Impediments to cross-project learning

by

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Management summary

Introduction
Today’s economy can be seen as a knowledge-based economy where knowledge is the prime asset of organizations (Chen and Chen, 2006; Sunassee and Sewry, 2002). An increasing tendency is for organizations to move towards project-based functioning, where projects are increasingly occupying organizations operations (Hobday 2000; Turner 1999), and becoming central carriers - as well as incubators - of knowledge (Schiindler and Eppler, 2003). The term “project-based learning” incorporates the creation and acquisition of the knowledge within projects (Ayas and Zeniuk, 2001) as well as the process of knowledge transfer to other sections of the organizations, including successive projects (DeFillippi and Arthur, 1998). The transfer process is named cross-project learning.

This process has certain challenges. Keegan and Turner (2001), in their study of quality versus quantity of project-based learning, concluded that all participating organizations had some form of post-project learning mechanisms aimed at capturing the knowledge created within the project, so that others could subsequently use it. However they also indentified three main impediments to this process: (1) time pressures- demanding schedules; (2) centralization- control of the resources is at one place (e.g. senior management); and (3) deferral- procrastination of the learning activities to a later stage. This research indicates the unsmooth path of project-based learning and that certain challenges might be faced. However there are relatively few empirical studies done on cross-project learning impediments.

To better understand cross-project learning and its potential impediments an empirical research will be conducted in an innovative organization-TNO. The prime objective of this research organization is to develop applicable innovations. TNO fits the topic of this study, because most of its activities are organized in projects. The research will be conducted in two divisions within TNO: Powertrains (PW) and Integrated Vehicle Safety (IVS).

Methodology and research question
For the purpose of this research case study methodology was chosen. This is an appropriate method when investigating “a contemporary phenomena within its real life context, especially when the boundaries between phenomenon and context are not clearly evident”
An accompanied method is semi-structured interviews. Nine cases were in total investigated. The research question (with additional sub research questions later presented) is: “How can cross-project learning be improved at TNO PW and IVS?”. This thesis focuses on providing a design-oriented solution. To structure the research as well as analysis Szulanski’s (1996) source-receiver-content-context framework was used as a basis. Due to its process structure it is suitable for investigating cross-project learning impediments.

Analysis

To better identify and structure the impediments a cause and effect diagram consisting of three generic cause and effect elements (causes – problem – strategic consequences) was used. There were two strategic consequences identified which need to be improved in the long-term: (1) improve project success; and (2) inhibition of the “reinventing the wheel” phenomenon. The main problem identified and verified as the enabler of the strategic consequences, is insufficient cross-project learning. To better tackle the problem and in doing so the strategic consequences, four causes (impediments) in total to cross-project learning were identified: (1) ineffective intranet; (2) close-proximity knowledge sharing; (3) no formalized post-project learning mechanisms; and (4) not following formalized processes. Digging deeper into the analysis the fourth cause, not following formalized processes, was decomposed into three sub-causes: (1) time pressure; (2) unstructured/unclear process; and (3) not being requested.

Solution design

To tackle these impediments a solution design was proposed. In general the proposed solution is comprised of two interrelated parts. First a Lessons Learned (LL) template, a mechanism for post-project learning where the most important learning points can be codified and shared, was designed. The template was tested and the feedback was incorporated in the final design. The second part proposed the creation of a project closure umbrella procedure at TNO PW and IVS which will be supported by management.

The project closure aims at tackling all identified (sub)causes and it is composed of three elements: (1) IPE- conducting an internal project evaluation (IPE) which can be used to reflect on project experiences and fill in the LL. This can be done in a team meeting; (2) KTA/KTE- the customer satisfaction surveys, which are standardized processes, should be
sent out. The IPE and KTA/KTE can be considered part of the ISO 9000:2008 quality standard which TNO possesses. (3) Fill in LL- the lessons learned template should be filled in. An overview of the impact of the solution design on the causes can be found in Figure 12.

**Conclusion**

Within TNO PW and IVS, an innovation organization with cutting edge applicable innovations, it cannot be said that there is no cross-project learning. Based on the data collected there is cross-project learning, but it has some influential impediments which if removed can improve the strategic consequences: (1) an improvement in project success; and (2) a reduction of the “reinventing the wheel” phenomenon. The general conclusion is that not all potential learning mechanisms are leveraged. The proposed solution design aims to change that.
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1.0 Introduction and problem definition

Within this chapter a short introduction to the topic of this master thesis will be presented. Following the introduction the company as well as the problem definition will be elaborated. The chapter will end with a final paragraph explaining the structure of the remainder of the thesis.

In today's highly competitive environment there is a noticeable shift towards a knowledge based society (Toffier, 1990) where organizations need to improve their knowledge faster than their competitors (Stata, 1989). Research strongly indicates that knowledge is an important strategic asset and essential resource in achieving the needed competitive advantage (Drucker, 1999; Davenport and Prusak, 1998; Ipe, 2003). As knowledge is seen as an essential strategic resource, sharing that knowledge becomes an important process as current competitive environmental conditions require organizational members to do just that (Nevis et al., 1995; Davenport and Prusak, 1998; Drucker, 1999).

There are a number of definitions for knowledge which in principle also depend on the context in which it is researched. For this research a suitable definition is given by Leonard and Sensiper (1998). They define knowledge in a business context as "information that is relevant, actionable and at least partially based on experience" (p. 113). In literature there seem to be several identified types of knowledge. The most widely accepted is the division between tacit (intangible, difficult to codify, based on experience) and explicit (put in writing, easily sharable) knowledge (Nonaka and Takeuchi, 1995). It is often the assumption that tacit is learned through a process experience and transforming it into the explicit form provides benefits for the organization (Kale et al., 2002; Kale and Singh, 2007).

As a significant amount of organizational knowledge is held in employees’ minds, organizations need to explore ways by which they will encourage employees to share what they know and find out what prevents them from sharing knowledge (Paroutis and Saleh, 2009). There are multiple definitions available, however “knowledge management” generally refers to how organizations create, retain and share knowledge (Argote, 1999; Huber, 1991). For knowledge sharing to occur, the process of learning needs to be present. Learning and knowledge are interlinked. Vera and Crossan (2003) indicate that knowledge
and learning are interlinked in an iterative mutually reinforced process where learning produces new knowledge and knowledge impacts future learning.

There is a strong indication that Western economies are heading towards a so-called “projectified society” (Lundin and Soderhold, 1998) where projects are increasingly occupying organization’s operations (Hobday 2000; Turner 1999). In a modern organization, the project is considered to be one of the most important characteristics (Clegg, 1990; Ekstedt et al., 1999; Whittington et al., 1999). Projects are mostly used to solve different types of tasks within different types of businesses (Maylor, 2001). The term “project” applies to activities ranging from small internal projects to international joint ventures (Turner, 1999; Brown and Jones, 1998). “Projects are created to achieve internal change, to deliver bespoke products and services to clients, and to undertake new activities on a trial basis as organizations experiment in the faceoff business change.” (Keegan and Turner, 2001, pp. 77-78). Projects are used by a multitude of industries with an aim to change and be competitive today, but also to prepare for tomorrow (Kanter, 1997; Turner 1999). Because of their unique nature in terms of an organizational form (eg. restricted time and resources, high complexity, pressure), projects seems to be suitable for learning (Damm and Schindler, 2002; Smith and Dodds, 1997; Lundin and Midler, 1998). Projects, as a central component of the functioning of an organization, are also the central carrier as well as incubator of knowledge (Schindler and Eppler, 2003).

The term “project-based learning” incorporates the creation and acquisition of the knowledge within projects (Ayas and Zeniuk, 2001) as well as the process of knowledge transfer to other sections of the organizations, including successive projects (DeFillippi and Arthur, 1998). For this paper cross-project learning will be used to refer to the transfer process.

This process has certain challenges. Keegan and Turner (2001) in their study of quality versus quantity in project-based learning concluded that all participating organizations had some form of post-project learning mechanisms aimed at capturing the knowledge created within the project so subsequent projects can use it. However they also indentified three main impediments to this process: (1) time pressures- demanding schedules; (2) centralization-control of the resources is at one place (eg. senior management); (3) deferral-
procrastination of the learning activities to a later stage. This research indicates the unsmooth path of cross-project learning and that certain challenges might be faced. However there are relatively few empirical studies done on cross-project learning impediments. The following theoretical chapter will elaborate the remaining empirical research done thus far within the cross-project learning impediments area.

To better understand cross-project learning and its potential impediments an empirical design-oriented research will be conducted in an innovative organization-TNO. Design-oriented research implies that solution design, tailored for the organization, will be presented at the end of the research. The prime objective of this research organization is to develop applicable innovations. TNO fits the topic of this study, because most of its activities are organized in projects. The organization together with the main and sub research question(s) will be presented in the following subchapter.

1.1 Company description

*Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek* or TNO which translates to Dutch Organization for Applied Scientific Research is a not-for-profit with a main aim of producing applied science. Its prime motto “Innovation for life” has a strong linkage to its mission statement: “connect people and knowledge to create innovations that boost the sustainable competitive strength of industry and well-being of society”. ¹

TNO profiles itself as an independent research organization with a strong belief that its research has applicable value that contributes to the competitiveness of organizations and society at large. To satisfy this aim TNO has structured itself based on themes within which research is concentrated. There are seven different themes subdivided into additional subsections where applicable innovation is created. Those seven themes are supported by the three expertise areas where the pool of professionals specialized in certain areas are drawn from to work on projects within the seven themes. This is presented visually in Figure 13 in Appendix I. Each theme (or *thema* in Dutch) has a managing director accountable for the projects within that theme.

The current project will be conducted in two departments, Powertrains (PW) and Integrated Vehicle Safety (IVS), which are under the Mobility (*Mobiliteit*) thema. One of the main

Reasons why these two divisions are part of the same research is influenced by the location. Both of them are situated at the Helmond campus of TNO, where the predominant focus is on the automotive industry. Formally this location was under the name of TNO Automotive which does not (legally) exist anymore. A more elaborate description of the company as well as the theme in which the departments are members of can be found in Appendix I.

1.2 Problem definition

All of the work related to projects conducted by TNO involves high knowledge creation and requires highly expert knowledge to produce applicable high-impact innovative products/services. For this purpose project evaluations are seen as an important activity in improving quality and at the same time being efficient with every subsequent project by learning from its predecessor.

There also seems to be a tendency not to regularly and systematically conduct internal project evaluations (IPE) and send out customer satisfaction surveys (KTV). IPE aims to reflect on projects after or near closure and extrapolate learning points (positive and negative) for future projects. KTV is the customer satisfaction survey and they are two types: (1) KTA- sent to an external bureau which afterwards contacts the client for feedback and (2) KTE-standardized template which is sent out by the project leader. KTA/KTE is specifically requested by the ISO 9001: 2008 quality standards, which TNO has been certified with. Although the IPE are not explicitly mentioned they are an important learning tool through which it contributes to the monitoring of the processes and improvements that need to be made according to the standard. KTA/KTE as a prime source of customer feedback can indicate certain problems in learning across projects. If a certain type of feedback persists, this indicates a lack of improvements and thus a lack of learning from previous experience. The KTA/KTE can indicate certain impediments to cross-project learning, but relating that feedback takes longer as the feedback takes time to be received. The processes related to internal project evaluation (IPE) and customer satisfaction surveys (KTA/KTE) are explained in more detail in Appendix I.

An initial indication of issues present in terms of cross-project learning impediments has been firstly indicated by the person responsible for ISO 9001: 2008 related activities at the PW and IVS departments (Helmond location). The research was set up within predefined
areas where the hosting organization wanted answers and a design-oriented solution. To provide sufficient room for identification of currently invisible impediments, a generic main research question was set. This enabled sufficient narrowing down of the problem area and at the same time did not exclude any elements which were important but not currently known in providing potential solutions to the identified impediments. Before the research question is presented, a definition of the current situation, based on initial interviews with the quality responsible as well as senior manager at TNO PW and IVS will be set:

1. There is a tendency towards the “reinventing the wheel” phenomenon where previously gained knowledge is not used to propel subsequent projects.
2. There seems to be an unsystematic execution of Internal Project Evaluations (IPE) and Customer Satisfaction Surveys (CSS) by project leaders after the completion of every project.

Based on this the main research question (MRQ) is formulated as:

**MRQ: How can cross-project learning be improved at TNO PW and IVS?**

This master thesis research has two main objectives: (1) provide additional insights into cross-project learning impediments and (2) help the organization to improve their cross-project learning processes. As this is a design-oriented research, the research question aims to incorporate both the practical as well as the scientific perspective. To better focus the research, additional sub-research questions are set. Some of these questions incorporate specific requests by the hosting organization. The following sub-research questions are defined:

**SRQ 1. What are the current impediments for cross-project learning at TNO PW and IVS?**

**SRQ 1.1 Why are Customer Satisfaction Surveys and Internal Project Evaluations not done systematically?**

**SRQ 2. How can these impediments be neutralized/eliminated/decreased?**

The sub research questions will help to better answer the main research question. Their aim is to provide a balance between the rigor as well as relevance of the thesis. The remainder of the report is structured in the following way. Chapter 2 will present the research which has been done thus far on identifying cross-project learning impediments. Chapter 3 will present
the methodology and in Chapter 4 the analysis will be elaborated. Following the analysis the solution design will be presented accompanied by the change plan. The thesis will end with a conclusion chapter elaborating on theoretical as well as managerial contributions and limitations with future research directions.

2.0 Theoretical background

Within this chapter the research currently available on the topic of cross-project learning impediments and proposed solutions will be elaborated. In a multitude of research the structure of the research itself is based on investigating a certain process, usually the interaction between one or a few constructs. In terms of cross-project learning, it is safe to conclude that the knowledge and experiences are being transferred from one entity to the other; thus, the research is the process of transfer. Garvin (1993) indicates that a learning organization is “skilled at creating, acquiring, and transferring knowledge, and modifying its behavior to reflect new knowledge and insights” (p.80). There seems to be a strong presence of the transfer interaction between one or few participants. For the aim of this research I will focus on explaining more on the transfer process of learning from one project, the source, to another, the recipient.

For this reason the Szulanski’s (1996) internal stickiness framework can be used as a basis for this research. Szulanski (1996) investigated the properties by which the internal stickiness of knowledge – transfer of best practices within the firm – is impeded by different factors. This is appropriate as the main focus of the current research is cross-project learning and for this purpose the design of the research is based on investigating in more depth the transfer of any type of knowledge from one project to another. Szulanski (1996), based on previous research, identified four sets of factors that can influence the transfer: characteristics of the knowledge transfer, the source (sender), recipient (receiver) as well as the context in which the transfer is taking place. This is visually presented in Figure 1.
Figure 1. Based on Szulanski’s (1996) internal stickiness framework

However the way Szulanski (1996) has structured his research is relatively too specific to identify certain impediments in this area of research, which is in its infancy (based on the literature study conducted as preparation for this thesis). To be better able to present the generic findings thus far in literature I will map the generic four categories of Szulanski (1996) with Von Zedtwitz’s (2002) four generic barriers to learning from post-project reviews. This can be found in Figure 2. As Szulanski’s structure will be used to structure and conduct this research as well as the analysis, this connectedness with the Von Zedtwitz’s generic barriers will narrow down the solution direction. This can be done by mapping the identified impediments, which will be in one of the four Szulanski’s elements, to correspond to a certain generic barrier of Von Zedtwitz. This “membership” will help to narrow down the solution direction by comparing what has been proposed in literature thus far and better structure the whole solution direction.

Von Zeidtwitz (2002) identified four main areas as barriers to post-project reviews, a stage where a significant amount of learning is done in a project: (1) *psychological* – human capacity limitation to learn; (2) *team-based* - poor internal communication and reluctance to point out blame; (3) *epistemological* – difficulty to generalize experience and elaborate tacit knowledge; (4) *managerial constraints* – lack of time to reflect and resistance to comply with bureaucratic procedures.
Von Zedtwitz (2002) indicates that as there is no organizational or team learning without individuals creating or sharing information, and as humans are limited with their natural capacity to learn, psychological barriers can be very much present in the learning process. Source and recipient are entities which generate or absorb knowledge. This learning and knowledge transfer is done by humans. As humans have certain natural limitations (e.g. memory bias, information selection bias), it is logical for the impediments identified within the source and recipient elements to be related to the psychological barriers identified by Von Zedtwitz (2002). As teams are composed of the same individuals which also possess certain psychological limitations, team-based impediments can also be related to both source and recipient.

For the transfer to occur some content has to be transferred. Which content is important, however depends on the perception of the individuals conducting the transfer. Because of limited human cognitive capacity, the ability to reflect on current practices with an aim to grasp main conclusions for future usage might be difficult. In addition, certain experiences which are seen from a strong personal point of view can be challenging to express and share with team members. Thus the epistemological barrier can be related to the content element of Szulanski (1996).

Every transfer occurs in some environment (in Szulanski’s framework context). However the one having a substantial influence on how this environment (context) is organized and conducted is management. The fourth and last generic barrier identified by Von Zedtwitz is managerial constraints. Because of strong managerial pressure for high project performance, the time constraint is dominant and leaves little space for reflection on the past. Due to this pressure employees might also ignore formalized guidelines imposed by project management rules. Thus the last element of Szulanski’s framework is mapped with Von Zedtwitz’s (2002) managerial barrier. The following section of the theoretical chapter will present, based on Von Zedtwitz’s (2002) generic barriers, the identified impediments thus far in literature.
Figure 2. Mapping Szulanski’s (1996) internal stickiness framework with Von Zedwitz’s (2002) framework of four major barriers to learning from post-project reviews

2.1 Psychological impediments

There is no organizational or team learning without individuals creating or sharing information, and humans are limited in their natural capacity to learn. As learning can be a complex process personal psychological barriers of different sorts can be present. Von Zedtwitz (2002) identified two psychological impediments to effective post-mortem (post-project completion) learning: (1) Inability to reflect and (2) memory bias and ambivalent experiences. The author argues that in today’s fast-paced world, management has little interest in reflection on the past, especially due to the predominant excuse that past models and experiences are not valid if circumstances change (Krandsorff, 1996). This prevalent, long-lasting tendency has created a certain mental inability for individuals to reflect and learn from the past. Another reason why this inability to reflect is present is because the conventional approaches to project management lack the focus and dedication to treat learning and reflection as central and important activities (Ayas, 1997). Because of this lack of focus, employees have more difficulty reflecting on past actions and learning from them.

Another psychological barrier was also found by Newell and Galliers (2006). In their paper the authors distinguished between three types of knowledge characteristics: distributed, ambiguous and disruptive. Knowledge is distributed as it is held by many different actors. Any business process will involve multiple actors, but each will be engaged in an aspect of
the process (Gherardi and Nicolini, 2000). Cook and Brown (1999) did indicate that the “body of knowledge” is held by groups instead of individuals, and not everyone in a group possesses all knowledge of the group. Newell and Galliers (2006) indicate that people are not aware that useful knowledge might be available outside of their group. The authors call these “blinkers”- the unawareness of the existence of knowledge outside the unit because of not looking for it. Actors in the process do not look for knowledge if they do not have a problem which they cannot solve with the current body of knowledge. This limits the potential for improvement. Newell and Galliers (2006) call this the supply and demand problem, where there is sufficient supply of knowledge but not demand. This finding indicates that actually searching for ready available knowledge is an impediment in the transfer process as actors need to actively look for already existing knowledge to improve their process.

2.2 Team-based impediments

Within the second generic team-based barrier, frank and honest feedback to team members might not be the conscious choice of many as social ties could be hurt. Face-to-face interactions might be much more complicated as different potential barriers, based on team interaction and connections, might be present. Von Zedtwitz (2002) identified two team-based shortcomings: (1) reluctance to blame and (2) poor team-communication. Being able to reflect on past experiences is important but not sufficient to learn. Gulliver (1987) did indicate in his research that reviews often suffer from reluctance to directly indicate blame and give criticism, as the consequence might be uncovering embarrassing events. This reluctance even overcomes the clear benefit in terms of learning that the organization would derive from the team’s experience (Kransdorff, 1996). It has been proven by research, in different industries, that good team communication is essential for the effectiveness of the team (e.g. Tushman, 1979; Allen et al., 1980; Imai et al., 1985). However it seems that in the real world, although this seems to be general knowledge, it is not always the practice. Individuals do not get along with every other individual. Team spatial distances as well as differing cultural or educational backgrounds can create communication impediments (e.g. language or referential context).

As knowledge is dispersed and embedded knowing where and from whom to look for type of knowledge is important. Since most organizations have their own unofficial human
network where knowledge is searched for, Cross et al. (2002), by using Social Network Analysis (SNA), provide a useful tool in investigating the extent to which the structure of the human network has an impact on effective information flow. Their findings indicate an important role for mid-managers in the organization, as they are crucial to the information flow within the network. As the stress of information requests can be high, an intervention was noticed through which the middle manager accomplished an effective relocation of information requests to other network members. This was an important intervention as it provided a smoother information flow within the network by lowering the negative impact of a bottleneck from high information requests.

This research provides rich insights into the potential impediments organizations might face in search of information via the unofficial human network present in many of them. This goes in line with the main findings of Bresnen et al. (2003) that processes of knowledge capture, transfer and learning are strongly associated with social patterns and practices.

2.3 Epistemological impediments
If all the impediments above were not present, and team members were willing and had the time to invest in reflection on what happened, then generalizing from one specific example and being able to express tacit knowledge might still be difficult. Von Zedtwitz (2002) does identify the difficulty to provide generalizable conclusions from a specific example. According to Hamel and Prahalad (1994) abstract knowledge can be the basis for a competitive advantage of the firm if it is well embedded. The human mind, because of natural limitations, is not made to abstract experiences to a generalizable level for future projects to utilize. Another limitation is the tacitness of knowledge. In general, tacit knowledge is difficult to codify and many organizations are struggling with this issue. Even with the difficulty of codifying tacit knowledge, Durrance (1998) indicates that Western cultures still prefer explicit codified knowledge, despite increasing awareness that tacit knowledge requires a different approach.

2.4 Managerial impediments
The fourth and last generic barrier identified by Von Zedtwitz is managerial constraints. Because of strong managerial pressure for high project performance, the time constraint is
dominant and leaves little space for reflection on the past. Because of this pressure employees might also ignore formalized guidelines imposed by project management rules.

We do see in literature a repeating reason why post-project reviews are not done – time pressures (Keegan and Turner, 2001). Employees are unlikely to dedicate time and energy to past problems, especially when the current incentive system in organizations rewards moving ahead quickly (Kotnour, 1999). Time appears to be such a valuable resource that even dedicating a small amount of it to reflection seems to be asking for too much.

If post-project reviews are seen as another bureaucratic overhead, imposed by management, they will be met with resistance. In some cases the requested information needing to be filled in, does not correspond with what actually happened in the project thus undermining the confidence of the team. In most cases the post-project reviews are done simply for the sake of complying with bureaucratic procedures, without having an honest approach of reflecting on past events. As long as incentive systems in organizations favor goals that strictly focus on costs, scheduling, performance and customer satisfaction, then it will prove difficult to conduct enthusiastic, value adding post-project reviews.

Dikmen et al. (2008) identified four main impediments to cross-project knowledge transfer via post-project appraisals: (1) Time and budget restrictions – the lack of time to properly document the lessons learned creates a huge hindrance to cross-project learning (Disterer, 2002; Williams, 2007); (2) Organizational culture – can be a true enabler or a strong hindrance to cross-project learning. There are multiple types of cultures but the ones that hinder cross-project learning are often a culture of blame (Williams, 2007) and employees’ avoidance in admitting mistakes (Disterer, 2002). Organizational culture was found to also be an impediment to knowledge management (Robinson et al., 2005); (3) Project-based nature – although the content of the project differs there seems to be an indication that processes across projects are likely to have much in common (Newell et al., 2006); (4) Type of knowledge – going beyond the debate as to whether knowledge is codifiable (Newell et al., 2006) or embedded in social relations (Blacker, 1995), as stressed by Newell et al. (2006), that knowledge placed into lessons learned should prove most useful for other subsequent projects.
Newell et al. (2006) investigated the effectiveness of ICT-led strategies in capturing and transferring knowledge across projects. One of the main reasons why the database of codified knowledge is not used is because they usually hold largely product rather than process knowledge. This is a consequence because the knowledge elaborated mostly on what was done and not how or why it was done. Based on their analysis they have concluded that the ICT-focus approach was not that effective and that organizational members relied more on social network and dialog than on ICT. The authors conclude the paper by indicating that some form of hybrid (mixed) approaches between social-technical systems is more effective in comparison to the pure one focus approaches that are present in research.

2.5 Summary of theoretical section

Based on research done thus far, it is noticeable that there a multitude of potential impediments from different perspectives which can impede cross-project learning. Research has shown that certain impediments are more frequent then others (time pressures, for example). However even with the contributions of these researchers there are still relatively few empirical studies done in the area of cross-project learning impediments.

When considering potential solutions directions on an organizational level, it seems because of the tacitness of knowledge some form of mixed systems as proposed by Newell et al., (2006) will need to be leveraged to maximize knowledge transfer between projects. Social interactions are important for tacit knowledge transfer (Nonaka, 1996).

The majority of the empirical studies thus far conducted within the cross-project learning impediments area used qualitative methodology and interviews were leveraged in majority of the cases as an accompanied method. Case study is useful when the boundary of the context where the phenomenon is impeded are not clearly defined (Yin, 1994). The following chapter will present the research design as well as the methodology.

3.0 Methodology

Within this section the methodology will be elaborated which will be used to collect data and answer the main as well as sub research questions. First the general research design will be elaborated. Following this section the methodology selected for this research together with the particularities will be presented.
3.1 General research design
This Master thesis has two objectives, the practical and the academic. To insure balance between rigor and relevance the two cycles proposed by Van Aken et al. (2007) will be used. The reflective cycle will be used to identify and extrapolate certain theoretical contributions based on the research. As defined by Van Aken et al. (2007) “the core of the reflective cycle is the reflective step. In this step cross-case analyzes are used to generate general knowledge by removing the case-specific elements from the results of the cases” (p. 37). The regulative cycle is used to achieve the practical objective by obtaining the set-up deliverables. Because of time and resource constraints the regulative cycle will end around the third step. However limited solution testing will be presented.

![Figure 3. Reflective cycle and Regulative cycle (Van Aken et al., 2007)](image)

3.2 Case study
For the purpose of this research the case study methodology was chosen. Case studies have been used in multitudes of fields including different ranges of social sciences (Ragin, 1992; Yin, 2003), health care (Stake, 1995) and also a strategy to solve practical problems
(Hammersly and Gomm, 2000). There are multiple definitions and in general not agreed upon specific standards (Bryar, 1999; Hammersley and Gomm, 2000; Stake 2000). Yin (1994), the pioneer of case studies, defines them as: “as an empirical inquiry that: investigates a contemporary phenomena within its real life context, especially when the boundaries between phenomenon and context are not clearly evident” (p. 13).

As there are not many empirical studies conducted within the cross-project learning impediments field, the case study methodology is suitable. The following section will elaborate on the unit of analysis.

3.2.1 Unit of analysis

There has been some ambiguity in defining what precisely the difference between a case and a “unit of analysis” is. There are researchers (Berg, 2001; Miles and Huberman, 1994) who argue that there is no difference between the case (itself) and the unit of analysis. However the pioneer of case studies, Yin (2003), does indicate a difference when multiple cases are used which leads to an embedded unit of analysis differentiable from the case itself. This type of embedded cases yields more generalizable data with external validity. For the purpose of this research I define the unit of analysis as the transfer process between two subsequent projects, while specific project transfers are the cases. This is visually presented in Figure 4.

To provide a certain focus of the research the so-called project-triangle will be narrowed down. The prime focus, with an aim to providing more insights into the impediments, will be the transfer process from one project to the subsequent one. In order to provide as much context as possible behind the transfer process ways of sharing, going beyond the predecessor and subsequent project relation, will also be investigate but to a limited extent. The ways of sharing will aim at general tendencies of the individual to share knowledge.
3.3 Method

In total nine cases of cross-project learning transfer were investigated. There are no agreed-upon standards of how many cases one research should investigate, but according to
Eisenhardt (1989) four to ten cases is a sufficient number within one research. Most of the researchers investigating cross-project learning impediments thus far have used qualitative methods; more specifically open-ended, semi-structured interviews. As Edmondson (2002) indicated: “qualitative research is a useful methodology for investigating phenomena that are not well understood” (p. 131). The interview questions were developed based on literature but modified to fit the current organization. The generic guidelines from Van Aken et al. (2007) were followed. The interview questions were checked by both a practitioner as well as a researcher and they can be found in Appendix III.

In total nine interviews were conducted with duration of approximately 45 minutes each. Each interview is considered to be an analysis of a case. Each interview followed a predefined structure with a list of questions, and probing questions were asked where appropriate to gain additional insights. All interviews were tape-recorded and listened to at least three times. Notes were taken during the interview process. The main criterion by which the interviewees were selected was that they had to have some experience in running projects. Thus most of the interviewees hold the project leader title or had some experience running projects. This was also important as project leaders have an oversight of the majority of the activities within a project and they are also responsible for executing the KTA/KTE as well as IPE processes. On average most interviewees, with the exception of three, have around two years working experience within the company. Most of them are certified with an IPMA (Project Management) certification. The balance of experienced vs. junior project leaders provided more rich data based on their different levels of experience.

3.4 Analysis framework development

Framework for analysis is an essential component of the research design in qualitative research. For this purpose I will draw from multiple sources in literature to provide a structure to the criteria for the analysis. The framework for case analysis will be hierarchical, meaning it will provide a step-wise framework, where top-level generic categories will be broken down, if applicable, to more detailed and to a certain extent company-specific categories.

To better categorize his research based on ethnographic fieldwork, Van Maanen (1979) has proposed the development of so-called first and second order concepts or as some other
authors called them categories (Nag et al., 2007). In simple terms Van Maanen labels the first order concepts as facts, real areas, while the second order concepts are the so-called theories the analyst uses to organize and explain these facts. I will use this hierarchical concept of Van Maanen to provide structure to the analysis framework. This specific research will revolve around determining, mostly based on literature, generic categories from which more case-specific subcategories will be placed. I will use the word categories for the first, second and third order elements. The identification of the first order categories will be based mostly on company specific facts.

The framework structure based on Van Maanen’s (1979) hierarchical categories:

- First order- company specific categories
- Second order- generic categories present in literature (based on preliminary content from the interviews and literature)
- Third order- generic categories (based on Szulanski, 1996)

First order categories will belong to certain second order categories, but some second order categories might not have first order subcategories because of the limited potential for branching out to more specific company categories. The full framework can be found in Figure 5.

3.5 Defining (sub)categories

As indicated within the theoretical section of the thesis, the Szulanski (1996) internal stickiness framework will be used as a basis for this research. The following four generic 3rd level categories based on theory are established:

1. Source - within this category, characteristics are placed which elaborate more on the source of knowledge and the motivation to share.
2. Learning content – classification of what type of learning has occurred.
3. Recipient – characteristics which elaborate more on the recipient of the knowledge.
4. Context- this category holds company specific characteristics and processes with an aim to provide insights of the environment in which the projects are conducted.
3.5.1 Source
As the main focus of the research is cross-project learning, gaining a better understanding of the source is essential. Within the source, which are human beings managing the whole project, understanding what is actually the content and what motivates the individuals to share is important. Von Zedtwitz (2002), in his research on resistance to learning from post-project reviews, indicates that inability to reflect is one of the psychological effects of humans. Motivation to share or lack of motivation was also indicated by Szulanski (1996) as a potential characteristic of the source.

3.5.2 Learning content
As indicated in the introduction knowledge can have multiple forms (tacit vs explicit). To better narrow down the knowledge transferred an additional subdivision of the type of knowledge will be placed in this category. Knowledge types differ and what has been learned and through which medium it has been transferred is an important insight. The medium subcategory will be placed here. The following differentiation of knowledge is made:

- **Human interaction knowledge**: This subcategory describes experience gained with dealing with people. It was one of the most difficult to elaborate and it is highly personal. This relates mostly to what Nonaka and Takeuchi (1995) refer to as tacit knowledge or as Newell et al. (2006) call it “soft knowledge”.

- **Process knowledge**: This subcategory aims to describe the knowledge gained on the bases of process experience. Ramesh and Tiwana (1999) define process knowledge “as tacit and explicit knowledge about activities, steps, and procedures” (p. 214). Examples include better risk analysis and additional unfamiliar components influencing process flow differently than predicted. These types of learning points are easier to share in comparison with the human interaction knowledge.

- **Technical knowledge**: This subcategory represents explicit technical knowledge gained from the project.

3.5.3 Receiver
In order for the recipient to benefit from the source’s knowledge sufficient understanding of the content of the receiver project is necessary. Thus within the receiver a subcategory of understanding will be present.
3.5.4 Context

All cross-project transfers happen within an organizational context. Szulanski (1996) does point out that intra-firm knowledge exchange is embedded in an organizational context and thus goes to reason that certain organizational characteristics might impact cross-project learning. For this reason two 2nd level categories are established: processes and characteristics. Within processes additional 1st level categories such as KTA/KTE, IPE, Project closure activities and Ways of sharing will be created.

KTA/KTE and IPE are specific company processes for which additional insight is required as to why they are not done systematically. A project closure activity is a more generic category by which all activities undertaken to close the project will be analyzed. The final sub category of ways of sharing will include current practices of how employees share what they know. This goes beyond the direct link between the source and receiver relation.

The 2nd order category Characteristics will be subdivided into three additional 1st order categories: Knowledge center, Project management (PM) process understanding and Project quality. The knowledge center category indicates an employee’s perception of how they perceive the organization to be center of knowledge creation or a center for knowledge improvement. PM understanding gives additional insights into how and to what extent employees understand the generic PM process. The last 1st order category of Project quality will elaborate more on employee’s perception of the current status of project quality and output.

3.7 Additional insight

During the interview additional insights were gained, predominantly into the preference of future projects-closure activities and lessons learned. These will not be explicitly analyzed within the “core analysis” but will be used as guidelines for the tangible recommendations for improvement. The filled-in framework can be found in Appendix IV.
Figure 5. Framework for Cross-project learning analysis
4.0 Analysis

Within this chapter the analysis part of the data will be placed. In order to better identify and structure elements of the analysis, a cause-and-effect structure will be used. The cause-and-effect diagram consists of causes, problem and strategic consequence (visually presented in Figure 6). Within the right hand side the strategic, long-term consequence will be identified. This element aims to identify what the long-term consequences related to the organization and caused by the current problem are. These strategic consequences were the prime motivator for this research and a main long-term goal of the organization. This will be presented first.

In the second section the problem will be verified based on the data. The initial problem definition was set to be insufficient cross-project learning which was based on the input from the quality responsible and senior manager. To verify that this is truly the case within the analysis problem verification (for simplicity the problem) will be presented. This problem is the enabler of the strategic consequences. The problem has occurred under an influence of some type of a cause. The analysis of the causes will follow the defined four categories of source, recipient, content and context based on Szulanski (1996). The chapter will end with a summary.

![Figure 6. Generic cause-and-effect diagram](image)

4.1 Strategic consequence(s)

In today’s “projectfied society” (Lundin and Soberhold, 1998) substantial amount of organizations are organized as project organizations which implies that most knowledge is created within projects. Leveraging knowledge created from one project to another can be considered as one component of knowledge management.

As indicated within the problem definition the “reinventing the wheel” phenomenon (Prusak, 1997) seems to be present at TNO PW and IVS. Interviewees said that “the mistakes that are being made are not the first mistakes being made of the same kind” and “we are
making mistakes again and again” referring to the same/similar type of mistakes. This clearly supports the initial problem definition that the “reinventing the wheel” phenomenon is preset at TNO PW and IVS.

The traditional approach to measuring the success of a project gravitates between three main components: time, costs and quality (Babu and Suresh, 1996). This traditional approach is deeply ingrained in organizations. Several interviewees did express concerns about the overall project quality. A senior project manager indicated that certification (IPMA D) is an increasingly common practice for project leaders as: “too many projects ended in losses instead of profit”. However there also seems to be a general agreement that deliverables are met and output for the client is good, but as one interviewee said: “It is ensured that the (average) quality is not too low...”. As there is no one standardized definition of quality (Reeves and Bednar, 1994) one interviewee summed it up as a sense that if project was finished within the budget, scheduled deadline and desired delivery it would be considered of a good quality. There seems to be usage of the term “project quality” to incorporate all three components of time, costs and quality. The overall impression is that the project quality can be improved. To avoid misunderstanding the term “project success”, which encompasses the time, costs and quality of a project, will be used (Babu and Suresh, 1996).

Based on the above analysis two main strategic consequences are identified which need to be addressed: (1) reinventing the wheel phenomenon and (2) project success.

4.2 Problem verification

Within this section verification of the main problem and enabler of the strategic consequences will be presented. Research clearly shows that knowledge and learning are essential components for a successful project completion. Thus learning from projects and leveraging the experiences from a previous project to subsequent ones can increase project performance and overall success.

One of the main reasons why this research was initiated is because of the unsystematic execution of IPE and KTA/KTE. Within in the IPE essential reflection is made which reconciles the learning that occurred within the project. Within this process it is also typical that some form of lessons learned is extrapolated.
There seems to be no official practice at TNO PW and IVS where knowledge and experience from previous projects are leveraged for those that follow. After every project no post-mortem are done which would attempt to codify and spread learning points across the organization. Most of these activities happen at the end of the project during the project closure phase. As indicated by some of the interviewees, project closure activities in whatever form, are in principle lacking at TNO PW and IVS: “there is not project closure…”, “we do not pay too much attention to it” and simply “we do not plan for it”.

When it comes to knowledge sharing there was an indication that people tend to share what they know with people within their close proximity and via unofficial, “coffee corner” conversations. As one interviewee indicated: “I do share... with people that are working within my project”. This seems to be the tendency within TNO, where tacit knowledge sharing mostly occurs in close proximity, via these informal conversations around the coffee machine. However, as one interviewee mentioned: “I do not use City [intranet] as usually I do not find what I am looking for”. This indicates that even explicit knowledge is searched for through the unofficial human network and shared via the unofficial coffee corner conversations. The human network is a personal social network of people that individuals know and ask for advice. This form of fully un-standardized knowledge sharing as well as search practices limits the potential benefits of leveraging the learning and knowledge created in one project by a subsequent project.

The above described practices verify the problem at TNO PW and IVS: insufficient cross-project learning. Both tacit (social interactions) and explicit (codified forms) types of project knowledge sharing are limited at TNO PW and IVS. The following section will identify the causes of the current problem.

4.3 The causes
Within this section, following the analysis framework, the causes of the problem will be identified. The causes belong to the four generic 3rd level categories: context, recipient, source and learning content. The context generic category will be presented first. Within the context category there are two additional subcategories: Characteristics and Processes in which the transfer took place.
4.3.1 Context category: Characteristics

The main aim of this category is to give a better insight into the context in which the transfer of cross-project learning is occurring. Within this category additional three sub categories were introduced, namely Project quality, Project management process understanding and Knowledge center. Project quality has been discussed in the previous subchapter.

Based on the data the knowledge of all employees of the project management process is sufficient but with a certain personal view. It was indicated that most of the project leaders need to undergo project management training to be certified. Most employees provided a more structured approach to the project management process. There was an indication that certain parts of the project management process are done differently depending on the type of project. Overall the interviewees have a solid understanding of the projects management process but although training has been provided to most employees who are involved with project management, there is still a tendency towards more intuition-based project management than a more structured formalized approach. There is however an indication that the project leaders’ guide, a manual for project managers, is consulted by some of the interviewees (mostly by younger PL without considerable experience). Most of the employees, while they have heard about the company manual (Managementsystems) have not read it or at least not recently: “...but I have not fully read it”.

Even with this mix of intuitive and formalized project management approach, projects are being finalized and the process itself, with exception of indicated final project closure activities such as IPE and KTA/KTE, are followed and executed. There appear to be no identified impediments arising from the lack of project management skills of the project leaders within the context of cross-project learning. In addition, most of the interviewees believe that TNO does represent a knowledge-creation organization that provides value to the client.

4.3.2 Context category: Processes

The aim of this subcategory is to provide more insight into current practices and processes at TNO PW and IVS. The Processes subcategory holds an additional four 1st level categories in relation to preferred Ways of (knowledge) sharing, Project Closure activities, IPE and KATA/KTE.
Project closure was partially tackled in the problem section of this chapter. Although there was a strong indication that project closure is truly lacking, there were rare individual instances where project closure was done via a meeting but this is more the exception rather than the rule. As it is not planned resources are not allocated. A partial reason for this current situation is that there is no official project closure activities defined at TNO, at least not present within the company manual. “If I haven’t [sic] told anyone that the project was closed no one would have asked” as one interviewee said. One reason for improper, unstandardized project closure activities is also indicated to be the lack of time and pressure from management to start with another project. Time pressures are not unheard of in literature. Keegan and Turner (2001) concluded that many project team members did not have sufficient time to actually do a proper project end review. Time pressures seem to be a common occurrence in a number of projects (Dikman et al., 2008). As most post-project learning mechanisms naturally occur at the end of the project process, this represents a strong impediment to cross-project learning.

Within TNO PW and IVS individuals generally do share what they know, mostly via unofficially “coffee corner” conversations: “Most people are really willing to help if you ask”. As was indicated within the problem area, sharing occurs in close proximity with people they know: “I shared what I learned with the other people in the project”. This close proximity, verbal exchange, centered within the coffee corners as the prime place for knowledge exchange, can represent an impediment to cross-project learning. As the proximity of sharing happens mostly within the project circle and “nearby”, the potential usage of the experience accumulated within the project is not leveraged for wider departmental or organizational use. This limits knowledge dissemination and supports the “reinventing the wheel” phenomenon.

As identified in the problem area, within TNO PW and IVS there are no formalized post-project learning processes (e.g. Lessons Learned/Best Practices) through which an attempt to codify important learning is made. Keegan and Turner (2001) in their research indentified that all participating organizations had some form of post-project practices aimed at extrapolating learning points so other future projects can benefit from them. There seems to be a clear indication that post-project practices are common practices in organizations.
When it comes to the KTA/KTE, the satisfaction surveys required by the ISO 9001:2008 standard to be conducted, almost all interviewees heard and knew of them but the difference between them was sometimes not clear: “I know about them…” The majority of project leaders knew of them and in most cases knew they should do them but it seems that they were not clear on the procedure. One the reasons an interviewee mentioned as to why they are not done: “they are forgotten along the way”. This goes in relation with the time pressures. Although almost all are aware of them and most understand what they are (despite lacking a clear cut differentiation between the two), there was rarely someone doing them. Another reason which seems to persist, as with the project closure activities, is that it is simply “...not asked for”. These processes, although official, are not followed because they are simply forgotten, partially because no one asked for them.

In relation to the internal project evaluation (IPE), the majority had not heard of it and is not familiar with its existence as a procedure at TNO. This is to be partially expected as the majority of the interviewees have not read the company manual recently. There was a small minority which did do some form of IPE, but would do so mostly because it made sense. This was done via a meeting and some notes were taken, most of the time in a simple TNO standard memo, and usually emailed to the responsible business line manager (blm) and research manager (rm). There were no official criteria by which it was structured and no official process on how to use it or disseminate the evaluation. It must be noted that the current format of IPE within the company manual is relatively vague and, does not provide any guidelines, just simple steps of noting down main points and sending what has been done to the blm. It lacks clarity, structure and formalized guidelines.

Both KTA/KTE and IPE occur at the end of the project. During IPE important insights are discussed which can be used to extrapolate learning points. Execution of these processes is not just important in terms of satisfying quality regulations but they also have the potential of contributing to the cross-project learning process. IPE conductance contributes to the learning process as the reflections within the IPE help in the identification of learning points while KTA/KTE provides indications, within a longer time frame, of potential impediments in learning across projects based on customer feedback (e.g. if the same type of feedback persists).
Within TNO PW and IVS there is a lack of formalized project closure activities which creates the issue of not providing a more codified spread of knowledge sharing as well as an unsystematic IPE. The culture is relatively open and employees are willing to share but as project closure is not required (not requested) and time pressure is high, it is simply left out. When sharing does occur it is limited to the proximity of the people around the individual and/or the people within the project.

4.3.3 Source
For the source the clarity of the description was evaluated. This is important as it goes to the ability of the interviewee to elaborate on his/her own work, provide insight into the project s/he is/was working on as well as test the understanding of the project leader’s knowledge about his/hers own project. Within all cases the interviewees were able to express in a relatively clear manner the main aim and objectives of the source project. This indicated an individual’s ability to clearly elaborate personal thoughts. The content of the project elaborated by the interviewees was clear.

In principle social psychologists have identified two supporting aspects of motivation for knowledge sharing: egoistic and altruistic (Deci, 1975). The first is basically the expectation of returns, either monetary or otherwise. The second assumes an individual is willing to better the welfare of the others without expectations of reciprocity. At TNO PW and IVS the answer to the question of what personally motivates you to share what you know, tended mostly toward the possibility of others to learn from him/her but also what s/he could learn from others. There is a clear expectation of reciprocity. In principle there is no issue with the willingness to share knowledge.

4.3.4 Recipient
The clarity of the description was evaluated for the recipient as well. The ability to understand the context of the receiver project is equality important as the source, because without clear understanding knowledge re-usage will be difficulty. As with the source, all interviewees were able to express in relatively clear manner the main aim and objectives of the receiver project. Thus no impediment was identified within this category.
4.3.5 Learning content

Depending of what type of knowledge – divided in this research into process, human interaction and technical knowledge – was being shared, the extent of its dissemination depended on the medium of transfer. In almost all cases the technical knowledge was easily shared because of its characteristic of being easily codified. In principle codification was not a problem for technical knowledge as in most cases written reports to clients had to be submitted, however finding information about it was. “I have my own network that I use [referring to the human network]” one interviewee said. This was partially indicated in the problem section. The interviewees indicated that it is in principle easier to ask people about a project they did then to find information about it on the intranet. There was a strong reliance on the informal human network. This was partially caused from not finding the proper information via the intranet. There seems to be an IT-related issue concerning employees’ inability to find what they were looking for within a reasonable amount of time: “I do not search the City [intranet] as I usually do not find what I search for”. One interviewee also gave an example where “…some people used LinkedIn to find people at TNO”. As ICT is an important mechanism for knowledge dissemination, ineffective intranet is an impediment to cross-project learning. If employees are not able to find what they are looking for in fair time, the capitalization of the previously accumulated, mostly explicit, knowledge is lost.

In relation to the more tacit knowledge, human interaction and process, there was a difference of medium. It was mostly shared verbally by talking to people within the project of the interviewee or the ones within close proximity: “I walk a lot and I talk a lot” one interviewee said. There was also one concern expressed by a senior manager that although fully acknowledging the importance of what the interviewee learned within the area of human interaction or how to act with certain clients, there was some difficulty sharing that relatively sensitive but important information in writing. It seems that tacit knowledge sharing, although inherently conducive to social interaction being shared (Nonaka, 1996), is still hindered by the limitations of close proximity dissemination.

Within TNO PW and IVS there has also been a practice of lunch presentations being made upon the completion of a project to present the results to the department. As the name implies these occur during lunch time, in an unofficial setting, and usually last for half an hour. This practice gradually became less frequent for no apparent reason. The lunch
presentations are an accepted and known practice at TNO PW and IVS that helps non-project departmental members (in some cases both departments during quarterly meetings) to be informed about more important projects.

There is a strong reliance on face-to-face, close-proximity sharing of all different types of knowledge. Although process knowledge can be more easily shared, the human interaction, or in the case of one of the interviewees, the communication style with a specific client, is difficult to put in codified form including for reasons of ethics. It seems within the knowledge-sharing improvement recommendations there should be a component for face-to-face practice. This is in compliance with Nonaka’s (1996) conclusion that social interactions are essential in tacit knowledge transfer.

4.4 Summary
Based on the analysis in the previous section the root causes of why certain practices impede cross-project learning can be identified. Within the recipient as well as the source categories there are no identified cross-learning impediments. All interviewees presented a clear description of the objectives of both the source and recipient projects. In addition there was no indication that people are not motivated to share what they know. Thus within the generic categories of source and recipient no impediments to cross-project learning were identified.

Concerning the learning content ineffective intranet is an issue. There was a strong indication by some of the interviewees that they were not able to find what they were looking for. Because of this they relied strongly on an unofficial personal network. This means that time and effort was dedicated to finding the right person. This indicate that the other person’s time was consumed as well, making this process highly inefficient. In addition to being a highly inefficient process, the dissemination of knowledge was limited to the proximity of that person holding the knowledge as well as availability.

Within the context category the majority of impediments were identified. As most interviewees indicated that proximity, either with other project members, or people they like, are the prime recipients of their knowledge, no matter the type. This causes limited dispersion of perhaps important learning content which other organizational members might find it useful.
Within TNO PW and IVS there are no formalized post-project learning mechanisms. This means that no attempt is made to codify in a simple, easy to use format, the main learning points of every project in order to prevent subsequent projects from repeating the same mistakes.

Based on the data there seems to be a strong presence of employee’s not knowing or neglecting under pressure formalized process. It must be pointed out that although some processes are officially in the company manual they lack structure and clarity.

By identifying the four main causes of impediments to cross-project learning the three element cause and effect structure is complete. Based on the analysis framework the causes were also embedded within a generic category based on Szulanski (1996). Because of the complexity of the process a clear-cut designation of membership to certain generic groups cannot be made, however strong associations are possible. As indicated in Figure 7, most of the causes of cross-project learning are within the context category. This is to be expected as environmental occurrences tend to influence process flows.

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<thead>
<tr>
<th>Causes</th>
<th>Problem</th>
<th>Strategic consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning content</td>
<td>Insufficient cross-project learning</td>
<td>1. Project success</td>
</tr>
<tr>
<td></td>
<td>Ineffective intranet</td>
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<td></td>
<td>Close-proximity knowledge sharing</td>
<td>2. Reinventing the wheel</td>
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<td></td>
<td>No formalized post-project learning mechanisms</td>
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<td></td>
<td>Not following formalized processes</td>
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**Figure 7.** Cause-and-effect complete diagram.
5.0 Defining requirements for the solution design

Within this chapter the constraints for the design-oriented solution will be presented. The aim of the solution design is to solve (most) identified causes of the problem and eventually improve, or permanently solve, the strategic consequences. There are certain real-life constraints, however, which the solution needs to adhere to. This chapter will be organized in the following way. First the requirements, user and functional, that the solution needs to solve will be presented. The following subsection will elaborate on the boundary and design constrains.

5.1 Requirements definition

According to the problem-solving book of Van Aken et al. (2007), there are two types of requirements which need to be taken in consideration while attempting to provide a design-oriented solution to an organizational problem: (1) Functional – the solution should solve the problem and the costs related to the solution should not in any way exceed the benefits (2) User- the system should be usable by the current organizational members and should be user-friendly.

5.1.1 Functional requirements definition

With the aim of improving the identified problem the causes of the problem should be tackled as they also indirectly (partially) cause the strategic consequence. For this reason the requirements will be set based on solving the current causes of the problem.

The functional requirements will be set partially based on literature and analysis but mostly based on discussions with the organization. One of the main impediments to cross-project learning is not having any form of post-project learning mechanisms. Some form of a post-project learning mechanism was also directly requested by the organization. Based on the analysis the solution design should improve both tacit as well as explicit knowledge sharing. Newell et al. (2006) do indicate that a mix of social and technical systems is a better approach to improve knowledge transfer in comparison to only ICT focus solutions. As close-proximity knowledge sharing is an impediment, the solution design should incorporate some form of wider dissemination of knowledge. The solution design should also hold relatively short-term implementable recommendations. Based on the above, the functional
requirements are derived and can be found in Table 1. The user requirements followed generic guidelines from Van Aken et al. (2007) as well as common sense.

<table>
<thead>
<tr>
<th>Functional requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Should improve cross-project learning by providing specific learning mechanisms</td>
</tr>
<tr>
<td>a. that provide some form of codification</td>
</tr>
<tr>
<td>b. incorporates wider dissemination</td>
</tr>
<tr>
<td>c. takes in consideration tacit and explicit forms of knowledge</td>
</tr>
<tr>
<td>2. Should improve project success within an intermediate period</td>
</tr>
<tr>
<td>3. Should reduce number of repeated mistakes within an intermediate period</td>
</tr>
<tr>
<td>4. Should solve (most) causes within the set requirements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>User - requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Should be similar if possible with current practices</td>
</tr>
<tr>
<td>2. Should be easy to use and understandable</td>
</tr>
<tr>
<td>3. Should be perceived as useful</td>
</tr>
<tr>
<td>4. Should be as pleasant to do as possible</td>
</tr>
</tbody>
</table>

**Table 1.** Functional and user-requirements

### 5.1.2 Boundary conditions and design restrictions

Van Aken et al. (2007) also point out that certain boundaries and restrictions should be placed to narrow down the solution and provide certain limitations to the direction within which the solution can head. For this reason the authors defined boundary conditions- compliance with safety/legal regulations, fit with corporate culture and current processes; and design restrictions- quantifiable limitations with an aim to minimally disturb the current processes structure. For this current research no specific data was given as limitations but generic, realistic, restrictions were set. The following is defined:

<table>
<thead>
<tr>
<th>Boundary conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The solution should use familiar format/templates</td>
</tr>
<tr>
<td>2. The solution should not create mental resistance among the organizational members.</td>
</tr>
<tr>
<td>3. The solution should be implementable in the current IT system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Should be acceptable to the organizational members</td>
</tr>
<tr>
<td>2. Should be implementable in the short term</td>
</tr>
<tr>
<td>3. No costs related to implementation of a new system</td>
</tr>
<tr>
<td>4. The solution should be sufficiently flexible to fit current processes</td>
</tr>
</tbody>
</table>

**Table 2.** Boundary conditions and Design restrictions
5.3 Narrowing down the solution design

Taking in consideration the presented requirements and restrictions certain causes might be neither applicable nor possible because of the boundary in which the solution is required to be placed. Because of these restrictions the solution proposed should be able to solve most of the causes within the defined boundaries.

Due to budget as well as a realistic requirement that the proposed solution remain within the current IT system, the ineffective intranet will not be possible to be tackled. In principle IT solutions, which are usually done organization wide, require a substantial budget and are planned as part of the IT strategy of the organization. Because of the massiveness of the IT-related issue and the restrictions set by the organization, the ineffective intranet will not be included within the solution design. The design will not completely ignore the IT-related issue, but will focus on somewhat improving searchability within the current system and available tools.

The close proximity knowledge sharing is not unheard of in literature. Davis (1984) does indicate that physical structures can influence people’s interaction within a project. Koskinen et al. (2003) concluded that “corporate proximity- a physical shared situationality – has a positive effect on tacit knowledge transferring in a project” (p. 288). People tend to share what they know with the people they know and like. The reasons for close-proximity sharing are understandable, but the costs for the organization as a whole are substantial and the solution should propose improvement by having practices which disseminate on a larger scale the knowledge created within a project.

Reich et al. (2012) did conclude that of the knowledge created within a project, essential for project completion, some will remain tacit but most must be made explicit with an aim to being examined, verified and shared. This is very much applicable to TNO as it is a technical organization which produces mostly technical knowledge. Post-project learning mechanisms (e.g. Lessons Learned or Best Practices) should help the organization to better and more widely spread the main learning points from a project.
To better tackle the not following formalized processes will be further decomposed into its subcauses. The not following formalized processes cause has three subcauses which are identified after analyzing the data: (1) time pressure; (2) unstructured/unclear process; and (3) not being requested. The proposed solution should tackle all three to insure cessation or reduction of the cause.

As we reflect back to the initial mapping of Szulanski’s (1996) categories with Von Zedtwitz’s (2002) barriers to post-project learning, it is noticeable that the majority of impediments belong to the context category which is mapped with the managerial barriers of Von Zedtwitz. This strongly indicates that the solution design should include managerial elements, process improvements, which will tackle the (sub) causes.

6.0 Proposed solution design

The solution design should provide holistic, comprehensive and concrete steps for tuning down the negative effects of the causes or permanently solving them. Looking at the causes presented in Figure 11, post-project learning mechanisms and not following formalized processes (KTA/KTE and IPE) are at the end of the project while close-proximity sharing can happen throughout the whole project but dissemination of that accumulated knowledge
mostly also happens at the end. This grouping of the causes, and keeping in mind the IT-related cause, suggests that a two part design solution is present.

6.1 Solution design - section I

Within TNO PW and IVS a practice is present where project leaders present via lunch presentations the progress of some project or the end results. Over time this practice gradually with time became rare for no apparent reason, but it is still present. This practice was very useful as it kept people informed about current project progress and also provided a chance for other organizational members to ask questions and deepen their knowledge about a certain topic. Learning points were shared but not in a formalized structured way, but just if they “pop-up”. This practice is familiar to organizational members, it was done before and it is generally found useful.

Keeping in mind the requirements and constraints, lunch presentations – where tacit and explicit knowledge are shared – are a cheap, accepted, known and functional way of disseminating knowledge from close proximity to a departmental level. To increase dissemination throughout the whole TNO, however, a more codified format needs to be present. The codified format, a template of Lessons Learned, will not just provide a standardized format which easily can be filled in and read, but will also help present the most important points during the lunch presentation to the department.

Creating a Lessons Learned (LL) template goes in line with TNO output of mainly creating technical knowledge which is easily codified. The Lessons Learned template was created based on the data from the interviews. It should be easy to use and read, one page, with bullet points. After a detailed research of TNO current templates, most of them had a tabular format with a relatively unpleasant way of filling in and searching for information. After a review of publically available LL templates the following template is proposed:
Figure 9. Lessons Learned template

To provide more structure to the notation process of the learning points the template follows a cause-and-effect line of thought. This aims at making the project leader think not just what the issues were and how it influenced the project outcome but what actually caused them. As most organizational members at TNO are individuals with an engineering background, this line of thought is compatible with their natural way of thinking, thus partially diminishing the psychological barrier of seeing this format as extra paperwork. The template should be filed in by the project leader and this step is connected to the second subchapter of the solution design which will be explained in the next section.

As the format needs to be flexible enough to provide sufficient space for self-expression it should also be sufficiently structured to guide the project leader in the preferred filling in format. On the top of the template the standardized identification characteristics of the project connected to the LL such as project name, number and leader are present. These are purely for identification purposes. In the middle there are two squares where the learning
points should be placed. In the left square via numbered bullet points the causes of the issue within the project should be made explicit. Within the second square the effect of the cause should be presented with the actions taken to reduce or solve the issue. The numbering of the bullet points should correspond between the two boxes. The boxes aim at presenting only the two-three most important learning points within a few concise sentences.

Within one of the interviews, an interviewee indicated that project members when working with a client, might know a potential lead for a subsequent project with the same or another client. The issue that the interviewee indicated is that relating this information to management, as they are the ones responsible for new business cases, is difficult. One main reason is that relating such information face-to-face within a relatively short space of time is almost impossible due to management’s tight schedule and relating it via email did not yield any effect. For this reason, as well as to increase overall management support for this process and especially LL, an additional small box called Leads is proposed. This box will provide the space in which the project leader can indicate any potential leads which s/he might know related to potential future projects with the client, or even with perhaps another one. This will add an additional value to the LL as it will also relate potential future projects to management. This will motivate management to read the LL and not just find out about potential projects but also be informed, at least partially, about what the main learning points were within a project.

6.2 Solution design – section 2

When analyzing the remaining two causes it is noticeable that both of them should be done at the end of the project. Both IPE and KTA/KTE are done (or sent out) at the end of the project while learning mechanisms aimed at capturing learning points from projects occur at or near the end (Kotnour, 1999). When taking a helicopter overview and keeping in mind the constraints a certain cluster is noticeable. All of the activities belong at the end of the project.

Currently at TNO PW and IVS there is no formalized project closure. According to Young (2003) project closure is very important as it gives the members the sense of a job well done. Young (2003) strongly indicated that project closure activities should be planned as there is a tendency to just let the pressure off when the end is approaching, a phenomenon called
project drift. One of the reasons why there is a strong time pressure at TNO is because the end activities, such as IPE and KTA/KTE, are not planned. By providing a holistic, official project closure with a strong support from management for implementation, both causes of not following official processes and not having learning mechanisms will be abolished or significantly reduced.

For the purpose of diminishing the negative influence of the two remaining causes the second section of the solution design, taking in consideration all constraints and requirements, proposes an official project closure activity at TNO PW and IVS. The project closure should consist of three relatively easy to do, clear subprocesses: (1) doing an internal project evaluation (IPE); (2) sending out the KTA/KTE; and (3) filling out the lessons learned.

![Diagram](image_url)

**Figure 10.** Components of the umbrella process project closure

### 6.2.1 Solution design – section 2 – IPE

IPE is a necessary and important process within TNO which is formalized and required. One of the reasons it is not done is because organizational members do not know about it. The main reason is because most employees have not read the *Managementsystem* (company manual) recently. As it goes beyond common sense to ask organizational members to actually read it, by presenting these results at the two departments the issues of not knowing or not knowing the clear cut distinction in the case of KTA/KTE, is solved. However the process is still unstructured, vague and lacks guidelines.

While thinking of the best way in which to actually conduct an IPE, one of the interviewees did mention that although there is no IPE at the end (one of the rare few who actually knew
about the process) he asked the project leaders to actually fill in for the last time the progress report as it contains all necessary information for a proper IPE. Progress reports are routinely done at TNO IVS, but are beginning to be used at PW as well, every month for every project. The format of the IPE which can be found in Appendix V contains all the elements by which a project is evaluated and its format is already familiar to most organizational members. It is only logical that in an aim to provide a more guided process of doing an IPE and taking in consideration the defined constraints, this format should be used for executing an IPE.

The context in which this IPE is conducted is very important. Lunch meetings are a common practice at TNO and should be leveraged for this as well. IPE can be done via a lunch meeting. One of the interviewees indicated: “no lunch during lunch meeting as after lunch we go lunching”. There should be an emphasis for an actual lunch (simple standard Dutch sandwiches will suffice) to be provided. This will additionally motivate project members to be present and will create a more enjoyable (gezellig) atmosphere.

One addition to the IPE is proposed for a more complete leveraging of its potential. An additional section called Lessons Learned can be added. This section will enable the project leader when filling in the progress report to also codify important LL which arose that month. This will aid in the retention of important learning points acquired during the course of the project. This is also important for filling in the LL which will be later elaborated in the following section.

One addition to the IPE is proposed for a more complete leveraging of its potential. An additional section called Lessons Learned can be added. This section will enable the project leader when filling in the progress report to also codify important LL which arose that month. This will aid in the retention of important learning points acquired during the course of the project. This is also important for filling in the LL which will be later elaborated in the following section.

The KTA/KTE both have standardized forms which simply need to be filled in and sent out. Depending whether an audit or etiquette is decided to be done for the project, the process differs slightly. This was not an impediment and by presenting the solution at the organization most misunderstandings were made clear. The LL has already been elaborated in the previous section.

6.3 Solution design – impact on causes
The main aim of the solution design is to improve or permanently solve the negative effects of the causes on cross-project learning. This section will elaborate more on the overall interconnectedness of the solution design on all of the causes.
Ineffective intranet
1. Project success
2. Reinventing the wheel
Insufficient cross-project learning

Figure 11. Solution design impact on (sub)causes
The close-proximity sharing cause has been tackled by proposing two elements: LL template and lunch presentation. The lunch presentations are mainly focused on the tacit knowledge transfer, and the LL helps in a more structured way to present the main learning points during the lunch presentation. Taking into consideration both types of generic knowledge is important and following Nonaka’s (1996) indication that social interactions are important for tacit knowledge transfer, the lunch presentations provide a good environment where this can be accomplished. To avoid cluttering of the above-presented cause and effect diagram the lunch presentations box is not shown.

LL is also part of the main solution design- project closure. The creation of an official, structured and easy to implement umbrella element at the end of the project that engulfs all currently required processes gives the members simple guidelines to perform a proper project closure with all the required elements. By providing the LL template a mechanism was introduced through which learning points can be codified and shared. Keegan and Turner (2001) did indicate that all of the organizations in which they did their research had some form of mechanism to codify learning points. It is a general practice at organizations to try and codify learning points as they are afterwards easily sharable. This seemed to be a logical step for TNO as it was also specifically requested by the organization as one of the deliverables, but also as it helps in solving one of the causes.

By having an official project closure mandatory for each project, the time pressures will also diminish as it will be planned. As Young (2003) indicated, project closure should be planned to be done properly. With the introduction of the progress report template to be used for the IPE, there will be less resistance to the format and if done via lunch meetings the motivation to participate will be greater. The sub-cause of unstructured/unclear will also be diminished.

One of the last sub-causes of not following formalized processes is because they are not requested. With the clear support of management this process can be insured to be followed. One additional motivation to follow this process for management is not just increased project success, but also potential new projects. This was made clear by introducing an additional box within the LL template so project leaders can indicate potential leads.
As the IT-related constraint was not directly dealt with within the solution design, an addition to improve the current situation is to actually place the LL into the project dossier. By using key-words with additional search criteria which the current search engine offers, organizational members can just look through the LL to quickly become informed of potential risks or desirable actions. This is very limited improvement but the design constraints did not allow further development.

With this two-section solution design most of the causes were tackled. The solution design incorporates all set requirements and restrictions, follows suggested preferences of organizational members and keeps in mind the pragmatic approach. Reflecting back on the theoretical section with Von Zedtwitz (2002), generic barriers to post-project learning, the solution does incorporate strong management presence. Newell et al. (2006) indicate that a mix of a social and technical system is the way to improve knowledge transfer. This solution follows this recommendation by incorporating IPE meetings and lunch presentations and proposing Lessons Learned template and limited IT suggestions. This is in line with the membership of the causes under managerial impediments as identified by Von Zedtwitz (2002). Following the suggestion of Van Aken et al. (2007) for constant communication and consultation with the supervisor of the project in the organization, the solution development process received continuous feedback, a clearly indicated benefit for the organization and the approval of the initial as well as the final solution design.

6.4 Solution design testing
With the main aim of proposing a more robust solution design and to partially test the proposed design, a pilot testing was done on the only component which was new but also made available during the project at TNO- the lessons learned template. The template was emailed to the interviewees and they were asked if they could fill it in based on a real-life project they have just finished. In total two senior project managers replied. After they filled in the template we discussed its structure, format, ease of use and benefit. The feedback was positive. They specially liked the cause-and-effect format which helped them think not just what happened but also why it happened. Small remarks were given in the elaboration of the short text within the boxes. These suggestions were incorporated in the final version of the template.
6.5 Solution design location in the project process

To better indicate to the reader where the solution design fits in the overall project timetable in Figure 12, a simplified process flow diagram can be found. Progress reports are conducted each month and this can be used as indicated within the previous section to conduct a structured IPE. Also by discussing the LL part of the progress report the LL afterwards can be more precisely filled in with the most relevant knowledge. As can be seen in the process flow diagram, the solution design is mostly focused at the end of the project. This is to be expected as post-project reviews, are done at the end of a project. If applicable before the subsequent project starts, the LL as well as IPE can be a rich source of hints and information for the new project team.

![Solution design location in the project process](image.png)

**Figure 12.** Solution design location in the project process

7.0 Change plan

Based on Van Aken et al. (2007) book, a solution design should be accompanied by a change plan. A change plan determines the risks associated by the proposed solution design and specifies activities for smooth implementation of the new solution design. The change plan consists of the following main elements:

1. Objective and delta analysis – analysis of major differences between the present and business system and the redesigned one
2. Specific actions for realization
3. Individuals needing to execute the above identified actions
4. Tailor-made communication plan

Following the main elements mentioned above, this section will elaborate on each of them chronologically. As indicated in the beginning of the solution design chapter, the main aim of
the solution design is to improve cross-project learning between projects within TNO PW and IVS.

7.1 Delta analysis
Within the delta analysis there are three additional subcomponents: stakeholder analysis, analysis of resistance and design of intervention plan.

7.1.1 Stakeholder analysis
In order to know where and how to implement the design solution the people involved in the change process need to be identified. Looking into those people both directly and indirectly affected by the solution, the following stakeholders are identified:

<table>
<thead>
<tr>
<th>Stakeholder analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
</tr>
<tr>
<td>1. Managers of the departments</td>
</tr>
<tr>
<td>2. Project leaders</td>
</tr>
</tbody>
</table>

Table 3. Stakeholder analysis

As management needs to support the new solution design, they are the ones directly involved in the change process. Also as the implementation of the solution design does not require any form of specialized skills, current employees can easily implement it in their practices. Practical, systematic execution of the solution design, however, is mostly dependent on project leaders as they are the ones (usually) doing the presentation and for sure closing the project. Indirectly all organizational members are affected, as the changes are intended to improve their effectiveness.

7.1.2 Analysis of resistance
Van Aken et al. (2007) identify five antecedents to change:

**Lack of understanding**: In principle the solution is based on current processes and the restructuring only provides a clearer, ease to implement umbrella process. Thus based on the reactions from unofficial feedback by participants of the final presentations of the project results, clear understanding was noticeable and directly indicated.
Based on the above written analysis an intervention plan seems unnecessary and will not be developed within this report.

7.2 Individuals conducting the changes
With every new change it is essential that the right competent individuals are made responsible for the right change activities. The solution design is adopted to fit current structure and procedures and thus its implementation can be relatively easily incorporated within the current functions and activities of the employees. There should be one person, preferably the supervisor of this research who will coordinate the activities. The coordination will be within his current job description as it does not require any form of additional skills.

7.3 Communication plan
Communicating the changes is an important component of the solution design implementation. Unclear communication might create unnecessary confusion and resistance
to change. To improve the chances of smooth, uninterrupted implementation, clear communication of the changes needs to be made. Based on van Aken et al. (2007), the communication plan is presented in the form of an activity diagram and can be found in Appendix VI.

The benefit of the new procedure must be communicated very clearly so there is no doubt of the importance of the solution design. Both personal as well as organizational benefit should be presented. With the clear communication activity diagram the change plan is complete.

**8.0 Conclusion and discussion**

Within this chapter the discussion section of the results and answering of the research questions will be placed. An additional subsection on managerial as well as theoretical contributions will also be presented. Limitations as well as potential directions for future research will be provided near the end. The chapter will end with a conclusion section.

**8.1 Theoretical contributions**

The main aim of this research is to shed more light on the impediments of cross-project learning. The generic research question was formulated so it can provide more insights into the elements comprising this field in which not many empirical studies have been conducted. The findings of this research do relate to what other researchers have concluded before. One noticeable occurring impediment to cross-project learning is time pressure (Keegan and Turner, 2001; Von Zedtwitz, 2002; Dikman et al., 2008). What research has not done before is actually provide answers of why this is happening, or what might be the subcauses of this constantly reoccurring impediment.

Within their study of quality versus quantity of project-based learning Keegan and Turner (2001) have indentified three main impediments to project-based learning: (1) time pressures-demanding schedules; (2) centralization-control of the resources is at one place (e.g. senior management); (3) deferral-procrastination of the learning activities at a later stage. Based on the analysis of the current research, it seems that time pressure is just one of three potential issues that influence deferral or in this research the impediment of not systematically following formalized processes. It is safe to assume that deferral as defined in the research of Keegan and Turner is compatible but named differently in the current one.
Formalized reflective and learning processes (e.g. IPE) are not followed thus a deferral of the learning process occurs.

All of the companies in Keegan and Turner’s research had some learning mechanisms in place, but the deferral contributed to significant time lapse and thus loss in learning potential. This research adds to Keegan and Turner’s research by indicating that time pressure is a subcause of deferral. Also it seems that deferral – or in this research the impediment of actually not following formalized processes – is also impeded by two additional subcauses: unstructured/unclear formalized processes and not requested conductance of formalized processes. This is an important insight as this research not only provides a new light on the interconnectedness of the impediments but also discovers additional subcauses. It seems that time pressure contributes to deferral and it is not directly linked to cross-project learning. This indicates a more complicated relationship of the causes primarily identified by Keegan and Turner (2001).

**8.2 Managerial contributions**

This study strongly reaffirms the importance of conducting a proper project closure. As we are moving to a “projectified society” (Lundin and Soderhold, 1998) where most knowledge is created within projects (Ayas and Zeniuk, 2001), project-based learning and cross-project learning become highly important. Young (2003) does emphasize the importance of project closure as it gives the team members a sense of job well done. This study emphasizes the importance of project closure as an element within the project time frame where a substantial amount of knowledge is being reconciled and prepared for organization-wide sharing. By knowing which impediments are present, activities can be taken to lower their negative influence. This research provides managers additional insights into cross-project learning impediments and their causes as well as subcauses, and a potential solution to lower their negative influences. Project closure seems to be an important element in cross-project learning.

This study strongly indicates the importance of management in the cross-project learning transfer. Without the support of management the indicated impediments will slowly reoccur. Reflecting back to the theory, the Von Zedtwitz’s (2002) managerial barriers, it is surely management the one who has an important role in the context by which the transfer
occurs. This indicates an even greater responsibility of management in the learning organization.

8.3 Limitations and future research
As in every research this one is also not without certain limitations. The ultimate goal of any scientific research is to generate data with high validity and reliability, while having an objective approach towards the data and eliminating alternative interpretations of it (Yin, 1984). A potential limitation is that this research is done on one organization. Although four to ten cases are sufficient for providing generalizable data (Eisenhardt, 1989), for even better generalizability it is always preferable that cases be from multiple organizations. Because of time and resource constraints, in addition to those inherent to this type of project (master thesis), the research had to be done on one organization.

Another limitation can be that the data collected was mostly from project leaders. Although project leaders have an overview of all of the activities within a project, the knowledge transfer occurs also between team members on the company floor. Future studies within this area should possibly consider including also team-members as data source. They might provide certain insights into currently not visible impediments to the cross-project learning process.

Future research should focus on further decomposing the impediments thus far identified in this research as well as those stemming from previous research. Keegan and Turner (2001) provide a solid basis for further research. However based on the data it seems that a certain structuring of the causes and additional subcauses of the impediments is present. Perhaps future researchers should focus on creating studies which tackle the identified impediments more deeply and shed even more light on their interrelatedness and perhaps also their level of influence.

8.4 Conclusion
The main research question within this study was: “How can cross-project learning at TNO PW and IVS be improved?”. Based on this research question subsequent subquestions were derived which were better able to answer the main research question. TNO PW and IVS quality responsible did notice a problem within their processes as “reinventing the wheel” phenomena were present, where subsequent projects repeated mistakes from previous
ones. One of the main reasons why this research was initiated was to also investigate the unsystematic execution of the two main processes of high interest for TNO – KTA/KTE and IPE.

Within TNO PW and IVS, an innovation organization with cutting-edge applicable innovations, it cannot be said that there is no cross-project learning. Based on the data collected, there is cross-project learning, but it has some influential impediments, which if removed can improve their main aim – improved project success and the reduction of the “reinventing the wheel” phenomenon. The general conclusion is that not all potential learning mechanisms are leveraged. It was found that in total there are four main causes or impediments of better cross-project learning: (1) close-proximity knowledge sharing; (2) ineffective intranet; (3) no formalized post-project learning mechanisms; and (4) not following formalized processes.

Within the fourth impediment, not following formalized processes, three additional subcauses were identified: (1) time pressures; (2) unclear/unstructured processes; and (3) that the processes were not being requested. To solve or significantly lower the negative influences of these causes a twofold solution was introduced: (1) project closure consisting of IPE, KTA/KTE and filling in LL; and (2) increased knowledge dissemination via lunch presentations and lessons learned template. By providing this solution most of the identified causes were tackled with exception of the IT-related cause: because of design constraints the solution was limited in lowering this cause’s negative influence.

TNO as an innovation organization – knowledge creation is at its core. Leveraging this knowledge across projects is becoming an essential process as environmental conditions dictate a strong competitive tendency. By implementing this simple solution design, it will provide TNO PW and IVS more formalized, improved cross-project learning via simple, easy to use steps.
References


Appendix I – company description

The seven themes and the three expertise areas

Information Society

- Research that has impact on the Information Society which is based on the latest ICT, Media and Aerospace Technology

Energy

- Insuring sustainable, efficient and secure energy supply

Industrial Innovation

- Innovation with a strong, sustainability focus, aiming to strengthen industry via innovative products and processes

Defence, Safety and Security

- A safe and secure society via creative innovations for individuals employed in defence, police and emergency services/industry

Build Environment

- Aiming to contribute to sustainable design and comfortable living in densely populated spaces

Transport and Mobility

- Make mobility clean, quite and safe by combining technological innovation, influencing human behavior and smarter organizations

Healthy Living

- Technological and societal innovation with a prime aim to provide healthy and dynamic society

Technical Sciences

Earth, Environmental and Life Sciences

Behavioral and Social Sciences

Figure 13. TNO Thema structure
Figure 14. Organizational chart of Technical services
Thema Mobility and Transport

The main focus of the Transport and Mobility Thema (short Mobility or Mobiliteit in Dutch) is to "accelerate innovation". To do so the thema focuses on actively involving three main actors: industry, governments and knowledge players. The thema is divided into seven topics that research is focused on, but they do interline within the business cases. Together with the external partners, at TNO Mobility there are around 300 highly specialized individuals with a strong focus on producing innovative solutions for today’s complex transport issues.

Figure 15. Organizational Structure of Thema Transport and Mobility (Mobiliteit)

Within the Mobility theme the business cases are organized based on the four business lines as shown in Figure 15. Each business line has a business line manager who is responsible for the projects under each business line.
Figure 16. Membership of the divisions
Appendix II – KTA/KTE and IPE explained

Customer Satisfaction Surveys (Klanttevredenheid or KTV)

After each project there is a procedure at TNO to send out so called customer satisfaction surveys (CSS) which later are used for process improvement. It has been noted that this is not the practice all the time (i.e. sending out surveys). To better understand the reasons behind it I will present the process below in Figure. 8 in a form of a flow chart. In principle there are two types of CSS: (1) klanttevredenheids-enquete or KTE which are sent out by the project leader (pl) directly to the client and (2) klanttevredenheid audit or KTA which are sent to an external bureau which takes over from there. The process for both type of KTE and KTA is explained but for this research the focus will be the KTE because of the accessibility of information (interviews with project leaders (pl)).

Each thema has a coordinator (KTC) as s/he coordinates the activities related to KTA/KTE making periodical trend analyses from which conclusions are derived, and that information is passed on to the line managers. On a yearly basis the department for Operational Excellence and Quality (kwa) analyzes all reports and makes conclusions as a source of information for the Board of Directors (rvb).
The blm is responsible for the KTV process and chooses between two process options.

Pl asks the assignment owner to fill in the KTE.

Pl fills in the KTA information page, sends it to ktc and informs og about the following KTA:
- ktc sends KTA info sheet to the external bureau
- external bureau does interviews and sends result to the ktc who stores it file
- ktc sends the KTA form to the pl

Ktc sends KTA info sheet to the external bureau.
- external bureau does interviews and sends results to the ktc who stores it file
- ktc sends the KTA form to the pl

Pl fills in a complaint form.

Pl stores KTE and KTA form to the Project dossier and sends a copy to blm and rm.

Pl sends one copy to the ktc and the ktc saves it on file.

Blm i.o.m. (rm) determines if they are reasons for follow up.

Blm initiates corrective and/or preventive activities towards og and controls the finishing up.
And/or
Rm initiates HR activities and controls the finishing up.

Client is (really) dissatisfied.

Pl sends one copy to the ktc and the ktc saves it on file.

Pl fills in a complaint form.

Pl stores KTE and KTA form to the Project dossier and sends a copy to blm and rm.

Yes

No

DONE

Figure. 17. KTA/KTE process flow
Internal Project Evaluations (IPE)

To improve project quality TNO conducts internal project evaluations. The procedure is relatively flexible and semi-formal. The limited information in the company’s manual indicates a lack of structure. Based on the company’s manual the following activities, within certain undefined format, are conducted.

**Aim:** Indicate learning points so other projects can profit from them

**When:** Every project should have an evaluation at the end of the project. In cases of longer projects min time is once per year.

**Form:** One round of open questions of what went well

**Alternatives:** *pl* asks for a meeting with the project members and one impartial person; *pl* makes a report and sends it to the *blm* and *rm*; *pl* stores the report in project dossier and sends a copy to Projectleidersgilde (with an aim to share Best Practices)
Appendix III – Interview questions

1. Can you please tell me your position, title, years that you have been working at TNO?
2. Do you find TNO to be a center for knowledge creation? (reflection more on the topic within the organization)
3. Can you describe the project management process at TNO? (general)
4. What is your experience within TNO when project quality is concerning (level, activities taken to insure it etc)
5. Can you please tell me about project X in short what the aim was? (project specific per person)
6. Based on the list which I have here which of the following projects is similar in terms of content and context with the previous one?
7. Can you please describe shortly (project), what was the main objectives, what were the main activities undertaken etc?
8. Can you recall if you used something from the previous project to the next one? If yes, what if not why not (elaborate).
9. What is the most important takeaway for you from a project? What do you think is essential to learn from projects? (might be even related to make it more specific with the previous project)
10. Do you think that Lessons Learned (explaining shortly what they are) will be beneficial for TNO?
11. How do you imagine the LL? What is the most important for you that you want to learn from the LL?
12. Are you familiar with the CSS/IPE? Can you shortly tell me about them
13. Do you do them every time? If not why not? What are the prime reasons for this?
14. Suggestions for improvement?
15. What is the best way according to you taking in consideration how things are done at TNO Helmond, to motivate people to share knowledge? How do you share knowledge and with whom?
   a. In what way and can you mentioned specific activities, based perhaps on certain current (unofficial) practices? (this is to provide general guidance for the process improvement)
1. Can you please tell me your position, title, years that you have been working at TNO?
2. Do you find TNO to be a center for knowledge creation? (reflection more on the topic within the organization)
3. Can you describe the project management process at TNO? (general)
4. What is your experience within TNO when project quality is concerning (level, activities taken to insure it etc)
5. Can you please tell me about project X in short what the aim was? (project specific per person)
6. Based on the list which I have here which of the following projects is similar in terms of content and context with the previous one?
7. Can you please describe shortly (project), what was the main objectives, what were the main activities undertaken etc?
8. Can you recall if you used something from the previous project to the next one? If yes, what if not why not (elaborate).
9. What is the most important takeaway for you from a project? What do you think is essential to learn from projects? (might be even related to make it more specific with the previous project)
10. Do you think that Lessons Learned (explaining shortly what they are) will be beneficial for TNO?
11. How do you imagine the LL? What is the most important for you that you want to learn from the LL?
12. Are you familiar with the CSS/IPE? Can you shortly tell me about them
13. Do you do them every time? If not why not? What are the prime reasons for this?
14. Suggestions for improvement?
15. What is the best way according to you taking in consideration how things are done at TNO Helmond, to motivate people to share knowledge? How do you share knowledge and with whom? a. In what way and can you mentioned specific activities, based perhaps on certain current (unofficial) practices? (this is to provide general guidance for the process improvement)
## Appendix IV – Analysis framework filled in

<table>
<thead>
<tr>
<th>Category</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic information</td>
<td>Experience</td>
<td>1,5 years of experience in the organization</td>
<td>2 years of experience in the organization</td>
<td>1,5 years in the organization</td>
<td></td>
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<tr>
<td>Title</td>
<td>Research Scientist</td>
<td>Research Scientist, PL ambition</td>
<td>Technical project leader</td>
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<tr>
<td>Context</td>
<td>Characteristic</td>
<td>Project Quality</td>
<td>Not many activities; &quot;No one asked if I closed the project, maybe the financial responsible, but besides deliverables that is it&quot;; A noticeable gap between Management and the floor; &quot;If I haven’t told anyone that the project was closed...no one would have asked &quot;Management only interested on the outcome (deliverables) if achieved.</td>
<td>&quot;All in the hands of the PL&quot;; PL responsible and depends on his activities; Pre Quality handbook and PLG; I asked people; If people follow QH and PLG quality is guaranteed</td>
<td>&quot;Below what could be achieved&quot;; Below what would guarantee good output; Uncertainty and risks are difficult to plan because projects are close to research; Lack of focus on risk at the organization; &quot;The mistakes that are being made are not the first mistakes are being made of the same kind&quot;</td>
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<tr>
<td>PM Process Understanding</td>
<td>Understanding: Familiar with company document, &quot;but have not fully read it&quot;; Mostly based on intuition; Officially the interviewee does not have a Project Leader (PL) role but s/he undertakes PL activities.</td>
<td>Familiar with PL gilde (PLG) and following their advice; The interviewee does not indicate a clear step wise knowledge of the PM process; Following the PM handbook &quot;People need to qualified to do PM&quot;-referring to the IPMA certification.</td>
<td>Project start with a validated project plan; PL assigned with a clear start/end date and budget; Personal knowledge used and good understanding of the process; Progress is done on gut feeling; lack of coordination between the projects;</td>
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<tr>
<td>Knowledge Center</td>
<td>&quot;we have some good stuff&quot;; indicated that certain focus is lacking in some business cases and proposes to dedicate resources on one topic to specialize.</td>
<td>&quot;Yes, it is&quot;; TNO as a whole new developments and initiatives coming from TNO; Helmond campus different; more efficient because of market clients.</td>
<td>True to a certain extent; sometimes at the edge of technology-new things are created;</td>
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<tr>
<td>Processes Ways of Sharing</td>
<td>Lunch presentations preferred way: &quot;People know what you did&quot;; more personal 1-1 feedback; no standardized procedure for feedback.</td>
<td>Call and talking; extroverts vs. introverts; you need to ask the introverts for knowledge;</td>
<td>&quot;I ask people for knowledge&quot;; &quot;I talk to them&quot;; &quot;I do not use the City ...as generally I do not find usually what I search for&quot;; Knowledge sharing is done by talking; &quot;I did specific documents searches and I didn't find it&quot; Most of the knowledge is shared because people are talking.</td>
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<tr>
<td>Project Closure</td>
<td>Special task-documentation in the budget planning; &quot;<em>We do not talk about it very much...&quot;</em></td>
<td>/</td>
<td>No project closure; Would make a template for myself; Closure is not planned &quot;<em>there is not project closure</em>&quot; &quot;...we do not plan for it..&quot;</td>
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<tr>
<td>IPE</td>
<td>&quot;<em>No, haven’t heard about it</em>&quot;; If I have to learn it: &quot;<em>I want more personal approach...by practical example</em>&quot;</td>
<td>&quot;<em>Never heard of it</em>&quot;</td>
<td>Yes heard about it, never experienced it; IPE-everyone should be involved but are not because of time pressure and as new projects start this will be dropped first; IPE are not planned</td>
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<tr>
<td>KTA/KTE</td>
<td>&quot;<em>I know about them, when Frank gave a presentation more than half year ago</em>&quot;; not clear to what type of Knows but never officially closed a project; The PL should be responsible for them;</td>
<td>&quot;<em>I know them but not from TNO</em>&quot;-No</td>
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<tr>
<td>Category</td>
<td>Subcategory</td>
<td>Description</td>
<td>Additional Notes</td>
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<tr>
<td>Recipient</td>
<td>Understanding</td>
<td>Clear description and understanding of the core activities and deliverables as well as field; some terms are mixed used but still relatively understandable</td>
<td>Unstructured and difficulty to elaborate the main aim of the project; Clear understanding of the topic; Clear elaboration of the main aim and short description;</td>
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<tr>
<td>Source</td>
<td>Understanding</td>
<td>Short description, understandable and clear</td>
<td>Difficulty to specifically narrow down the prime aim of the project</td>
<td>Clear understandable description</td>
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<td></td>
<td>Motivation to Share</td>
<td>&quot;it is difficult&quot;; &quot;Other people to learn from it, but to get feedback from it&quot;. Personal motivation: other to learn but to also get feedback</td>
<td>Short lunch presentation; usage of results from a project;</td>
<td>Willingness is high; &quot;People can learn from me&quot;; &quot;the attitude is very open&quot;</td>
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<tr>
<td>Learning</td>
<td>Technical</td>
<td>Additional building blocks, better understanding of modes and development. &quot;Documentation with the technical stuff could be better&quot;</td>
<td>how testing is performed</td>
<td>A model;</td>
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<tr>
<td>Process</td>
<td>Project development; better structuring of the process; Multiple steps in development; budget vs. task vs.…; “making planning's better”; “I learned to use the quality handbook”- financial aspects of projects; “Budget according to plan”</td>
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<tr>
<td>Human</td>
<td>Better understanding of why certain actions the PL does</td>
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<tr>
<td>Medium</td>
<td>Models from the previous project used; Knowledge transfer via personal knowledge; documented deliverables; LL are not placed; written down in the project dossier- technical knowledge; the take away (not technical) was not shared; &quot;I do not do that&quot;- transferring knowledge; Personal opinion that s/he is not sufficiently experienced to share knowledge</td>
<td>Discussed inside the project; documented in the meeting minutes</td>
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<tr>
<td>Category</td>
<td>Experience</td>
<td>Project Leader</td>
<td>Research Scientist/Project Leader</td>
<td>Project Manager</td>
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<tr>
<td>Basic information</td>
<td>4 years</td>
<td>3,5 years of experience in the organization</td>
<td>1 year</td>
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</tr>
<tr>
<td>Basic information</td>
<td>3,5 years of experience in the organization</td>
<td>1 year</td>
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</tr>
<tr>
<td>Title</td>
<td>Project Leader</td>
<td>Research Scientist/Project Leader</td>
<td>Project Manager</td>
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<tr>
<td>Context</td>
<td>Project Quality</td>
<td>Is pretty good of deliverables; sometimes more then required; Quality is not insured but check are present to insure average quality-no differentiation between good and pretty good; A bit contradictory with the previous statement; &quot;It is insured that the quality is not too low&quot; by project reviews and progress reports &quot;..stuff like that&quot;;</td>
<td>OK; senior technologist checking everything; check lists are used usually (made by the team);</td>
<td>It belongs to the PM in the team; good communication with customer, meeting the milestone, timely, meeting customer expectations with the milestones; certain parts of projects are not so good related also to expectation management; &quot;Making sure that the customer and TNO are on the same page, that can be improved&quot; The communication channels from sales to customer needs to be improved;</td>
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<tr>
<td>PM Process Understanding</td>
<td>Official and practical is different; balance between resources, time and work; at the organization plus communication and politics; PL= PL+System architect+Politcs and customer sensibility-more compared to other organizations;</td>
<td>Acquisition by sales , first talk with customer and making a quotation; definition of the details; forming the team, kick-off meting and facilitate the project. The interviewee (few seconds after) indicates also evaluation at the end. &quot;We are making mistakes again and again&quot;</td>
<td>Solid understanding of the process; relatively structured; sort proposal, discussion with the customer, PM facilitating the plan (developed with the team), evaluating the project with the team and the feedback of the customer;</td>
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<tr>
<td>Knowledge Center</td>
<td>good in certain areas but not better than the competitors; certain things are worse</td>
<td>yes and no; lack of money internally to things that should be done (things which are not marketable)</td>
<td>Yes and no; market oriented mostly which invests in long term innovation; difficulty with budget and people's support</td>
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<tr>
<td>Processes</td>
<td>Sharing only within the group which I am working in partially because they are more experienced people out there; &quot;I walk a lot and talk a lot&quot;; Mostly person-to-person also via meetings; department PPT are a good way of knowledge sharing-used to identify who is working on</td>
<td>Human network; coffee corner; lunch meetings (not current practice )&quot;no lunch during meetings as after lunch we go lunching&quot;; &quot;I have my own network that I use &quot;Its informal its all informal&quot; referring to sharing of knowledge</td>
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</table>
| which subject | Project Closure | Did it only once; They way should work is they should request for it and should be in the process | No format for LL; The report to the client does not explain why something was done; Normal to do some closure, to do a meeting to ask at the end how to do it. | Meeting based on points made by the myself and added some points from other before the meeting, grouped to be made more discussable; Points in the book but not share; Planned to put in in a report and "spread it around to the blm, group and sales"

<p>| IPE | &quot;No never did one...wait&quot;; Unclear understanding, lack of formalized steps; did send request for a meeting (two months after project end) but no reply | Yes, There is no format, I had something from before, they made something...; 1 or 2-via a meeting with the team Managementsystems: &quot;I checked it once&quot; BLM needs to request an evaluation at the end | &quot;I know the ones that I do&quot;; &quot;team chat-that is how I see it like that&quot; &quot;I did see that once(PE process in the MNG system) but...that is what I did&quot;; It is the job of the PM. |</p>
<table>
<thead>
<tr>
<th>Recipient</th>
<th>Understanding</th>
<th>KTA/KTE</th>
<th>Yes familiar, but &quot;not asked for&quot;</th>
<th>Yes, familiar with the KTA, Did 1 or 2</th>
<th>KTA yes, KTE no.; Yes never knew that KTE existed;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Understanding</td>
<td></td>
<td>Clear description and understanding of the aim;</td>
<td>Clear understanding and elaboration of the project's aim</td>
<td>Understanding of the project content;</td>
</tr>
<tr>
<td>Motivation to Share</td>
<td>/</td>
<td>&quot;Most people are really willing to help if you ask...&quot; &quot;To learn more...if I share what I learned people are telling things from which I can learn&quot; Reciprocity</td>
<td>/</td>
<td>Excited to work on a project; motivation to be part of the team and sharing what ones is working on; showing interest of what the other is working on; &quot;What motivates me is my learning curve&quot;; Understanding each other struggles in the company;</td>
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<tr>
<td>Learning content</td>
<td>Technical</td>
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<tr>
<td>Process</td>
<td>Certain activities forgotten before but do know for next one</td>
<td>&quot;Ask yourself and the people around you if it is necessary to do something&quot;</td>
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<tr>
<td>Human</td>
<td>How to manage people, a lot of politics with stakeholders</td>
<td>always check everything; less trust in people; learn to say no</td>
<td>Personalize work style with certain guidance and freedom, different individuals &quot;delegate&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>Personal knowledge, myself &quot;talking with people&quot; - for technical; &quot;I do share it...with people that are working within my project&quot; The things I learned I am sharing it with them&quot; - process/human knowledge</td>
<td>Personal communication; human-to-human. &quot;Even some people used LinkedIn to find people at TNO&quot; - search for knowledge</td>
<td>Personalized; Meeting minutes made from the meeting after the project, not disseminated yet</td>
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<tr>
<td>Category</td>
<td>Experience</td>
<td>Title</td>
<td>Project Quality</td>
<td>Context</td>
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<tr>
<td>3</td>
<td>12,5 years</td>
<td>Scientific Researcher/Project Leader</td>
<td>Depends on the person; customers in general very satisfied; Strict on the money so risk are calculated more sticker; You check from other colleagues at the beginning for the proposal; You work till the customer is satisfied; Presentation is not check all the time with internal experts because of time constrains;</td>
<td>Quality of work within budget within time against the requested quality in the way the customer wants with an intention to start a new one; IPMA C; &quot;too many projects ended in losses instead of profit&quot;, reason for IPMA trainings to professionalize the PM process; Best way to measure the quality is the response of the customer; Vision sharing is important; Focus people on the activities they do, regular contact with the customer with an update for the heading;</td>
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<tr>
<td>2</td>
<td>17 years at the organization</td>
<td>Business Case Management</td>
<td></td>
<td>From technological standpoint its fine, but not always on time and within budget; PM is responsible: on time, right results within budget= quality high; Planning on time, update it, keep track, in contact with the team members, and if necessary with customers;</td>
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<tr>
<td>1</td>
<td>6 years in the organization</td>
<td>Product Manager/Project leader</td>
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<tr>
<td>PM Process Understanding</td>
<td>different types of project different process; different start of the projects; first a lot of discussion internally and with the customer; generating project proposal, get feedback and finalize; after the project starts;</td>
<td>Initial discussion and in lime about the basic settings with Product Manager; PM involved in the earlier stages, PM needs to be aware of the budget; Good understanding of the overall process</td>
<td>Acquisition phase, PL and technical people involved in the project proposal, PM is always involved in the set up of the project proposal, cost calculations, before start content and cost price are given; Deliverables, timing and budget are well defined; The team is set up, PM facilitates the project and the end the right deliverable are delivered at the right cost and time; Solid understanding of the process; Project closure not mentioned &quot;we do not pay too much attention to it&quot;;</td>
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<tr>
<td>Knowledge Center</td>
<td>The idea is created at TNO and sometimes at Universities but TNO puts it at the market;</td>
<td>Yes, internationally seen, the bridge between fundamental knowledge at Universities to the application of knowledge in industry; Focus on application of knowledge;</td>
<td>Yes, management focus and money invested in knowledge; internal culture that pushes for knowledge</td>
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<tr>
<td>Processes</td>
<td>Ways of Sharing</td>
<td>Project Closure</td>
<td>IPE</td>
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<td>LL were not shared; at the coffee machine knowledge is sharing; &quot;at the coffee machine you only tell people that you like&quot;; &quot;the colleagues that you like you share more...more personal things...more social stuff&quot;;</td>
<td>Group meetings; Put the progress reports on shared folder and are discussed every 6 weeks with RM and blm within project progress meetings; project finished reviewed is conducted there;</td>
<td>&quot;Yeah..&quot; &quot;that is not alligned within the organization&quot;using the project status report. Not familiar with the official procedure in the MNG</td>
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<td>Coffee machine, meetings and presentations</td>
<td>Using the project status reports at end for the final closure; MNG system I have not read it; Info the administration, SAP closed and invoice send-that is it;</td>
<td>No, not aware of it, Never done it, never worked on it; Didn’t know about; &quot;No one request it, requires it and makes you aware of it, I</td>
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<td>At the end its close and that is it; no strict closure, haven't seen recently the MNG system; Time pressure without projects and deadlines;&quot;The heat is on fulltime nonstop&quot; &quot;What is done is done, we are technicians and innovators, Its just boring to wrap up and do documents, the temptations to go forward is higher&quot;;</td>
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<tr>
<td>KTA/KTE</td>
<td>projector as well I do not do it;</td>
<td>system</td>
<td>suppose that is the first starting point!</td>
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<tr>
<td>KTA/KTE</td>
<td>Knows about KTA, &quot;they are send by the secretary&quot;</td>
<td>Yes, knows both KTA or KTE understanding the process, Not so many projects as a PL</td>
<td>Understanding of both but had not had a clear distinction between the two; 60-70% we send out to customers the rest is &quot;just forgotten along the way&quot;;</td>
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<table>
<thead>
<tr>
<th>Recipient</th>
<th>Understanding</th>
<th>Short and clear</th>
<th>Clear and understandable</th>
<th>Short and clear;</th>
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</thead>
<tbody>
<tr>
<td>Source</td>
<td>Understanding</td>
<td>Short and clear</td>
<td>Clear and understandable</td>
<td>Short and clear;</td>
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<tr>
<td>Motivation to Share</td>
<td>&quot;When I think it is valuable for other people then I will share it&quot;; No obligations to present your results, its more voluntary;</td>
<td>Attending the meetings: technology and content; Higher aim motivation &quot;at the end my motivation is to reduce traffic casualties&quot;;</td>
<td>Because they want to know, they get enthusiastic, would share depends on what I learned, share verbally between the group-direct importance of the project and it gets back to you; Main trigger-direct impact!</td>
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<tr>
<td>Learning content</td>
<td>Technical</td>
<td>Model</td>
<td>Simulation details</td>
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<tr>
<td>Process</td>
<td>/</td>
<td></td>
<td>Responsibility division between the two partners (operational side and sales)</td>
<td>Communication with the customer with regular updates;</td>
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<tr>
<td>Human</td>
<td>/</td>
<td></td>
<td>Generally dealing with people</td>
<td>/</td>
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<tr>
<td>Medium</td>
<td>the basis model from previous model taken from the database; personal (process and human) knowledge via coffee machine; person to person within similar hierarchical level as well as within the department</td>
<td>Documentation/methodology developed and put in the software. Shared via a meeting/presentation</td>
<td>Shared with the PM, verbally (face-to-face); Other info is also shared verbally within the group</td>
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<tr>
<td>Preferences (not analyzed directly)</td>
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<tr>
<td>Case A</td>
<td>Case B</td>
<td>Case C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influence of KTA/KTE outcome on project</td>
<td>If KTA/KTE negative project is also not a success; further insight if client is unsatisfied;</td>
<td>Not positive if the client is unsatisfied, CS is more important then delivered</td>
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<tr>
<td>Benefit of LL and IPE</td>
<td>LL should be done as they are beneficial; Current documentation can also be better;</td>
<td>Beneficial if you do not have experience;</td>
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<td></td>
<td>&quot;I do not know how LL function within the organization&quot;; &quot;It is not part of the organization's processes&quot; LL is beneficial as mistakes are repeated-partially related to young group members</td>
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<tr>
<td>Preference of LL structure and format</td>
<td>&quot;Which problems I have run into and how did I solved them&quot;; easy to find; both process and technical LL; just tips with bullets; one page</td>
<td>&quot;LL should be addressed to quality handbook&quot;; Feedback from experienced colleagues is preferred; Place within the project dossier; The IT system should prompt to tell you what you need to do</td>
<td>&quot;If there is no template then I just use Google&quot;; &quot;I will think about it&quot;</td>
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<thead>
<tr>
<th>Case D</th>
<th>Case E</th>
<th>Case F</th>
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<tbody>
<tr>
<td>Influence of KTA/KTE outcome on project</td>
<td>very important</td>
<td>Important, interesting points to discuss,</td>
</tr>
<tr>
<td>Benefit of LL and IPE</td>
<td>LL is beneficial as it is good to learn from the mistakes.</td>
<td>Important having LL, making the same mistakes and people are switching jobs/functions;</td>
</tr>
<tr>
<td>Preference of LL structure and format</td>
<td>Basic content; Important things; Things that went well because of certain actions and things that went really bad because of certain actions; 3-5 important notification</td>
<td>&quot;What went very well, what went very wrong&quot;; &quot;Process and Technical separately&quot;; Subsections; Time costs money which we do not have; planning, budget, quality all of these things as well as technical, Opportunities, something missed, internal projects...&quot;Ask yourself what is interesting for us to do if we had money&quot; It should be requested; It should be in the project directory; During progress report mention it; &quot;if you do not need to feel in everything you should not&quot;</td>
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<tr>
<td>Case G</td>
<td>Case H</td>
<td>Case I</td>
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<tr>
<td>-----------------------------------------------------------------------</td>
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<tr>
<td>Influence of KTA/KTE outcome on project</td>
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</tr>
<tr>
<td>Benefit of LL and IPE</td>
<td>&quot;... <em>codified form...but who will read it</em>&quot;; LL should be present with the technical part;</td>
<td>Yes beneficial; &quot;<em>all in the minds of people</em>&quot;; Search for info by walking around and at the coffee machine; Yes and no, good to share the LL but not to be bureaucratic update;</td>
</tr>
<tr>
<td>Preference of LL structure and format</td>
<td>Do not keep the knowledge on the floor, inform the managers; Potential possibility for future cooperation with the same customer on a different project; Share more with the colleagues with the same position; For EU project is valuable to present the content but also the LL; &quot;to warn the people, the process is though&quot;; Everyone should have &quot;<em>I can never imagine you could have those, communication with the partners, in the system</em>&quot;; Process to relate the more sensitive learning; IPE should be formalized and required statement (form of a check list); &quot;<em>It is good to have some formal closure</em>&quot;;</td>
<td>A check list to take within a project; LL to be presented via the departmental meetings; Current Project Status Reports are good, add Project closure and LL; Short meeting just briefly; Formalize it, put it in the end review requirement (e.g.. 90% of your project needs to be done); &quot;<em>Project check list on the wall will help</em>&quot;.</td>
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</table>
an obligations to present to the group that it is valuable with a end slide LL; The evaluation should not cost too much effort; Technical people do not like administration;
Appendix V – Progress report standardized format with additional LL section

![Project status report](image)

### Key Issues

<table>
<thead>
<tr>
<th>Planning</th>
<th>Actual status</th>
<th>Corrective actions</th>
<th>Resp. status</th>
</tr>
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<tbody>
<tr>
<td>Financial</td>
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<tr>
<td>Technical</td>
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### Opportunities and Risks

### Market Development

### Customer Satisfaction

### Lessons Learned

Green = According to original timeline
Yellow = Not according to plan, correction possible within team
Red = Not according to plan, emergency plan required assistance IT
Appendix VI – Activity diagram of communication plan implementation
Appendix VII – Glossary

[blm] Business Line Manager

[BP] Best Practices

[CSS] Customer Satisfaction Surveys

[doi] Director of Innovation

[dor] Director of research

[IVS] Integrated Vehicle Safety

[KTA] Klanttevredenhied audit

[KTE] Klanttevredenheids-enquete

[KTV] Klanttevredenheid

[kwa] Stafafdeling Operational Excellence and Quality

[LL] Lessons Learned

[Im] Lead manager

[mde] Managing Director Expertisegebied

[med] Medewerker

[MRQ] Main research question

[og] Opdrachtgever van een project

[om] Offertemanager

[pl] Projectleider

[pm] Projectmanager

[PW] Powertrains

[rm] Research Manager
[rvb] Raad van Bestuur TNO

[SRQ] Sub research question