highly dependent on the degree of formality which is why the PPR meeting is illustrated as a triangle in Figure 12.3 which is intended to highlight the scattering of different formality degrees. Ideally, a PPR is conducted with a degree of formality which allows explicit as well as tacit knowledge aspects to be transferred.

Apart from the PPR meeting as such and the resulting minutes of PPRs, the research also provided first insights into other potentially positive methods for knowledge transfer. For example, presentations of project experiences to a wider audience, regular project manager meetings to discuss common problems or personal coaching of junior project managers. Although these were not empirically investigated during the research, it is highly likely that the degree of formality with which these methods are introduced and actually performed, has again an impact on the kind of knowledge that can be transferred. For example, if informal coaching from senior to junior project managers or regular meetings between managers of different R&D projects are a compulsory event rather than a positive and voluntary experience for the people involved, tacit knowledge is less likely to be transferred.

12.2.3 Contribution to the Methodology Used

One of the contributions of this thesis was that it developed a sophisticated research design, based on different data sources which provided a mixture of qualitative and quantitative data. The research design provided a basis for data triangulation which could be applied to future research into PPRs as well. In addition, it could also be used for research in other areas of R&D and knowledge creation.

As mentioned many times in this thesis, the whole area of tacit knowledge is complex, often misunderstood and empirically largely unknown ground. As empirical studies are rare, this is why our understanding of how knowledge is generated in R&D is only just emerging. Yet, this should not be seen as a reason for not investigating the phenomenon of tacit knowledge further. R&D researchers could and should take a lead in investigating how tacit knowledge is generated and how it can be observed and operationalized. This is because the R&D context is arguably the area of business most dependent on knowledge generation and so an ideal laboratory for learning research. Too many of the papers on knowledge management have taken a purely philosophical view. In contrast, this thesis attempted to look at organizational learning with a focus on project-to-project learning and to take an empirical stance based on multi-source data collection and analysis procedures.

Similarly, one of the most important points for academics resulting from this research remains the question how the occurrence of tacit learning can best be operationalized. As recommended by the organizational learning literature, the use of metaphors and stories was taken as a proxy measure for the creation and sharing of tacit knowledge. The evidence from the PPRs observed was that such mechanisms play a role. Therefore, a key contribution of this thesis is that it has collected a first sample of metaphors used during PPRs, and it is one of the first broad and systematic studies of metaphors and stories in management practice. However, more sophisticated approaches to understand tacit knowledge are needed and here the repertory grid technique applied in this thesis offers a potentially important approach to studying knowledge. Other approaches could be to use action research and discussing the metaphors mentioned with the interviewees so that a more detailed analysis is made possible.

12.2.4 Contribution to Practice

Overall, R&D managers are particularly interested in the results of case study research, in order to apply the experiences of other organizations within their own context. Especially learning from management processes of other organizations, which are not necessarily from the same industrial sector, is considered to be vital by most R&D mangers. This was so for the five case companies, all of which have already expressed interest in receiving further information about the overall results from the research.

A clear contribution for management is the list of constructs or "typical lessons learnt" that was derived on the basis of 30 interviewees. These key lessons learnt are clearly relevant for most R&D organizations and could be considered by R&D managers when critically reflecting on their own R&D processes or when setting up new projects. Based on the recommendations derived in Chapters 9, 10 and 11, Figure 12.4[35] summarises in diagrammatic form the main findings regarding PPRs and how these can be transferred to managerial practice in order to establish an optimal PPR process. In addition, Figure 12.4 also includes recommendations, some of which are based on ideas from Lindkvist (1998), whilst the majority comes from insights that occurred to the researcher during the research. The objective was not to create another checklist for PPRs, but to identify clear steps based on which R&D managers can improve their current PPR processes (or introduce PPRs if they have not yet used them) according to their very individual needs and circumstances.

First of all it is important to note that PPRs are not only considered as a restricted event happening on one specific day, but as part of an overall PPR process which consists of four different steps as illustrated in Figure 12.4.

[35] The brackets indicate the source of different recommendations. [9], [10] and [11] refer to findings from Chapters 9, 10 and 11, while [R] represents additional ideas from the researcher's reflection. The recommendations which were derived in Chapter 9 and which are particularly targeted at the 14 key characteristics of PPRs are presented in bold. Since more than one recommendation was found for some key characteristics, more than 14 are listed in bold in Figure 12.4.

Figure 12.4: Recommendations for a PPR Process in R&D Organizations

2 – Before a PPR

- **Extend invitation to important external people in order to facilitate dissemination [9,10]**
- Ensure maximal participation as this is key for knowledge creation and common insights [11]
- **Choose ideal location to support team reflection and social interactions [9]**
- **Encourage individual reflection as preparation for PPR [9]**
- **Choose suitable social event to combine with PPR [9,10]**
- Choose a variety of brainstorming techniques and methods to trigger tacit knowledge during the PPR [R]
- Visual preparation of main hurdles and main positive aspects during the project lifecycle [R]·
- Gather personal anecdotes and stories that happened during the project to support social bonding [R]
- Ask participants to prepare the key lessons learnt from earlier projects (comparable to key constructs) [R]

3 – During a PPR

- Start every PPR with a discussion of the objectives [9]
- **Use moderators especially for longer PPRs [9] and visual aids to support the quality of the PPR discussion [9,10]**
- **Trigger** Metaphors & Stories [11] and **other ways of stimulating the discussion [9],** e.g. repertory grids [R]
- **Set constructive atmosphere [9,10]**
- **Allow sufficient time for common reflection [9]** and in-depth brainstorming [10, 11]
- **Consider (partial) presence of top management to acknowledge team achievements [9,10]**
- Prepare presentation of final results together with team to support subsequent dissemination [R]
- Introduce a feedback round at the end to improve future PPRs [R]
- Find main points to be integrated in future kick-offs (technology, planning, resources, costs, etc.) [R], e.g. based on key lessons learnt in the organization [11]

4 – After a PPR

- **Dissemination should be a mixture of documents, personal, informal and presentation approaches [9]**
- **Use written minutes for documentation of action lists [9,10]**
- **Allocate responsibility for regular update of guidelines and follow-up of action points and improvement suggestions [9, 10]**
- **Organize verbal presentation of PPR results [9, 10, 11]** across business units and general access to minutes [10]
- **Test innovative approaches like video interviews of project managers [9]**
- Foster person based transfer mechanisms (PM meetings, physical proximity, godfather system, coaching of junior staff, job rotation etc.) [10,11]
- Adapt Project Management training with insights from PPRs [R]
- Recognize the value of tacit results from PPRs [10]
- Create internal metaphors for key learnings [R]
- Communicate success stories about how PPR findings help other projects [R]
- Analyse effectiveness of PPRs and dissemination to improve future PPRs [R]

1 - Establishing the PPR Process

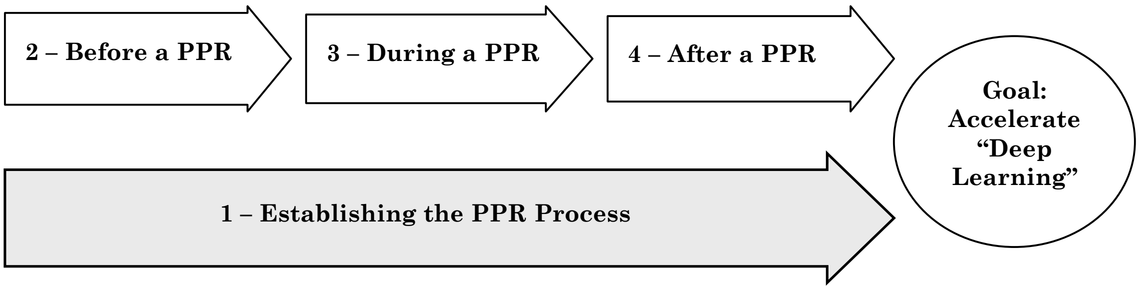
- Guarantee a company culture open for learning and constructive criticism with full support from the top management [9,10]
- **Establish PPRs as a firm step in the development process for all projects with a firm delay between market launch and date of PPR[9,10,11]**
- **Confirm clearly the objective why PPRs are conducted [9]**
- Encourage personal motivation to learn by rewarding improvement suggestions and penalize misuse of knowledge [R]
- **Adapt PPRs to size and strategic importance of projects [9]** and establish different levels of PPRs in terms of participants, duration, etc. [R]
- **Ensure quality and relevance of guidelines for PPRs and handbooks [9]**
- Use senior experts to regularly overhaul the PPR process [R]
- Focus on long-term objectives for the R&D performance [R]
- Limit personell fluctuation during projects [R]
- Support "deep learning" by integrating key lessons learnt to the PPR process [11]
- **Apply general action points and improvement suggestions to the PPR process and R&D project management practices [9]**
- Use PPRs as an opportunity for project-to-project learning [10] by following the steps listed in phases 2,3 and 4

The four steps are:

- *Step 1 - Establishing the PPR process*:
  This is the first step when introducing PPRs, and supports the further three steps (as shown in Figure 12.4). For example, it seems to be important that the PPR process is regularly improved with the help of senior R&D personnel focusing on the longer-term objectives for the R&D organization. If not, the risk is too high that project teams' reflections are too short-sighted. This means the focus should be on what the research proposes should be termed "deep learning" within a R&D organization. The results of the repertory grid interviews show the deep learning that is the result of years of experiences. PPRs should be utilized to accelerate this process of learning through experience and transfer it widely. This deep learning is also dependent on a low fluctuation level of personnel during the project, which helps to avoid that important know-how is lost before the PPR takes place;
- *Step 2 - Before a PPR:*
  This step contains the detailed preparation of the PPR which is not only done by the project manager, but also by the project team members and PPR participants. Especially the location chosen and the different discussion methods prepared are of particular importance to guarantee a fruitful PPR. Although the discussion mode used for the PPR is clearly of high importance for the learning that can result, it is interesting to note that none of the existing guidelines suggest how to foster an optimal PPR discussion. Visual aids and the gathering of personal anecdotes and metaphors thus appear to be clearly relevant when preparing a PPR;
- *Step 3 - During a PPR:*
  This step concentrates mainly on the way discussion is stimulated and how moderators, visual aids and the triggering of personal anecdotes and metaphors are vital for the creation and transfer of tacit knowledge. Another important recommendation is to introduce a feedback round at the end of each PPR in order to collect ideas how to improve the process and the PPR meetings as such. The final phase of a PPR would also be the ideal time for preparing a presentation of the main results to support the subsequent dissemination and to agree on the key lessons learnt which should be integrated into future kick-off meetings;
- *Step 4 - After the PPR*
  In this step, the focus lies on the dissemination of the PPR results. Apart from clearly explicit findings, it is recommended to use metaphors and stories mentioned during PPRs and establish some of the most relevant ones as firmly established internal metaphors which easily transfer tacit know-how. In order to support the PPR process as such, it is also important to communicate success stories of PPRs and to analyse their effectiveness, for example by looking at certain mistakes which are not repeated in future projects.

Overall, the four steps should support "deep learning" (Figure 12.5) and the nine key constructs derived from the 30 repertory grid interviews are clear examples of such deep learning which should ideally be spread within R&D organizations. In addition, it is of particular importance to think of special ways to stimulate the PPR discussion. These are not mentioned in the existing literature, but represent the key to support the creation and transfer of tacit knowledge during a PPR.

Figure 12.5: Four Steps in the PPR Process



12.3 REFLECTIONS ON THE RESEARCH DESIGN

It is important to mention that the analysis method was refined on the basis of a continuous feedback system from one case to the next. Not only insights from the pilot case were incorporated into the analysis, but also those of further case studies (with re-analyses of data from earlier cases). While the pilot case study was mainly used to probe the research design as such and the different data collection techniques, the main case studies provided continuous methodological feedback and refinement for aspects like coding or the best way to document observation comments. Yet, this does not mean to imply that the overall case study logic and design of the research changed during the course of the research, rather the analysis was continuously improved.

12.3.1 Document Analysis

The choice of documents to collect and analyse did not change after the pilot study, but it was realised that several managers should be contacted in parallel to check what guidelines are available. An example of this was Appliances Co., where the main contact person stated that the company does not have any guidelines, but two interviewees provided training documents and short checklists which are particularly targeted at the conduct of PPRs. Thus, it was realized that the existence of documents should be doubly checked with as many people from the case study company as possible.

12.3.2 Interviews

Regarding the repertory grid interview, it was found that the new question posed to interviewees (which was changed after the pilot study) worked very well and was therefore used for all interviews in the four remaining companies. In addition, it was realized during the course of the research that the list of provided elements presented to interviewees in the beginning (i.e. the list of pre-selected completed projects) was not relevant for the cross-case analysis or the collation of common constructs. However, this comparison of common elements (i.e. projects) was helpful when companies asked out of interest for an analysis of lessons learnt from these provided elements after the research had been conducted.

An aspect regarding the interview which should be reconsidered, though, is the time allowed. If the total length would not have been restricted to a maximum of one hour, it would have been possible to elicit some more constructs during the repertory grid and also to allow more stories and thick descriptions during the semi-structured interview part which might have provided even more insight into the PPR processes and perceptions. However, this stands in sharp contrast with the fact that all five case companies only agreed to participate to the research, because the time investment for each interviewee was assured to be a maximum of one hour. This is a strong illustration of the trade-offs that researchers must make.

Another insight regarding the interviews concerns the questionnaire and in particular the questions regarding personal perceptions regarding PPRs. During the course of the research it was found that very often, personal perceptions were already expressed when answering general questions or that interviewees started to tell very detailed stories regarding their personal experiences which contained a lot of their perceptions as well. This led to two different scenarios. Firstly, the researcher had to dig very deep into the transcripts to extract these personal perceptions. Secondly, because the researcher did not want to interrupt the storytelling in some cases, it was not always possible to derive answers for all questions. Yet, this again is related to the limited time frame mentioned above.

12.3.3 Coding

The researcher learnt that the coding process for constructs and lessons learnt should have been conducted differently in the early phases of the research. That is to say that the first codes allocated led to a very long list of different constructs which differed sometimes only in nuances. Therefore, all codes needed to be grouped and allocated in several coding loops in order to derive a tighter and clearer list of lessons learnt.

12.3.4 Metaphors and Stories

As previously mentioned, there were no guidelines available how to operationalize and analyse metaphors and stories. Nevertheless, it was important to investigate the use of metaphors and stories in great detail for this research, because it was one of the main sources of evidence for the creation and transfer of tacit knowledge. Although the novel approach chosen provided a wealth of insights for this PPR research, the detailed analysis of the metaphors and stories could be done in even more depth in future studies. For example, the different places when metaphors and stories were used in a PPR discussion could be discussed or even verified with the participants after the PPR took place. Furthermore, it could also be interesting to present a summary of all metaphors and stories found during a PPR and ask the participants for two statements: firstly, why the metaphors were used and secondly, what the metaphors were supposed to represent and get across to the team members.

12.4 LIMITATIONS

Many academic authors state that the only way to avoid limitations when conducting research is not to conduct research at all. Therefore, the task for a researcher is to be aware of limitations and to highlight them in an appropriate way.

A limitation of this study is that it was conducted in German language, but reported in English, so that especially transcripts from interviews and observations had to be translated by the researcher. The problem of this became especially apparent when analysing the metaphors and stories, because not all metaphors were easy to translate from German to English. Furthermore, since all case companies were located in Baden-Württemberg, which has a strong tradition for its local dialect (*Schwäbisch*[36]), it was challenging to translate some expressions without losing their original meaning.

Another limitation is that most of the data collection steps were done by one researcher only (only in the pilot a second researcher was strongly involved). This might have led to a certain degree of researcher bias, because for example less notes were taken during the PPR observations. Nonetheless, the coding process of the transcripts as well as the grouping of coding was reviewed by more than one person, which ensures that the analysis process suffers less from researcher bias than the data collection.

Unfortunately, one major source of data – the observation of a PPR at Publishing Co. – is missing and could not be included in this thesis. While

[36] Schwäbisch has both verbal and written forms.

this is undoubtedly a limitation to the study, it has to be stressed that it proved to be extremely difficult to get access to companies, in particular because most companies were not willing to have external people present during a PPR discussion. Those companies which confirmed that they have active PPR processes, often stated that their R&D departments are subject to various confidentiality regulations. One reason frequently mentioned for these regulations is the current economic crises in Germany, where granting any sort of access into R&D activities is perceived to carry a high risk.

Apart from these operational limitations, it is also important to note that research into tacit knowledge aspects can always be subject to criticism, because its operationalization is not yet developed and firmly proven. In fact, the term tacit knowledge itself implies that it cannot be expressed or observed. Nevertheless, this thesis presented an approach of looking into the processes of tacit knowledge creation and transfer by looking at the emergence of metaphors and stories, which has not been done in a similar way in the R&D context before.

One could argue that the range of lessons learnt identified was subject to some bias dependent on the minutes of PPRs read, interviewees selected, and particular PPRs observed. Nevertheless, the frequency with which some key constructs were found across the five case companies definitely weighs against bias being a major issue, although it is not intended to claim that these are generalizable to the total population of R&D organizations. This current study provides a depth of understanding of the usage of PPRs at five companies in Baden-Württemberg. Later research will need to look at the issue of generalization.

Another critical comment likely to arise is that any knowledge which surfaces during a PPR might be a result of other projects, previous activities, previous experience and education, etc. Yet, as the objective of this research is to investigate the learning potential of PPRs in R&D, it does not seem to be relevant when, where or how experiences were originally gained by the individual or project team that conducts a PPR. Since PPRs form the final stage of a R&D project, it can be assumed that its participants have a wide array of such shared experiences and common backgrounds. Therefore, PPRs can be considered as ideal mechanisms or events to share tacit knowledge within the project team or to support the conversion of tacit into explicit knowledge which ultimately results in learning.

Finally, the learning potential of PPRs could have been analysed by long-term research with a focus on inter-project learning, too, which was not the focus of this thesis. Yet, it is likely that the application of the results of PPRs in future projects could shed an important light on learning in R&D and prevention of similar mistakes in later projects. Yet, this should be investigated in follow-up research to this thesis as discussed in the following section.

12.5 SUGGESTIONS FOR FUTURE RESEARCH

The findings of this thesis provide a rich pool of directions for future research, be it methodological, theoretical or more directed at managerial practice.

First of all, findings from this thesis regarding the current PPR practices of R&D organizations could be followed up by a survey based on a wider population in Germany, or internationally. This would need to be done via a postal or telephone survey - based on the PPR characteristics discussed in this paper - and would then allow firm generalisations to R&D organizations. Furthermore, there is a need to understand what the frequency of usage of PPRs in R&D organizations is, and this could also be an outcome of such a survey.

Parallel to the research focus of this thesis, each of the five case companies received feedback and recommendations from the researcher on how to improve their PPR processes. This was very well received and so it can be recommended to conduct action research at various R&D organizations in order to be able to compare PPR results from current processes compared to those from optimised processes based on the research results from this study. In addition, project-to-project learning has been given too little attention in the past, so that it is highly recommended to conduct long-term and in-depth studies in selected organizations to identify how the lessons learnt from completed projects change future projects in the same R&D organizations.

Furthermore, lessons learnt from completed projects or the way lessons learnt are disseminated could be compared at R&D organizations with active PPR processes versus R&D organizations where no PPRs are conducted. The literature suggests that PPRs can avoid similar mistakes being made on later projects[37] - but evidence is missing. Such an approach could provide further insights into the potential of PPRs to support a learning organization. Parallel to this, the exact nature of the lessons learnt in PPRs must be investigated. This is due to the stark contrast between the lessons learnt in the official minutes of PPRs and the lessons identified in interviews and PPRs which need further investigation.

Overall, there is an urgent need for more research on knowledge creation in R&D, because it is somewhat ironic that the role of knowledge in

[37] Tidd, Bessant & Pavitt (1997) is an often quoted source that PPRs can prevent similar mistakes being made in later projects, but it is not based on empirical data.

business is probably nowhere more important than in R&D, but in this context it has been only superficially investigated. Thus, as already mentioned earlier, it is important to identify ways to operationalize and research the phenomena tacit knowledge, atmosphere etc in a R&D context.

Finally, it could be interesting to investigate how the use of metaphors during PPR meetings can be triggered and supported and how metaphors could be applied when moderating PPRs. This could also be supplemented by research on why metaphors are used at certain points of a PPR discussion, by reviewing the PPR transcripts with the participants and highlighting their metaphors to them in hindsight.

12.6 FINAL THOUGHTS

Looking back at the whole research project (which took 5 years part time) it became clear that a wealth of insights was gained along the way. Furthermore, the academic journey I took made me look into areas which I originally did not consider as important for the purpose of my research, but then appeared as key aspects to be investigated. These new insights - one example was the detailed analysis of metaphors and stories - were particularly challenging, but also the most rewarding ones from my personal point of view.

I started this research based on the personal opinion that PPRs are not effectively utilized as a learning mechanism at many R&D organizations and the findings presented in this thesis clearly confirm this opinion. Although the main results are based on a limited sample of five companies, it soon emerged from discussions with other academic researchers or R&D professionals, that the practices found and the problems identified regarding PPRs can be described as “typical” in the widest sense.

Overall, three personal reflections arise from the completion of this research:

- The topic of this research is a very relevant one for many R&D organizations today. An anecdotal example of this was an encounter during a trans-atlantic business flight during which I finalised the coding of lessons learnt and derived the list of key constructs found across the five companies. A senior executive sitting next to me asked to get a copy of the key constructs identified, because he found that these were the most pressing problems to be solved in his own organization. Although this does not imply that the research results are generalizable, it is only a small, but for the researcher encouraging example of the interest of practitioners in the results. In addition, several R&D managers have expressed interest in the findings of the research;

- This thesis provides evidence supporting the importance of PPRs, but also highlights the need for further research in this area. Thus, it is hoped that this thesis stimulates further investigations of PPRs and, secondly, wider studies of knowledge generation in R&D. There is more than ample scope for valuable research in this area;
- Having heard the opinions of managers and R&D employees over the years of research, I have become personally convinced of the value of PPRs. Therefore, I think it appropriate to give the final word to an interviewee who provided a striking but representative view of why PPRs are valuable: *"It is only during this last meeting* [the PPR] *and in such a group of people* [the NPD project team] *that a project is analysed from all angles and that one becomes aware of all important aspects"* (Interviewee 6, Engineering Co.)[38]

[38] Original German quote: „*Nur bei diesem letzten meeting mit diesen Leuten wird das Projekt von allen Seiten angeschaut und dann bemerkt man die wirklich wichtigen Dinge*."

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OVERVIEW OF APPENDICES

Appendix 1.1 Basic Details of Pre-pilot Study

Company	A	B	C	D
Industry Sector	R&D Project Management Consulting	Lifts & Elevators	IT	Automotive
Interviewee	Managing Director	Head of Corporate Technology Management	R&D Manager Point of Care Diagnostic	Project Manager Driver Assistance
Personal Experience with PPRs?	Yes	Yes	Yes	Yes
Definition of PPRs?	Formal closure of project	Discussion of necessary corrective actions	Exchange of project information and discussion of experiences gathered	Formal controlling step of the parameters cost, time and quality of technological output
Are PPRs currently conducted?	No, only formal closure of project	Yes for strategic projects and those with higher budgets	Yes for almost all projects	No, only formal closure or marketing presentation
When are PPRs conducted?	Shortly after project end	Roughly two years after product market launch	Few months after market introduction	After last milestone is delivered

Appendix 2.1 Characteristics of Different Research Designs

Method	Application	Pros	Cons
Survey	• To obtain information from or about a defined population • Mostly used for questions regarding behaviour, attitudes, beliefs, opinions, characteristics, expectations, self-classification and knowledge	• Cheap • Offers anonymity and avoids interviewer bias • Uniform stimulus to all subjects • Accuracy and generalizability	• Response rate • Conditions of completion cannot be controlled by researcher • Limits the type of questions a researcher can use • Missing data difficult to get • People may find it difficult to explain attitudes, values opinions on questionnaire
Interviewing	• To understand the constructs that the interviewee uses as a basis for opinions and beliefs • To develop an understanding of the respondent's World • To find facts or opinions	• High response rate • Surroundings and non-verbal communication can be captured • Better response rate than questionnaires • Very flexible • Option for probing • Quick way to get large amounts of data	• Complexity often underestimated • Time consuming • High costs • Interviewer bias • Interview might change respondent's attitude • Validity and reliability of data may suffer • May not lead to a thorough understanding of the phenomenon under investigation
Observation	• Used to carefully scrutinise a social setting • Used to get accurate pictures of what events take place but not useful for discovering why events are happening	• Observer can obtain data about behaviour that subjects may be unwilling or unable to report themselves • Observer can make inferences about what caused the behaviour • Behaviour is observed as it occurs, thus retrospective reports by subjects are avoided	• Observers are fallible measuring devices • More reactive method of measurement • May be extremely costly
Action research	• To solve immediate problems and to facilitate long-term change and learning within a large organization • Aims to build theories within the practice context itself and test them there through intervention experiments • Aims to transform the social environment through a process of critical inquiry	• Provides a richness of insight which could not be gained in other ways	• Difficult to claim external validity • Findings are often not accessible to potential users

Appendix 2.1 Characteristics of Different Research Designs (ctd.)

Method	Application	Pros	Cons
Experiments	• Most effective for explanatory research, involve a relatively small number of people and address a well-focused question • Only those research problems that let a researcher manipulate conditions are appropriate for experimental research • To prove strong assumptions about a relationship	• Comparisons between different research setting and groups possible • Allow for the manipulation of a study's independent variable and the subsequent assessment of the impact • Suitable for longitudinal studies	• Selection bias • Total control of experimental setting by researcher often not feasible • Historic effects might influence dependent variables • Researcher bias • Mainly useful for individuals or groups, not organizations
Archival analysis	• Rarely applied to specific research questions • Appropriate when a researcher wants to test hypotheses involving variables that are also in official reports	• Possibility to research the past • Excludes bias of respondents if official reports and literature is used • Very cheap way of research • Allows for objective and direct classification of data	• Evidence is usually limited and indirect, because direct observation or involvement by a researcher is often impossible • Depends heavily on the survival of data from the past • Interpretations subject to researcher bias
Case study	• Presentation of evidence on a rare phenomenon • Exemplifying or illustrating a concept • Demonstrating the use of a technique • Establishing a pool of data that may be useful at a future point in time • Challenging existing modes of thought	• Full complexity of organization studied is considered • Flexible data collection • Useful vehicle for the generation of hypotheses and insights • Natural setting • Less expensive	• Multiple theoretical insights and therefore lack of focus • Data overload • Time consuming • Least systematic • Causal inferences are impossible • Data collection may alter setting under study • Hypothesis testing not possible • Generalisation not possible

(Source: Easterby-Smith et al, 1991; Hartley, 1994; Marshall & Rossmann, 1989; Neumann, 1991; Stone, 1978)

Appendix 2.2 Top 50 Companies in Baden-Württemberg

Rank	Company and town	Sector
1	DaimlerChrysler, Stuttgart	Cars, Aerospace
2	Robert Bosch, Stuttgart	Electronics
3	IBM, Stuttgart	Computer
4	Heidelberger Zement, Heidelberg	Building materials
5	ZF, Friedrichshafen	Car supplies
6	SAP, Walldorf	Software
7	Röchling Gruppe, Mannheim	Electronics
8	EnBW, Karlsruhe	Energy
9	Heidelberger Druckmaschinen, Heidelberg	Machinery
10	Hewlett-Packard, Böblingen	Computer
11	Südzucker, Mannheim	Food
12	Bilfinger & Berger, Mannheim	Construction
13	Freudenberg, Weinheim	Car supplies, textiles
14	Carl Zeiss Stiftung, Heidenheim	Optics
15	Porsche, Stuttgart	Cars
16	ABB, Mannheim	Electronics
17	Debitel, Stuttgart	Mobile communication
18	Hoffmann La-Roche, Grenzach-Whylen	Pharma
19	Voith, Heidenheim	Machinery
20	Liebherr, Biberach	Machinery
21	Mahle, Stuttgart	Car supplies
22	Holtzbrink, Stuttgart	Media
23	IWKA, Karlsruhe	Machinery
24	Behr, Stuttgart	Car supplies
25	Dürr, Stuttgart	Investment goods
26	Alcatel SEL, Stuttgart	Electronics
27	Züblin, Stuttgart	Construction
28	Agilent, Böblingen	Measurement instruments
29	John Deere, Mannheim	Machines
30	Michelin, Karlsruhe	Wheels
31	Burda, Offenburg	Media
32	Wieland Werke, Ulm	Metal goods
33	Iveco Magirus, Ulm	Cars
34	Andreas Stihl, Waiblingen	Electronics
35	Eberspächer, Esslingen	Car supplies
36	Alcan Deutschland, Singen	Aluminium
37	Byk Gulden, Konstanz	Pharma
38	Festo-Gruppe, Esslingen	Pneumatik
39	Gemplus, Filderstadt	Chip cards
40	Trumpf, Ditzingen	Machinery
41	M+W Zander, Stuttgart	Construction
42	Pfizer, Karlsruhe	Pharma
43	Reiter & Schefenacker, Esslingen	Car supplies
44	SEW Eurodrive, Bruchsal	Car supplies
45	Paul Hartmann, Heidenheim	Hygiene goods
46	Kärcher, Winnenden	Cleaning goods
47	Mann & Hummel, Ludwigsburg	Car supplies
48	Boss, Metzingen	Clothes
49	Dekra, Stuttgart	Car services
50	Fuchs Petrolub, Mannheim	Oil

(Source: Wirtschaftsministerium Baden-Württemberg, 2001)

Appendix 3.1 Questionnaire for the Semi-structured Interview Part (German Version)

Demographische Fakten:
- Name:
- Abteilung:
- Titel und Position:
- Erfahrung in der case study Firma in Jahren:
- PPR Erfahrung:

PPR Praktiken und allgemeine Fakten:
- Warum werden PPRs überhaupt durchgeführt?
- Was möchten Sie persönlich durch ein PPR erreichen? [P]
- Wie werden PPRs bei Ihnen in der Organisation durchgeführt?
- Seit wann werden PPRs in dieser Weise durchgeführt?
- Wie bewerten Sie den PPR Prozess in Ihrer Organisation?
- Gibt es eine offizielle PPR Richtlinie?
- Wann sollte ein PPR idealerweise stattfinden?
- Wie bereiten Sie ein PPR vor?
- Wie sind Ihre persönlichen Erfahrungen bzgl. PPRs in Ihrer Organisation?
- Wie stehen Sie persönlich zu PPR ganz allgemein ? [P]

Wissensgenerierung:
- Wo liegt der Schwerpunkt der PPR Diskussion?
- Welche zusätzlichen Themen kommen typischerweise während der PPR Diskussion auf ?
- Liegt der Schwerpunkt mehr auf den negativen oder den positiven Aspekten?
- Welche Themen sollten aus Ihrer Sicht während einem PPR diskutiert werden?
- Wie würden Sie persönlich die Atmosphäre während der PPRs beschreiben?

Wissenstransfer und – verteilung:
- Was sollte für Sie idealerweise das Ergebnis eines PPR sein? [P]
- Wie bewerten Sie persönlich dieses Ergebnis?
- Wie werden Ergebnisse dokumentiert, aufbewahrt und verteilt?
- Wie sollten PPR Ergebnisse verteilt werden? [P]
- Wie werden diese Ergebnisse in neuen Projekten angewandt?
- Gibt es noch andere Methoden Erfahrungen miteinander zu teilen?
- Werden im Team während des PPRs neue Erkenntnisse gewonnen?

Lernen:
- Wie lernen Sie ganz persönlich aus abgeschlossenen Projekten?
- Wie könnte man diesen Lerneffekt noch intensivieren?
- Wie können PPRs den Lerneffekt von Projekten aus Ihrer Sicht unterstützen? [P]
- Wie verfolgen Sie Verbesserungsvorschläge als Resultat eines PPR weiter?
- Können Sie mir ein Beispiel geben, falls Sie schon einmal aufgrund eines PPR Ihr Verhalten/Arbeitsweise in irgendeiner Weise verändert haben?

Prompt:

➔ Habe ich irgendeinen wichtigen Aspekt bzgl. PPRs vergessen, den Sie noch gerne ansprechen möchten?

Appendix 3.1 Questionnaire for the Semi-structured Interview Part (English Version)

Demographic facts:
- Name:
- Department:
- Title and position:
- Working experience at the case company in years:
- Experience with PPRs:

PPR practices and general facts:
- Why are PPRs conducted?
- What do you personally want to achieve with a PPR? [P][39]
- How are PPRs conducted in your organization?
- Since when are PPRs conducted in the current way?
- How do you rate the PPR processes in your organization?
- Is there an official guideline for PPRs?
- When should a PPR take place ideally?
- How do you prepare a PPR?
- What are your personal experiences regarding PPRs in your organization?
- What do you think of PPRs in general? [P]

Knowledge generation:
- What is the focus of the PPR discussion?
- Which additional topics are usually mentioned during PPRs?
- Is the focus on negative or positive aspects?
- Which topics should be discussed during PPRs?
- How would you describe the atmosphere during PPRs?

Knowledge transfer and dissemination:
- What should ideally be the outcome of a PPR? [P]
- How do you personally rate this result?
- How are results documented, stored and disseminated?
- How should PPR results be disseminated? [P]
- How are the results applied in future projects?
- Are there any other mechanisms to share experiences?
- Are new insights gained during the PPR discussion?

Learing:
- How do you personally learn from completed projects?
- How could this learning effect be intensified?
- How do PPRs support the learning from projects from your point of view? [P]
- How do you follow up improvement suggestions as a result from PPRs?
- Can you give me an example how you changed your behaviour because of the results of a PPR?

Prompt:
➔ Did I forget to mention an important aspect regarding PPRs which you would like to comment on now?

[39] The [P] refers to personal perceptions, see Analysis Instrument 2 explained in Chapter 6.

Appendix 3.2. Triangulation with Analysis Instrument 1

No.	PPR issue	Evidence from guidelines for PPRs	Evidence from minutes of PPRs	Evidence from interviews	Evidence from PPR observation	Conclusion
1	Objective of PPRs					
2	Timing of PPRs					
3	Duration of PPRs					
4	PPR participants					
5	Moderation of PPRs					
6	PPR discussion method					
7	Location of PPRs					
8	Use of guidelines for PPRs					
9	Preparation of PPRs					
10	Atmosphere during PPR					
11	Results of PPRs					
12	Dissemination of PPR results					
13	Creation of action points					
14	Agreement on improvement suggestions					

Appendix 3.3 Triangulation with Analysis Instrument 2

Code	Evidence from interviews	Evidence from observation notes	Conclusions
PPR judgement			
PPR objective			
PPRs and Learning			
PPR outcome			
Dissemination of PPR results			
PPR replacement			

Appendix 3.4 Triangulation with Analysis Instrument 3

Code	Minutes of PPRs	Repertory grids	PPR observation
BURx	X		X
COMx		X	X
EXPx		X	X
TECHx	X		
ORGx		X	X
PMx	X	X	X
Etc.			

Appendix 4.1 Summary of the Research Used for Access Negotiation (German Version)

POST-PROJECT REVIEWS (PPRs) IN RESEARCH & DEVELOPMENT: CURRENT PRACTICES AND MISSED POTENTIALS

Hintergrund der Forschungsidee:
Post-project reviews sind insbesondere in der Forschung & Entwicklung heutzutage für jeden ein Begriff. Interessant ist aber, dass trotz der unbestreitbaren Vorteile nur wenige Firmen festgelegte PPR Prozesse haben, falls überhaupt PPRs durchgeführt werden. Darüber hinaus beschränken sich PPR Diskussionen in der Praxis oft auf die drei Parameter Kosten, Termine und Qualität des Endproduktes. Auch die bisherige akademische Forschung in diesem Gebiet geht oft nicht über Checklisten auf Basis einzelner Praxisbeispiele hinaus. Was bisher nicht eingehend empirisch untersucht wurde, ist der mögliche Einfluß von PPRs auf die Generierung und Weitervermittlung von Wissen und Erfahrungen, der nicht dokumentiert werden kann, während einem PPR aber eventuell unbewußt erzeugt wird. Der Vorteil solch implizites Wissen eines F&E Teams zu verbreiten und die eigenen Kernkompetenzen dadurch kontinuierlich zu verbessern, wurde bisher nicht mit PPRs in Verbindung gebracht.

Zielsetzung und Forschungsschwerpunkt:
- Untersuchung der aktuellen Praktiken bzgl. der Durchführung von PPRs in F&E Organisationen.
- Entwicklung von Thesen wie und warum PPRs die Generierung von Wissen und Lernen ermöglichen und unterstützen.
- Analyse von PPRs und ihrem Lernpotential aus Sicht von F&E Führungskräften.

Forschungsmethodik:
Die Datenerhebung beinhaltet mehrere Schritte, die sich inhaltlich ergänzen bzw. aufeinander aufbauen:
- Die Analyse von relevanten Dokumenten, z.B. PPR Protokolle, Projektarchive, interne Richtlinien zum Projektmanagement, etc. der beteiligten Firmen.
- Die Durchführung von Interviews zum Thema PPRs mit Projektmitgliedern bestimmter F&E Projekte nach der „repertory grid technique".
- Die neutrale Beobachtung eines PPRs.
- Die Präsentation der Ergebnisse vor den beteiligten F&E Managern.

Nötiger Input von F&E Organisationen:
Grundsätzlich ist der Aufwand für die Firmen relativ gering. Konkret geht es dabei um:
- Bereitstellung der relevanten Dokumente, so daß diese noch vor den Interviews analysiert werden könnten.
- Benennung von ca. 6 F&E Mitarbeitern für Interviews von jeweils einer Stunde
- Auswahl der zu analysierenden Projekte bzw. PPRs.
- Erlaubnis zur neutralen Beobachtung eines PPRs.

Nutzen für die teilnehmenden F&E Organisationen:
- Neutrale Analyse der eigenen aktuellen PPR Prozesse, auch im Vergleich zur akademischen Literatur.
- Bericht mit Vorschlägen was aus Sicht des externen Forschers im Unternehmen bzgl. PPRs verändert werden könnte bzw. wo noch Verbesserungspotential besteht (Stärken – Schwächen Analyse).
- Präsentation der Gesamtergebnisse der Doktorarbeit, falls gewünscht.
- Erfahrung mit der „repertory grid" Methode, die sich auch für andere Problemstellungen im Unternehmen nutzen lässt.

Zur eigenen Person:
Nach dem Studium der Europäischen Betriebswirtschaftslehre in Reutlingen und London folgten drei Jahre im kaufmännischen Bereich der zentralen Forschung der DaimlerChrysler AG in Stuttgart-Möhringen. Aufgabenbereich war dort vor allem das Projektmanagement von EG geförderten Forschungsprojekten mit internationalen Partnern und das Projektcontrolling im Auftrag des Forschungsvorstands. Weitere Tätigkeiten waren Benchmarks im Bereich F&E Management in Zusammenarbeit mit der Universität St. Gallen und interne Projekte zur Prozeßgestaltung. Im Jahr 1999 Wechsel zur Ravenburger Spieleverlag GmbH. Hier hauptsächlich Tätigkeiten im Ausland: zwei Jahre bei der englischen Niederlassung zur Verlagerung von Produktion und Logistik und schließlich als kaufmännischer Leiter. Danach neun Monate in der französischen Niederlassung zur Einführung von Planungsprozessen. Zur Zeit verantwortlich für die Märkte Skandinavien, Luxemburg, Spanien, Portugal und Lateinamerika. Seit Herbst 1999 zusätzlich Promotionsstudium an der Cranfield University unter Betreuung von Professor Keith Goffin .

Appendix 4.1 Summary of the Research Used for Access Negotiation (English Version)

POST-PROJECT REVIEWS (PPRs) IN RESEARCH & DEVELOPMENT: CURRENT PRACTICES AND MISSED POTENTIALS

Background of the research idea:
Post-project reviews are nowadays well known in the area of Research and Development. However, it is interesting that despite the obvious advantages only few companies have defined PPR processes, if PPRs are conducted at all. Furthermore, PPR discussions focus in practice very often on the three parameters costs, deadlines and quality of the final product. The existing academic research on PPRs also hardly offers more than simple checklists based on single practical examples. An aspect that has not been empirically investigated so far is the potential influence of PPRs on the creation and transfer of knowledge and experiences which cannot be documented, but which might be created during PPRs. The advantage to distribute such implicit knowledge of a R&D team in order to continuously improve the own core competences has not yet been connected with the concept of PPRs.

Objective and focus of the research:
- Investigation of current practices regarding the conduct of PPR in R&D organizations.
- Development of hypotheses how and why PPRs enable and support the generation of knowledge and learning.
- Analysis of PPRs and their learning potential from the viewpoint of senior R&D managers.

Research methodology:
The data collection contains several steps which build on each other:
- Analysis of relevant documents, e.g. minutes of PPRs, project archives, internal project management guidelines, etc. of the participating companies.
- Interviews on PPRs with project members of selected RD projects based on the "repertory grid technique".
- Neutral observation of a PPR.
- Presentation of the results to interested R&D managers.

Required input from R&D organizations:
The effort for the participating companies is overall very small. It requires the following:
- Providing the relevant documents so that these can be analysed before the interviews.
- Selection of about 6 R&D members of staff for interviews of one hour each.
- Selection of projects respective PPRs to be analysed.
- Permission to neutrally observe a PPR.

Advantage for participating R&D organizations:
- Neutral analysis of their own current PPR processes, also in comparison to the academic literature.
- Report with suggestions from the viewpoint of the external researcher how the PPR processes could be improved or what could be changed (SWOT analysis).
- Presentation of the overall results of the PhD research, if this is asked for.
- Experience with the repertory grid method, which can also be used for other areas of the organization.

Background of the researcher:
After studying European Business Administration in Reutlingen and London, the researcher worked for three years in the administrational area of the central Research & Technology Unit at DaimlerChrysler in Stuttgart-Möhringen. Main responsibilities were project management of R&D projects funded by the EU with international project partners and the project controlling for the CTO. Other responsibilities were benchmarks about R&D management in cooperation with the University of St. Gallen and internal projects regarding process change and development. 1999 change to the Ravensburger Spieleverlag GmbH. Here mainly responsibilities in foreign countries: two years in the UK subsidiary in order to transfer production and logistics and as Finance Director. Then nine months in the French subsidiary to introduce planning processes. Currently responsible for the markets Scandinavia, Luxembourg, Spain, Portugal and Latin America. Since autumn 1999 part-time PhD student at Cranfield University supervised by Professor Keith Goffin.

Appendix 4.2 Coding of Guideline for PPRs at Engineering Co. (p. 50 of Process Guideline) Based on Analysis Instrument 1

Projektrückblick / Projektreview / (feed back)

Nach Auslieferung und Inbetriebnahme der ersten Serienprodukte und Umsetzung der wichtigsten Änderungen und Verbesserungen werden die Produktverantwortlichen aller beteiligten Bereiche aus ihrer Sicht einen kurzen Erfahrungsbericht zum Projekt abgeben.

Prozess / Projektrückblick	Ziel / Ergebnisse	Prozessbeteiligte	Hilfsmittel / Hinweise
• Gesamt-Projekt • Zuständigkeiten • Personalaus-stattung • Termineinhaltung • Mitsprache-möglichkeit • Information • Verbesserungs-potenziale: Produkt (eigener Bereich) Produkt (andere Bereiche) Ablauf (eigener Bereich) Ablauf (andere Bereiche) • ? • usw.	Erfahrungen sammeln auswerten und bei neuen Projekten / Nachfolgeprojekten anwenden	PL / Alle PV / GF	Projektdokumentation Maßnahmenlisten Versuchsberichte Serviceberichte Risikolisten
• Zusammenfassung erstellen	Abschlußbericht	PL	

Objective of PPRs

Preparation of PPRs

PPR participants

Agreement on improvement suggestions

Results of PPRs

Dissemination of results

Appendix 4.3 Coding of Minutes of a PPR at Engineering Co. Based on Analysis Instrument 1 and 3 (Extract of Original Minutes)

ENGINEERING CO Datum: 22.11.2001

Verteiler:
Teilnehmer und 5ki, 5hg, 510e, 340b

Objective of PPRs

Betreff:
Protokoll „Manöverkritik Serieneinführung XYZ vom 19.11.2001“

Die Besprechung fand in einer sachlichen, fairen und von guten Ideen geprägten Atmosphäre statt. Ziel war es, aus den Fehlern genauso wie aus den mit Erfolg abgeschlossenen Projektphasen zu lernen, um die entsprechenden Erkenntnisse und Verbesserungen in den nächsten Maschinenprojekten einzubringen.

Motto der Besprechung war „Projektreview“ so wie dies in der RL „integrierte Produktentwicklung“ dokumentiert ist.

Atmosphere

TIME1

Terminplananalyse:
Rückwirkend betrachtet wurde der Terminplan um ca. 30% überschritten. Die Gründe der Differenz erklären sich damit, dass zu diesem Zeitpunkt die Aufgaben nur teilweise definiert waren.

CAP1

Engpaß Versuch:
Bei der Planung wurde keine Rücksicht auf die Ressource der Versuchsabteilung genommen.

Key:

Coding for Analysis Instrument 1

Coding for Analysis Instrument 3

Appendix 4.4 Translation of Interview Questionnaire Used at Engineering Co.

Demographic facts:
- Name:
- Department:
- Title and position:
- Working experience at the case company in years:
- Experience with PPRs:

PPR practices and general facts:
- Why are PPRs conducted?
- What do you personally want to achieve with a PPR? [P]
- How are PPRs conducted in your organization?
- Since when are PPRs conducted in the current way?
- How do you rate the PPR processes in your organization?
- Is there an official guideline for PPRs?
- When should a PPR take place ideally?
- How do you prepare a PPR?
- What are your personal experiences regarding PPRs in your organization?
- What do you think of PPRs in general? [P]

Knowledge generation:
- What is the focus of the PPR discussion?
- Which additional topics are usually mentioned during PPRs?
- Is the focus on negative or positive aspects?
- Which topics should be discussed during PPRs?
- How would you describe the atmosphere during PPRs?

Knowledge transfer and dissemination:
- What should ideally be the outcome of a PPR? [P]
- How do you personally rate this result?
- How are results documented, stored and disseminated?
- How should PPR results be disseminated? [P]
- How are the results applied in future projects?
- Are there any other mechanisms to share experiences?
- Are new insights gained during the PPR discussion?

Learing:
- How do you personally learn from completed projects?
- How could this learning effect be intensified?
- How do PPRs support the learning from projects from your point of view? [P]
- How do you follow up improvement suggestions as a result from PPRs?
- Can you give me an example how you changed your behaviour because of the results of a PPR?

Prompt:

➔ Did I forget to mention an important aspect regarding PPRs which you would like to comment on now?

Appendix 4.5 Example of a Repertory Grid Matrix (Interviewee 6 at Engineering Co.)

Repertory Grid – Interviewee 6
Department: Development and mechanical design
Title: Head of department
Date: **30.04.2002** **Start:** **12:00**
Finish: **13:00**

Constructs	P 1	P 2	P 3	P 4	P 5	P 6	Counter pole
1) Complexity of cooperation, number of units involved	*4	*5	*3	2	4	1	Not many departments or interfaces
2) Importance of project due to number of products that will be sold	2	5	*3	*2	*4	4	No strategic market importance
3) Project is in line with strategy and was well planned and prepared	1	*5	5	*2	5	*2	Project started clueless without strategy
4) Size of project in terms of resources	*1	5	3	2	*4	*3	Not many resources needed
5) Depth of organization structure - many participants	1	*5	*2	3	*3	3	Not many different participants
6) Detailed specification was provided	5	5	5	*1	*5	*3	No specification provided
7) All compulsory documents according to the guideline were provided*	*3	*5	3	*3	5	4	No document had to be done during the project
8) All project objectives were achieved	2	3	*4	*2	4	*4	None of the project objectives was achieved
9) High risk of development	1	*4	3	*4	*5	3	No risk of development
10) Quality of market volume estimations	3	4	*2	1	*2	3	Market volume was not estimated at all

* This construct was mentioned without referring to the triad cards.

Appendix 4.6 Total List of Codes Derived Regarding Lessons Learnt from Completed Projects (Analysis Instrument 3)[40]

Construct no	Construct name
BUR1	Bureaucracy of project organization
BUR2	Use of bureaucratic guidelines
BUR3	Internal politics
BUR5	Formality of project
BUR6	Use of bureaucratic checklists
CAP1	Necessary capacities and resources
COM1	Intra-team communication
COM2	Communication with customer
COM3	International communication
COM4	Communication of project objectives
COM5	Communication with external parties
COM6	Use of international communication coaches
COM7	Use of technical communication aids
COST1	Meeting of targeted project costs
COST2	Meeting of targeted product costs
COST3	Allocation of costs (internal vs. external)
EXP1	Experience of project manager
EXP2	Managerial experience of project team
EXP3	Technical experience of project team
EXP4	Networking between departments
EXP5	Teamwork
EXP6	Satisfaction of project managers
EXP7	Process improvement during project
EXP8	Creative freedom for project team
EXP9	Inter-project learning
EXP13	Learning from flop products
EXP15	Experience of working with top management
MARK1	Quality of market research
MARK2	Importance of international brand registration
MARK3	Quality of marketing support
MARK4	Planning of TV activities
ORG1	Project matrix organization
ORG2	Involvement of external parties
ORG3	Complexity of project organization
ORG6	Attention of top management
ORG7	Turnover of project managers
ORG12	Work overload of project manager
ORG14	Coordination within R&D departments
ORG15	Coordination between R&D and other areas
PM1	Allocation of responsibilities
PM2	Project closure with PPR
PM3	Use of testing coordinators
PM4	Quality of project management
PM7	Quality of market launch
PM8	Quality of transfer between different development phases
PM10	Quality of project planning

[40] It is important to mention that the construct codes allocated to lessons learnt are not always subsequent in their numbering (see Appendix 6.1).

Appendix 4.6 Total List of Codes Derived Regarding Lessons Learnt from Completed Projects (Analysis Instrument 3) (ctd.)

Construct no	Construct name
PM11	Clarity of project structure
PM16	Quality of electronic project archive
PM17	Use of project coach
PM21	Transfer of action list into practice
PM22	Clearly established team rules
PM23	Quality of project controlling
PROD1	Design of product
PROD2	International product requirements
PROD3	Creation of new product ideas
PROD4	National quality demands
SOC1	Importance of respect and mutual trust in the team
SOC2	Number of intercultural experiences in the team
SOC3	Team-internal working conditions during business trips
SOC4	Project success depends on social relationships in the team
SUPPLY1	Analysis of supply chain
SUPPLY2	Use of external suppliers
SUPPLY3	Buy in ready products
SUPPLY4	External supply chain influences delivery service
TECH1	Post-launch problems
TECH2	Project iterations due to technical problems
TECH3	Innovation degree of project
TECH4	Quality of transfer to customer
TECH5	Quality of final assembly
TECH6	Feasibility of specification
TECH7	Changes of specification
TECH8	Quality of technical project output
TECH9	Complexity of technical requirements
TECH10	Frequency of measurement deviations
TECH11	Quality of technical documentation
TEST1	Use of prototypes
TEST2	Length and depth of test phase
TEST3	Use of golden samples
TIME1	Development time needed
TIME2	Meeting of milestones & deadlines
TURN1	Turnover achieved after market launch
TURN2	Quality of sales forecasts

Appendix 4.7 Coding of Interview Transcripts at Engineering Co. Based on Analysis Instruments 1 and 2 (Extract from Interviewee 2)

PPR timing

<u>*Researcher:*</u> *When should a PPR happen?*

<u>Interviewee 2:</u> It should not be directly after the serial release, but later. The aim is to do it 2 or 3 months later. Not too much later, but not directly after series release either.

PPR result

<u>*Researcher:*</u> *And what is the result of a PPR for you?*

<u>Interviewee 2:</u> Firstly that the relevant employees inform each other about positive and negative results. To state concentrated the good and bad sides. One could also supplement it by looking at the functional side, time and costs at the beginning. Costs and time are easy to look at, functions is a bit more difficult. So to look at the objectives, what did we achieve? And then I would stop. Of course you could do all sorts of surveys, ask the management or god knows what, but I do not think that would help us.

<u>*Researcher:*</u> *How do you follow up improvement suggestions like in the 5000R minutes?*

<u>Interviewee 2:</u> By reading it and registering it and then try to integrate it in one of the next projects.

<u>*Researcher:*</u> *So via the distribution list on the document it is being communicated?*

<u>Interviewee 2:</u> Yes, but this is not controlled by anyone - it is principally integrated in the guideline. It is just a look back to see what was good and what was bad and maybe there are changes to the guidelines as well. But this is not determined, this depends.

<u>*Researcher:*</u> *Do you receive the minutes of PPRs from, e.g. the Laser unit, or other units?*

PPR outcome

<u>Interviewee 2:</u> No.

<u>*Researcher:*</u> *And do you give yours to other units?*

<u>Interviewee 2:</u> No, because they would not understand the context. I think it would be incredibly difficult to write things down in a way that it can be understood anywhere.

…

…

…

Dissemination of PPR results

Dissemination of PPR results

Key:

Coding for Analysis Instrument 1

Coding for Analysis Instrument 2

Appendix 4.8 Coding of PPR Observation Transcript at Engineering Co. Based on Analysis Instruments 1, 3 and 4 (Extract)

PPR discussion method

TIME2

…

- How do you feel from the other areas regarding time planning?
- Well, I can agree to Michael that the time in the beginning was very short and this means for training not that we cannot do it in the time given, that is not the problem, but that we when the machine is not ready and there are still changes that we have the effort of documentation many times. That can probably be better explained by Mr. Müller but if we want to do a proper training, we also need documentation, that is totally legitimate. But the effort we took to change all these documents constantly was really huge. Jörg, maybe you can add something to this from your side.
- Good, well, we are always at the end of the food chain. I have to start from the beginning. We had the preshow, for which we needed the product information. Then only a day later a brochure and all these things where you noticed that the development is still in a phase where the development does not have the brain capacity or time and we had problems to have a proper argumentation because partly we did not have samples ready where we could make comparisons between 3030 and 3050. It was partly very difficult to get pictures, just because of the reason I just mentioned and yes it was overall very difficult to get serious data you could give to external parties. And I think that was also very difficult for sales sometimes. That was the point and in the end we were forced to prepare a product definition although the machine was still far from being finished and this means when you think about a huge document like the handbook manual a huge effort, because you constantly have changes. The same thing is true for the spare part list. We did not have final data for the different assembly groups and then you end up with giving away documents which are not complete, which you then need to send again once they are really finished and all this means additional effort. All this is obviously because we hang at the end of the chain and also the topic service handbook and for me also an area like a workshop for setting up the machine which I should have to document everything properly. But everyone in development would have killed me if I said you sit down with me for two days and develop a procedure for the machine installation. And the same was true for all the installation and service work. We had so many changes over the time that causes a huge problem for the service training. How am I supposed to train the service technicians if I do not yet know how the single components of the machine look like as they might look completely different next week or in eight weeks time. Today, however, we can say that we are more or less satisfied with what we have, but the installation we have to document again, there is no way around that, but that was like I said because we are the last bit in the food chain.

TECH2

Key:

Coding for Analysis Instrument 1

Coding for Analysis Instrument 3

Coding for Analysis Instrument 4

Appendix 4.9 Summary of Quotes Regarding Perceptions of PPRs at Engineering Co.

Question	Interviewee	Quote	Code
PPR judgement	Int. 3	*"It should be a firm step in the development process."*	Positive
PPR judgement	Int. 2	*"I would do them definitely, this is why we integrated them later in the guideline, but I would not expand it into a huge team meeting, because the project is basically finished for about a year, but I think it is important that each expert raises his issues and that it is documented in writing and that we have a communication while doing this."*	Positive
PPR judgement	Int. 1	*"Of course I would* [do a PPR in my next project] *you see where you stand, you also see where action is still needed."*	Positive
PPR judgement	Int. 4	*"Often it is the problem that no-one wants to admit that something did not go very well."*	Neutral
PPR judgement	Int. 5	*"… if we do it the way we do it today we might as well stop doing them."*	Negative
Personal PPR objectives	Int. 1	*"I would reflect on the topics was it necessary, how did it go, do we need to change something. So these would be my three questions for each single issue."*	Evaluation Improvement
Personal PPR objectives	Int. 4	*"My aim is to document the mistakes that we made in order to have them in front of our eyes,… and then how can we apply this to the next project as we cannot do the same mistake twice."*	Evaluation Learning
Personal PPR objectives	Int. 5.	*"I would do PPRs in order to improve our development processes."*	Improvement
Personal PPR objectives	Int. 3	*"The objective is to learn something and to do it better next time."*	Learning
Personal PPR objectives	Int. 6	*"…there are things that go wrong in these huge development projects and you can and have to learn from your mistakes…if you do it in a very open manner and discuss these issues with some sort of detachment from the project, you can learn for the next project."*	Learning
PPRs and Learning	Int. 1	*"You do not always have to fill huge files if you conduct a PPR and if you have a good team, it works without."*	Positive
PPRs and Learning	Int. 6	*"It is only during this last meeting and in such a group of people that a project is analysed from all angles and that one becomes aware of all important aspects."*	Positive
PPRs and Learning	Int. 3	*"Me as a project manager might see things different than someone from documentation. The focus is always different, each one has different points of view what went wrong during the project, this is why it is important to exchange these views and to hear different opinions."*	Positive
PPRs and Learning	Int. 2	*"I think the effect that you learn something during the meeting only happens with departments which do not deal closely with development, such as controlling, marketing, these kinds of departments."*	Neutral
PPR outcome	Int. 6	*"It is more than an exchange of information. I also want to solve problems. That means exchange problems and try to find a solution."*	Action based
PPR outcome	Int. 5.	*"What is missed out a bit is to find actions out of the PPR. So my personal opinion is that there are a lot of things on the table during our PPRs, but we do not do enough with it."*	Action based

Appendix 4.9 Summary of Quotes Regarding Perceptions of PPRs at Engineering Co. (ctd.)

Question	Interviewee	Quote	Code
PPR outcome	Int. 1	*"Ideally, our internal checklists would be updated as a result of the different PPRs."*	Document-based
PPR outcome	Int. 2	*"That the relevant employees inform each other about positive and negative results."*	Social interactions
PPR outcome	Int. 3	*"The result of a PPR is clearly a project team which is wiser than before the meeting."*	Social interactions
Dissemination of results	Int. 1	*"Then you have multiplicators, i.e. individuals from different departments who carry the knowledge of PPRs into these departments."*	Social interactions
Dissemination of results	Int. 2.	*"The relevant employees inform each other about the positive and negative results. I think it would be incredibly difficult to write things down in a way that everybody understands what is meant."*	Social interactions
Dissemination of results	Int. 3	*"The most effective way is communication with known colleagues."*	Social interactions
Dissemination of results	Int. 4.	*"A verbal presentation always works best if you ask me."*	Social interactions
Dissemination of results	Int. 5	*"Those who participated have taken something new away and if they are in the next project they might get up and say attention please we had this before."*	Social interactions
Dissemination of results	Int. 6	*"I am not even sure if there will be minutes. I think because we have further projects running within this team, the exchange of information is very important. You do not have to write this down. Therefore it is important to have the core team present and you go and it is done."*	Social interactions
Alternatives to PPRs	Int. 5	*"Workshop with 5 experienced project managers under the topic project management. Each one could give his experiences, we add them up and could thus provide a one-page document with the most important issues."*	Meetings
Alternatives to PPRs	Int. 1	*"I tried to explain myself how to manage a project and of course there are a few older colleagues who can provide some advice, based on their experience, but this is not done automatically, you really have to pester them. Before it was called officially a PPR the most effective communication was the round of department managers that happened regularly."*	Social interactions
Alternatives to PPRs	Int. 2	*"We have the practice to have godfather project managers for a new project manager. They meet once a week roughly and the godfather supports him with information and experiences."*	Social interactions
Alternatives to PPRs	Int. 3	*"If there is only one person, I would take a sample project as an example and go through the details with him. If it were a group of people, I would do some brainstorming or a week-end away somewhere."*	Social interactions
Alternatives to PPRs	Int. 4	*"Well, in my department there are quite a few project managers, and these people tend to pop in to more experienced colleagues like me and ask about my experience and we pass on our advice informally and verbally."*	Social interactions
Alternatives to PPRs	Int. 6	*"Personal discussion, but this is by far not as efficient, because it is always only one person. And I would not really get the information I want…if I only talk with single colleagues I would never get the overall picture and this only works if you sit together."*	Social interactions

Appendix 4.10 Lessons Learnt Across the Three Data Sources

Code	Minutes of PPRs	Repertory grids	PPR observation
BUR1		Degree of bureaucracy of organization	
BUR2		Documentation during project done according to guideline	Are we really working according to our guidelines
BUR3			Decision power of the development team
BUR5		Degree of formality of project team	
BUR6	Test specification list has been a good experience		There used to be a list, what happened to all these points that were still open
BUR7			We had everything on our list which we considered to be important
BUR	**1**	**3**	**4**
Cap 1	More resources in testing area needed	High volume of resources	It is always a capacity problem (5)
CAP	**1**	**1**	**1**
COM1		Information flow within project	I have more problems because the information flow does not yet work properly
COM2			We have to improve the feedback from the customer
COM3		Bad communication between locations and teams	
COM4		Specifications and objectives are given	
COM5			Important not to forget external suppliers in the information flow
COM6			Use of coaches for transfer of knowledge and experiences
COM7			More communication with more meetings and more involved people.
COM	**0**	**3**	**5**
COST1	Cost management	Sticked to project budget	
COST2		Sticked to objective regarding targeted production costs	The machine costs are always important.
COST	**1**	**2**	**1**
EXP1		Project manager had experience	
EXP2			I am here for 30 years now and we always had the same problems
EXP3			We did not have enough specialists for the pre series phase
EXP4		Project ideal example for lessons learnt	Can we maybe learn from the other project and do it the same way?
EXP5			Topic of team work is a key
EXP6		Project manager satisfied with project and therefore motivated	
EXP7		Process was improved during project	We already integrated into the guidelines that we need to be involved earlier

Appendix 4.10 Lessons Learnt Across the Three Data Sources (ctd.)

Code	Minutes of PPRs	Repertory grids	PPR observation
EXP9	Learning from mistakes and successes from previous projects		Parallel projects cannot have the same level of learning from each other than subsequent projects
EXP	**2**	**4**	**6**
MARK1			You never know how quick the competition is with a similar machine.
MARK1			Quality of feedback from market research and test customers
MARK4	Choice of test customers		Timing for the EMO was not bad
MARK	**1**	**0**	**3**
ORG1		Number of departments involved in project	We are now involved from the beginning of a project, otherwise we would have had problems
ORG12	Work overload, especially regarding cost management		Coordination for project manager almost impossible
ORG13			But we do not have the capacities we need
ORG15			Coordination in the development team and other areas
ORG16			Different organization of all project development phases
ORG2		Degree of dependence from external suppliers (licence rights)	
ORG20			I think the market would have tolerated to present the machine in November and then wait with the delivery a bit longer
ORG3		Number of locations involved in project	There were so many parties involved
ORG9			We can only be quick with well-known components and not with innovations
ORG	**1**	**3**	**8**
PM1		Clarity PM responsibilities	
PM10		Quality of project planning and board approval	
PM11		Clarity of project structure	
PM19			Regular meetings of core team and other departments
PM2		Active PPR process	
PM4		Efficient project management	
PM7		Detail of market launch preparation	
PM8		Quality of transfer to next development phase	
PM	**0**	**7**	**1**

Appendix 4.10 Lessons Learnt Across the Three Data Sources (ctd.)

Code	Minutes of PPRs	Repertory grids	PPR observation
PROD1	Design decisions earlier needed		Design decisions
PROD	**1**	**0**	**1**
SOC1			Respect and understanding between team members
SOC4			Thanks to everyone involved
SOC	**0**	**0**	**2**
SUPPLY2			Use external suppliers, e.g. for testing of components
SUPPLY	**0**	**0**	**1**
TECH1		Length of time to find mistakes after launch	Complexity of after launch problems
TECH2		Number of loops in the development process	You constantly have changes and that causes huge problems
TECH3		Degree of risk factor of development project	
TECH4		The final assembly at the customers site is always problematic	
TECH6			The whole tried to veto the plan, but that did not change anything
TECH7	Missing specification in the beginning and frequent changes afterwards	Specifications and objectives changed	It is sometimes little changes, but we simply do not know about it
TECH8		Degree to which project objectives were achieved	Only well tested machines are allowed in the field.
TECH9		Degree of technological jump - real new product development	
TECH	**1**	**7**	**5**
TEST1	Number of prototypes used		All prototypes look the same, or should we use them in parallel
TEST2		Length and depth of test phase	If it necessary to ask if 5 pre series machines are really necessary
TEST	**1**	**1**	**2**
TIME1		Duration or length of project.	Development time was too short
TIME2	Controlling of deadlines and milestones	Time for pre series test	The time plan and deadlines was very short - almost impossible to control.
TIME	**1**	**2**	**2**
TURN1		Quality of estimated market volume	If we wait too long with the delivery, our turnover will suffer.
TURN	**0**	**1**	**1**
	11 constructs	**39 constructs**	**43 constructs**

Appendix 4.11 Metaphors Mentioned During Interviews

Interviewee	Company	Metaphor quote	Related construct
Int. 1	Engineering Co.	*"This was one of our hey Joe projects."*	BUR5
Int. 5	Engineering Co.	*"One of the project managers said this is so separate there is actually a wall in between."*	COM3
Int. 5	Engineering Co.	*"…and in the end you always run out of time."*	PM10
Int. 4	Engineering Co.	*"In the past we made many mistakes by giving our stuff to the production, then lean back and let them alone."*	PM8
Int. 6	Engineering Co.	*"Here I should really say do not blow your own trumpet."*	TECH8

Appendix 4.12 Examples of Stories and Metaphors During the PPR at Engineering Co.

Data source	Quote	Connected construct
PPR Engineering Co.	*"The whole test area was constantly with their backs to the wall."*	CAP1
PPR Engineering Co.	*"We ended up falling on our faces."*	CAP1
PPR Engineering Co.	*"We also had some other 'Nebenkriegsschauplätze'."* (direct translation: smaller wars which happen at the same time than the main war).	CAP1
PPR Engineering Co.	*"I think I can put your mind at rest: I am now more than 30 years with Engineering Co. No matter which product was introduced, even very simple ones, had problems when they were launched and there were an awful lot of changes done. C' est la vie my friends."*	EXP2
PPR Engineering Co.	*"Two weeks ago I talked to a colleague from the development and said that he could have predicted the problems we have today with the machine right on the day when we started the delivery. He knew it was coming. And today, one year later, the customers start to complain and the issues raised prove the points that he could have predicted a long time ago."*	EXP2
PPR Engineering Co.	*"If I think about this I really start to cry because I can only dream about such a situation."*	ORG13
PPR Engineering Co.	*"And if we do not achieve them the alarm bells need to go off."*	ORG16
PPR Engineering Co.	*"All this is obviously because we hang at the end of the chain."*	TECH2
PPR Engineering Co.	*"We are always at the end of the food chain."*	TECH2
PPR Engineering Co.	*"Everyone in development would have killed me if I said you sit down with me for two das and develop a procedure for the machine installation."*	TECH2
PPR Engineering Co.	*"We need to get away from the Microsoft mentality, i.e. not the market introduction, but the quality is priority number one. That should be really held under the directors noses."*	TECH8
PPR Engineering Co.	*"I can only talk for myself, but sometimes it would already help me to know that I am on the wrong track somewhere."*	TIME2
PPR Engineering Co.	*"We are on thin ice and still have quite a few problems."*	TURN1
PPR Engineering Co.	*"All this is a balancing act."*	TURN1

Appendix 5.1 Quotes Regarding Judgements of PPRs

Interviewee	Quote	Code
Int. 1 Machinery Co.	*“Some kind of conclusion I think is definitely necessary. I think you have some sort of an obligation to deliver towards your team members. In order to officially conclude the whole thing, too. We are very free and can do it very minimalistically, that is up to everyone individually.”*	Positive
Int. 1 MedCare Co.	*“For me it is also a recognition of the performance of the project team. You present the whole result because many people work on only a partial element and it is really nice for them to see the overall outcome.“*	Positive
Int. 3 Engineering Co.	*“It should be a firm step in the development process.”*	Positive
Int. 5 MedCare Co.	*“Because it might be more sensible to discover that product x is not needed, to find this out during a PPR of a bout 2 hours and to invest these two hours. Because it would be highly efficient to gain a lot of time and save about 50.000 Euro. So these two hours would definitely be worth it.”*	Positive
Int. 2 Appliances Co.	*“I think PPRs are well accepted, it is important to do it to see how other colleagues see the project.”*	Positive
Int. 2 Engineering Co.	*“I would do them definitely, this is why we integrated them later in the guideline, but I would not expand it into a huge team meeting, because the project is basically finished for about a year, but I think it is important that each expert raises his issues and that it is documented in writing and that we have a communication while doing this.”*	Positive
Int. 2 Machinery Co.	*“I am sure I can get something out of it. Of course you invest a lot of effort in that, you work a long time on it, and that has to come out of it somewhere, I mean, you look at the critical points in the beginning, where the problems could arise, and then you can watch these things especially.”*	Positive
Int. 2 MedCare Co.	*“You are very quickly in a new project or just in your daily routine, so I really think it is important to think about the lessons learnt in the end in order to be able to apply these to future projects. Not only negative ones, but also positive ones, so a bit motivating really. The PPR is also an important idea pool, as a documentation for other people and in order to avoid, that we start something purely because no-one remembers that something else was decided in the beginning.”*	Positive
Int. 3 Appliances Co.	*“It is important to get everyone involved at the same level of knowledge. It is not only important to gather all the relevant issues about a project, but you also have to ask other people to look into the mirror. Everyone needs to be brutally honest to each other and to himself.”*	Positive
Int. 3 Medcare Co.	*“The first PPRs were probably done because of the audit. Before that the only interest was if the product was launched. No-one asked what were our experiences, negative or positive ones. Only now with PLP we demonstrate with the management that a PPR and final report do make sense. It has also an advantage for the project manager like no-one can come to me and say it is still running because my responsibility ended with the PPR. Apart from that, it is really important to find an end, otherwise you always get these never-ending loops.”*	Positive
Int. 1 Engineering Co.	*“Of course I would* [do a PPR in my next project] *you see where you stand, you also see where action is still needed.”*	Positive

Appendix 5.1 Quotes Regarding Judgements of PPRs (ctd.)

Interviewee	Quote	Code
Int. 4 Machinery Co.	*"Well, I would see it this way, that everyone sits down again and looks at everything that happened and sees what the status is and what still needs to be done or worked on. But of course one should do it pragmatically. It is not about knighting everyone involved really."*	Positive
Int. 5 Appliances Co.	*"I think it is good because you reflect commonly."*	Positive
Int. 6 Machinery Co.	*"The PPR is not superfluous at all because the project manager is assigned a task and has to be relieved from his duties at some point. Then we have to say o.k. the task is completed. You are free of this project."*	Positive
Int. 6 Appliances Co.	*"I would always recommend to do a PPR. It has the effect that the things you try to ignore during the project you have to look at again. What you always remember are the problems, they are known to anyone and you have discussed about it a lot. But the things you really achieved you do not look at and that was a positive effect. We have had the whole project team around the table so that everyone could say his opinion and everyone left the review with the feeling that what was not perfect was accepted from the team."*	Positive
Int. 2 Publishing Co.	*"I am quite sceptical if the result would be a better understanding of responsibilities, etc. For big projects it makes sense. For other companies with much more expensive products the risk is much bigger than for our cheap things. But for this you need competent people round the table as well. What we do is only trouble shooting at the moment."*	Neutral
Int. 7 Appliances Co.	*"For me the question is always, how honest is everyone, how important is it really, what do I expect from it or the other way round, maybe it would need to be prepared more clearly and more consequently."*	Neutral
Int. 4 Engineering Co.	*"Often it is the problem that no-one wants to admit that something did not go very well."*	Neutral
Int. 6 MedCare Co.	*"The question for me is if it should take place in an official meeting. With middle sized and big projects yes, for smaller projects with only a few people involved, it should really happen informally. I would not support all this official stuff then."*	Neutral
Int. 1 Appliances Co.	*"Most things I know already. There was no big awakening, because everyone was involved, it was just a touch different."*	Negative
Int. 1 Publishing Co.	*"If I go to my boss and say I want to do a PPR he will say, well if you have nothing better to do and some spare time, I will not hinder you from doing it. But then you also need a culture of trust…In our climate it is comparatively nonsense to do an evaluation. It needs to be possible to say yes I have expected this from the product, but it did not work out so I will learn from this for the future. I am not responsible and secondly I think that the people who are responsible consider it to be a duty and thus the result is very bad. If you force someone to do something he is not convinced about, you might as well forget the whole idea."*	Negative
Int. 3 Publishing Co.	*"From my point of view there are no PPRs here. I think an important reason is that for the people who have pushed a project like the project manager and myself if you want, then the project is finished in his head at a very early stage, before it is really finished in real life even."*	Negative

Appendix 5.1 Quotes Regarding Judgements of PPRs (ctd.)

Interviewee	**Quote**	**Code**
Int. 4 Appliances Co.	*"Everybody has different problems, you do not really have the time to discuss all details while sitting around for a day, and we should really be cautious that the whole thing does not get too artificial."*	Negative
Int. 4 Publishing Co.	*"We are not really doing PPRs in the classical way because our directors do not place importance on it. That is because we do not really care about our backlist if you know what I mean. We have some things which happen per coincidence, but not in a structured way."*	Negative
Int. 5 Engineering Co.	*"…if we do it the way we do it today we might as well stop doing them."*	Negative
Int. 5 Publishing Co.	*"So in general here in the company you are probably right in saying that we are not doing it often enough. But the problem is also that if you are ready with one product, then you are already running towards the next and you simply do not have the time to reflect and review. It really depends from the project manager or product manager if it is done or not."*	Negative
Int. 6 Publishing Co.	*"I think it just happens by sheer coincidence here, but not on purpose because it is not asked for by the management. I think for us this point is not that important and we believe we know everything already without looking for it in a systematic way."*	Negative
	15 positive comments **4 neutral comments** **9 negative comments** **28 comments in total**	

Appendix 5.2 Quotes Regarding Personal Objectives of PPRs

Interviewee	Quote	Code
Int. 1 Machinery Co.	*"So that everyone has the same level of information, I think, and also improvement suggestions for future projects are included in these final reports."*	Discussion Improvement
Int. 7 Appliances Co.	*"The idea is to communicate the good and negative things and to give others a chance to learn. The aim of a PPR is to become a learning organization. Not to repeat experiences all the time, but to give one the chance to profit from the experiences of the colleagues."*	Discussion Learning
Int. 4 Publishing Co.	*"You can do a PPR only when you for example noticed because of missing sales that the product was not successful. Then you should ask why it was not successful, and when you then found out why it was no success, then you have to find out why the decisions were taken to come up with this product in a certain way. Then you can see if there is a problem in the process or if the circumstances changed which led to the flop without any internal processes being wrong."*	Evaluation Learning
Int. 1 Engineering Co.	*"I would reflect on the topics was it necessary, how did it go, do we need to change something. So these would be my three questions for each single issue. "*	Evaluation Improvement
Int. 2 Appliances Co.	*"I think it makes a lot of sense to ask after a project is finished what went pear-shaped, because you can only learn from it, but I have the impression that if criticism is mentioned regarding the management, not a lot is changed as a result from it."*	Evaluation
Int. 2 Machinery Co.	*"I think that you have been working together with your team relatively closely for a long time and then you want to evaluate together. Everybody can voice their criticism, what should be done differently the next time, that is actually important to improve the project management."*	Evaluation Improvement
Int. 2 Medcare Co.	*"Firstly in order to critically reflect how the project was conducted and maybe also from a motivation point of view so that it not just fizzles out in the end. "*	Evaluation Team
Int. 3 Machinery Co.	*"Well I think the team needs it . It is important to receive feedback about the whole project and of course one should gather up all the feedback, so you can draw conclusions from it."*	Evaluation
Int. 3 Medcare Co.	*"It makes sense to see if the objectives are met or if there are some deficits. And also to see where we have improvement potential for future projects, what we could do better."*	Evaluation Improvement
Int. 4 Engineering Co.	*"My aim is to document the mistakes that we made in order to have them in front of our eyes,… and then how can we apply this to the next project as we cannot do the same mistake twice."*	Evaluation Learning
Int. 4 Medcare Co.	*"To think about what we wanted to achieve, what we actually achieved, how the route to there was. Did we really achieve our objective and also critical questions what could have done better thinking of new and future projects. "*	Evaluation Improvement
Int. 5 Appliances Co.	*"I think it is a good idea because you reflect consciously what was the problem in the past and I think you should also work on the positive issues because we always tend to focus on the negative ones."*	Evaluation
Int. 5 Machinery Co.	*"Simply in order to be able to evaluate the projects and as far as this conclusion meeting is concerned, the project manager is supposed to present three recommendations how the project should contribute… in order to conduct projects better in the future."*	Evaluation Improvement

Appendix 5.2 Quotes Regarding Personal Objectives of PPRs (ctd.)

Interviewee	Quote	Code
Int. 5 Publishing Co.	*"We all agreed that the process did not work o.k. and we said that we have to sit together and <u>reflect</u> on what had happened."*	Evaluation
Int. 6 Machinery Co.	*"The project manager is obliged by the directing committee to take over a task, then he has <u>to justify if he can achieve that which is requested of him</u>, if that goes into the right direction."*	Evaluation
Int. 1 Medcare Co.	*"It is important to show all members of the project team that the <u>project is now finished</u>."*	Formal
Int. 5 Engineering Co.	*"I would do PPRs in order to <u>improve</u> our development processes."*	Improvement
Int. 3 Appliances Co.	*"We want to <u>learn</u> from our projects. They last about 4 years, cost a lot of money and a lot of people are involved."*	Learning
Int. 3 Engineering Co.	*"The objective is to <u>learn</u> something and to do it better next time."*	Learning
Int. 4 Appliances Co.	*"I guess it is the wish to <u>conserve</u> <u>something</u> for the future. "*	Learning
Int. 5 Medcare Co.	*"You need to pin down what we have <u>learnt</u>, what was bad, what was good. You do not need to repeat the mistakes like that."*	Learning
Int. 6 Engineering Co.	*"…there are things that go wrong in these huge development projects and you can and have to <u>learn</u> from your mistakes... if you do it in a very open manner and discuss these issues with some sort of detachment from the project, you can learn for the next project."*	Learning
Int. 6 Medcare Co.	*"In order to <u>learn</u> from the project as well from the positive and negative things. It is always also a possibility to thank all the <u>involved people</u>."*	Learning Team
	13 evaluation objectives **9 learning objectives** **7 improvement objectives** **2 discussion objectives** **2 team objectives** **<u>1 formal objective</u>** **34 objectives in total**	

Appendix 5.3. Quotes Regarding PPRs and Learning

Interviewee	Quote	Code
Int. 1 Appliances Co.	*"Non-optimal things might be perceived by the team, although everyone else thought it was perfect. So therefore I think PPRs help a lot."*	Positive
Int. 1 Engineering Co.	*"You do not always have to fill huge files if you conduct a PPR and if you have a good team, it works without."*	Positive
Int. 4 Machinery Co.	*"It is possible that some people say I did not know this before, especially since you only hear about the results and such things if you take part in the PPR."*	Positive
Int. 1 MedCare Co.	*"For me it was good because during the project not everything was mentioned to me and now in hindsight I have personally learnt something for the next project. For the team members it is just a different feeling to see the outcome of a project and this alone is beneficial for them."*	Positive
Int. 1 Publishing Co.	*"For us learnings from one project are comparatively easy to transfer to new projects."*	Positive
Int. 2 Machinery Co.	*"Certainly it happened that I was sitting in one of these meetings and thought "oops – I was not even aware of that" although I was member of the team. Yes, definitely that happened to me."*	Positive
Int. 3 Appliances Co.	*"Some of them definitely learnt more about the project than they new before the PPR."*	Positive
Int. 3 Machinery Co.	*"That happens in the discussion. I mean a lot of things only go through my head then and I do think of a few things I want to say."*	Positive
Int. 3 MedCare Co.	*"I learn a lot via these meetings because I am only involved in the internal issues and nothing that happens externally."*	Positive
Int. 3 Publishing Co.	*"What happened was a meeting between purchasing and product development, where we really sit together and analyse what has happened, how this could have happened and partly also with the external supplier."*	Positive
Int. 7 Appliances Co.	*"During the discussion the real important points emerge within the team - you will never find these points in minutes or databases."*	Positive
Int. 4 Appliances Co.	*"Of course there are always some issues that everyone is surprised about how they develop into big problems during the PPR discussion or vital elements without anyone realizing this before."*	Positive
Int. 4 Publishing Co.	*"It needs a bit of discipline that the operational tools that you have available like e.g. a design workshop, that these are used in order to improve things instead of not just mentioning them. So the tools we have already, we just need to use them now."*	Positive
Int. 2 Appliances Co.	*"There are certain issues that only come up at the end in the review, because only then you have the time and quietness to actually think about causes and consequences."*	Positive
Int. 5 Appliances Co.	*"I mean we are not wearing uniforms and the others might have a different viewpoint. So also in the PPR there are other aspects coming up that in the daily work would not be noticed This is also why I think this official project end is good because you get to know the different viewpoints when you turn the project upside down."*	Positive
Int. 5 MedCare Co.	*"I can imagine an aha-effect during PPRs very well. Maybe less a big aha, but it was much more concrete and in detail discussed. But maybe aha in the sense, this is really important for this specific department. And that you then realise if it was important for one or many project team members."*	Positive

Appendix 5.3. Quotes Regarding PPRs and Learning (ctd.)

Interviewee	Quote	Code
Int. 6 Appliances Co.	*"As I tried to show the topics with these cards there were many aha-effects. We have of course seen it, but the influence of certain things on the remaining project only became really clear to us when looking at the details together."*	Positive
Int. 2 MedCare Co.	*"Principally the method PPR is enough, but we witness all the time that if a know-how carrier disappears you only are left with about 70% of his knowledge. So basically you have milked him as long as he was here, but the 30% you did not need or no-one asked about it. I think it is not possible to keep this in a database. Not at all. Therefore you need to do a meting with the whole team to discuss together and get this mutual exchange of views."*	Positive
Int. 6 Engineering Co.	*"It is only during this last meeting and in such a group of people that a project is analysed from all angels and that one becomes aware of all important aspects."*	Positive
Int. 3 Engineering Co.	*"Me as a project manager might see things different to someone from the documentation. The focus is always different, each one has different points of view what went wrong during the project, this is why it is important to exchange these views and to hear different opinions"*	Positive
Int. 6 Machinery Co.	*"Certainly - there are always some team members who realize something they did not know all along. Sure, I mean that is the advantage of team work, that the special knowledge of the individual departments overlaps and that we can determine as a result."*	Positive
Int. 6 MedCare Co.	*"What I noticed is that if you have a hidden conflict then the discussion is not as open and free as it should be, but with a bit of time delay you see something differently than at the beginning of the project when it was a huge problem. So I also had PPRs where some departments admitted their mistakes in hindsight."*	Positive
Int. 6 Publishing Co.	*"It came up more systematically and it was documented more concrete. It was hardly so that I was completely surprised, there were many points where I said, yes, yes, but if you could have expressed them in the same clear cut way is the big question."*	Positive
Int. 1 Machinery Co.	*"Us developers of course really get wind of everything, we know where it's at. So we would not really need to go. For other people, who were not involved everywhere, for them it is interesting."*	Neutral
Int. 2 Engineering Co.	*"I think the effect that you learn something during the meeting only happens with departments which do not deal closely with development, such as controlling, marketing, these kinds of departments."*	Neutral
Int. 2 Publishing Co.	*"We will see in the next adaptation if the PPR helped."*	Neutral
Int. 5 Machinery Co.	*"The meetings are basically to discuss problems and I would say these problems we cannot really solve right there."*	Negative
Int. 5 Publishing Co.	*"Important from a psychological view is the simple fact that not many people are willing to admit that they have done something wrong as well. And this is also down to our company culture. As soon as I say there is room for improvement I admit that I have done something wrong or that I have not worked in the optimal way and this of course offers a lot of potential for critics."*	Negative
	23 positive comments **3 neutral comments** **2 negative comments** **28 comments in total**	

Appendix 5.4: Quotes Regarding PPR Outcomes

Interviewee	Quote	Code
Int. 1 Publishing Co.	*"I think a general brainstorm without any result in the end is not really helpful. It is important to discuss how the project performed, what should be improved in the future and also who will be responsible for which action point."*	Action based
Int. 5 MedCare Co.	*"The most important outcome are a list with the outstanding actions which need to be done before the project can be 100% closed."*	Action based
Int. 6 Engineering Co.	*"It is more than an exchange of information. I also want to solve problems. That means exchange problems and try to find a solution."*	Action based
Int. 5 Appliances Co.	*"I would prefer to have a list of three positive and three negative points which were realized and discussed during the PPR and which are relevant to be followed up in future projects."*	Action based
Int. 5 Engineering Co.	*"What is missed out a bit is to find actions out of the PPR. So my personal opinion is that there are a lot of things on the table during our PPRs, but we do not do enough with it."*	Action based
Int. 1 Engineering Co.	*"Ideally, our internal checklists would be updated as a result of the different PPRs."*	Document-based
Int. 1 Machinery Co.	*"There is the final report as our main result. This protocol should only be one or two pages, very short, just like a bullet point list. Plus there is a list of improvement suggestions from the team and the team will try to have these issues taken off its hands."*	Document-based Action based
Int. 1 MedCare Co.	*"There is a final project report in written form which is very much figures driven, not so much technical really. Also a responsible person and deadline for each action point."*	Document-based Action based
Int. 2 Appliances Co.	*"The minutes, but also the presentation to the board with the results from the group discussion."*	Document-based Social interactions
Int. 2 Machinery Co.	*"Well, we do a protocol for every meeting, so also for the final meeting. The project manager has to do that."*	Document-based
Int. 2 MedCare Co.	*"It is the responsibility of the project manager that we have minutes, an overview of all to dos, then we go into the details, who has to do what until when, etc."*	Document-based Action based
Int. 3 Machinery Co.	*"The team gets around 70% of what the project manager writes, a summary of costs and so cost transparency is provided for. "*	Document-based
Int. 3 MedCare Co.	*"I think we need to stick to the minutes, otherwise we never reach all the people we need to."*	Document-based
Int. 4 Publishing Co.	*"For us here it is mainly important to document the mistakes - the other question is if we repeat them or not."*	Document-based
Int. 5 Machinery Co.	*"The result are minutes. They also contain all the tasks, like to be completed by whom until when."*	Document-based Action based
Int. 5 Publishing Co.	*"Thanks to our company culture we have no choice than to write minutes, the rest will only work against the project manager."*	Document-based
Int. 6 Appliances Co.	*"Our minutes of PPRs are really important, because everybody knows them, but the actions and how they are followed up are also crucial from my point of view."*	Document-based Action based
Int. 6 Publishing Co.	*"It was documented what was good, what was bad and what do we need to do."*	Document-based
Int. 7 Appliances Co.	*"A dual system of minutes for the non-participants and the presentation to the board is recommendable."*	Document-based Social interactions
Int. 6 MedCare Co.	*"My recommendation would be to inform all other business units as well, so the only chance you have are the official minutes, because you do not even know the people there."*	Document bases

Appendix 5.4: Quotes Regarding PPR Outcomes (ctd.)

Interviewee	Quote	Code
Int. 2 Engineering Co.	*"That the relevant employees inform each other about positive and negative results."*	Social interactions
Int. 2 Publishing Co.	*"You cannot really write down experiences, even if you try. This is almost impossible and it would be a huge book."*	Social interactions
Int. 3 Appliances Co.	*"I think our approach to present the summary to a wider audience is a good practice which we should keep."*	Social interactions
Int. 3 Engineering Co.	*"The result of a PPR is clearly a project team which is wiser than before the meeting."*	Social interactions
Int. 4 Appliances Co.	*"Well, you saw some of our minutes of PPRs, so I guess you agree that we better focus on our informal networks and personal presentations as the main result. The document is worthless."*	Social interactions
Int. 4 Machinery Co.	*"I always prefer to do personal presentations after the PPR took place, because only the interaction between people can really transfer the knowledge gained during the meeting."*	Social interactions
Int. 4 MedCare Co.	*"It does not make sense to have a form sheet with all sorts of potential problems listed. I think those people who witnessed these things live and also remarked these deficits will definitely remember it and try to do it better in future projects."*	Social interactions
	15 document-based outcomes **10 action based outcomes** **8 social interaction outcomes** **33 responses for outcomes in total**	

Appendix 5.5 Quotes Regarding the Dissemination of Results

Interviewee	Quote	Code
Int. 1 Machinery Co.	*"Our minutes are not so bad at all, assuming that they have not more than one or two pages - we really suffer from information overload in this company."*	Document-based
Int. 1 Publishing Co.	*"I would sometimes look at the minutes of my colleagues because they might have questions or issues which I did not come across before and so I could definitely learn something more from them."*	Document-based
Int. 4 MedCare Co.	*"One possibility would be to integrate these issues in the handbook, but I think you have to differentiate also if it is a project problem or a process problem. "*	Document-based
Int. 5 Appliances Co.	*"The minutes of PPRs are really read in this company."*	Document-based
Int. 5 Machinery Co.	*"People not involved in the project usually do not have access to minutes unless someone would ask for it because he wants to know what is being discussed there. This should be changed."*	Document-based
Int. 5 MedCare Co.	*"We would need to check if anything of it is so relevant that it needs to be integrated into a company guideline or the PLP. I think lessons learnt I can only disseminate if I register it myself and then use it again in the projects I work in and like that pass the experience on to my colleagues."*	Document-based Social interactions
Int. 5 Publishing Co.	*"The participants would need to get he minutes and MT as IPM of course."*	Document-based
Int. 6 Appliances Co.	*"I get the minutes of PPRs in order to learn from it. I insist on getting them. It is very important even if I only know the projects from the far."*	Document-based
Int. 6 Publishing Co.	*"The minutes would be distributed to all participants on the different levels. But then also you have to try to send the essence of the whole event to the bosses, but this depends on the importance of the product."*	Document-based
Int. 7 Appliances Co.	*"I got all minutes down the hierarchy levels. Basically I have seen all from the last two to three years. I got them, read them and had my personal aha–effect. My impression was that the minutes were made very general and no real actions were agreed upon because those people who did the review cannot work on the actions. But I cannot think of a better way."*	Document-based
Int. 1 Engineering Co.	*"Then you have multiplicators, i.e. individuals from different departments who carry the knowledge of PPRs into these departments."*	Social interactions
Int. 1 MedCare Co.	*"We currently do IT-based on final reports and minutes, but I think we should start to think about presentations as well."*	Social interactions
Int. 2 Appliances Co.	*"I hope that we will find a way that replaces the written minutes, because they are useless. We probably have to do it more on an informal personal level to make it happen."*	Social interactions
Int. 2 Engineering Co.	*"The relevant employees inform each other about the positive and negative results. I think it would be incredibly difficult to write things down in a way that everybody understands what is meant."*	Social interactions
Int. 2 Machinery Co.	*"You would not have the time to read all the minutes and most of it you hear through the grapevine anyway."*	Social interactions
Int. 2 MedCare Co.	*"The responsibility should be with the project manager – it is his baby and he is personally responsible to use his networks to pass on the results and learnings."*	Social interactions
Int. 2 Publishing Co.	*"It is really against my character to write down experiences. I much rather talk to my colleagues about it."*	Social interactions

Appendix 5.5 Quotes Regarding the Dissemination of Results (ctd.)

Interviewee	Quote	Code
Int. 3 Appliances Co.	*"You want my honest opinion? We should send the project team with some other R&D managers for a week-end to the Bahamas, or to Mallorca because it is cheaper. After that disseminations would have been done in a perfect way I am sure."*	Social interactions
Int. 3 Engineering Co.	*"The most effective way is communication with known colleagues"*	Social interactions
Int. 3 Machinery Co.	*"I do not send out reports, I would pass on the moods. More in the hallway and in the canteen than in official meetings."*	Social interactions
Int. 3 MedCare Co.	*"I would pass on lessons learnt to a bigger steering committee assuming that they are taking care of passing on these lessons to the wider organization."*	Social interactions
Int. 3 Publishing Co.	*"Talking to colleagues but certain mistakes in the process established themselves are then also forwarded to more people."*	Social interactions
Int. 4 Appliances Co.	*"A distribution of the written information in the end is just bullshit, because it ends up in a drawer. For me it is much more interesting to hear it from the project manager directly."*	Social interactions
Int. 4 Engineering Co.	*"A verbal presentation always works best if you ask me."*	Social interactions
Int. 5 Engineering Co.	*"Those who participated have taken something new away and if they are in the next project they might get up and say attention please we had this before."*	Social interactions
Int. 6 Engineering Co.	*"I am not even sure if there will be minutes. I think because we have further projects running within this team, the exchange of information is very important. You do not have to write this down. Therefore it is important to have the core team present and you go and it is done."*	Social interactions
Int. 6 Machinery Co.	*"I am sure that minutes from other PPRs would be interesting, but you will not get them, I mean you can hear it through the grapevine, but you will not efficiently disseminate the information any other way."*	Social interactions
Int. 6 MedCare Co.	*"The easiest thing is to rely on the experienced senior colleagues and their advice. I think they would suggest a coffee round and that is all that is needed."*	Social interactions
	19 social interactions **10 document-based** **29 dissemination comments in total**	

Appendix 5.6 Quotes Regarding Alternatives to PPRs

Interviewee	Quote	Code
Int. 2 Publishing Co.	*"Now new is the operating manual and I really think this helps to avoid some mistakes if you use it in a consequent way."*	Document-based
Int. 4 Appliances Co.	*"There is a project management handbook, but that is more like the bible, something you know that exists, but does not always help in real life."*	Document-based
Int. 4 Machinery Co.	*"Only the checklists and also the things that are contained in these check lists."*	Document-based
Int. 4 Publishing Co.	*"We try to limit the repetition of mistakes by doing business plans, we try to limit it by more market research, by more manuals and guidelines for stepwise process approaches, that is mainly what we try to do. "*	Document-based
Int. 1 Appliances Co.	*"Yes, there are databases in some areas with different names."*	IT-based
Int. 1 Machinery Co.	*"We used to have a sort of database for the main problems encountered, but that sort of dried out. Then we also had these project manager information meetings, but that kind of fell off as well. "*	IT-based Meetings
Int. 3 Appliances Co.	*"Lessons learnt database are discussed in regular meetings of a project team."*	IT-based
Int. 5 Appliances Co.	*"We have a big number of databases to gather knowledge. But the knowledge is of course a lot in the heads of people. A lot, because you cannot document it and we use this a lot if someone has a problem, then also across units we ask such an experienced colleague. And I always say it would be nice to put all that knowledge and save it in a PC or on a piece of paper and to systemize it."*	IT-based Social interactions
Int. 5 Medcare Co.	*"Databases are good but alone it is not enough. Everyone thinks that once we have a data base and can access things, the problem is solved. But that is not true. It is maybe electronically saved, but not yet in my head or the head of my colleagues. We also have a meeting soon with 5 project managers to analyse what sort of practical problems they have in their daily work."*	IT-based Meetings
Int. 6 Machinery Co.	*"All data is filed in a common electronic folder, basically everything you see here is in this folder and the whole team can look at it."*	IT-based
Int. 7 Appliances Co.	*"We have a lot of databases. E.g. a database where you can look at occurrences when testing a component. Then there is an action database with all the problems that the product caused from the V series onwards."*	IT-based
Int. 3 Machinery Co.	*"I would introduce a monthly meeting of the project managers, so they could exchange their worries. I do not know if that already exists. I cannot tell you at the moment, but probably no, because we have a lot of side-job project managers here."*	Meetings
Int. 4 Medcare Co.	*"A regular meeting of project managers every two or three months could be useful. That we look together at projects and say what does not work properly. This should be optimised really, because at the moment there is nothing formal yet."*	Meetings
Int. 5 Engineering Co.	*"Workshop with 5 experienced project managers under the topic project management. Each one could give his experiences, we add them up and could thus provide a one-page document with the most important issues."*	Meetings
Int. 5 Machinery Co.	*"We had this project manager circle, somehow, somewhere in a restaurant here in town … and we exchanged information about projects and we exchanged experiences. That was earlier. I do not know of anything nowadays."*	Meetings

Appendix 5.6 Quotes Regarding Alternatives to PPRs (ctd.)

Interviewee	Quote	Code
Int. 1 MedCare Co.	*"Overall there is more informal exchange. The longer you are here the better you know whom to ask about certain topics. But it is not extremely structured or unstructured really, you just think about the most experienced person."*	Social interactions
Int. 1 Publishing Co.	*"Well, we have an experience exchange in an informal way, but not structured."*	Social interactions
Int. 1 Engineering Co.	*"I tried to explain myself how to manage a project and of course there are a few older colleagues who can provide some advice, based on their experience, but this is not done automatically, you really have to pester them. Before it was called officially a PPR, the most effective communication was the round of department managers that happened regularly."*	Social interactions
Int. 2 Appliances Co.	*"What I usually do is to ask the person who sits opposite of me when I have a question. This informal way works good enough, it does not need to be introduced formally."*	Social interactions
Int. 2 Engineering Co.	*"We have the practice to have godfather project managers for a new project manager. They meet once a week roughly and the godfather supports him with information and experiences."*	Social interactions
Int. 2 Machinery Co.	*"All of us sit in one room, if you have a problem you just walk over to a colleague or through the room. You see who does the same thing and of course the exchange of experiences works quite well. Apart from that we have team or group meetings every month where we discuss new issues."*	Social interactions Meetings
Int. 3 Engineering Co.	*"If there is only one person, I would take a sample project as an example and go through the details with him. If it were a group of people, I would do some brainstorming or a week-end away somewhere."*	Social interactions
Int. 3 Publishing Co.	*"Apart from that we only have bilateral discussions and talks when the one tells the other what needs to be changed, what went wrong, etc."*	Social interactions
Int. 4 Engineering Co.	*"Well, in my department there are quite a few project managers, and these people tend to pop in to more experienced colleagues like me and ask about my experience and we pass on our advice informally and verbally."*	Social interactions
Int. 5 Publishing Co.	*"Well here with my colleague of course automatically. Then there is also a PM jour fixe during which we discuss general topics like if I thought of something that is relevant for the other PMs as well, then it would be there."*	Social interactions Meetings
Int. 6 Appliances Co.	*"It only works via communication. You know who to ask and who has the experience and there you go and that is more than in any database. Of course the problem is that the know-how also disappears with the relevant colleagues. Right now we do not have a method to capture the information. Of course it is difficult to empty a head, but we do not even try to do this."*	Social interactions
Int. 6 Engineering Co.	*"Personal discussion, but this is by far not as efficient, because it is always only one person. And I would not really get the information I want…if I only talk with single colleagues I would never get the overall picture and this only works if you sit together."*	Social interactions
Int. 6 MedCare Co.	*"Firstly of course the discussion with my colleagues. Then we have also formal exchange circles of the project managers also combined with training sessions for the project managers and then the departmental jour fixes."*	Social interactions Meetings

Appendix 5.6 Quotes Regarding Alternatives to PPRs (ctd.)

Interviewee	Quote	Code
Int. 6 Publishing Co.	*"I think that <u>experience in form of people</u> is a very important aspect. People who have a long-term experience in a company, but are full of power at the same time. Someone like that is an important point."*	Social interactions
	15 social interactions **9 meetings** **7 IT-based** **<u>4 Document-based</u>** **35 comments in total**	

Appendix 6.1 Total List of Repertory Grid Constructs[41]

Construct code	Construct name	Poles	Example quotes	Frequency	Frequency in %	Average weighted variability
BUR1	Bureaucracy of project organization	high / low	"The b*ureaucratic demands became very high and there are people in this company who create each month a new project form-sheet.*" (Int. 1, Engineering Co.)	2	7%	9.80%
BUR2	Use of bureaucratic guidelines	compulsory / not compulsory	*"In this project we were forced to stick to the official internal guidelines."* (Int. 4, MedCare Co.)	2	7%	6.84%
BUR3	Internal politics	Disturbing / not disturbing	"*The intensity of politics involved in a bureaucratic project varies."* (Int. 6, MedCare Co.)	2	7%	13.37%
BUR5	Formality of project	High / low	"O*ne of these projects was not really a formal project for me, because it was done without a formal project team."* (Int. 5, Engineering Co.)	2	7%	12.14%
CAP1	Necessary capacities and resources	Available / not available	"*Very often the necessary development capacities are just not available and we all know the consequences."* (Int. 7, Appliances Co.)	7	23%	11.41%
COM1	Intra-team communication	Efficient / not efficient	*"With every project, even if it is a very small one, there are communication problems."*(Int. 1, Appliances Co.)	6	20%	8.17%

[41] It is important to mention that the construct codes allocated to lessons learnt are not always subsequent in their numbering. The reason for this is twofold: firstly, the coding was done in several steps, i.e. during the first coding steps more than 65 common constructs were identified and these were then grouped further so that a subsequent numbering was not always possible to achieve. Secondly, the same coding list was also used for the analysis of documents and transcripts, which happened in parallel to the analysis of the repertory grid results of individual cases. Consequently, codes which were not mentioned by interviewees, but in other data sources sometimes received codes which "disturbed" the sequential coding.

Appendix 6.1 Total List of Repertory Grid Constructs (ctd.)

Construct code	Construct name	Poles	Example quotes	Frequency	Frequency in %	Average weighted variability
COM2	Communication with customer	Efficient / not efficient	"*We had no problems with this project, because the communication with the customer was very good.*"(Int. 1, Machinery Co.)	2	7%	11.07%
COM3	International communication	Efficient / not efficient	"*A purely German project is much easier with regards to communication.*" (Int. 6, MedCare Co.)	3	10%	13.73%
COM4	Communication of project objectives	Clear / unclear	"*It is critical how a goal and objective is communicated.*" (Int. 1, Publishing Co.)	10	33%	10.06%
COM5	Communication with external parties	Efficient / not efficient	"*Communication with external parties is very crucial for the project success.*" (Int. 3, Publishing Co.)	1	3%	8.82%
COST1	Meeting of targeted project costs	Project cost budget met / not met	"*Lets take project costs now, although it is only a marginal topic here. We do not really care about our project budget.*" (Int. 3, Appliances Co.)	9	30%	14.28%
COST2	Meeting of targeted product costs	Met / not met	"*We really have to look at each single penny regarding the targeted product costs per unit.*" (Int. 2, Machinery Co.)	4	13%	10.06%
EXP1	Experience of project manager	High / low	"*A good new project manager - a doer - with a lot of the right technical and interpersonal expertise.*" (Int. 5, Appliances Co.)	6	20%	12.61%
EXP2	Managerial experience of project team	High / low	"*Qualification of project members was mixed. We would have preferred team members with more managerial experience.*" (Int. 3, Appliances Co.)	4	13%	8.68%
EXP3	Technical experience of project team	High / low	"*The people in the team had not been given the necessary technical training.*" (Int. 4 Machinery Co.)	3	10%	10.13%

Appendix 6.1 Total List of Repertory Grid Constructs (ctd.)

Construct code	Construct name	Poles	Example quotes	Frequency	Frequency in %	Average weighted variability
EXP4	Networking between departments	Possible / impossible	"*There were positive side effects because we worked across different departments. This networking habit works."* (Int. 2, MedCare Co.)	4	13%	10.12%
EXP5	Teamwork	Ideal / difficult	"*Here I think of a good project team. The chemistry was right on the personal level but also on the professional level."* (Int. 6, MedCare Co.)	8	27%	8.68%
EXP6	Satisfaction of project managers	High / low	"*This is a very good construct - how satisfied was the project manager personally with the project compared to previous ones.*" (Int. 2, Engineering Co.)	2	7%	5.84%
EXP7	Process improvement during project	Possible / Impossible	"I*nstead of just doing the project we also improved the processes based on our experiences.*" (Int. 5, Engineering Co.)	3	10%	6.05%
EXP8	Creative freedom for project team	High / low	"T*he degree of creativity necessary for the project is something that I have learnt."* (Int. 6, MedCare Co.)	3	10%	9.87%
EXP9	Inter-project learning	Discussed / not discussed	"*These are projects which could act as examples for today's projects in terms of the processes applied."* (Int. 6, Appliances Co.)	3	10%	11.93%
EXP13	Learning from flop products	Achieved / not achieved	"*We have to improve the way we learn from flop products.*" (Int. 2, Publishing Co.)	2	7%	14.30%
MARK1	Quality of market research	High / low	"*In the end we learnt that the project objectives did not correspond to the market requirements.*" (Int. 3, Appliances Co.)	6	20%	10.62%

Appendix 6.1 Total List of Repertory Grid Constructs (ctd.)

Construct code	Construct name	Poles	Example quotes	Frequency	Frequency in %	Average weighted variability
MARK2	Importance of international brand registration	High / low	"*The problem we always have with our brands on an international basis is to get the brand registered.*" (Int. 5, MedCare Co.)	2	7%	8.28%
MARK3	Quality of marketing support	Good / bad	"*The quality of the marketing support was here very positive.*" (Int. 3, Publishing Co.)	2	7%	5.58%
MARK4	Planning of TV activities	In advance / too late	"*Certain things need to be checked well in advance, like the TV spots and when they need to be booked.*" (Int. 1, Publishing Co.)	2	7%	7.27%
ORG1	Project matrix organization	Strong / weak	"*Matrix rules always have their pros and cons, but with a strong team it usually works.*" (Int. 4, Appliances Co.).	5	17%	9.88%
ORG2	Involvement of external parties	Helpful / disturbing	"*There were several external parties involved and the result was a real belly-flop.*" (Int. 5, Appliances Co.).	5	17%	11.70%
ORG3	Complexity of project organization	High / low	"*With more than one development site, it always becomes more difficult and complex for the project organization.*" (Int. 2, Engineering Co.)	9	30%	14.07%
ORG6	Attention of top management	Strong / weak	"*If top managers are involved and part of the project team, the attention the project gets from the board is far above average.*" (Int. 1, MedCare Co.)	3	10%	7.85%
ORG7	Turnover of project managers	Frequent / rare	"*We had at the time a very high fluctuation of project managers. Each year there was someone new and this makes project work very difficult.*" (Int. 4, MedCare Co.)	1	3%	14.18%

Appendix 6.1 Total List of Repertory Grid Constructs (ctd.)

Construct code	Construct name	Poles	Example quotes	Frequency	Frequency in %	Average weighted variability
ORG12	Work overload of project manager	High / low	*"The bad organization created a lot of work and overlapping tasks for the project manager."* (Int. 1, Machinery Co.)	1	3%	8.89%
PM1	Allocation of responsibilities	Clear / unclear	"*It is always a problem if no one feels responsible. This needs to be put down black on white - otherwise it will be a disaster."* (Int. 5, Appliances Co.)	7	23%	9.91%
PM2	Project closure with PPR	Done / not done	*"We still don't have an official project conclusion or review the way it should be."* (Int. 5, Machinery Co.)	2	7%	21.47%
PM3	Use of testing coordinators	Yes / no	"*Since 4 or 5 years we have coordinators from the test department allocated to each R&D project."* (Int. 7, Appliances Co.)	1	3%	11.27%
PM4	Quality of project management	Professional / beginners level	"*Here we had a high quality project management which increased the projects efficiency.*" (Int. 5, Appliances Co.)	7	23%	9.12%
PM7	Quality of market launch	High / low	"*We learnt here that there is never to much care involved when thinking of the market launch. You can never repeat it."* (Int. 3, Engineering Co.)	4	13%	11.27%
PM8	Quality of transfer between different development phases	Efficient / not efficient	"*It is always difficult to transfer the project from one development phase to the next."* (Int. 4, Engineering Co.)	2	7%	6.84%
PM10	Quality of project planning	High / low	"*This whole project was completely unplanned. Someone just said we need it."* (Int. 6, Engineering Co.)	5	17%	12.03%

Appendix 6.1 Total List of Repertory Grid Constructs (ctd.)

Construct code	Construct name	Poles	Example quotes	Frequency	Frequency in %	Average weighted variability
PM11	Clarity of project structure	High / low	"*The bigger we get the more difficult it is to have a clear cut structure from beginning to end.*" (Int. 2, Engineering Co.)	2	7%	13.83%
PM16	Quality of electronic project archive	Good / bad	"*Filling in the necessary documents and, form sheets on the common drive is crucial but often not done.*" (Int. 3, MedCare Co.)	2	7%	10.57%
PM17	Use of project coach	Helpful / not helpful	"*…we had a very experienced person from our unit as a project coach.*" (Int. 2, MedCare Co.)	2	7%	10.39%
PM23	Quality of project controlling	High / low	"*We had a very useful controlling tool here that I learnt to appreciate a lot.*" (Int. 1, MedCare Co.)	5	17%	11.41%
PROD1	Design of product	Important / not important	"*Optical Impression. What does the machine look like design-wise.*" (Int. 6, Machinery Co.)	3	10%	9.32%
PROD2	International product requirements	Complex / comparable to Germany	"*Some projects are very similar, but then it depends what specific national requirements the customer has, e.g. if he is Japanese or Swiss.*" (Int. 2, Machinery Co.)	3	10%	13.42%
PROD3	Creation of new product ideas	High / low	"*Sometimes a project creates potential for further projects and products, I think this is a very important issue for us.*" (Int. 3, MedCare Co.)	1	3%	14.60%
PROD4	National quality demands	Same / different	"*There are very different quality standards in the different markets.*" (Int. 6, Publishing Co.)	1	3%	7.36%

Appendix 6.1 Total List of Repertory Grid Constructs (ctd.)

Construct code	Construct name	Poles	Example quotes	Frequency	Frequency in %	Average weighted variability
SUPPLY1	Analysis of supply chain	Good / bad	"*What I mean is our know how in purchasing and the supply chain analysis.*" (Int. 6, Publishing Co.)	2	7%	15.89%
SUPPLY2	Use of external suppliers	Risky / without problems	"*You should not overestimate the benefits of outside sourcing, because you do not have the same kind of.*" (Int. 6, Publishing Co.)	3	10%	10.95%
SUPPLY3	Buy in ready products	Often / seldom	"*An advantage would be if you could buy in a ready developed component, that is really a clear advantage.*" (Int. 6, Publishing Co.)	1	3%	11.16%
TECH1	Post-launch problems	Many / few	"*…problems after the launch, which are always very complex, costly and difficult in our industry.*" (Int 2, Machinery Co.)	3	10%	11.91%
TECH2	Project iterations due to technical problems	Frequent / seldom	"*There was a project where we needed an awful lot of iterations which was not expected.*" (Int. 6, Appliances Co.)	6	20%	12.88%
TECH3	Innovation degree of project	High / low	"*These two projects included a lot of real innovations which makes the project work more risky.*" (Int. 1, MedCare Co.)	10	33%	11.78%
TECH4	Quality of transfer to customer	High / low	"*In the past we just dropped the machines at the customers site and did not care about it afterwards.*" (Int. 1, Machinery Co.)	3	10%	11.95%
TECH5	Quality of final assembly	Fast / slow	"*These series were very well in the final construction, very rapidly conducted and constructed.*" (Int. 1, Machinery Co.)	1	3%	3.95%

Appendix 6.1 Total List of Repertory Grid Constructs (ctd.)

Construct code	Construct name	Poles	Example quotes	Frequency	Frequency in %	Average weighted variability
TECH6	Feasibility of specification	Checked/ not checked	"*We often make the mistake of accepting customer specifications without looking at them in detail and realise too late the effort it takes to develop them.*" (Int. 1, Machinery Co.)	4	13%	11.40%
TECH7	Changes of specification	Frequent / seldom	"*It became sort of an illness that the specifications are changed on a regular basis.*" (Int. 2, Machinery Co.)	8	27%	15.09%
TECH8	Quality of technical project output	High / low	"*The specification regarding the technical objectives was fulfilled to 100%.*" (Int. 4 Appliances Co.)	5	17%	15.37%
TECH9	Complexity of technical requirements	High / low	"*These projects are less complex from a technical point of view.*" (Int. 1, Engineering Co.)	8	27%	8.26%
TEST1	Use of prototypes	Helpful / disturbing	"*I would say use of technical prototypes. We had prototypes long time before the series which was very helpful.*" (Int. 7, Appliances Co.)	5	17%	8.55%
TEST2	Length and depth of test phase	Long and intense / short and superficial	"*Testing can actually never be long enough.*" (Int. 2, Engineering Co.)	6	20%	12.81%
TIME1	Development time needed	Short / long	*This took longer than planned, which is not really unusual in our company.*" (Int. 5, Engineering Co.)	9	30%	11.57%
TIME2	Meeting of milestones & deadlines	met / not met	"I*t was time intensive really, we could not stick to the launch date although we always had the milestone dates in the back of our minds.*" (Int. 4, MedCare Co.)	16	53%	10.90%

Appendix 6.1 Total List of Repertory Grid Constructs (ctd.)

Construct code	Construct name	Poles	Example quotes	Frequency	Frequency in %	Average weighted variability
TURN1	Turnover achieved after market launch	High / low	"T*he first check is quantified objectives reached, i.e. does my customer reach the targets.*" (Int. 3, Appliances Co.)	8	27%	9.18%
TURN2	Quality of sales forecasts	Good / bad	"*Forecasting of sales quantities is a real problem for us. We still make a lot of mistakes here."* (Int. 2, Publishing Co.)	3	10%	12.18%
Total				**272**		

Appendix 6.2 Partial Comparison of Lessons Learnt

Construct code	Construct name	Poles	Minutes of PPRs	Repertory grids	PPR Observation
BUR1	Bureaucracy of project organization	high / low		2	1
BUR2	Use of bureaucratic guidelines	compulsory / not compulsory		2	2
BUR3	Internal politics	Disturbing / not disturbing	1	2	2
BUR5	Formality of project	High / low		2	1
BUR6	Use of bureaucratic checklists	Good / bad	3		6
BUR			**4**	**8**	**12**
CAP1	Necessary capacities and resources	Available / not available	1	7	13
CAP			**1**	**7**	**13**
COM1	Intra-team communication	Efficient / not efficient	2	6	7
COM2	Communication with customer	Efficient / not efficient		2	2
COM3	International communication	Efficient / not efficient		3	4
COM4	Communication of project objectives	Clear / unclear	1	10	1
COM5	Communication with external parties	Efficient / not efficient		1	2
COM6	Use of international communication coaches	Helpful / not helpful			5
COM7	Use of technical communication aids	Helpful / disturbing	1		1
COM			**4**	**22**	**22**
COST1	Meeting of targeted project costs	Project cost budget met / not met	1	9	4
COST2	Meeting of targeted product costs	Met / not met		4	3
COST3	Allocation of costs (internal vs. external)	Clear / unclear			1
COST			**1**	**13**	**8**
EXP1	Experience of project manager	High / low	1	6	8
EXP13	Learning from flop products	Achieved / not achieved		2	
EXP15	Experience of working with top management	Gathered / not gathered			1
EXP2	Managerial experience of project team	High / low	1	4	3
EXP3	Technical experience of project team	High / low	1	3	2
EXP4	Networking between departments	Possible / impossible		4	5
EXP5	Teamwork	Ideal / difficult	1	8	5
EXP6	Satisfaction of project managers	High / low		2	2
EXP7	Process improvement during project	Possible / Impossible	1	3	3

Appendix 6.2 Partial Comparison of Lessons Learnt (ctd.)

Construct code	Construct name	Poles	Minutes of PPRs	Repertory grids	PPR Observation
EXP8	Creative freedom for project team	High / low		3	
EXP9	Inter-project learning	Discussed / not discussed	2	3	5
EXP			**7**	**38**	**34**
MARK1	Quality of market research	High / low	1	6	4
MARK2	Importance of international brand registration	High / low		2	
MARK3	Quality of marketing support	Good / bad		2	
MARK4	Planning of TV activities	In advance / too late	1	2	2
MARK			**2**	**12**	**6**
ORG1	Project matrix organization	Strong / weak	1	5	4
ORG12	Work overload of project manager	High / low	1	1	2
ORG2	Involvement of external parties	Helpful / disturbing		5	1
ORG3	Complexity of project organization	High / low		9	5
ORG6	Attention of top management	Strong / weak	1	3	1
ORG7	Turnover of project managers	Frequent / rare	1	1	1
ORG14	Coordination within R&D departments	Efficient / not efficient	1		4
ORG15	Coordination between R&D and other areas	Efficient / not efficient	1		7
ORG			**6**	**24**	**25**
PM1	Allocation of responsibilities	Clear / unclear		7	6
PM10	Quality of project planning	High / low		5	2
PM11	Clarity of project structure	High / low		2	
PM16	Quality of electronic project archive	Good / bad		2	2
PM17	Use of project coach	Helpful / not helpful		2	
PM2	Project closure with PPR	Done / not done		2	1
PM23	Quality of project controlling	High / low		5	4
PM3	Use of testing coordinators	Yes / no	1	1	
PM4	Quality of project management	Professional / beginners level		7	2
PM7	Quality of market launch	High / low		4	3
PM8	Quality of transfer between different development phases	Efficient / not efficient		2	1
PM21	Transfer of action list into practice	Done / not done	1		

Appendix 6.2 Partial Comparison of Lessons Learnt (ctd.)

Construct code	Construct name	Poles	Minutes of PPRs	Repertory grids	PPR Observation
PM22	Clearly established team rules	In place / missing	1		1
PM			**3**	**39**	**22**
PROD1	Design of product	Important / not important	1	3	1
PROD2	International product requirements	Complex / comparable to Germany	2	3	2
PROD3	Creation of new product ideas	High / low		1	
PROD4	National quality demands	Same / different	1	1	1
PROD			**4**	**8**	**4**
SOC1	Importance of respect and mutual trust in the team	High / low			6
SOC2	Number of intercultural experiences in the team	High / low			3
SOC3	Team-internal working conditions during business trips	Good / bad			3
SOC4	Project success depends on social relationship in the team	Yes / no			8
SOC			**0**	**0**	**20**
SUPPLY1	Analysis of supply chain	Good / bad		2	
SUPPLY2	Use of external suppliers	Risky / without problems		3	2
SUPPLY3	Buy in ready products	Often / seldom	1	1	
SUPPLY4	External supply chain influences delivery service	Problem / no problem	1		4
SUPPLY			**2**	**6**	**6**
TECH1	Post-launch problems	Many / few		3	1
TECH2	Project iterations due to technical problems	Frequent / seldom	2	6	1
TECH3	Innovation degree of project	High / low	1	10	2
TECH4	Quality of transfer to customer	High / low		3	
TECH5	Quality of final assembly	Fast / slow	1	1	1
TECH6	Feasibility of specification	Checked/ not checked	1	4	2
TECH7	Changes of specification	Frequent / seldom	3	8	4
TECH8	Quality of technical project output	High / low	2	5	3
TECH9	Complexity of technical requirements	High / low	1	8	3
TECH10	Frequency of measurement deviations	Frequent / seldom			1
TECH11	Quality of technical documentation	High / low			3
TECH			**11**	**48**	**21**

Appendix 6.2 Partial Comparison of Lessons Learnt (ctd.)

Construct code	Construct name	Poles	Minutes of PPRs	Repertory grids	PPR Observation
TEST1	Use of prototypes	Helpful / disturbing	2	5	4
TEST2	Length and depth of test phase	Long and intense / short and superficial		6	3
TEST3	Use of golden samples	Applied / not applied	1		
TEST			**3**	**11**	**7**
TIME1	Development time needed	Short / long	1	9	13
TIME2	Meeting of milestones & deadlines	met / not met	5	16	8
TIME			**6**	**25**	**22**
TURN1	Turnover achieved after market launch	High / low	1	8	2
TURN2	Quality of sales forecasts	Good / bad	1	3	2
TURN			**2**	**11**	**4**
Total				**272**	

Appendix 6.3 Metaphors and Stories in Minutes of PPRs

Company	Metaphor quote	Related construct
Engineering Co.	NONE	
Appliances Co.	*"Regular meetings and short cuts helped to support the team and project work."*	PM4
	"We always had clear playing rules in our team."	EXP5
MedCare Co.	NONE	
Machinery Co.	*"Not clear who is supposed to give the green light."*	ORG2
Publishing Co.	*"Some products wander through this risky phase for several years."*	PROD2

Appendix 6.4 Metaphors and Stories in Repertory Grids

Interviewee	Company	Metaphor quote	Related construct
Int. 4	MedCare Co.	*"It was not necessary to re-invent the wheel."*	BUR2
Int. 1	Engineering Co.	*"This was one of our hey Joe projects."*	BUR5
Int. 1	Appliances Co.	*"There are many little puzzle pieces that influence the success."*	COM1
Int. 5	Appliances Co.	*"We ended up with a blue eye."*	COM1
Int. 5	MedCare Co.	*"In the past we had a tower marketing and a tower technical department and we have thrown our not very well defined wishes over the wall to the other tower and what we got in return was not what we wanted."*	COM1
Int. 5	Engineering Co.	*"One of the project managers said this is so separate there is actually a wall in between."*	COM3
Int. 1	Appliances Co.	*"If you get the responsibility for producing playing parts made out of wood, the internal customer should not be surprised if you do not deliver a Pachisi game."*	COM4
Int. 4	Appliances Co.	*"Here the project manager was very short-sleeved (*meaning: casual*)."*	EXP1
Int. 4	Publishing Co.	*"It was beyond good and evil."*	EXP13
Int. 4	Publishing Co.	*"Instead of hiding between the bushes and having this stupid gut feeling that something went wrong."*	EXP13
Int. 5	Appliances Co.	*"In some difficult situations during a project you have to go through the valley of tears."*	EXP2
Int. 5	Appliances Co.	*"In short: we did a belly flop"*	EXP3
Int .1	Appliances Co.	*"Is it a home run or do I play on foreign fields? Do I have 8 or 11 players and a goalkeeper?"*	EXP4
Int. 2	MedCare Co.	*"Certain things have to be done in a relay race."*	EXP5
Int. 6	Publishing Co.	*"Martini for Vermouth is a well known brand, but this does not mean that a Martini Whiskey also sells well."*	MARK2
Int. 5	Publishing Co.	*"It was like the squaring of the circle."*	ORG2
Int. 5	Engineering Co.	*"…and in the end you always run out of time."*	PM10
Int. 2	MedCare Co.	*"Maybe we would have needed a referee."*	PM17
Int. 2	MedCare Co.	*"This was a bit too much carved by hand."*	PM23
Int. 1	Appliances Co.	*"Here I made the craftsman diploma and I learnt there are always several different ways to get to Rome."*	PM4
Int. 4	Engineering Co.	*"In the past we made many mistakes by giving our stuff to the production, then lean back and let them alone."*	PM8
Int. 2	Publishing Co.	*"We often score own goals."*	SUPPLY2
Int. 6	Publishing Co.	*"You then have the chance to examine this very thoroughly."* (auf Herz und Nieren prüfen.)	SUPPLY3
Int. 1	Appliances Co.	*"I am very seldom stresses, I also hardly have any grey hairs. It is a personal thing, my philosophy is that I have a distance to certain tasks and of course I take them seriously, but I can still sleep at night, that is very rare for me because I learnt it does not help me at all."*	TECH3
Int. 2	Publishing Co.	*"We often go along the shore – it is often a ridge walk."*	TECH3
Int. 4	Publishing Co.	*"When I came here I had a crying small heap sitting in front of me who said that it is a disaster and that he refuses to work on the project."*	TECH3

Appendix 6.4 Metaphors and Stories in Repertory Grids (ctd.)

Interviewee	Company	Metaphor quote	Related construct
Int. 6	Publishing Co.	*"This was our biggest ever belly flop."*	TECH3
Int. 1	Machinery Co.	*" We really fooled around for at least two years."*	TECH6
Int. 5	Appliances Co.	*"You cannot build a pick up, a truck and a convertible at the same time."*	TECH7
Int. 7	Appliances Co.	*"We used the breaks too late."*	TECH7
Int. 6	Engineering Co.	*"Here I should really say do not blow your own trumpet."*	TECH8
Int. 3	Appliances Co.	*"If you come again next month and want us to do overpaid, my wife will put my bed in front of the door."*	TECH9
Int. 5	Machinery Co.	*"According to my information the thing is still sitting in its box and is rusting away."*	TECH9
Int. 3	Machinery Co.	*"Where I live I usually have sunshine, for others it might be different."*	TIME2
Int. 2	Publishing Co.	*"What is the right quantity and how can you balance it on various shoulders?"*	TURN2

Appendix 6.5 Metaphors and Stories Mentioned During PPRs

Data source	Quote	Connected construct
PPR MedCare Co.	*"We are not able to find a rule that is 100% water proof."*	BUR 2
PPR Appliances Co.	*"This was done via the short way."*	BUR1
PPR MedCare Co.	*"That is routine. The aim is clear and the route is clear. In a project I do not know the way and therefore need to search for it first. That exactly is product development, to find this way. And if there are basic discussions about it then we have these two final judges if in doubt."*	BUR7
PPR Appliances Co.	*"You mean the one who moves first is the loser?"*	CAP1
PPR Engineering Co.	*"The whole test area was constantly with their backs to the wall."*	CAP1
PPR Engineering Co.	*"We ended up falling on our faces."*	CAP1
PPR Engineering Co.	*"We also had some other 'Nebenkriegsschauplätze"* [direct translation: smaller wars which happen at the same time than the main war]	CAP1
PPR Machinery Co.	*"Yeah, and then you have a meeting of 3 hours- of course in Japanese, I did not understand a single word and that served nothing at all."*	COM2
PPR Appliances Co.	*"This is my question mark"*	COM3
PPR Machinery Co.	*"Without Bernd we would have drowned in Japan. They would have tricked and fooled us till the very end."*	COM6-
PPR Appliances Co.)	*"This amount does not seem to bother anyone here. Even the project manager only remarked it as a side comment. According the motto – it is only money really."*	COST1
PPR Appliances Co.	*"The new project process is blowing up our project budget a lot."*	COST1
PPR Appliances Co.	*"Well then, red traffic lights crossed one point in Glücksburg and 4 weeks no driving licence."*	COST1
PPR Appliances Co.	*"Only 'Wermutstropfen' are the project costs."*	COST1
PPR Appliances Co.	*"It was like this mole game. You hit one on the head and somewhere else appear 4 or 5 other ones."*	EXP1
PPR Machinery Co.	*"If my wife would rate the project she would say it was a disaster. Because I was hardly at home and if I was at home I was tired or bad tempered or I was only there physically, so from her point of view it was a catastrophe really."*	EXP1
PPR Engineering Co.	*"I think I can put your mind at rest: I am now more than 30 years with Engineering Co.) No matter which product was introduced, even very simple ones, had problems when they were launched and there were an awful lot of changes done."*	EXP2
PPR Engineering Co.	*"Two weeks ago I talked to a colleague from the development and said that he could have predicted the problems we have today with the machine right on the day when we started the delivery. He knew it was coming. And today, one year later, the customers start to complain and the issues raised prove the points that he could have predicted a long time ago."*	EXP2
PPR Machinery Co.	*"Cooperation with our sales colleagues was like in a good marriage."*	EXP5
PPR MedCare Co.	*"We still have to tick off this homework."*	EXP9
PPR Appliances Co.	*"I know that in the beginning there was quite a bit of tummy ache in the team."*	ORG11
PPR Engineering Co.	*"If I think about this I really start to cry because I can only dream about such a situation."*	ORG13
PPR Appliances Co.	*"The new process started and there was between production a huge wall at that point in time."*	ORG15
PPR Appliances Co.	*"This was also the tenor I heard from my colleagues."*	ORG15
PPR Engineering Co.	*"And if we do not achieve them the alarm bells need to go off. "*	ORG16

Appendix 6.5 Metaphors and Stories Mentioned During PPRs (ctd.)

Data source	Quote	Connected construct
PPR Appliances Co.	*"The knowledge needs to be put on broader shoulders really."*	ORG7
PPR Appliances Co.	*"So it was basically a forced marriage really."*	ORG8
PPR Appliances Co.	*"It is clear that if you change the rules in the middle of the game, you automatically have to stumble."*	ORG8
PPR MedCare Co.	*"Also a task requires planning. If I go shopping on Saturday morning and do not have a shopping list then I buy a lot of things I do not need and I spend too much money. And finally I have the things I need not in my kitchen. But my wife is definitely cross with me."*	PM10
PPR Appliances Co.	*"We do not want to sit on an island and plan this completely alone."*	PM10
PPR Appliances Co.	*"The topic of public drives. That is a nightmare, it is a data graveyard."*	PM16
PPR Appliances Co.	*"For the moment we only play here a bunch of 'Reichsbedenkenträger'."* [no direct translation possible, meaning people who only have doubts, pessimistic thoughts and problems]	PM18
PPR Appliances Co.	*"That just goes like butter, it is extremely professional.".*	PM34
PPR Appliances Co.	*"I think I can tick this off now."*	PM4
PPR MedCare Co.	*"National beauty is always a problem."*	PROD2
PPR Machinery Co.	*"Japan was a special experience for everyone really. It was muddy, cold, wet, we did not have a proper toilet or room to have our meals or a coffee."*	SOC2
PPR Machinery Co.	*"We are always the second squadron in the war really."*	TECH2
PPR Engineering Co.	*"All this is obviously because we hang at the end of the chain."*	TECH2
PPR Engineering Co.	*"We are always at the end of the food chain."*	TECH2
PPR Engineering Co.	*"Everyone in development would have killed me if I said you sit down with me for two das and develop a procedure for the machine installation."*	TECH2
PPR Appliances Co.	*"He was almost like a shepherds dog and kept circling the project like a herd of sheep."*	TECH7
PPR Appliances Co.	*"Yes, this is again the example with the herd of sheep."*	TECH7
PPR Appliances Co.	*" 'Wechselbad' of feelings."* [direct translation: changing baths, meaning frequent change of feelings]	TECH7
PPR Appliances Co.	*"I really have to dig a bit deeper here because for me this point was really a surprise."*	TECH7
PPR Engineering Co	*"We need to get away from the Microsoft mentality, i.e. not the market introduction, but the quality is priority number one. That should be really held under the directors noses."*	TECH8
PPR Appliances Co.	*"But I think he put his finger in the right wound really."*	TEST1
PPR Appliances Co.	*"Somehow we need to create the appetite in the market."*	TEST1
PPR Appliances Co.	*"But that we might as well kick into the dustbin straight away, because we do not live this in practice."*	TEST1
PPR Appliances Co.	*"We are no longer the masters of the quantities that are bought."*	TEST1
PPR Appliances Co.	*"The absolute number of damages is only one piece of the total puzzle."*	TEST2
PPR Engineering Co.	*"I can only talk for myself, but sometimes it would already help me to know that I am on the wrong track somewhere."*	TIME2
PPR Engineering Co.	*"We are on thin ice and still have quite a few problems."*	TURN1
PPR Engineering Co.	*"All this is a balancing act."*	TURN1
PPR Appliances Co.	*"If we had problems we had to juggle with several balls, but we always had a safety net as well."*	TURN2
PPR Appliances Co.	*"So I guess there we need to introduce a system that those who send us a box of red wine will get a machine."*	TURN2