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LEARNINGS FROM DEVELOPMENT PROJECTS
FOR ORGANISATIONAL DEVELOPMENT

Master´s Thesis in
Industrial Management

VAASA 2015

TABLE OF CONTENTS   **Page**

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

EPT	Environmental Products and Technologies
KM	Knowledge Management
PM	Project Manager
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMMM	Project Management Maturity Model
R&D	Research and Development

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Topic of the Master´s Thesis:	Learnings from development projects for organisational development
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Degree:	Master of Science in Economics and Business Administration
Major subject:	Industrial Management
Year of Completing the Master´s Thesis:	2015
Number of pages:	77

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ABSTRACT:

This study was done to examine how the case organisation utilises the knowledge gained from different technology and product development projects to learning in organisation and improving the way of working with future projects.

In theoretical part the different knowledge types, knowledge management, learning in organisation, project management and project management maturity model is introduced.

The study was done with qualitative survey (appendix 1) to evaluate how the case organisations experts, designers and managers evaluate their performance with development projects and where do they see the future development points for the organisation.

In the end of this study the results of the questionnaire are evaluated towards the theories presented and conclusions and recommendations are given based on them.

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VAASAN YLIOPISTO

Teknillinen tiedekunta

Tekijä:	Jarkko Kangasmäki
Pro gradu -tutkielma:	Learnings from development projects for organisational development
Tutkinto:	Kauppatieteiden maisteri
Oppiaine:	Tuotantotalous
Työn ohjaaja:	Päivi Haapalainen
Valmistumisvuosi:	2015
Sivumäärä:	77

TIIVISTELMÄ:

Tämä tutkimus tehtiin selvittämään, miten tutkittu organisaatio hyödyntää eri teknologia- ja tuotekehitysprojekteista saamaansa tietoa organisaation oppimisessa ja kehittymisessä tulevissa kehitysprojekteissa.

Teoreettisessa osuudessa esitellään eri tiedon tyypit, tiedon hallinta, oppiminen organisaatiossa sekä projektin hallinta ja projektin hallinnan maturitteetimallin kuvaus.

Työn tutkimus tehtiin laadullisena kyselytutkimuksena (liite 1) tarkoituksena arvioida kuinka tapausorganisaation ekspertit, suunnittelijat ja päälliköt arvioivat omaa suoriutumistaan kehitysprojekteissa ja missä he näkevät organisaation kehitystarpeet.

Lopussa esitellään kyselytutkimuksen tuloksia verrattuna aiemmin esitettyihin teorioihin sekä johtopäätökset ja suositukset näiden pohjalta.

AVAINSANAT: Tiedon hallinta, oppiva organisaatio, projektinhallinta, projektinhallinnan maturiteetti, kehitysprojektit

1. INTRODUCTION

When a new organisation is formed, there is always much to be learned and ways of working to be adjusted. Personnel might be gathered from several different departments and outside of the company as well. It takes time to formalise a way of working with the company's processes, tools and past experience for the teams to function in cohesive way. An organisation develops during time and too often, there is too much work to stop to think what has been learnt so far and where are the future development points. Therefore a need rises to stop for a while and ask how the way of working is at present, what the strengths of the organisation are and where the challenges to be improved on are.

This study is made for a technology and product development department for environmental products in a large international company. It is a line organisation providing experts and designers for project-based work with the main focus in new technology and product development.

1.1 Purpose of the study

Currently the technology and product development department does various projects in the field of environmental technologies, but there are no strategies on how to utilise the gained knowledge from past and ongoing projects for the whole organisations use and tools to evaluate the project management maturity level of the organisation.

Also the needs of missing skills in project work, are to be identified. The learnings from development projects can be utilised for better performance in future projects where the knowledge often equals time and money during project execution. This study combines the gained knowledge from the development projects to evaluation of the learning as an organisation to the level of project management maturity to give an overall understanding the current situation and future development possibilities for the organisation to grow.

1.2 Scope of the study

This study focuses on gained knowledge from technology and product development projects and level of project management maturity of the organisation. Also with a specific questionnaire, the aim is to define the overall learning's of the organisation and find actions that can be utilised in daily work. The literature will be reviewed based on the subject. The literature section defines different knowledge types and knowledge management, learning in organisation and project management with focus to different project management matrices and project management maturity model. The aim is to find discussion between the theory and the results from questionnaire as well as find the level of organisations project management maturity from organisational learning's perspective.

1.3 Research question

The research question of this study is:

What can be learnt from the development projects for organisational development in perspectives of utilisation of gained knowledge, learning in organisation and project management maturity?

The study will focus on defining the use of gained knowledge, learning in the organisation and project management maturity with a questionnaire to case department's teams. The aim is to define how the teams see their capabilities, roles, responsibilities, communication and co-operation with different parties and how would they overall develop their way of working in development projects. With these focus points, the objective is to have a definition what has being learnt from the development projects focusing on gained knowledge, learning in the organisation and project management maturity at the time of the study and what is to be developed to improve the organisation performance.

1.4 Limitations

This study doesn't give a suggestion of a model for way of working as there are many other aspects affecting the way of working of the organisation, like company directions, but moreover give suggestions and ideas on how to develop the way of working in development projects and further develop the level of project management maturity.

1.5 Structure of study

The thesis structure is described below with short summaries.

Introduction
Here the reader is introduced to the subject. The purpose, scope, research question and limitations are described for the reader.

Literature review
The different knowledge types, terms and different models of knowledge and project management (such as Nonaka, Senge and Kerzner) are introduced to the reader.

Research methods and case organisation
The qualitative methods are discussed here, focusing on questionnaire methods. Also the case organisation is introduced for the reader and how the organisation utilises knowledge management currently.

Data analysis and interpretation
The results of above mentioned qualitative methods are discussed here. The questionnaire findings are interpreted based on results and theories.

Findings, conclusions and recommendations

The main findings are evaluated here and conclusions based on the findings, are shortly discussed. The main focus is on the recommendations based on the study. There are actions/tools introduced, for the organisation to utilise on their daily work and organisational development in order to gain organisational knowledge transfer and project management maturity.

2. LITERATURE REVIEW

This chapter presents the knowledge terminology with different knowledge types and knowledge and learning in the organisation. Also project management is discussed with focus point on project management maturity.

2.1 Knowledge definition

Knowledge is social, where we know how to do and do things with each other, but collaboration and tools are needed to enable it (Senge 2006: 270). Also Nonaka (1994) highlights the fact that knowledge is essentially related to actions of humans (Nonaka 1994: 59).

Below the differences between knowledge, data and information are more defined by Davenport et al. (1998) and Nonaka (1994).

Knowledge is a mix of different variables such as experience, values, contextual information, etc. Knowledge itself exists within persons as a part of parcel of human complexity and unpredictability. The term knowledge cannot be defined as data or information. It consists of partly both of them (Davenport et al., 1998: 4). Nonaka (1994) has three observations of knowledge. He states that knowledge is first about beliefs, secondly about action and thirdly about meaning. He defines knowledge to be context-specific and relational (Nonaka 1994: 57-58).

Data can be defined as objective facts about events. Companies usually use some data storage technology or systems to store data (Davenport et al., 1998: 4).

Information is considered as messages between sender and receiver. Between this communications the receiver of the data considers if the received message is really information or not (Davenport et al., 1998: 5). Nonaka (1994) specifies the information from two perspectives, "syntactic" which refers to volume and "semantic" which refers to information. "Syntactic" aspect refers to the amount of knowledge whereas the semantic aspect of information focuses on convoyed meaning (Nonaka 1994: 58).

2.2 Different knowledge types

There are three general types of knowledge, explicit, implicit and tacit knowledge (Nonaka 1994:16). They are described below in the diagram described by Nickols (2010).
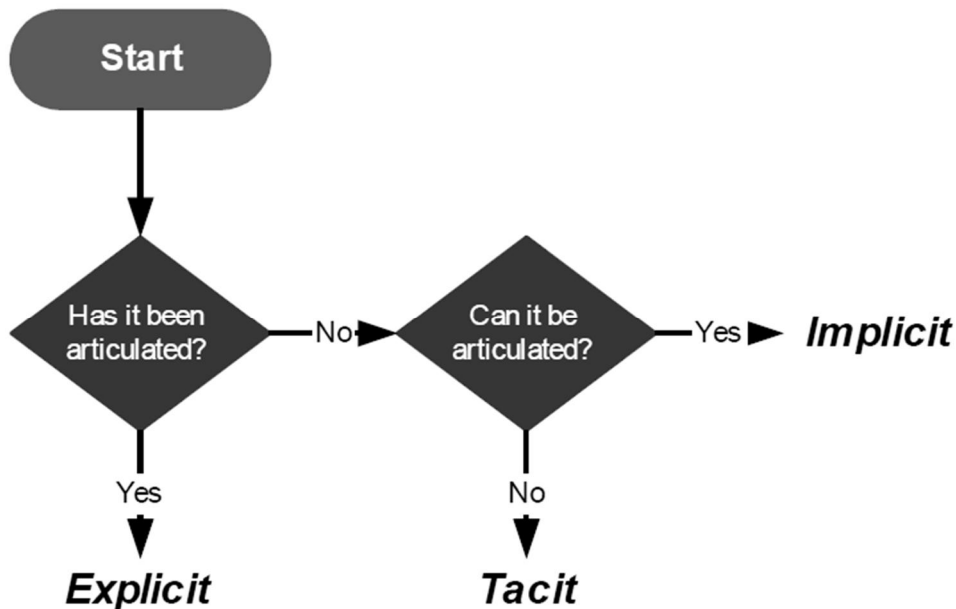
Figure 1. Explicit, Implicit and Tacit Knowledge (Nickols 2010: 3)

The above figure (Figure 1) shows how to distinguish the knowledge types. Well-articulated knowledge is described as explicit (e.g. tables, texts, diagrams), something that can be articulated as implicit (e.g. applications, surveys, polls) and knowledge that can't be articulated as tacit (e.g. human expressions, body language, behaviour). (Nickols 2010: 3). The three knowledge types are discussed in following chapters.

2.2.1 Explicit knowledge

Explicit knowledge is formal and systematic. It can be expressed in words and numbers and can be easily communicated and shared in the form of data (Nonaka 1995: 8). It is something that can easily be convoyed particularly from someone taking care of the task to someone else through writing or verbally (Bergeron 2003:18). Explicit knowledge is

something we are all familiar with. Also written objectives, expectations and formalised best practices can be described as explicit knowledge (Nickols 2010: 3). It can also be articulated, readily transmitted and visualised for example with drawings, pictures, plans, manuals and other documents (Tonnquist et al., 2009: 292).

Nonaka (1995) describes the explicit knowledge differences with tacit knowledge described in the next chapter (2.2.2). They are not totally separate and interact with and interchange into each other, especially in creative activities of people (Nonaka 1995: 61). This interaction is called knowledge conversion described in section 2.2.4.

2.2.2. Tacit knowledge

Tacit knowledge is something that is not easily seen or expressible (Nonaka 1995: 8) and is ingrained at a subconscious level and difficult to explain to others (Bergeron 2003: 17). It is knowledge that cannot be articulated (Nickols 2010: 3).

Capturing tacit knowledge is a difficult task and worth of effort. Mapping who knows what creates an essential inventory. Nickols (2010) claims that the knowing is in the doing (Nickols 2010: 3). Tacit knowledge can leave the company with the person when he/she leaves the company (Davenport et al., 1998: 81).

In projects, the tacit knowledge can be transferred between persons working with the same project. Tacit knowledge can be described as a glue that holds the explicit knowledge together and enables its transferring between individuals (Tonnquist et al., 2009:292). Bergeron (2003) claims that most of the patterns involving recognition skills fall under tacit knowledge (Bergeron 2003:18).

According to Nonaka (1995) tacit knowledge has two dimensions, technical and cognitive. The technical dimension can be described with personal skills and crafts that have developed over time, "know-how" as cognitive includes beliefs, mental models, schemata and perceptions. (Nonaka 1995: 8).

Davenport (1998) argues that in order to transfer tacit knowledge, a lot of personal contact is needed. The tacit knowledge needs a personal relationship in order to pass on, like a mentoring program or apprenticeship. These kind of methods transfers the tacit

knowledge from one person to another. To pass a tacit knowledge for large amount of people, the more technology should be used, different kind of databases and such (Davenport et al., 1998: 95-96).

2.2.3 Implicit knowledge

Knowledge that could be articulated but hasn't is implicit knowledge. Its existence is inferred from observable behaviour or performance. Implicit knowledge is often referred as the technical dimension of the tacit knowledge, whereas cognitive dimension purely represented the tacit knowledge which he considered as always being tacit (Nickols 2010: 3-4).

Bergeron (2003) defines a practical approach to defining the implicit knowledge. He states that the implicit knowledge as well as tacit knowledge are controlled by the experts. The difference between the knowledge types is that implicit knowledge can be extracted from the expert through a process termed knowledge engineering. An example of that is an experienced expert of insurance company that assigns the risk to insurance prospects based on the age or marital status. This can be formed to a set of rules or decision tree and then later be used by a new employee in similar case (Bergeron 2003:18).

2.2.4. Knowledge conversion

Nonaka (1995) describes the conversion from tacit knowledge to explicit knowledge with four modes; socialisation, externalisation, combination and internalisation (Nonaka 1995:62). These are illustrated in Figure 2.

	Tacit knowledge	To	Explicit knowledge
Tacit knowledge	Socialisation		Externalisation
Explicit knowledge	Internalisation		Combination
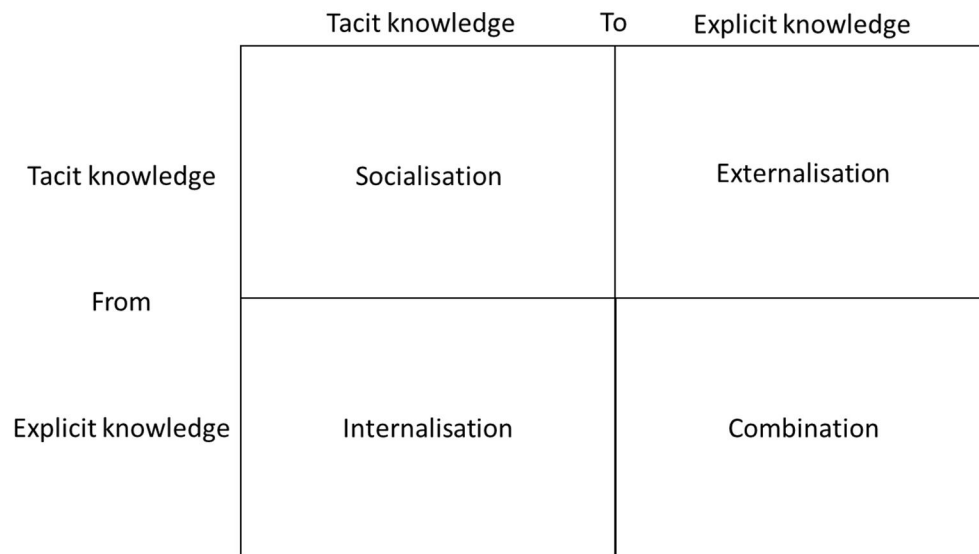
(From)

Figure 2. Four modes of knowledge conversion (Nonaka 1995: 62)

Socialisation is a process of sharing experiences by creating tacit knowledge to technical skills and mental models so it can be described as from tacit to tacit knowledge transfer mode. The learning can happen through observation, imitation and practice and no common language is needed. Experience is the key for the tacit knowledge (Nonaka 1995: 62-63).

Externalisation articulates the tacit knowledge into explicit concepts where the tacit knowledge shapes into metamorphoses, analogies, concepts, hypotheses or models. Externalisation is often seen in concept creation and can be based on a dialogue or collective reflection. Out of the four modes, externalisation creates new, explicit concepts of tacit knowledge (Nonaka 1995: 64-66).

Combination process systemises concepts into a knowledge system. This mode combines different bodies of explicit knowledge. The explicit knowledge can be combined in documents, meetings, conversations and communication networks and can result to new knowledge (Nonaka 1995: 67).

Internalisation embodies explicit knowledge to tacit knowledge where experiences from socialisation, externalisation and combination are internalised to individuals' tacit knowledge.

In order to transfer explicit knowledge into tacit, it is beneficial that the knowledge is documented verbally or diagrammed so that the individual can internalise what they have experienced, which compliments the tacit knowledge. Also ones experiences can create internalisation where the success stories or like, are shared with other organisation members. If the members feel the realism and essence of the story, the experience changes the tacit mental model. Then this tacit knowledge might become part of organisational culture (Nonaka 1995: 69-70).

2.2.5 Knowledge transfer enabling and hindering factors

The knowledge transfer methods should always be suitable for different kinds of cultures and organisations. The value of personal meetings and online conversations should be appreciated. Sometimes persons can be blamed as being lazy at work if they read books at their desks, rather than reply quickly to all e-mails. It might be that the quick responses are less valuable information wise than the knowledge received from the books and the possibilities of use of new knowledge (Davenport et al., 1998: 93).

The knowledge transfer is more efficient when transferred knowledge is more explicit and relatively less tacit and is considered to be universal. The context between the sender and receiver is considered as homogeneous. The tacit knowledge can be demonstrated for example by trainings, but it is considered as time consuming and expensive. Therefore, in most organisational settings the knowledge is transferred into as explicit form as possible (Schwartz 2006: 541).

Davenport (1998) describes the hindering factors of knowledge transfer when companies hire intelligent persons to work for them and what usually happens, is that they are put together in a team, but in many cases overload them with work or doesn't give them tasks that are challenging enough. Most often it is noted that the knowledge transfer between personnel in the company passes around simply in everyday discussions (Davenport et al., 1998: 88).

2.2.6. Knowledge management

Knowledge management (later KM) can be described as getting most out of the needed knowledge resources. It can be identified to individuals and organisations' attention are recently more attracted towards it. KM is viewed as an important discipline that promotes the corporations knowledge creation, sharing and leveraging (Becerra-Fernandez et al., 2010: 4). King (2009) gives KM the following definition:

"KM is the process of acquiring knowledge from the organization or another source and turning it into explicit information that the employees can use to transform into their own knowledge allowing them to create and increase organizational knowledge" (King 2009:28).

He illustrates the statement with the figure (Figure 3) below.
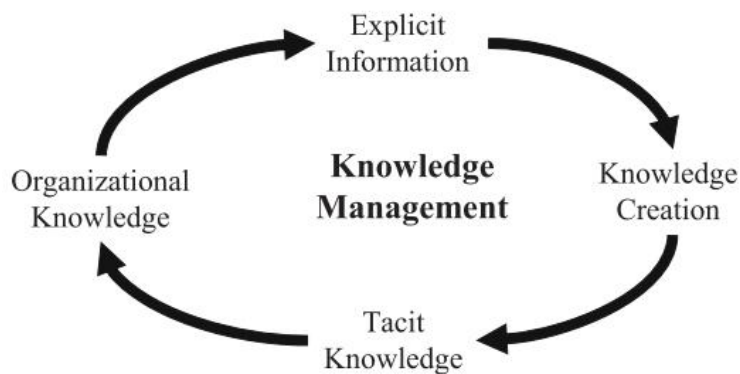
Figure 3. Knowledge management (King 2009: 28)

King (2009) describes the need for the organisation to be able to put knowledge in format where employees can utilise it and put tacit knowledge into explicit information. The employees need to be able to transform the explicit information into their knowledge and also be able to create and share additional knowledge based on it (King 2009: 28).

KM enables employees to become more flexible and enhances the job satisfaction by learning from each other as well as from external sources. This is due to enhanced ability to learn about solutions that worked in the past as well as solutions that didn't work (Becerra-Fernandez et al., 2010: 71-72).

Becerra-Fernandez et al., (2010) defines the benefits on how the KM accrues directly to individual employees. Personnel are able to learn more than employees in the firms lacking of KM and are also more prepared for the change. This effects on employee's satisfaction to be aware of their knowledge acquisition and skill enhancement and increase their own market value relative to other organisations employees. Knowledge sharing between employees can positively effect on revenue and profit. It has been also stated that the reason for the brightest knowledge sharing employees to change their job was because of they felt that their talent was not fully leveraged (Becerra-Fernandez et al., 2010: 74).

2.3 Learning organisation

The greatest knowledge base is not a distant computer database. It is in the heads of the individuals associated with the organisation. Their knowledge bases constant change and adapts to real world in front of them. Technology alone does not create trust and necessary interpersonal context to achieve true network. The change of the cultural background is needed (Schwartz 2006: 561).

Maula (2006) separates the organisational learning and learning organisation as follows:

"A learning organisation emphasises the structural and other aspects that make learning process possible. Organisational learning deals with the learning process and its stages and characteristics". (Maula 2006: 13).

Nonaka (1995) describes the learning organisations as a place where people are continuously discovering how they create and change their reality (Nonaka 1995:45). According to Tonnquist et al. (2009) the purpose of the learning organisation is on creating an environment where the employees seek new knowledge to share with their co-workers (Tonnquist et al., 2009: 296).

Maula (2006) highlights the strategic advantages of organisational learning as a dynamic concept that emphasizes the continuous change of organisations. She points out that in a

global learning economy, learning is a joint development and sharing of worldwide knowledge (Maula 2006:13).

Learning consists of two kinds of activity, obtaining knowhow and establishing new premises. Creation of knowledge involves interaction between these two and creates a dynamic spiral (Nonaka 1995: 44). Learning organisation has two types of learning capacity, generative also called active and adaptive also called passive for sustainable sources of competitive advantage (Nonaka 1995: 44).

Senge (2006) describes the team learning with three different dimensions that can be applied to organisational learning;

1. A need to think insightfully about complex issues, meaning that the teams need to realise the value of having more minds than one.

2. A need to innovate in coordinated action, where team members are aware of other team members' actions and they complement each other.

3. A role for team members on other teams, where the work is actually carried out through other senior team and the learning team fosters other learning teams through inculcating the practices and skills of other learning team (Senge 2006: 219).

Senge (2006) also discusses that the team learning involves dealing with creativity with the powerful forces opposing productive dialogue and discussion in working terms. These are called "defensive routines" that protect from embarrassment and threats, but also blocks the learning from the team (Senge 2006: 220).

2.4 Inter-organisational learning

The primary focus of inter-organisational learning is on how the individual organization can be a "good partner" or try to win the internal "race to learn" among the partners. There are two dilemmas in inter-organisational learning first one being the good partner to maximise the individual appropriation of the joint learning and secondly the opportunistic learning strategies that undercut the collective knowledge development in strategic alliance (Bengtsson et al.,) (1998:286).

Bengtsson et al. (1998) also discusses how two or more organizations can learn by changing its inter-organisational routines or repertoire of possible joint activities. Inter-organisational learning can be the collective acquisition of knowledge among organizations. Transferring existing knowledge from one organisation to another, completely new knowledge can be created. It requires transparency and receptivity among organisations (Bengtsson et al., 1998:287-288).

The below figure (Figure 4) illustrates the individual strategies for inter-organisational learning.
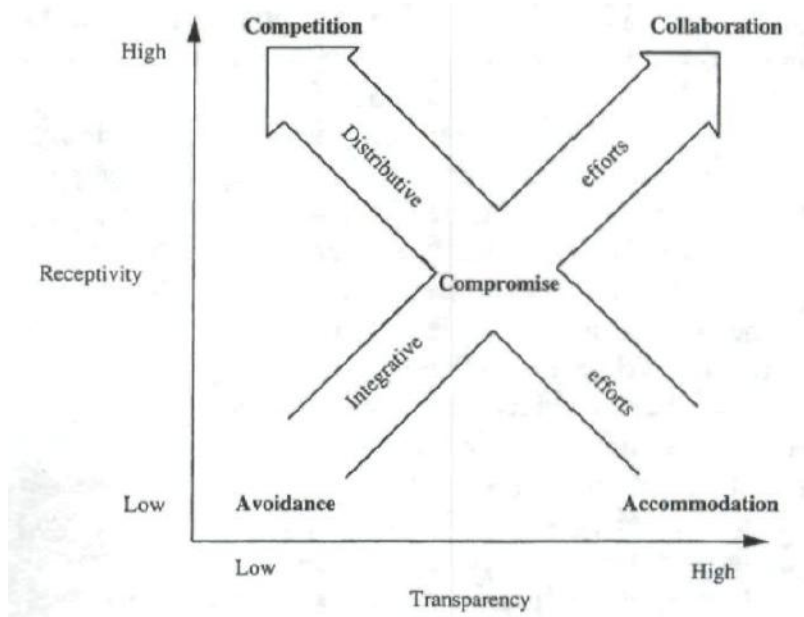
Figure 4. Individual Strategies for Inter-organisational learning
(Elaborated from Thomas (1979) (Bengtsson et al., 1998: 289).

From the figure (Figure 4), it can be seen that transparency represents the cooperativeness of disclosing knowledge to the other organisation while receptivity corresponds to the assertiveness of absorbing the disclosed knowledge. The adoption of the learning strategies limits both the organisations motivation as well as the capacity to assert receptivity and also the motivation and capacity to be transparent in cooperation (Bengtsson et al., 1998: 289).

2.5 Project management

"Project management is the art of creating the illusion that any outcome is the result of a series of predetermined, deliberate acts, when in fact, it was dumb luck" (Kerzner 2013: 4).

Lester (2004) defines the project management as essential management of change while running a functional or ongoing business or as it can be called, "business-as-usual". (Lester 2014: 1).

By Project Management Institutes (later PMI) definition project management includes application of knowledge, skills, tools, and techniques to project activities so that project requirements are met. PMI defines five process groups that define the project management process: 1) Initiating, 2) Planning, 3) Executing, 4) Monitoring and Controlling and 5) Closing (Project Management Institute 2013: 5).

PMI describes the task of project management to develop and implement plans for achieving specific scope. The scope of the project is defined by the objectives of the program or portfolio management to support organisational strategies (Project Management Institute 2013: 7).

Also PMI describes project management to include five character; 1) requirement identification, 2) knowing the different needs, 3) concerns and expectations of the stakeholders when planning and executing the project, 4) setup, maintain and take care of communications with stakeholders whom are active, effective and collaborative in nature and 5) stakeholder management on meeting project requirements and defining project deliverables (Project Management Institute 2013: 6).

Project constraints compete with each other in a balance. These constraints are by PMI's definition: scope, quality, schedule, budget, resources and risks (Project Management Institute 2013: 6).

2.5.1 Project definition

By PMI's definition, a project is defined as an endeavour that is temporary in nature and it is created for a purpose of a unique product, service, or result. A defining character is that the project has a definite start and ending. To reach the end, the project objectives have being achieved or project is terminated due to reason that the objectives are not met or the project doesn't exist any longer (Project Management Institute 2013: 3).

The project's success can be measured with three constraints:
1) time, 2) cost and 3) performance (Kerzner 2013: 7).

The definition of success is prolonged also to include in completion within:
a) the allocated time period, b) budgeted cost, c) at proper performance or specification level, d) acceptance by the customer/user, e) mutually agreed upon scope changes, f) not disturbing the main work flow of the organisation and g) not changing the corporate culture (Kerzner 2013: 7).

To clarify the last three points, seldom projects are completed within original scope of the project when scope changes are necessity. The threat is also that the changes destroy, not only the morale on a project, but the entire project. Changes need the mandatory from both project manager (later PM) and the customer/user (Kerzner 2013: 7).

2.5.2 Program management

A group of related projects, subprograms and program activities that are beneficially managed in coordinated way instead of managing them separately, is called program management (Project Management Institute 2013: 9).

Other definition of program management is an application of knowledge, skills, tools and techniques to a program to meet its requirements and benefit as well as control, that is not available when projects are managed as separate (Project Management Institute 2013: 9).

Nicholas (2012) describes that the projects in programs share common goals and resources, however being independent. Also in programs, after the delivery of the end item, product or service program management ensures that it is integrated with other systems and operational (Nicholas 2012: 30-31).

According to Lester's (2014) definition, the role of the program manager of having the responsibility for the overall management of the time, cost, and performance aspects of a group of related projects and the motivation. The program manager has the overall picture of the organisations project commitments (Lester 2014: 11).

2.5.3 Project teams

Project teams can be described with three organisational and behavioural issues. They define the groups based on how they are organised and integrated, leadership styles of PM's and roles and responsibilities of the project team members (Nicholas et al., 2012: 464).

The concept of organisational structure applies to all kind of organisations as well as their subunits, like projects and teams. The type of most beneficial structure depends on the organisations goals, work type and environment. The structure usually forms based on planned and evolutionary responses to ongoing problems (Nicholas et al., 2012: 465).

Subunits in organisation do not act as independent entities, but in theory, interact and support each other. How subunits interact, coordinate and mutually adjust their actions, is defined as *integration*. Organisations can create specialised roles and units with suitable expertise and resources (Nicholas et al., 2012: 465).

The environmental changes effect on formation of new subdivisions and groupings, for example based on regional origin, depending on need. This is called *differentiation* (Nicholas et al., 2012: 465).

Geographic differentiation is often related to meet unique requirements of local customers, markets, suppliers, etc. Regional subunits might operate with limited autonomy, but applying the standardised financial and reporting rules and procedures (Nicholas et al., 2012: 466).

Product differentiation makes often the split to subdivisions based on design, manufacturing and markets its own product line. Subdivisions might be breakdown based on function, geographic location or other form of subdivision (Nicholas et al., 2012: 466).

2.5.4 Project organisation

Project organisations can be categorised on macro-level to project-driven, non - project driven or operational-driven organisations. Project driven organisations have their work characterised around the project with own cost centre, like in construction projects. The summation of total profit is based on the profits of all projects. In non-project driven organisation, profit and loss is measured on vertical or functional lines. Projects are typically done for support of product and functional lines and their priority on resources are assigned based on revenue instead of projects (Kerzner 2013: 25-26).

PMI defines the project based organisations that they refer to several of organisational forms where the work is carried out in different organisation types, like in matrix, functional or project based. The organisational governance criteria can impose on the project constraints as the project success may be judged based on measured how the result of the project or service is supporting it. Therefore the PM is required to know the policies and processes of the corporate/organisational governance (Project Management Institute 2013: 15).

2.5.5 Matrix organisations

Matrix organisations are most likely the most common type of project organisations as it utilises the existing functional organisation. The departmental manager is responsible of the staff compliance with the standards and procedures like quality and technical compliance. The team members are allocated to projects based on the need of the project (Lester 2014: 41-42).

Lester (2014) also describes the benefits and disadvantages of matrix organisations as follows:

Six highlighted benefits:

1) Resources employing efficiently as staff can switch to different projects based on need, 2) latest "state-of-the-art" techniques are immediately incorporated due to the expertise built up on the department, 3) project team members don't need to move physically which reduces disrupting staff movements ,4) no effect on team members career prospects, 5) organisations ability to react quickly to scope changes and 6) the PM can fully concentrate on project management (Lester 2014: 42).

Four noted disadvantages:

1) Conflicts with other projects, 2) split loyalties between PM and departmental due to dual reporting, 3) communication difficulties if locations of departments are far apart, 4) executive management needs to balance with fairness between the PM and department manager (Lester 2014: 42).

By PMI's definition, there are three different types of matrixes; weak, balanced and strong. They differentiate by the relative level of power and influence between functional and PMs'. The weak matrix (Figure 5) has many similarities to functional organisation where the PM's role is more of a coordinator or expediter. The project expediter has a role of a staff assistant and communications coordinator. The expediter cannot make or enforce decisions and has a limited authority (Project Management Institute 2013: 23).
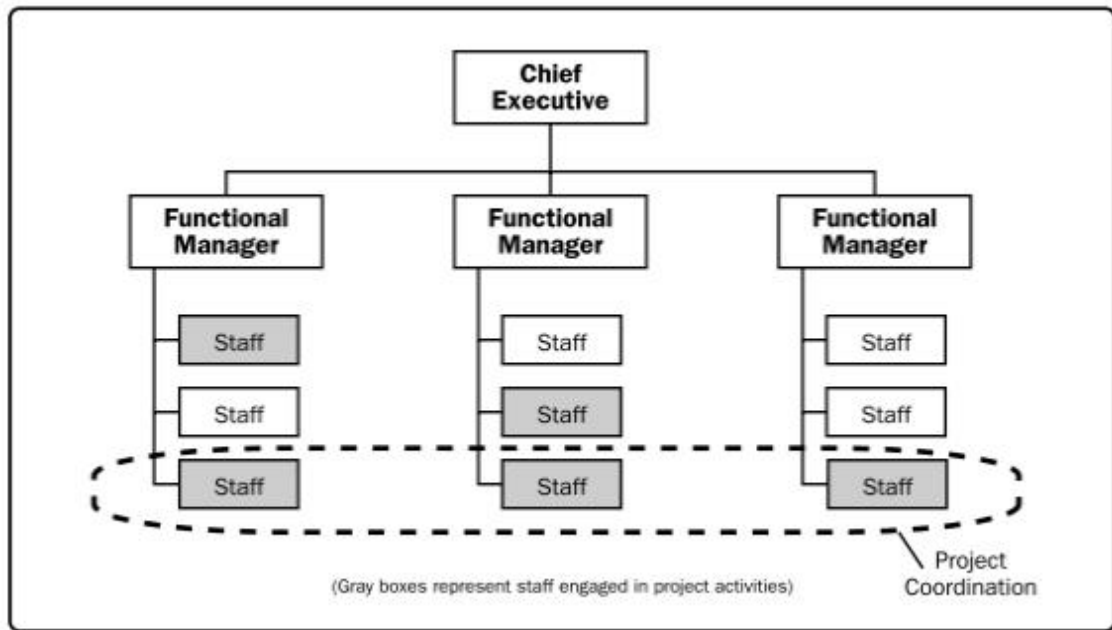
Figure 5. Weak Matrix Organisation (Project Management Institute 2013: 22)

In a strong matrix organisation (Figure 6), there are full time PMs who have considerable authority and full time project administrative staff (Project Management Institute 2013: 23).
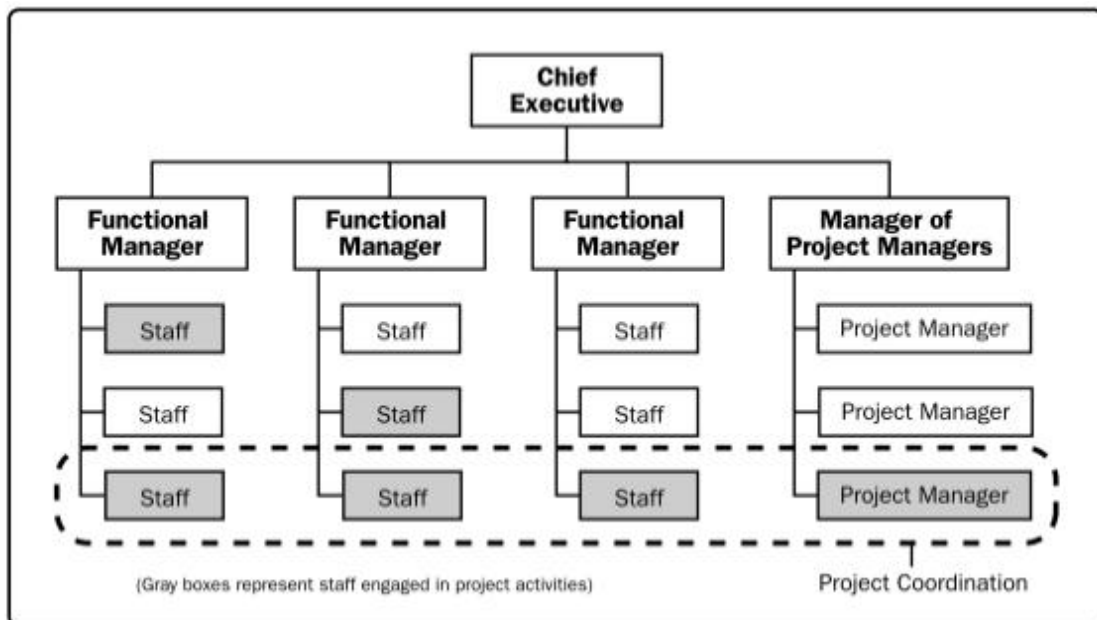
Figure 6. Strong Matrix Organisation (Project Management Institute 2013: 23)

The balanced matrix (Figure 7) has the need for PMs, but doesn't give the full authority over the project and project funding (Project Management Institute 2013: 23).
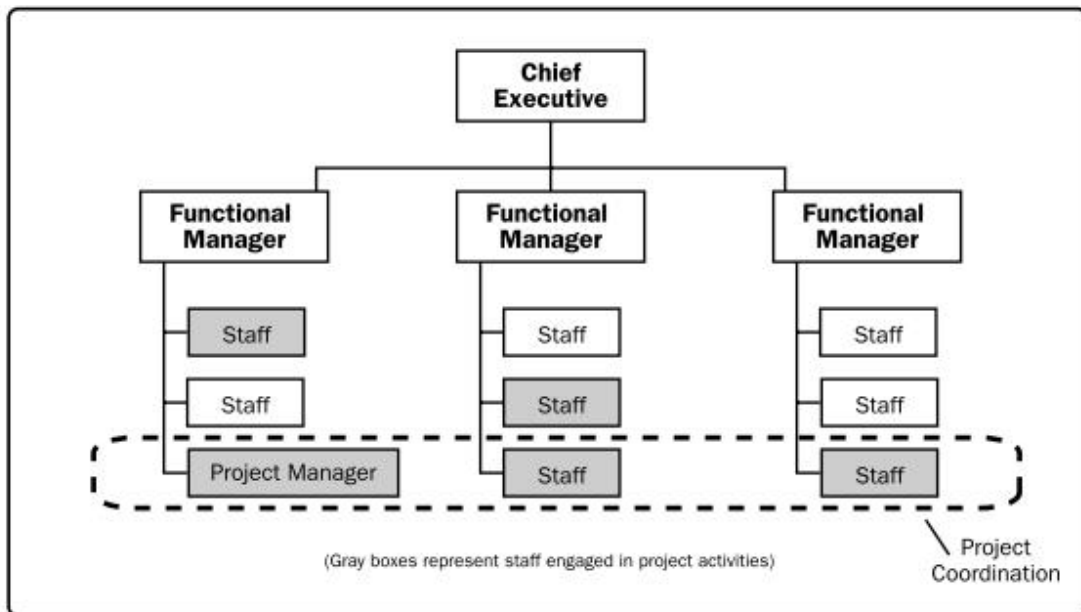
Figure 7. Balanced Matrix organisation (Project Management Institute 2013: 23)

2.5.6 Project management maturity model (PMMM)

Project maturity needs to be increased in order to strengthen competitiveness. The balance between the age groups in every organisation and occupational group is necessary for the collective experience. Informal networking with more experienced work colleagues enables the most knowledge to be passed on, especially between the inspired and experienced and the less experienced colleagues (Tonnquist et al., 2009: 289-290).

Kerzner (2001) has made the definition for the project management maturity model (later PMMM) that can best be described as the foundation for achieving excellence in project management. This model has five levels which describe the different degree of maturity in project management (Figure 8).
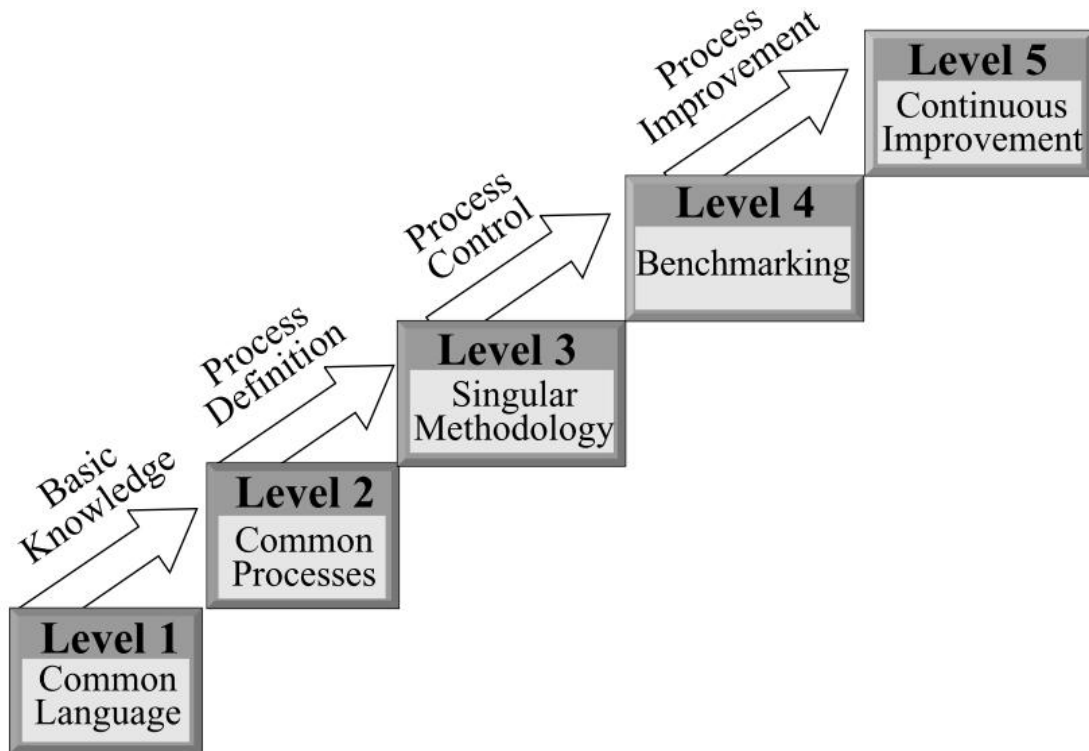
Figure 8. The five levels of project management maturity (Kerzner 2001: 42)

The levels Kerzner (2001) defined are:

Common language, where the organisation recognises the need for basic level project management and its common language and terminology (Kerzner 2001: 42).

The use of project management is commonly sporadic and management level support is meaningless or non-existing. Also the support for project management training and education is not supported due to fear of new knowledge interfering the existing way of working (Kerzner 2001: 47).

Common processes, where the repetitiveness of projects through common processes is recognised. Here also the need for recognition of the application and support of the project management principles to other methodologies in the company is understood (Kerzner 2001: 42).

The organisation also makes effort to develop processes and methodologies to support and commit to its effective use. The tangible benefits are more apparent and project management is supported in throughout all levels of the organisation. (Kerzner 2001: 67).

Singular methodology, where the combination of corporate methodologies to singular methodology is recognised, where the project management is the centre. This eases the process control when there is only one methodology instead of multiple (Kerzner 2001: 43).

The organisation is totally committed to concept of project management through integrated processes where multiple processes are streamlined as one. The execution of singular process effects on corporate culture which supports visibly project management approach. The role and support needed is understood by each level of management. (Kerzner 2001: 77)

Benchmarking, where the process improvement is necessary to maintain a competitive advantage. Benchmarking needs to be continuous process where to decide what and whom to benchmark (Kerzner 2001: 43).

Benchmarking of project management can be accomplished through surveys, questionnaires, conferences and symposiums. Benchmarking should be legal, confidential, open, agreed and sensitive between the parties. In order to do benchmarking, the organisation is needed to be willing to do changes to existing processes (Kerzner 2001: 98).

Continuous improvement, where the information obtained through benchmarking is done in continuous basis and evaluated if it improves the current singular methodology (Kerzner 2001: 43).

Lessons learned gathered after each project is essential to be debriefed in order to avoid repeating mistakes as well as take care that the lessons gathered are to other projects and teams. Mentoring is also important aspect for grooming future PMs. The final characteristic is that the understanding of strategic planning of project management is continuous and ongoing process which is understood by the whole corporation (Kerzner 2001: 109).

Kerzner also defines the need for continuous improvement that comes more obvious when the organisations mature in project management and reach some degree of excellence in it. Achieving the excellence might give the competitive advantage and be the most important strategic objective of the company. The below figure (Figure 9) illustrates this

need for continuous improvement in terms of sustained competitive position and time (Kerzner 2001: 120-121).
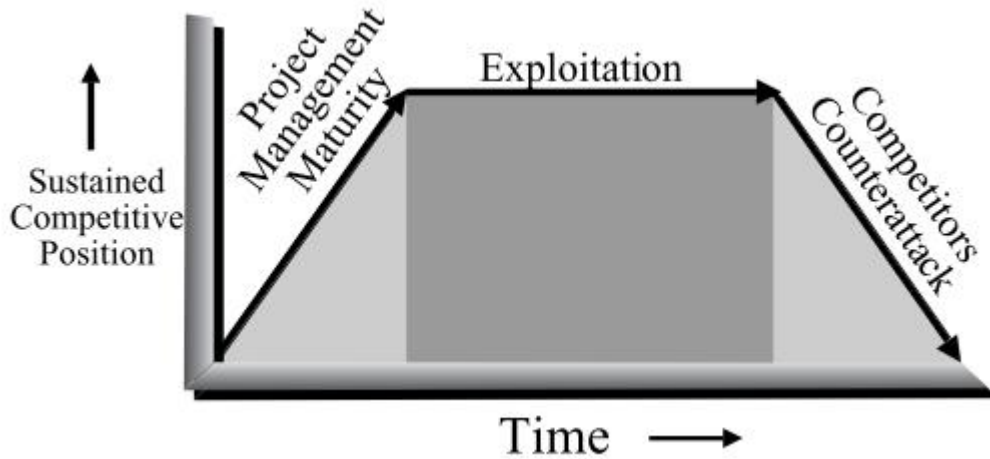
Figure 9. The need for continuous improvement (Kerzner 2001: 121).

The above figure (Figure 9) also shows that the competition also counterattack when the company has gained the competitive advantage which leads to understanding the need of continuously develop and improve (Kerzner 2001: 121).

2.5.7 Project management capacity planning

When companies become excellent in project management, they often realise the amount of work to be done increasing with fewer resources and shorter amount of time, but how much work can be put on the organisation (Kerzner 2001: 122)?

There is a way to approach this question with the below figure (Figure 10) illustrates the classical way of performing capacity planning in companies. The planning horizon line shows when the capacity planning should be performed. The shortage of this figure is that it only shows human resources are indicated (Kerzner 2001: 122).
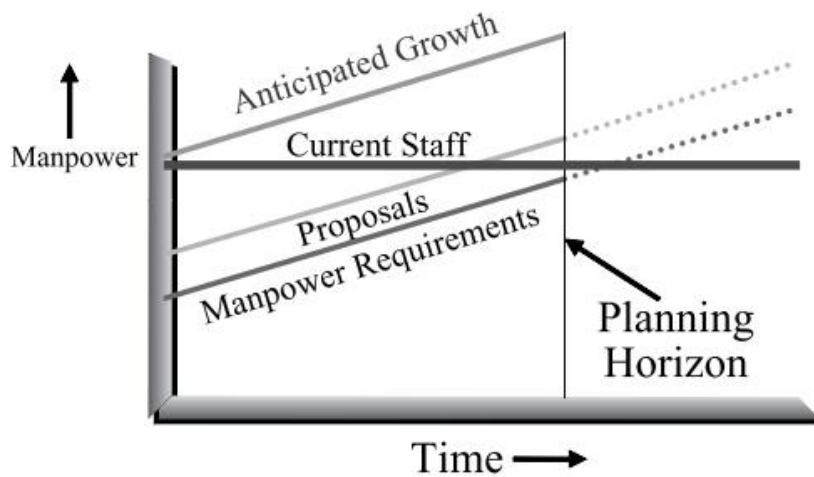
Figure 10. Classical capacity planning (Kerzner 2001: 122)

More realistic model is to use a suitable model for project and non-project driven organisations. Kerzner (2001) illustrates this model in the below figure (Figure 11).

Figure 11. Realistic capacity planning (Kerzner 2001: 122)

Kerzner (2001) describes that the suitable model would select projects based upon such factors as strategic fit, profitability, customer and corporate benefits, which leads to model where the projects are selected by the business and the technical terms. This model realises that both terms can act as constraints as well. The next box identifies capacity constraints from the summation of schedules and plans. The final box is the determination of

the capacity constraints, where critical path can be determined by manpower but also with constraints of time, facilities, cash flow and technology (Kerzner 2001: 122-123).

3. RESEARCH METHODS AND CASE ORGANISATION

The first step of every research is to define and agree on the research objectives. These are then translated into set of key research questions. For each research question, one or several survey questions are formed, depending on what the goal of the study is.

The main problems often occur in question wording, flow, context and choice of response categories (de Leeux et al., 2007:4-5).

3.1 Qualitative research

Qualitative research crosscuts disciplines, fields and subject matters in field of inquiry (Denzin 2000: 2).

The term qualitative emphasises the qualities of entities, processes and meanings that are not experimentally examined or measured, if at all, as measured by quantity, amount, intensity or frequency (Denzin 2000: 8).

The qualitative research can be described as placing the observer into the world, which is interpretive and naturalistic. The research material is empirical, such as case study, personal experiences, and interviews and so forth (Denzin 2000: 3).

3.2 Questionnaire

The purpose of the questionnaires is intended for brief communication facilitation and answers are replied conversationally (Davies 2007:82).

There are four purposes for questionnaire to fulfil;

1. To draw accurate information from the respondent,
2. The respondents are asked the same questions,
3. To provide a standard format for recording of facts, comments and attitudes and
4. To facilitate data processing. (Hague 1993:11-12).

One important aspect is how people understand questions. The choice of vocabulary is very important. There are several other features that can create ambiguity;

1. Using unfamiliar, complex or technical words and phrases,
2. Lack of time frame,
3. Imbedded assumptions about respondents view of things and
4. Asking multiple questions simultaneously (de Leeux et al., 2007:139).

There are three types of questionnaires, structured (predefined answers), semi-structured (mixture of predefined questions and free to say) and unstructured (free to say) (Hague 1993:21-22).

There are three types of questions in structured and semi-structured questionnaires;

1. *Behavioral*, for measuring the factual information on respondents' doing, owning or presence.
2. *Attitudinal*, for personal beliefs, imaginations and ratings of things
3. *Classification,* for group of respondents to discover the difference from one another, such as age and gender (Hague 1993:29-30).

The measurement of the validity refers to how well the answers to questions correspond with the value for the construct that is being measured. The reliability has two meanings;

1. *given respondents*, whose true value on a construct, is the same should answer the questions in the same way and
2. *two respondents*, whose true value on a construct is the same, should answer the questions in the same way. The questions determine the ultimate measure of validity. (de Leeux et al., 2007 :137)

3.3 Case organisation

The case organisation is a line organisation in research and development (later R&D) organisation working in the field of product and technology development in environmental technologies within a global industrial company. The organisation is called *Environmental Products and Technologies* (later EPT).

3.3.1 Environmental products and technologies (EPT)

The organisation was formed in 2009 and it begin to operate 2010 as a separate organisation within a company that is a global leader in complete lifecycle power solutions for the marine and energy markets.

The personnel to this new organisation were hired from the company's different organisations as well as by external recruiting. The personnel consist of managers, experts, engineers and designers. Most of them have previous experience from R&D work in field of environmental technologies and many have academic education.

The main focus of this organisation was to focus on exhaust gas cleaning, energy efficiency and emission monitoring. The organisation had own PMs leading the development projects and reporting to EPT management team. The PMs were located in Engineering and Project management department, reporting to general manager of that department. In some projects, the general manager worked also as a subordinate to PM's as the engineering resources where under his responsibility.
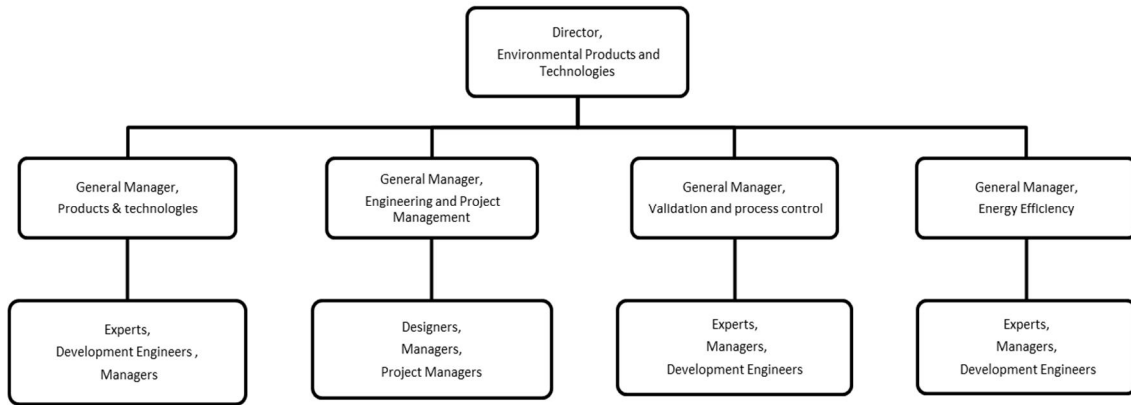
Figure 12. EPT before joined to global R&D

In 2012, the EPT organisation was emerged to company's global R&D organisation by top management's decision. This was performed in order to get more focused way of working with technology and development projects as similar activities where ongoing in the global organisation. The energy efficiency and part of exhaust gas cleaning was moved to business organisations within the company as their focus was more on customer sales projects. This resulted that remaining organisation was put under the global R&D organisation as a separate line organisation (Figure 13).
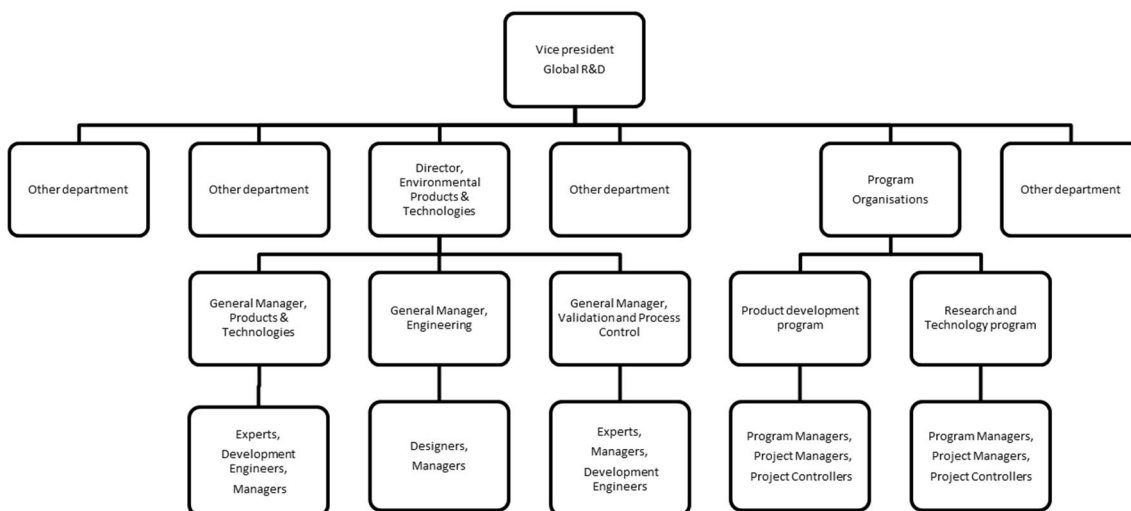
Figure 13. Global R&D of case company where EPT and program organisations are highlighted

In the global R&D organisation, projects are under program organisations which resulted that the PMs from EPT organisation where moved to separate programs based on innovation, technology and product development projects in autumn of 2013.

3.3.2 EPT organisation at the time of the study

The case organisation had twenty four employees at the time of this study and has personnel located in four different offices in Finland, Vaasa, Turku, Espoo and Helsinki. Personnel include experts, designers, development engineers, managers and general managers of separate departments (Figure 13). The organisation functions as a know-how unit with main purpose to identify new opportunities, emission legislation know-how and promotion and also supply resources for different technology and product development projects. The organisation has also product management of existing and future products. Main external customers of EPT are shipyards, ship owners and stationary power plants. There are no PMs in the organisation and all the development projects are run by the global R&D model based on the previously mentioned programs.

3.3.3. Project management in the global R&D of case company

The case company has a project management model (Figure 14) based on gates, where there are four main gates and smaller gates between gate two and three. The amount of gates in between depends on the project type.
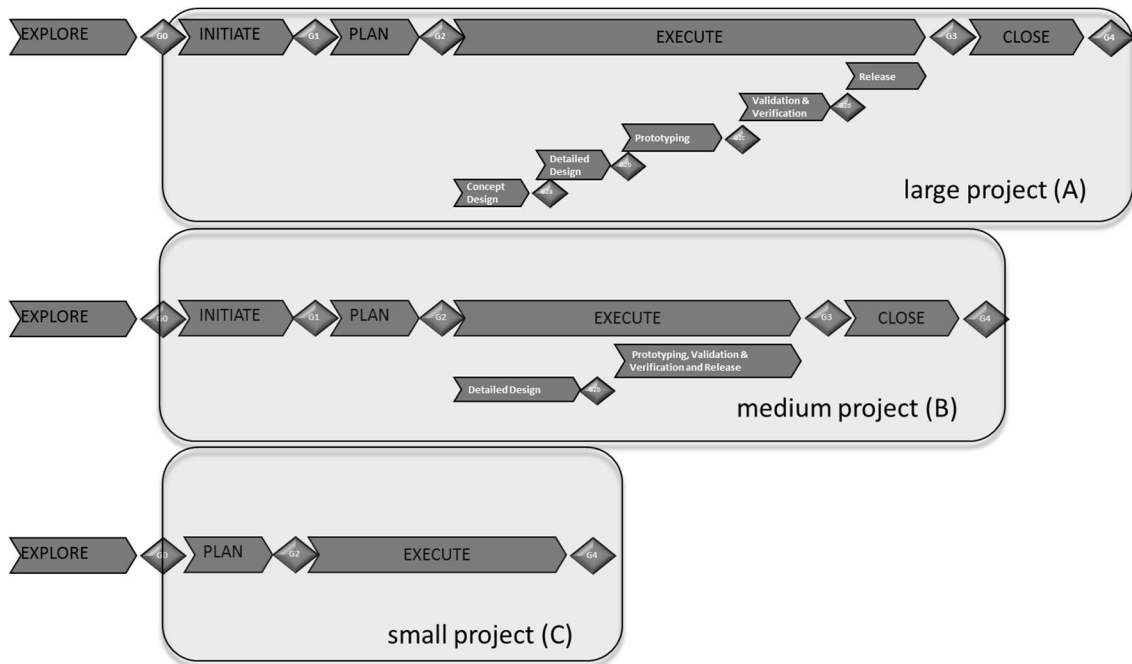
Figure 13. Case company's project model

The projects are divided to three different categories based on complexity, A, B and C, where the A is the largest and C is the smallest in scope.

The gate zero (0) is the project feasibility phase where the new project initiative is proposed and explored. In gate one (1) the project has moved forward and the project planning have started. The gate two (2) is the actual project work starting gate, where the project execution begins. The gate two b (2b) is for the design completion and gate two c (2c) after the prototyping. With large projects there is also gate two d (2d), which is for validation and verification before gate three (3) that is the handover and start of project closure. At gate four (4) the project is closed and final report is made.

The projects are steered by R&D Management team (Figure 13.) as per what was introduced in section 3.2.1.

3.3.4 Project management in EPT projects

The projects are led by PMs who work under program organisation (Figure 13) depending on project type. The organisation also focuses on delivery projects of the products that they have developed and are developing at the moment. The sales amounts are still on moderate level but the number of deliveries is increasing. As the products are still mostly custom made, the amount of engineering, measuring and management is high on sales delivery projects. The same resources of the organisation work with sales delivery and development projects due to limited amount of personnel in the organisation. Generally the sales delivery projects have higher priority on development projects.

3.3.5 Questionnaire for EPT

The questionnaire for the teams of EPT department, was conducted between 6.3-21.3.2014 as an e-mail survey (appendix 1.).

The aim of this survey was to identify how the teams of EPT see, from development projects point of view, what are their current strengths and challenges within the teams and with other stakeholders such as other R&D line organisations. Also the questionnaire gave an opportunity to state other development points that were not directly asked by the surveyor (question 5). It is also to be noted that the director of the organisation didn't participate to the survey.

The target of the survey was to identify what has the organisation learnt from the way of working with the development projects and identify the common themes of strengths and challenges for the future improvement on way of working and knowledge sharing.

The response rate was approximately 80%, where out of 21 send surveys was replied by 17 respondents. Replies were send by email except for one printed copy.

The questions were understood and replied sufficiently to have a good overall result.
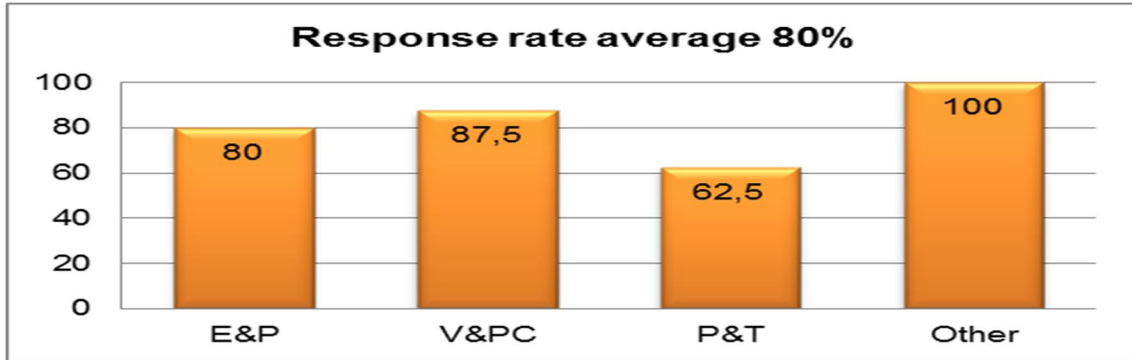
Table 1. Response rate average in teams

The questionnaire was mainly qualitative, but in order to define the participant's roles and experience in the organisation as well as overall rating from one (1) to five (5) in first three questions, quantitative measuring was also needed for overall grading.

Personal info:	
Position:	Designer ☐ Engineer ☒ Expert ☐ Manager ☐ General Manager ☐
Team:	E&P ☐ V&PC ☒ P&T ☐ Other ☐
Experience in development projects in other organisation(s): Experience in development projects in current organisation:	6 years ~1 years
Participation to development projects (innovation, technology, products)	
Current development projects on going:	5 (amount)

Table 2. Example reply for personal info

The aim of the personal info field was to identify the respondent's role in the organisation, the experience in the development projects in current organisation and previous develop-

ment project experience, if any. This was done in order to identify are there any differences on the replies based on persons role, experience and previous experience. Also the amount of development project ongoing was measured to identify a common average in the organisation and also to see if it had any relevance to replies.

Out of 17 replies the roles of the respondents whereas per below table.
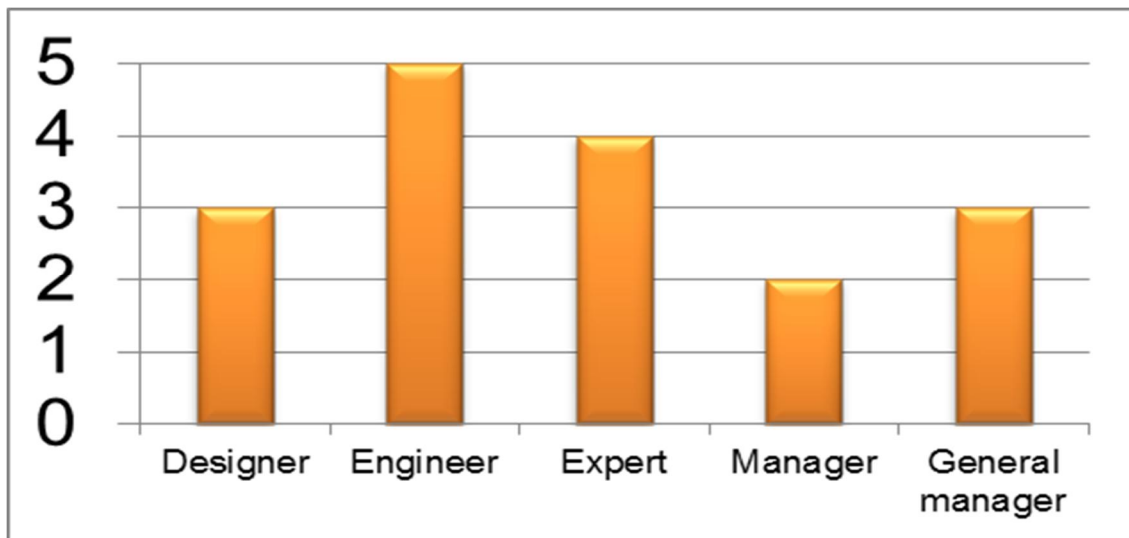
Table 3. Participants amount per role in the organisation

EPT organisation consists of three teams which each include positions of engineers, designers, experts, managers and general managers, who are line managers for the different teams. The three different teams are engineering and project management, validation and process control and products and technologies. Also one person is a manager under direct authority of the director of the EPT organisation. The engineering and project management team includes mainly designers and managers as in validation and process control and products and technologies include all role types.

3.3.6 Results of the questionnaire

The results of the questionnaire were presented with strengths and challenges for the organisation as they were asked in all questions except question five.

The results are combined and modified from the given answers so that no individual person is to be recognised and to summarise the results. Also number from one (1) to five (5) was requested in order to discuss the overall opinion and the answers given.

Next the results are presented as per each question.

Question1. Between 1-5, rate the level of technical capabilities of your own team, on how the development projects are being performed? Describe your answer shortly with strengths and challenges.
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Strenghts:	Challenges:

Table 4. First question of the questionnaire

In first question the technical capabilities of the teams where asked. The technical capabilities mean the skills and the level of education and experience of the personnel within the team. The aim was to define overall estimate of the team members where their teams are and are there common nominators for strengths and challenges.

The estimated rating of the question was four out of five. Validation & process control and products and technologies evaluated the technical capabilities as four and engineering and project management as three.

 The technical capabilities were on a high level that was identifiable from the answers. It was described to enable the technical communication, support from the experienced team members and the important role in the projects. Other identifiable strengths were good motivation and efficiency and also technical cost awareness.

The main challenges were around the team size. The teams are relatively small, less than ten persons in each team, which effects on workload, lack of specified technical expertise and projects roles. Especially the delivery projects interfere and consume time from the development projects and can block the essential resources. It was noted that university level technical analysis/problem solving skills and outside core competencies support is

often requested, like skills on handling variety of development tools and experience of industrial equipment commissioning, was mentioned to be lacking.

Question 2. Between 1-5, rate the level how project roles and responsibilities are defined and executed in your own team? Describe your answer shortly with strengths and challenges.	
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
Strenghts:	Challenges:

Table 5. Seconds question of the questionnaire

On the second question, the personnel where requested to describe how they see the project roles and responsibilities executed within their own teams. Aim is to define the level of clarity and understanding of roles and responsibilities for the personnel in projects.

The estimated rating of the question was three out of five. Validation & process control and products and technologies evaluated the technical capabilities as three and engineering and project management as four.

The specific roles within the teams are clear. The independence due to wide expertise of own field and individual responsibility of own roles was appreciated. The value of the definite project plans in projects and company's R&D project model was also highlighted in some of the replies.

The co-operation between other teams enabled the support with technical issues and also workload sharing, when re-assigning task, was beneficial.

The noted challenges where concentrated around leadership, work priorisation and communication, where the mentioned issues were related to uncertainty in decision-making, work distribution and workload sharing between the team members. Poor communication and decision-making resulted tasks floating, multitasking and engaging right expertise. Also, too much independence might result to poor utilisation of the team's skills and knowledge.

The time management between the development projects and delivery projects was raised also in this question. It was mentioned that the key resources are often booked in small

teams to delivery projects. This leads to resource overloading and difficulties on keeping the timeframe as the development projects are often small, but wide in scope. This leads to difficulties on optimising the expertise between the projects which effects on project budgets and responsibility sharing.

Question 3. Between 1-5, rate the level of communication of your own team in development projects? Describe your answer shortly with strengths and challenges.	
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
Strenghts:	Challenges:

Table 6. Third question of the questionnaire

Question three focused on communication within the team in development projects. The aim is to define how the teams communicate the project related information and knowledge and where are the main strong points and challenges.

The estimated rating of the question three was four out of five. Validation & process control and products and technologies evaluated the technical capabilities as four and engineering and project management as three.

Open atmosphere with very easy and straight communication, which is also informal, was noticeable strength in this question. The likely effecting factor was small teams, which was also noted as strength. In small teams, reacting to sudden changes in projects rapidly and the contact points within the team are clear for everyone, effect on good communication and working atmosphere. Face-to-face or virtual communication enables sharing of experiences as well as regular team meetings that were also highlighted in questionnaire, where the projects and other issues are discussed regularly.

Remote locations geographically create challenges like being left out of communication loop with some of the teams as travelling is also limited to certain extent. This might partially result in excessive communication that was also noted to disturb the work. It was requested that more focus is need on what is to be communicated via e-mail. Also opposite opinion was presented, where it was noted that more communication is better than

less, where the receiver can decide the importance of the communication to own work. This is clearly individual perspective on how the communication is seen.

Other mentionable challenges where that the development project documentation needs more focus.

Also, too much independence effect on creativity and challenging of own taught of the personnel and not utilising the skills within the team.

On leadership side, superiors are also requested to focus on task assignment as they are often loosely defined as the personnel do not understand what is being requested on the task.

Question 4: Describe with strengths and challenges, during development projects, how do you see your teams co-operation between:	
TEAM ITSELF	
Strengths	Challenges
OTHER TEAMS IN EPT	
Strengths	Challenges
PROJECT MANAGERS	
Strengths	Challenges
OTHER R&D ORGANISATIONS	
Strengths	Challenges
BUSINESS UNITS	
Strengths	Challenges

Table 7. Fourth question of the questionnaire

The co-operation with different parties was asked in the fourth question including five different stakeholders. Purpose was to define how the co-operation between the different stakeholders and counterparts is seen in everyday work and what are the common strengths and challenges. Overall rating wasn't requested in this question due to difficulty to have a reliable value.

Question 4 a: Describe with strengths and challenges, during development projects, how do you see your teams co-operation between:	
TEAM ITSELF	
Strengths	Challenges

Table 8. Question 4a of the questionnaire

Openness and attitude are the focus points of strengths. An open minded and good co-operation within the team itself was highlighted. The team members consult each other and discuss problems/solutions openly with a "can-do" attitude.

Communication is mentioned to be transparent and easy to manage in small team. It was notable that the activity level of communication varies within the group. Some are very active communicators where some team members need leadership support to be communicative. Also the ability to discuss and share the challenges within the team was highlighted. The physical location was noted to assist in co-operation and willingness to help and support due to that enabled the agile mentality and expertise in various fields.

One mentionable thing was also that the role definitions were known and defined. This enables independency to work alone in the given projects.

Even though the communication was highlighted as transparent and easy, it was stated that it needed improving as well. More focus was requested on what is to be communicated and what to be left out when communicating within the team. The hindering factors of communication are the time for the information sharing and remote locations.

Other factors effecting on the co-operation within the team are workload, too independent way of working and lack of decision making and support from the management in technical issues. From the responses it came clear that when team is short on resources and working too independently with their own responsibilities, the co-operation and communication within the team is notably affected.

Question 4 b: Describe with strengths and challenges, during development projects, how do you see your teams co-operation between:	
OTHER TEAMS IN EPT	
Strengths	Challenges

Table 9. Question 4b of the questionnaire

The co-operation between the other teams in EPT organisation where noted to be open and the ability to discuss with common technical language was a notable asset. Also the roles and responsibilities of other teams where known. Know-how and knowledge combination in the teams were described to be good which enables efficient way of working. Main challenges where related to knowledge sharing between the teams. The main concerns were the unwillingness to exchange core knowhow, occasional uncertainty of working towards the same goal. Also occasionally, teams are unaware what the other teams are working on and what challenges they are having. Some uncertainty of other teams' skills and roles is also notified. Occasionally communication of working tasks from several directions creates challenges. Separate management was requested for those.
Also the physical location limitations due to many offices with travel constraints create challenges for communication as well as management issues with unclear responsibilities and task assignments from other teams.

Question 4 c: Describe with strengths and challenges, during development projects, how do you see your teams co-operation between:	
PROJECT MANAGERS	
Strengths	Challenges

Table 10. Question 4c of the questionnaire

The communication is described good and open and the tasks are communicated in meetings or personally. Also activity level has been described relatively high and PMs considered as part of the team. Change to worse has being noted when PMs were moved to program organisations.

PMs are noted to have result orientation and administrative leaders taking care of bureaucracy outside the organisation. They have high priority on time schedules, budgets and progress milestones. Also the PMs that used to work in the organisation have product knowledge that is considered as a benefit.

The issue of project planning rose as a major concern for the teams. Project planning was occasionally unrealistic, where the reason can be related to knowledge level of products of the PM. Also the project reporting was said to hinder the focus of producing a good and working product.

Also the distance of the PMs' was highlighted as they are now outside of the organisation. It was said that the effectiveness of and importance of everyday communication, visibility, presence and touch with the experts, designers and engineers in EPT is missing. This might lead to a situation where the PM can become more a project controller instead of PM. It can happen especially when the PM is working from another country in a global company. Also the role of the PM is open to some of the less experienced employees. PMs are considered as "gate keepers" watching over the project deliverables, instead of the actual product outcome. The need of involving the personnel without occupying time with unnecessary meetings was raised.

Question 4 d: Describe with strengths and challenges, during development projects, how do you see your teams co-operation between:	
OTHER R&D ORGANISATIONS	
Strengths	Challenges

Table 11. Question 4d of the questionnaire

The major strengths of the with other R&D organisations where considered as open, helpful, active and communicative. Especially with common development projects strengthen the co-operation. The feeling of acceptance among the R&D unit through common projects and overall interest towards the EPT organisation was highlighted.

In development projects the resource allocations are necessity and the importance of them through good co-operation was separately issued.

The priorisation of projects, technology knowledge and understanding and also knowledge protection were raised as major challenges. Other organisations of R&D are not that familiar with the organisation yet and the relevant persons are not known. The familiarity can effect on the project priorisation, technology knowledge and understanding as well as the knowledge protection. The familiarity goes both ways where the other organisations are not aware of EPT and also EPT not familiar with the other organisations in R&D.

Question 4 e: Describe with strengths and challenges, during development projects, how do you see your teams co-operation between:	
BUSINESS UNITS	
Strengths	Challenges

Table 12. Question 4e of the questionnaire

The business units provide valuable knowledge to EPT through feedback and technology awareness which is considered valuable for improving in development projects in the future. The value of customer contact was also highlighted. Open communication between sales organisations is considered as positive and it enables the understanding of the needs of the customer. It was referred also as a buyer-supplier model that enables clear way of working. Also the business units are interested about emission reduction technologies which strengthens the co-operation and cross communication.

The major challenges where related to communication barriers and external controlling of development projects from business units side. There is insufficient amount of information shared from business units and end customers as well as mixed messages when communication lines are not clear. Occasionally the contact points are unclear to personnel. Also the EPT message is not reaching the business units which mean that EPT is not familiar enough to business units. This also results to priorisation of projects where EPT

often hasn't got the highest priority. The necessity of face-to-face communication was raised as an improvement point for these.

The external controlling from business side is shown in projects where the request of the end result is too business oriented, which means that it might not be suitable for other business units' purpose. Also feedback is often missing when requested. This might result to blaming attitude with difference of point of view.

Question 5:
In your own words, describe how would you develop EPT in general on development project performance?

Table 13. Fifth question of the questionnaire

The main development points that were brought up were wrapping up the previous questions. The main issue that was raised was the way of working between the development projects and delivery projects. There are mixed resources between the project types which effects on the performance of development projects. Development projects suffer from delivery projects priorisation where the skilled resources are occupied. One suggestion was to have selected resources only for development project purposes. The main benefits of this were said to be shorter project schedule when there is no multitasking between the project types. This argument was justified that personnel have more focus on the project when the roles are clear and there is more focus on the project. This might also effect on project costs when there is more focus. The challenge of this scenario was also noted as there is challenge with the organisation size. Also suggestion to this was that the delivery project responsibility should be more focused towards the dedicated department.

The way or working was seen also as an improvement point where the organisational rules and processes should be treated more as guidelines than exact rules. Key performance index and bonuses should not affect the project measuring as such. At the moment, the index is measured with performance given by project management software to R&D management team. The management team judges the status of the project with one percentage of information about the project with a short status report. More investment on

the development of the project management tools and documented processes is requested and more authority to project organisation to take decisions. Also the priorisation of the projects should be considered more thoroughly. Now it seems that every project has a top priority.

Other issue that was brought up was the effect of the PMs in program organisations. The way of working had changed for worse from the line organisation perspective as the PMs are now in program organisations. The request for non-linear and more agile project model was raised to adjust constantly changing development targets. Current project model was considered too bureaucratic where the focus of product management is reducing. This point of view was also presented as a request for project personnel to have the basic technical expertise on products. Also finding ways to synergise the development projects for example with testing activities, was raised.

Overall there seems to be a gap between the project team and the project core team.
The common goal setting and improvement in team spirit was highlighted in order to achieve more and faster. The need of brainstorming within the groups on how things and products could be done better and importance of separate points of view of the whole organisation needed was raised. The teams are young with new persons and lacking some experience but the motivation and commitment to learn and improve is on a high level to compensate lack of experience.
The importance of training was raised as an important development point. More knowledge outside of own core competence is needed on basic level knowledge from general issues and expert level knowledge needed from the support teams.
The need of benchmarking the competitors for further development and innovation needs was also raised. The importance of participating to conferences for the personnel is seen as a necessity.

3.3.7 Summary of the questionnaire

Technical capabilities

According to the survey, the teams of EPT feel the technical capabilities are on a high level. The defined improvement points were that there are skills needed on specific narrow expertise areas on field of emissions. Focus is also needed on workload between the delivery and development projects within the team.

Project roles and responsibilities

Roles and responsibilities within the team are clear and independence was appreciated. Also the co-operation between other team members enables the support especially in technical expertise. Sharing of workload with other teams was a mentionable asset. There rose issues related to leadership relating to decision making and sharing of workload within team. Also the roles and responsibilities are not communicated sufficiently which leads to multitasking between different projects and tasks. Work priorisation between development projects and delivery projects, can block key resources in small team.

Communication

The open technical and informal communication within small teams, especially face-to-face was a strongly highlighted. One form of face-to-face communication was the appreciated regular team meetings. The amount of communication is a challenge; especially unnecessary e-mails create too much pressure for personnel that are struggling with high amount daily email communication. Also for the travelling personnel, being out of office, might lead to miscommunication as well as in remote locations. The importance and need of improvement of development project progress documentation was also noted.

Co-operation within the team

The openness was once again highlighted as well as transparency in communication. The physical location of the team members was important for some teams as well as good role definition with ability to work independently. Communication about general issues within the remote team was highlighted and also the need to evaluate what to share and when.

Resource shortage effects the co-operation as well as too independent way of working with sometimes lack of technical question support from the line managers. The local teams share information well, but focus is needed on the remote teams.

Co-operation with other teams in EPT

The teams have open co-operation within the organisation and staff knows roles of other team members relatively well. The ability to discuss the technical issues was highlighted as positive asset. Some knowledge sharing boundaries occasionally have occurred with clarity of common goal. Also, the skills of other teams are not always known. Cross team working tasks communicated from several direction cause uncertainty with the responsibilities. Also the remote locations create challenges in the co-operation. Organisation has an open atmosphere for technical and non-technical co-operation improvement.

Co-operation with project managers

PMs communicate and participate actively with results in mind in the view point of the personnel. Administrative value was noted as well as the PMs who worked previously in the organisation, have knowledge about the products. Project planning too optimistic at times and project administration takes way the focus on the product. PMs are often considered to be too distant and invisible to EPT organisation. Also the role of PM and the company project model is open to many. Involvement is requested from PMs without occupying too much time from the actual work.

Co-operation with other organisations in R&D

Other organisations in R&D have been very helpful and open in co-operation. EPT has being accepted as part of the R&D organisation and interest toward environmental products has increased. Challenges with project priorisation and understanding of environmental technology create still issues. Knowledge protection exists with some organisations and EPT is unfamiliar to many whom haven't had common projects with the organisation. Also the cost distribution is open between the organisations.

Co-operation with business units

Feedback and emission technology awareness are valuable for improving in development projects. Importance of customer contact and understanding business needs is essential. The boundaries are still quite high and mutual trust is not on a high level.

General development

The development project versus delivery project issue was highlighted again. The need for specific resources for both project types was raised. This would enable to have more focus on the different project types.

Organisational rules and processes create issues where they are considered too bureaucratic. Personnel want more focus on the products instead of different processes and project management tools in the organisation. Also the project performance should be measured more based on the product instead of the process by the R&D management team. Also more authority and responsibility was requested for the project teams.

The new way of working with program organisations is seen as a disadvantage. The PMs are too distant from the project teams and might not have enough technical expertise on the product.

The common goal setting and improvement in team and the need of brainstorming within the groups was raised. The importance of training was raised as an important development point. Also benchmarking the competitors for further development and innovation needs was also raised.

3.3.8 External evaluation within the company

The case company has an external evaluator who evaluates the company as whole and also per each department. Also EPT is a part of this evaluation as a separate organisation. In this evaluation, there are questions that are related to the questionnaire made in this thesis, but it is to be noted that this evaluation doesn't take into account the development project aspect as the survey of this thesis. However, similarities can be referenced for comparison the questionnaire of this thesis.

The evaluation was reported 28.11.2013 which is a bit less than half a year before the questionnaire of this thesis.
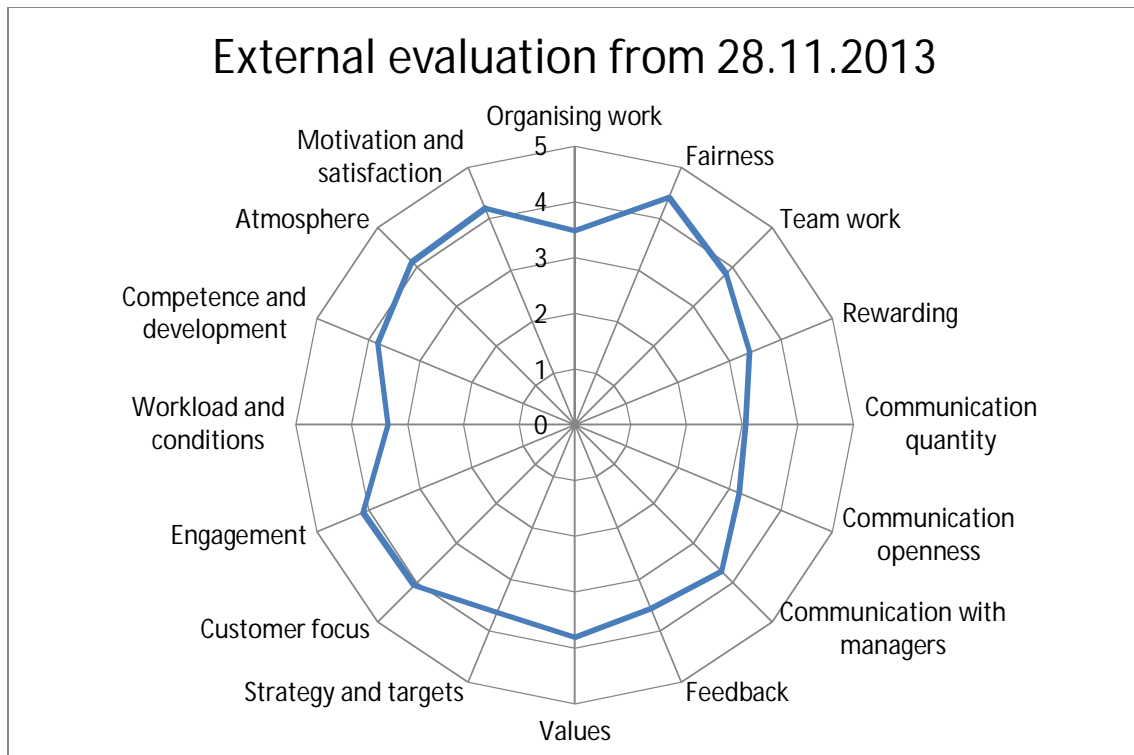
Figure 14. External evaluation from 28.11.2013 for EPT

The ranking of this survey is from zero to five. The evaluation was made as quantitative e-mail questionnaire for every person in the company. The respondent chooses the number closest to own opinion between the rates.

3.3.9 External evaluation for the case organisation

The quotes mentioned below are from the result evaluation of the external surveyor, which are not in public distribution and availability.

Based on the evaluation, the external surveyor raised the main improvement areas on two levels; 1) EPT and 2) team level.

The EPT level improvement areas are communication, strategy and targets, values and customer focus. On team level especially the organising of work, training and team work were highlighted.

The surveyor noted that the communication quantity and quality are not on a sufficient level. Most critical areas noted where between businesses and from businesses to management to personnel. The strategy and targets were logically low due to short history in R&D and fragmented responsibility field. Other topic risen was the values that haven't been discussed yet and the meaning of them not yet communicated.

One notable issue highlighted was that the employees feel the distance between the end customer and their expectations, employees feels to be in a silo.

4. DATA ANALYSIS AND INTERPRETATION

This chapter discusses the findings of the questionnaire and analyses the results based on the questionnaire, existing research and selected articles for reference. The data will be referred to thesis questions and analysed based on literature references on this thesis.

4.1 Questionnaire evaluation

The questionnaire had very high answering rate, eighty percent which is 17 out of 21 surveys sent, and can be considered as reliable. For the most parts, the questions were understood and over half of the answers had all questions filled. The two weeks given for the answers was sufficient. Most likely no more than one or two answers could have being received after the deadline, if waited for few weeks.

Anonymity factor needed to be taken into account as the questionnaire was done in a small organisation and some of answers could be defined to specific persons. Therefore, all of the answers were combined together and rewritten in a form where the context is kept exactly the same, but the wording differs somewhat and some of the replies are combined together if they relate to each other naturally.

The questionnaire had five questions of which four had given limitations based on strengths and challenges. In first three questions scoring was also given in between one to five to indicate that, are the given answers in correspondence to overall rating. This was asked in order to mirror the given answers to the scoring.

The questionnaire had four different views to evaluate the knowledge sharing and project management maturity of the EPT project teams as previously discussed.

The first question was related to the technical capabilities of the EPT teams. The technical capabilities here meant the technical skills and competencies that the teams have internally. This question raised few comments as the technical capabilities term wasn't clearly understood and would have being needed to be more defined. This might have had some minor variance for the results of the questionnaire, but based on results, the consistency was noticeable. The overall rating of the question was in line with the answers.

The second question was the project roles and responsibilities. Here the teams needed to evaluate how clear the tasks and roles in development projects are and what are the challenges with them. This question was well understood as the answers were quite consistent. Similar strengths and challenges rose in several answers and rating of the question was in line with the answers received.

The third question was related to communication between the team. This question was understood well and was received consistent answers. The importance physical presence was noted in most of the answers. Few answers were only short, like "good", but overall the consistency in answers was found here also and rating also reflected the given answers.

The fourth question was the largest focusing on co-operation. The aim of this question was to define the co-operation between different stakeholders of the EPT teams. The question was extensive and received variance in answers. Some of the parts were left blank, possibly due to ability to answers as some stakeholders, like customers, might not be familiar to all of the employees. This question also didn't have the rating from one to five like (1-5) like first three questions for the same reason. It was seen unreliable to ask to give rating of co-operation if there is no familiarity to the stakeholder asked. The answers gave good consistency and reliability for the evaluation and gave also some good insights of the factors effecting the co-operation.

The fifth and final question was an open ended question in order to give room for ideas and points that might not be covered in previous questions. This question was the most popular one and gave good feedback and viewpoints for the future improvements of the organisation. This was one of the factors why the qualitative questionnaire was made instead of quantitative so that new viewpoints and ideas could be recorded and define how the organisation identifies the future needs.

The questionnaire succeeded in terms of response rate, respondents understanding the questions and responses received. For the future improvement, there is space for discussion on concentrating the questionnaire more specifically so that respondents are familiar with all the stakeholders asked as well as defining even more what is being asked so that there won't be room for misunderstandings, like in this questionnaire the technical capabilities raised few questions that needed clarification.

4.2 Questionnaire compared to existing evaluation

The questionnaire had similarities with the research done by the external evaluator introduced in the section 3.2.6 and 3.2.7. The external surveyors' evaluation was done less than half a year before, but the main focus was in the whole organisations daily work and not the development projects. Also, it is to be noted that the questionnaire was qualitative with possibility to select between zero to five (0-5) based on respondent own view.

Similarities between the external surveyors' questionnaire and the qualitative questionnaire performed for this thesis can be seen especially on the improvement points. The external surveyor raised the communication, strategy and targets, values and customer focus. On team level especially the organising of work, training and team work were noted. On the questionnaire for this thesis the communication was specially asked and the results were relatively similar than with the external questionnaire. The effect of physical presence rose in this question to be the key for good communication. Also the workload was noted in both surveys and results were relatively close to each other. The training factor that was raised in the external evaluation wasn't particularly asked in the thesis questionnaire but the importance of the benchmarking and overall development was brought up also.

The difference between the questionnaires were that the one made for the thesis also focused more on the stakeholders within the organisation and outside of it to get more perspective of the overall level of co-operation. This question gave understanding on how the organisation positions itself and its stakeholders. Also the strategy factor was not asked in the thesis questionnaire, but for the development projects point of view, it doesn't give any significant importance.

Overall, the questionnaires complement each other. The similarities validate some of the results received from the thesis questionnaire and give overall picture that the questionnaire was successful in terms of results received.

4.3 Knowledge management in the case organisation

Through the questionnaire, it can be seen that there are different knowledge types that can be identified. As the case organisation consists of experts from different backgrounds, there is lot of *tacit knowledge* (chapter 2.2.2) that can be implemented and transferred for the organisations use, like mentioned by Tonnquist (2009) and Davenport (1998).

The knowhow and skills of experts can be utilised for the whole organisation's use, for example in the questionnaire one of the mentioned strengths on technical capabilities was the support from the experienced to less experienced team members. This can be referred to the technical dimension of tacit knowledge introduced by Nonaka (1995). Also the ability to identify the knowledge needs in specific areas, is a part of this knowledge type, like Nickols (2010) refers the knowing is in the doing.

The explicit knowledge (chapter 2.2.1) could be identifiable from the questionnaire in terms of understanding the ways of working with new processes, like the change of the PMs to separate organisation and effect of it to everyday working. Also the understanding of the existing project management tools and critical evaluation of the use of them can be considered to be part of explicit knowledge.

Overall, the *implicit knowledge* can be seen in the question five where the general development points were asked and based on the high amount of replies and feedback, the performance and behaviours could be critically evaluated like Nickols (2010) refers to. Also as per Bergeron (2003) defined, the knowledge engineering exists in EPT. Example of this is the questionnaires questions three and four. The communication with common technical language enables the knowledge sharing and the co-operation in the teams enables the knowledge sharing from experienced persons to less-experienced.

From the results of the questionnaire it can be seen that the Nonaka's (1995) four modes of knowledge conversion exists in the organisations normal way of working whether it is recognised or not. It came clear that the socialisation by sharing experiences and technical skills is normal way of working in the teams and it is in a good level. The cycle can be

seen to continue to externalisation where for example the co-operation between the teams in EPT creates dialogue and reflection on different cases. The combination mode is normal way of working in EPT where the knowledge is shared when working with projects and within different meetings. The lack of combination process could be noted where the co-operation between the teams of EPT was good, but there was also notification that not all necessary information of development projects is shared. The importance of the internalisation should be brought to focus as it is the creator of the tacit knowledge that develops the organisational culture as Nonaka (1995) stated.

The knowledge transferring came across in the questionnaire question number three when asked about the communication as well as in question four when asked about co-operation between different parties. Within the teams the communication and co-operation were considered to be good, but with some parties, like other R&D units, the co-operation wasn't that eminent. The explicit knowledge transferred like Schwartz (2006) refers to is recognisable in answer of the question 4b in the questionnaire where the common technical language benefit was raised and how it enables the knowledge sharing between the teams. But there are also difficulties in knowledge transfer if the respondent doesn't understand the technical content of the subject, which occurred in question five of questionnaire, where the importance of technical knowledge of the PM's was highlighted. Also the effect of the workload what Davenport (1998) rose came eminent in the response of the question one in the questionnaire.

Based on the questionnaire, it can be identified that in EPT there is no defined form of KM practice working. The knowledge created is based on the everyday work and the tacit knowledge shared is based on discussions between different parties and the recorded data is basically technical. However, there is recognition of KM when for example the lack of specific technical skills where noted in the answers for question one of the questionnaire. This requires understanding on the skills that are already exists and what are still missing.

4.4 Learning organisation in EPT

Based on the questionnaire EPT has lot of tacit and explicit knowledge and understanding of sharing it. Also the needs for the specific skills bring up the KM existence of it. It can be stated that EPT has some forms learning in organisation skills as it recognises the early stages of learning processes and characteristics of it as stated by Maula (2006). It can be defined in forms of understanding the current skill set and needs to develop from the high rating of four given to technical capabilities in the questionnaire question one and specific skills needed. However, it came obvious that learning in the organisation does not happen at least in consistent way. It can be seen from the answers to questionnaire that there is no knowledge sharing environment like Tonnquist (2009) referred to in whole EPT.

On a team level however, the regular team meetings can be considered as a form of knowledge sharing environment. But at least it didn't come across from the questionnaire, is there a link between these team meetings where the discussed topics could be shared with other teams. Also the three dimensions of learning that Senge (2006) referred to can be seen on the team level. Based on the questionnaire, the teams realise the benefit of communication and co-operation in the team and how it benefits the problem solving in technical issues as well as the roles and responsibilities are known in teams. Also the other teams of EPT are quite well known, who is responsible of what and what the other teams are working on. However, there was lack of communication also noted in the questionnaire. This might also relate to "defensive routines" that Senge (2006) also mentioned.

The inter-organisational learning can be referred to above when the team co-operation is good as well as the co-operation between the other stakeholders, like business units. The feedback from the business needs was highlighted in the question four of the questionnaire in positive and negative sense. Positive in a way of understanding the customer needs and negative in internal bureaucratic of responsibilities. The ranking of co-operation in question four can be defined on Figure 3 (individual strategies for inter-organisation learning). It can be stated that the teams of EPT rank in high on receptivity and transparency, PMs' high on collaboration and possibly in the middle on transparency due to mentioned distance and business units and other organisations of R&D on middle in receptivity and low or middle in transparency.

4.5 Effect of organisation changes to PM practices in case organisation

The case organisation can be described as non-project driven as Kerzner (2013) referred to even though it has many activities around projects. In EPT, there are no defined project teams, but teams based on specialised roles and units with suitable expertise and resources as Nicholas et al., (2012) refers to. EPT has had several changes during its lifetime. It started out as a separate unit with own R&D activities and PMs and later being included to a part of global R&D organisation.

The different matrix types introduced in the section 2.4.5 can be used to define the organisation change. The projects in EPT have being led in matrices like Lester (2014) describes. The projects take members from different team in EPT depending on the type and the need of the project.

When the EPT organisation was formed, the project management functions were performed in a weak matrix (Figure 5) like introduced by the Project Management institute (later PMI) (2013), where the project management coordination was done by experts in line functions. The project management was done beside the expertise work and lead by the line managers of different fields.

After a while, the management of the organisation noticed that the project management tasks needed separate coordination and dedicated PMs were hired. The PMs worked under the line organisation lead by the line manager. The project management was transformed in to a balanced matrix (Figure 6) model as described by PMI (2013). In this model, the experts could focus on their work and projects were lead in controlled manner, but the reporting responsibility was under a line manager who also had other responsibilities besides leading project management. This resulted to situations where the line manager of PMs' could be working under the PM in some of the development projects. This isn't the ideal situation when considering the managerial responsibilities.

When the case organisation was moved under the global R&D, the PMs soon moved to separate program organisations which are responsible for the project management func-

tions in the global R&D organisation. The remaining of the case organisation was functioning as a line organisation giving resources and expertise to different development projects. This project management type can be defined as strong matrix (Figure 6) as per PMI's (2013) definition. The case organisation functioned in strong matrix during the time of the study. The PMs have program managers as their superiors and there is no more conflict in managerial issues in the projects. However, the distance between the PMs and the line organisations can be argued to be more distant.

The effect of the organisation changes was highlighted in the questionnaire for this thesis in question four, when asked about the co-operation between the PMs. The everyday communication, visibility, presence and touch with the experts was said to be missing. This relates to the fact that the PMs had been present in the organisation before when they worked under the line management.

One of the main highlights from the questionnaire that was raised in several questions was related to personnel capacity and amount of work to be done. According to Kerzner's (2001) models on capacity planning (figure 10 and 11), it can be argued that the EPT battles between the growth of business with new products as they require more resources and the development projects to be done. It can be seen that some strategic decisions have being made already so that the sales projects take the highest priority, which refers to realistic capacity planning model (Figure 11), but there are still elements of the classical capacity planning model (Figure 10) as well because personnel are informing about the unbalance on the amount and priorities of workload.

4.6 EPT project management maturity compared to PMMM

When considering only the EPT way of working with projects towards to PMMM presented by Kerzner (2001) we can identify the level of project management maturity based on the questionnaire made for this thesis.

From the questionnaire it is identifiable that the teams have common language which Kerzner (2001) refers to with ability to discuss technical issues between the teams. However the project management model of the company is supported by the management as the way of working is obviously very project oriented in strong matrix as discussed in previous chapter. This refers to common processes that Kerzner (2001) defined on the second stage of the five level of PMMM illustrated in Figure 7. The third stage of the model refers to singular methodology where Kerzner (2001) defines the project management to be focused around one model. This can be identified from the questionnaire from the same as previous level. There is clear way of leading the projects and the gate model of the company is known and sometimes, criticised by the personnel. The fourth level of benchmarking needs came also obvious in the questionnaire on question five where the need for benchmarking was identified. The fifth level of continuous improvement is not achieved based on the questionnaire. It came obvious that there is no active benchmarking that is done in continuous bases that Kerzner (2001) refers to unless the lessons learned gathered after each project is taken in to account as it is part of company's project management model.

So based on questionnaire the level of the organisation could be evaluated to be on level three with recognisable understanding on how to reach the fourth level.

5. CONCLUSIONS AND RECOMMENDATIONS

This chapter discusses the conclusions based on the questionnaires results and theory compared in previous chapter (chapter 4). Also recommendations and future research possibilities introduced and evaluated.

5.1 Research conclusions

As the scope of this study was quite extensive, when describing the linkage between gained knowledge to learning in organisation and project management maturity, this thesis wasn't strictly narrowed based on one or two different theories. R&D related studies have proven to be difficult in terms of subject and methods, like in study of Assessment of quality and maturity level of R&D (Berg et al, 2000), where the R&D effectiveness was also measured by using five step maturity model. The same study highlighted that the R&D can be observed from company level and project level and that the measurement system should be close to the company and its strategic objectives (Berg et al. 2000: 30). Therefore in this study, the decision to focus on gained knowledge, learning organisation and project management maturity, combined the theory to received results in very reflective manner and gave an opportunity to evaluate the organisation from individual to team level to organisation level.

The discussion of different knowledge types and KM was needed to be taken into account to learn how they show while working with the development projects and is there active knowledge sharing within the teams of EPT and level of learning in the organisation. The learning of the development projects has being studied before in similar manner, like in the study Organizational learning through post-project reviews in R&D (von Zedtwitz 2002), where the focus was on post-project reviews, but acknowledged the learning throughout the project lifetime and that it cannot be measured exclusively with formal methods and neglect the tacit means of knowledge and build experience (von Zedtwitz 2002: 257).

The effect of organisational changes of EPT was seen throughout the questionnaires replies. Therefore, when reflecting the different matrix types to replies of the questionnaire, the organisational changes effect of changing from balanced to strong matrices was eminent. People felt strongly the effects of change when project managers were moved to program organisations and the reactions came out from replies. This gave a good perspective to see how the changes that might be considered minor, as the physical change of personnel considered only the project managers, can make big impacts on ways of working and overall atmosphere of the organisation.

The project management maturity model was a good approach to study the development needs on the organisational level. The model gave a good indication for the organisation where they are at the moment and how could they improve to move further ahead. The same model has being used in other studies like in Achieving Levels of Project Management Maturity in Organization (Szpitter 2013), where the same model was used to organisations project teams identify the level of project management maturity in the case company with a qualitative questionnaire (Szpitter 2013: 79).

All these three viewpoints gave an overall understanding where the organisation is at present and what challenges it has, but also tools to evaluate the organisation by utilising existing theories, like the five levels of project management maturity by Kerzner (2001) and the Nonaka's (1995) four modes of knowledge conversion.

5.2 Recommendations based on research

This study proved how difficult it is to identify the KM, learning in organisation and project management maturity in organisations that are working with development projects. The approach how to research these in the case organisation needed careful planning and the approach to investigate on the team level seemed to be the most efficient in order to identify if there are differences within the organisations teams or are they harmoniously aligned on the subject. The consistency between the teams was in this study was notable.

The need for active KM should be highlighted and for example the use of Nonaka's (Nonaka 1995) four modes of knowledge conversion model would be useful in order to promote active KM culture. This can be performed with proactive approach with separate knowledge sharing activities like workshops, monthly meetings and so forth or as with organisational way of working by making sure that the personnel interact within the teams and with other teams of the current organisation. This could simply mean for example taking a designer to a customer visit at early stage or by having the expert and designer sit side by side when planning a new design.

The results of this study recommends that there are needs to improve on the way of working between the development projects and delivery projects with specified focus. However, after the questionnaire was conducted, the EPT organisation has changed under a different business unit from 01.01.2015 onwards and now having responsibility mostly on delivery projects for existing products and the R&D work focuses more on improving the already existing products with minor scoped projects.

Although, the way of working between the development projects and delivery projects need to be clarified for the personnel as the occasional uncertainty of work priorisation creates unnecessary pressure for the teams. The Kerzner's (2001) capacity planning model (Figure 11) would be beneficial to investigate and revise the current business strategy towards it for improving the balance on the workload for the personnel.

Also the roles and responsibilities that they need to be clearly defined in the teams in order to reduce the confusion and uncertainty of what is being expected of the personnel. The co-operation with different stakeholders requires attention in the new organisation structure. The questionnaire of this thesis showed that there were unfamiliarity with some of the personnel towards other departments in R&D and business units. Especially the effect on current change towards knowing the business units should improve in new organisation, but effects might be different on R&D.

5.3 Future research possibilities

As the organisation has now moved to another business unit, it would be beneficial to revise the questionnaire and see how the organisation is reflecting to the new situation. The future questionnaire could be performed after one year after the organisation has started to function with the new way of working and in new environment and the organisations teams are now having different setup and partly separate tasks than during this study.

Interesting factors for the future research would be the communication related issues as well as the co-operation issues between the other stakeholders like global R&D where the organisation used to be. Is there active co-operation still, are there any barriers for the co-operation and so forth.

Also the open question like the question five of this thesis questionnaire, is beneficial to grasp the ideas and issues the possibly haven't been considered.

Other interesting topic to investigate could be how the organisation is reflecting to new way of working with the development projects when the PMs are again part of the same organisation in balanced matrix model (figure 7). Most likely the effect of the distance of the PMs should be visible.

REFERENCES

Becerra-Fernandez, Irma & Sabherwal, Rajiv. (2010). Knowledge management: systems and approaches. New York. M.E. Sharpe. ISBN: 978-0-7656-2351-5

Bengtson, Lars; Henriksson Kristina; Larsson, Richard; Sparks, Judith. (1998). The Interorganizational Learning Dilemma: Collective Knowledge Development in Strategic Alliances. Organization Science. Vol 9. pp. 286-289.

Berg, Pekka; Leinonen, Mikko; Leivo, Virpi; Pihlajamaa, Jussi. (2000). Assessment of quality and maturity level of R&D. International Journal of production economics 78. pp 29-35.

Bergeron, Bryan P. (2003). Essentials of knowledge management. New Jersey. John Wiley & Sons. ISBN: 0-471-28113-1

Greer, Stephen. (2008). A Lessons-Learned Knowledge Management System for Engineers: An organizational lessons-learned system facilitates the transfer of knowledge from one project team to another. Chemical Engineering, 115, 8, pp.50-51.

Hague, Paul. (1993). Questionnaire design. The market research series. London: Kogan page limited. ISBN: 0-7494-0917-7

De Leeuw, Edith. D, Hox, Joop J., Dillman, Don A. (2009). International Handbook of Survey Methodology. European association of methodology. East Sussex: Psychology press. ISBN: 978-0-858-5753-5.

Davenport, Thomas H. & Prusak, Laurence. (1998). Working knowledge: how organizations manage what they know. Boston. Harvard Business School Press, cop. ISBN: 1-57851-301-4

Davies, Martin Brett. (2007). Doing a Successful Research Project. Using Qualitative or Quantitative Methods. Hampshire: Palgrave Maximillian. ISBN-13: 978-1-4039-9379-3

Denzin, Lincoln. (2000). Handbook of qualitative research. Second edition. London. Sage Publications, Inc. ISBN: 0-7619-1512-5.

Kerzner, Harold. (2013). Project Management: a systems approach to planning, scheduling, and controlling. Eleventh edition. New York. John Wiley & Sons. Inc. ISBN: 978-1-118-022227-6.

Kerzner, Harold. (2001).Strategic planning for project management using a project management maturity model. New York. John Wiley & Sons. Inc. ISBN: 0-471-40039-4

King, William R. (2009). Knowledge Management and Organisational Learning. New York. Springer. ISBN: 978-1-4419-0011-1

Lester, Albert. (2014). Project management, planning and control. USA Sixth edition. Elsevier Ltd. ISBN: 13:978-0-08-098324-0

Maula, Marjatta. (2006). Organisations as learning systems: Living compositions' as an enabling infrastructure. First edition. Oxford. Elsevier. ISBN-10: 0-08-043919-5

Nicholas, John M. & Steyn, Herman. (2012). Project management for engineering, business and technology. Fourth edition. New York. Routledge. ISBN: 978–0–08–096705–9

Nonaka, Ikujiro & Takeuchi, Hirotaka.(1995). The knowledge-creating company: How Japanese companies create the dynamics of innovation. New York. Oxford University Press Inc. ISBN: 0-19-509269-4

Project Management institute Inc. (2013). A guide to project management body of knowledge (PMBOK® guide). Fifth edition. Atlanta. ISBN: 978-1-935589-67-9

Senge, Peter M. (2006). The fifth discipline: the art and practice of the learning organization. New York. Currency Doubleday. ISBN: 0-385-51725-4

Schwartz, David G. (2006). Encyclopaedia of Knowledge Management. London. Idea Group Inc. ISBN: 1-59140-574-2.

Szpitter, Agnieszka A. (2013). Achieving Levels of Project Management Maturity in Organization. Versita. DOI: 10.2478/manment-2013-0006. ISSN 1429-9321. pp 78-89.

Tonnquist, Bo & Hørluck Jens (2009). Project Management: A complete guide. 1st edition. Denmark. Academica. ISBN: 978-87-7675-728-1

Von Zedtwitz, Maximilian. (2002). Organizational learning through post-project reviews in R&D. R&D Management 32, 3. Blackwell Publishers Ltd. pp. 255-268.

APPENDICES

Appendix 1. The e-mail questionnaire for this thesis

Appendix 1.

Survey of development project performance in view of the doers for Environmental Products & Technologies

Jarkko Kangasmäki

06.03.2014

This survey is made for Environmental Products & Technologies (later EPT) department.

Purpose:

The purpose of this survey is to identify the level of performance of development projects in EPT. The view point here is on how the doers see the performance their selves. This performance is measured here with the level of technical expertise, project roles and responsibilities, communication and co-operation with different parties.

Focus:

The survey focuses on teams in EPT. The aim is to define how teams see their strengths and where are the challenges to be improved. Also the co-operation between the team, other teams and other parties outside of EPT is to be identified in order to point out the improvement points.

Focus area:

This survey is only concerning only the **development projects** in field of *innovation, technology and product development*. Delivery projects are to be excluded from this, with the exception of pilot projects.

Confidentiality:

This survey is confidential and the results will be reported as one anonymous report. Replies of participants won't be handed over to other parties than the surveyor.

Reply date:

Please send your reply as soon as possible or latest **14.3.2014**

THANK YOU FOR YOUR CONTRIBUTION!

Personal info:	
Position:	Designer ☐ Engineer ☐ Expert ☐ Manager ☐ General Manager ☐
Team:	E&P ☐ V&PC ☐ P&T ☐ Other ☐
Experience in development projects in other organisation(s): Experience in development projects in current organisation:	_____ years _____ years
Participation to development projects (innovation, technology, products)	
Current development projects on going:	_____ (amount)

Question1.
Between 1-5, rate the level of **technical capabilities** of your own team, on how the development projects are being performed? Describe your answer shortly with strengths and challenges.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
Strenghts:	**Challenges:**

Question 2.
Between 1-5, rate the level **how project roles and responsibilities are defined and executed** in your own team? Describe your answer shortly with strengths and challenges.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
Strenghts:	**Challenges:**

Question 3.

Between 1-5, rate the level of **communication** of your own team in development projects? Describe your answer shortly with strengths and challenges.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
Strenghts:	**Challenges:**

Question 4: Describe with strengths and challenges, during development projects, how do you see your teams **co-operation** between:

TEAM ITSELF	
Strengths	**Challenges**

OTHER TEAMS IN EPT	
Strengths	**Challenges**

PROJECT MANAGERS	
Strengths	**Challenges**

OTHER R&D ORGANISATIONS	
Strengths	**Challenges**

BUSINESS UNITS	
Strengths	**Challenges**

Question 5:

In your own words, describe how would you develop EPT in general on development project performance?