Improving group-level knowledge re-use

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Abstract

Due to knowledge being difficult to imitate, effective knowledge management provides several key competitive advantages. It involves managing knowledge within organizations in order to ensure the right knowledge reaching the right person at the right time.

Scania CV AB is one of the world's leading manufacturers of trucks, busses and engines for marine and industry purposes. As part of the work with streamlining processes, knowledge management has become a focus area within their R&D. This master thesis has been carried out at four groups grouped under the section UTP Process support, consisting of a mechanical workshop, logistics, improvement coaches, and logistics and measurement. The purpose was to identify areas with potential for improvement, and present suggestions for improvements, with reusability of knowledge as the main focus.

A total of 132 interviews and surveys, and four workshops were conducted in order to gather data, generate improvement proposals and anchor ideas. A literature study was conducted to provide a frame of reference.

A four-quadrant model was generated, to make possible the mapping of knowledge work within the involved groups. This aims to provide a general model supporting improvements in knowledge management, by establishing a conceptual frame of reference where ambition and current state can be compared, providing a base for improvements and follow-ups over time.

The improvement coach group is at the forefront of the issues addressed in this thesis report, which in this context also poses their primary challenge. Suggestions on how work can keep improving are presented, including further developments of the group's so called skills matrix.

For the other groups, freeing up time of experienced employees is recommended in order to transfer knowledge to less experienced colleagues. Furthermore, improving the availability of documents controlling the employees' work is recommended, as well as ensuring these are fully updated to a larger extent. Lastly, the groups should work on increasing knowledge exchange between them and external parties, such as customers and suppliers.

Future recommendations include carrying out a pilot study of the proposed model, in order to improve the model and examine how different business units within product development organizations can benefit from it. A follow-up should be carried out to examine if the recommendations have made a difference.

Keywords: Knowledge management, knowledge reuse, knowledge transfer, lean product development.

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Sammanfattning

En effektiv kunskapshantering kan ge unika konkurrensfördelar, då kunskap är svår att imitera. *Knowledge management* inbegriper hantering och ledning av kunskap i organisationer för att säkerställa att rätt kunskap når rätt person vid rätt tillfälle.

Scania CV AB är en av världens ledande tillverkare av lastbilar, bussar och motorer för marin och industri. I arbetet att effektivisera processer har kunskapshantering blivit ett fokusområde för R&D. Detta examensarbete har utförts mot fyra grupper under sektionen UTP Process support, med en mekanisk verkstad, logistik, förbättringscoacher samt logistik och mätrum. Syftet var att identifiera områden med förbättringspotential och presentera förslag för fortsatt förbättringsarbete, med återanvändbarhet av kunskap som fokus.

Totalt 132 intervjuer och enkäter, och fyra workshopar genomfördes för att samla in data, generera förbättringsförslag och förankra idéer. En litteraturstudie genomfördes för att ge en referensram för studien.

För att kartlägga hur kunskapsarbetet fungerade på de olika grupperna, genererades en fyrfältsmodell. Denna syftar till att ge en generell metod för förbättringsarbete kring kunskapshantering, genom att formulera en konceptuell referensram där ambitionsnivå och nuläge kan jämföras, för att ge underlag till förbättringsarbete och uppföljning över tid.

Gruppen med förbättringscoacher ligger i framkant i frågorna som examensarbetet behandlar, vilket i detta sammanhang också utgör dess främsta utmaning. Förslag ges på hur arbetet kan fortsätta förbättras, däribland en vidareutveckling av gruppens så kallade kompetensmatris.

För de övriga grupperna rekommenderas att frigöra tid för erfarna medarbetare att överföra kunskap till mindre erfarna. Vidare rekommenderas att tillgängligheten av dokument som styr arbetet ses över, och att dessa hålls fullständigt uppdaterade i högre utsträckning. Slutligen bör grupperna arbeta för ökat kunskapsutbyte mellan grupperna och externa parter såsom kund och leverantör.

Som framtida arbete rekommenderas en pilotstudie av den framtagna modellen, för att förbättra denna och undersöka hur olika grupper inom produktutvecklingsorganisationer kan dra nytta av den. En uppföljning bör genomföras för att undersöka om implementering av givna rekommendationer har gjort skillnad.

Nyckelord: Knowledge management, kunskapsöverföring, lean produktutveckling, återanvändbarhet.

NOMENCLATURE

This section lists the acronyms and Scania-specific words used in this thesis.

Explicit knowledge	Knowledge that is easily formulated in words
Gantt-chart	A schedule of activities and phases in a project
Implicit knowledge	Knowledge that is hard to formulate in words
Knowledge management	The management of knowledge
Codification	Strategy knowledge management in written media
Knowledge transfer	Transfer of knowledge between individuals
LAMDA	Look, Ask, Model, Discuss, Act
Lean	A set of principles for effective processes by waste elimination
PDCA	Plan, Do, Check, Act
Personalization	Strategy for knowledge management between individuals
UT	The section Technology Development within R&D
UTP	The section Process support within UT
UTPI	The Improvement coaching group
UTPL	The group R&D Logistics
UTPM	The group Logistics and measurements
UTPW	The group Mechanical workshop
VP	Visual planning

PREFACE

This report has been written as part of a master thesis conducted at Scania under 2013. Two KTH students examined how knowledge reusability could be improved in four groups under UTP – Process support, and developed a generic model for group level knowledge management mapping and follow-ups.

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Faraz Kuhpai

Stockholm, March 2014

"And what, Socrates, is the food of the soul?
Surely, I said, knowledge is the food of the soul."

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1. INTRODUCTION

Following an increasing global competitions, rising prices of raw materials and stricter environmental requirements, achievements in innovation and product development will become increasingly important for the continuous competitiveness of Swedish companies. One fundamental part in this is innovative work processes. (Heper, 2010)

In light of this, more and more companies have adopted some form on initiative for not only efficiency improvements in manufacturing, but to an increasingly higher amount product development processes. The term *lean* was coined during the 1990s and is comprised of a set of principles for waste elimination, where waste is defined as anything that is not of any value for the customer – parts of the process the customer isn't willing to pay for (Ullman, 2010). The application of lean in product development process poses a number of new challenges for companies (Liker & Morgan, 2006).

As part of waste elimination in product development processes, initiatives have been taken to examine whether standardized work processes can be applied in areas prone to a higher degree of task variation than in manufacturing, since this is believed to minimize the risk of mistakes being repeated and current solutions not being used (Alagic, 2012). Since knowledge is hard to imitate, effective knowledge management can provide unique and necessary competitive advantages (Davis et al., 2006). Alavi and Leidner (2010) say that the competitive advantages lie first and foremost in the application of knowledge, rather than in the knowledge itself. This is also confirmed by Milton (1999), who writes that many of the most successful companies in the world are the ones who are best at managing their knowledge. Knowledge management is compromised of the managing of knowledge within organizations to ensure that the right knowledge reaches the right person at the right time (Riege, 2005).

1.1 Background

Scania CV AB is one of the world's largest manufacturers of trucks, buses, and marine and industry engines. Following an increasing global competition, Scania has a need for streamlining their processes for continued profitability. During the past ten years, the number of employees within R&D at Scania has more than doubled. Peter Palmér, head of UTP – Process support within R&D and the industry supervisor of this thesis, means that rapidly growing organizations must apply knowledge management to tackle these challenges.

1.2 Problem definition

A pre-study within the limits of this theses demonstrated that the management of knowledge varied between the groups under within UTP. Initiatives had been taken with standardized work processes, manage deviations daily, visualize processes and planning, using the A3-format for a number of purposes, shortening instructions and reference guides and introducing checklists. A more thorough investigation of how the management of knowledge functions within and between these groups was desired by the industry supervisor, to examine how reusability of knowledge could improve, by mapping how knowledge was transferred, stored and returned on group-level.

1.3 Purpose

This thesis aims at examining the management of knowledge at four groups within R&D at Scania, to identify areas of improvement and preset improvement proposals. The main focus is knowledge reusability.

1.4 Research question

The overall research question is:

How can reusability of work-related knowledge improve at group-level?

To specify this further, the following sub-questions are added:

SQ 1 What barriers and shortcomings exist in the management of knowledge in the examined groups?

SQ 2 How can a generic model be formulated to map areas of improvement in an organization's knowledge management?

SQ 3 How can the groups at UTP work to reach their knowledge management ambitions?

1.5 Delimitations

The thesis was limited to the groups at UTP. Interview and survey respondents were chosen within these groups. By examining several groups, with differences in work tasks, the results could be made generic enough to also be useful for other groups. In the final stages, additional respondents in other parts of the company, who held an insight of the research topic, were chosen as well.

1.6 Organization

This section provides an overview of the groups at UTP Process support, and their context within the organization UT Technology development, taken from Scania Inline (2013).
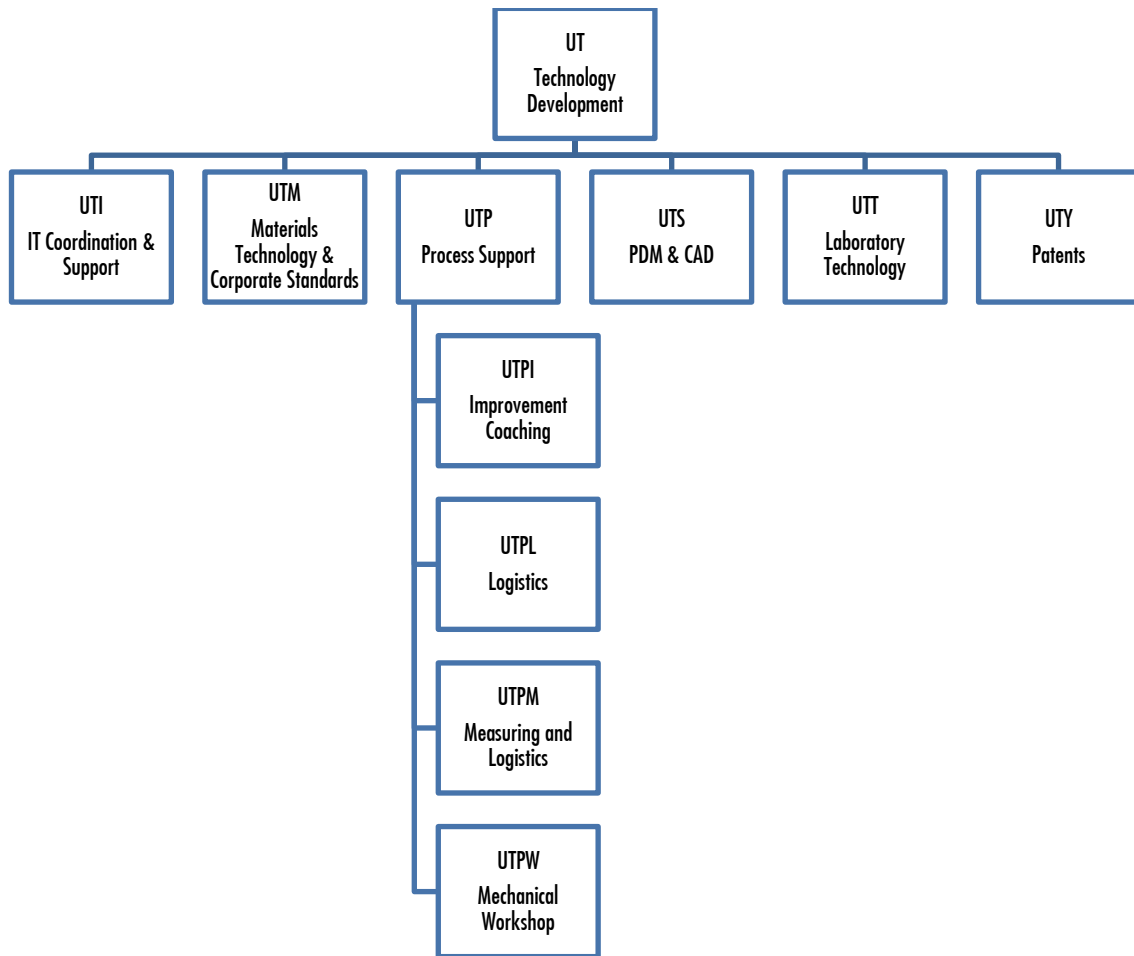
Figure 1. Organization chart UTP (adopted from Scania Inline, 2013)

UT – Technology Development	UT consists of a number of sections, with the mission to support developing groups within R&D.
UTP – Process support	UTP consists of the groups UTPI, UTPL, UTPM and UTPW. Their mission is to support the R&D organization with improvement coaching, logistics, measurements and a mechanical workshop.
UTPI – Improvement coaching	UTPI consists of one manager and two improvement coaches, with the mission to support managers at UT in their improvement efforts.
UTPL – Logistics	UTPL accounts for materials handling of prototype parts in R&D, and consists of one manager and 16 employees. The customers consists of R&D and the sections working with chassis and engines. They have a continues exchange with UTPM due to their similar work tasks, to be able to support each other's work forces when needed.

UTPM – Measuring and Logistics

UTPM handles logistics of standard parts and measurements, and consists of one manager and nine employees. The measuring room supports all of R&D with measurements, and measures mainly engine parts in the testing process.

UTPW – Mechanical Workshop

UTPW is the name of the mechanical workshop, with a mission to produce pre-prototype parts and sample parts. Their main customers are design engineers within R&D. The group consists of one manager and 21 employees, with tasks ranging from processing, water jetting, free form manufacturing, sheet metal and welding to part preparation and process handling.

2. METHOD

In this section, the methods used in this thesis' different phases, and the supporting literature are presented.

2.1 Approach

This thesis aims to provide recommendations to the examined groups on appropriate knowledge management improvements. This was possible using the theoretical frame of reference and the empirical data gathered in interviews and workshops, in conjunction with a model developed for mapping of knowledge management. Figure 2 illustrates the approach taken during the study.
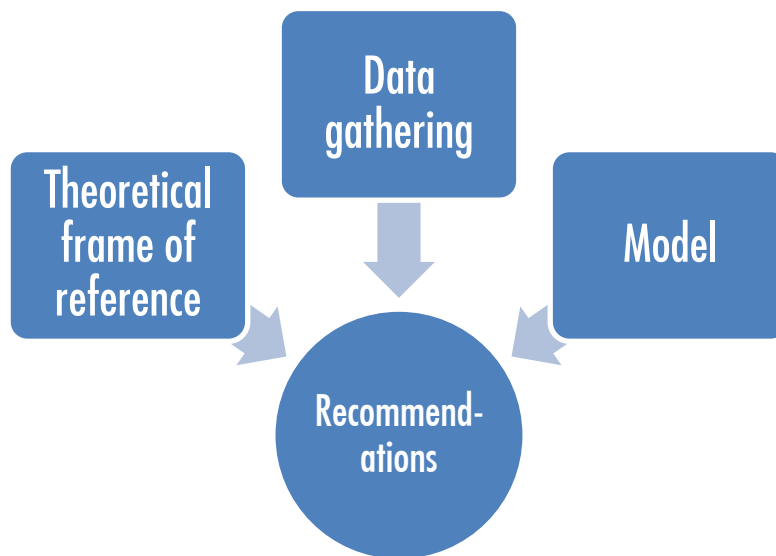
Figure 2. Overview of the approach taken to carry out this thesis

2.2 Planning

The planning of this thesis was based on the LAMDA method, as described by Ward (2002), and was seen as appropriate due to the fact that large portions of the work consisted of mapping areas of improvement. The acronym LAMDA stands for *Look, Ask, Model,* Discuss and *Act. Look* is about going and seeing for yourself, and not just take note of problems through reports and reviews. *Ask* puts an emphasis on going to the bottom with the root causes of any given problem, and asking the questions needed to do so. *Model* is about analyzing, simulating and prototyping solutions. *Discuss* involves discussions with mentors, experts and developers of adjacent systems, to validate solutions. *Act* is the last phase and is about testing your assumptions experimentally. The method is of an iterative nature and assumes going into the Look-phase when the Act-phase is done (ibid).

Figure 3 illustrates a rough overview of the phases and activities undertaken in this thesis, in relation to one LAMDA cycle.
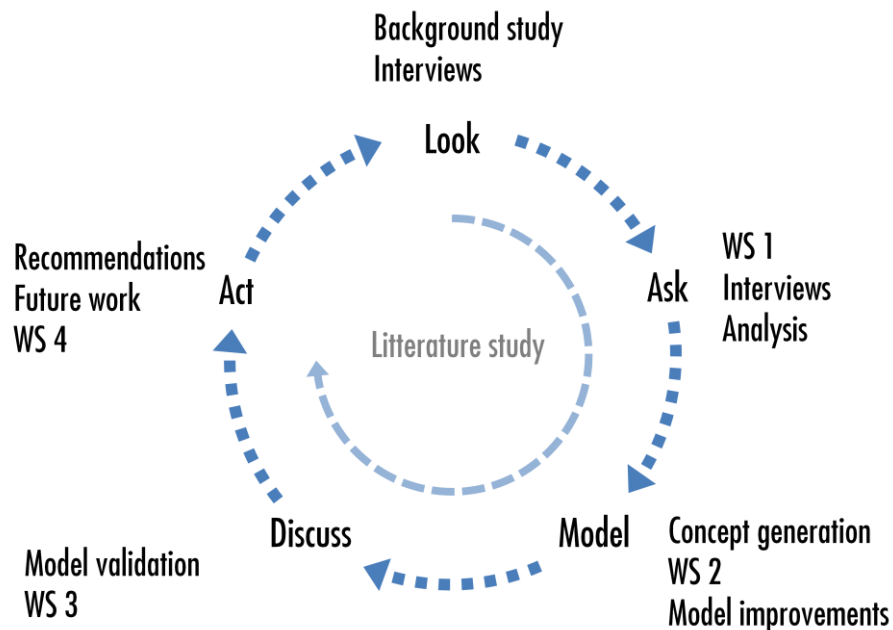
Figure 3. LAMDA phases undertaken during the writing of this thesis

The LAMDA cycle was used on two levels during the project – phase and project level. Figure 3 illustrates activities on project level; however, the cycle also proved to be useful within the phases themselves. *Look* was about reviewing the results of the previous cycle, *Ask* relates to interviews and data gathering, *model* was the thesis writers' own ideation sessions, such as the concept generation, *discuss* consisted of workshops, ongoing discussions with for example supervisors, and *act* relates to drawing conclusions of the work done up until the end of each phase.

During the project, a visual planning board, a *VP,* was developed and used by the writers of this report, and is attached in Appendix A. This VP included common and individual activities at day-level. Activities for the following three weeks was represented as separate columns, done at week-level. In addition to the activities, there was also room for ideas, pending issues and ideas for solution proposals. This board was used to facilitate planning using Post-it® notes to show what activities were to be done and by whom. Every Friday, a review session was held to plan upcoming weeks and walk through the pending, solution and idea boxes of the VP. This also facilitated communication and knowledge transfer between the theses writers, as described by Sobek and Smalley (2008, in Lindlöf & Berggren, 2011), and reduced the risk of misunderstandings while also enabled spontaneous discussions around the planning, as described by Olausson and Berggren (2010, in Lindlöf & Berggren, 2011). The planning of the thesis work was also done on week-level as a Gantt-chart, as described by Tonnquist (2010).

2.3   Tour

Early on in the project, observations in the form of tours were conducted at the examined groups. Managers of the respective groups showed the thesis writers around the workplaces while open dialogues were held. The purpose was to get an overview of the employees' tasks as well as how knowledge was managed within each group.

2.4 Literature study

Since the thesis didn't wasn't given a clear mission statement its start, but rather aimed at examining areas of improvement in the management of knowledge in the examined groups from the ground up, a literature study was conducted continuously during the writing of the thesis. The literature consisted mostly of articles, theses, e-books and physical books. These were found using the search engine provided by the Royal Institute of Technology, KTHB Primo, Google scholar, the library of KTH and the Stockholm Public Library.

2.5 Interviews

Interviews were conducted in several of the thesis' different phases. The interview approaches are described in the this section.

2.5.1 Interviews 1.1 – Open

The first round of interviews was conducted with the managers of UTPL, UTPM and UTPW, as well as the two improvement coaches at UTPI. The interviews were of open form and aimed at providing an overview of and insight into the groups' work, their view on knowledge and knowledge management, and the respondents' spontaneous view on what problems the groups had in their daily work. Lantz (2013) writes that the open interview form contributes to conclusions about qualities, an understanding of the individuals' experiences. Notes were taken and served as basis for formulating interview guidelines to the next round of interviews, the semi-structured interviews.

2.5.2 Interviews 1.2 – Semi-structured

Semi-structured interviews were conducted with the same people as in the open interviews, with the addition of the manager of UTPI. The interviews were conducted with individually adapted interview guidelines, designed to capture the respondents' understanding of the concepts at hand, as Lantz (2013) describes that semi-structured interviews should be designed.

In conjunction with these interviews, the respondents from UTPI were asked to describe how knowledge flows within the group. This was done by filling out arrows and distributing the knowledge flow in percentages, in relation to where they turn to seek knowledge when their work tasks demand that they do so. The illustration filled out by the respondents is attached in Appendix B.

2.5.3 Interviews 1.3 – Observations

When the managers of each group had been interviewed, there was a need to observe the daily work and ask open-ended questions to the employees of each group about how they learn and teach in their daily work. These observations also aimed at taking in the employees own, spontaneous thoughts about common problems in their work. The questions are attached in Appendix G.

2.5.4 Interviews 1.4 – Directed open-ended interviews

Further interviews examining two aspects of the work at UTPI – their log and a case question – were conducted following a proposal by the industry supervisor. The respondents were asked to answer directed open-ended questions, which according to Lantz (2013) gathers data increasing the understanding of people's subjective experiences. The respondents were also asked to describe, step by step, the procedures of initiating a new coaching assignment, to provide an insight into how standardized work routines were used in practice at UTPI.

2.5.5 Interviews 2 – Structured

This round of interviews was conducted with each and every employee in the examined groups. The interview part consisted of 16 main questions, where most questions were formulated as statements with a response scale of 1-5, where 1 accounted to *Disagree* and 5 *Completely agree*. The interview guide is attached in its entirety in Appendix C.

Along with these main questions, supplementary questions were also asked to complement with qualitative explanations, thereby providing an understanding of underlying causes. The questions were based on previous indicators that needed further investigation. Lantz (2013) writes that structured interviews are done to capture the perception of phenomena determined in advance. At this stage, a first version of the developed model was generated.

2.5.6 Interviews 3 – Validation

These semi-structured interviews aimed at getting feedback on the proposed model, from managers and senior employees with experiences of knowledge management in different parts of Scania. The main question was the applicability of the proposed model.

Respondents were selected through a search in Scania's intranet, HR Inline, by querying people who had put knowledge management as keywords in their intranet profiles. The interview questions were aimed at getting the respondents' view on the model's strengths, weaknesses, opportunities and threats, in order to evaluate the model in a SWOT analysis, as described by Tonnquist (2010). The respondents were first asked to describe how knowledge was managed at their respective groups. After this, the model was presented in an A3 format after which the respondents were asked to answer a series of questions regarding their view of the proposed model. Lastly, the respondents were also asked to answer questions regarding their interest in using the model. The interview guideline is attached in Appendix D.

2.6 Workshops

Four workshops were held during the execution of this thesis project in conference rooms at UT, in order to hold discussions regarding the questions examined at each occasion, present an insight of the status of the thesis project, hold ideation sessions and take in opinions and feedback from people affected by the subjects examined in the thesis project. Each workshop contributed to the results of the thesis project, in ideas for improvement proposals as well as the developed model.

2.6.1 Workshop 1 – Interferences, knowledge transfer, flow

The purpose of this workshop was to discuss areas hitherto found to be interesting based on the interviews that had then been conducted with UTPI, more specifically knowledge management, knowledge flows and interference management. The workshop commenced with an exercise called *Random Word Association*. This is a warm-up exercise aimed at practicing the associativity within a group (Breiler, 2004). The workshop leaders, which were the writers of this report, began by saying a word, whereby the workshop participants in turn were asked to freely associate and say the first word they could come up with. The remaining parts of the workshop consisted mainly of discussions on the three topics of the workshop, which were based on analysis of the interviews that had been conducted up until then. Lastly, the participants were asked to summarize the workshop in an A4 landscape format. The purpose of this was to test difficulties of summarizing large quantities of information in a condensed way, similar to the idea of the A3 format. The workshop lasted approximately two hours and was held July 4.

2.6.2 Workshop 2 – Model improvements

The purpose of this workshop was to present an early version of the developed model to the employees of the improvement coaching group, in order to test usability by discussing where the group found one selves in relation to the model, and to brainstorm improvements of both the design of the model as well as the questions used to gather input data to the model.

The model, which had been generated after the round of structured interviews described in section 2.5.5, was presented to the participants during this workshop. By presenting the underlying theory and its proposed use, the participants were provided with basic knowledge, enabling them to contribute with ideas on the model's further development. The exercise used was the *Relay baton* described by Breiler (2004), where the participants could build upon each other's ideas. Besides from developing the model further, ideation was also held to obtain improvement suggestions for the questionnaire designed to gather input data to the model. The participants were also asked to discuss where they found themselves in relation to the model, where they wanted to be and how they could work to get there. The workshop lasted about two hours and was held on October 9.

2.6.3 Workshop 3 – Model test at UTP

This workshop was held during a management meeting with UTP to hold a discussion on how the managers wanted the employees at their respective groups to manage knowledge in the future. The purpose was also to test the model and test its suitability for this kind of discussions, as well as if it was easy to relate to.

A short review was given on the underlying theory, whereupon the managers were asked to individually write on Post-it® notes where in the model's four quadrants they considered their groups to have an emphasis at the times, where they wanted to have an emphasis in the future, and ideas on how they could work to bridge any gaps therein between. After the discussions, the group's respective outcomes based on the answers given in the structured interviews were presented. The workshop lasted about one hour and was held on November 4.

2.6.4 Workshop 4 – Model implementation at UTPI

Toward the end of the execution of this thesis project, a workshop was held with the employees of UTPI to deal with four points: ambition, future improvements, the thesis writers' improvements suggestions and the skills matrix.

The first part of the workshop aimed at formulating an ambition for the group in relation to the proposed model. This was done in two ways: by answering three questions, and by drawing directly in the model. The purpose was to formulate a group ambition, and to examine which of these two ways of doing it was more suitable.

The participants had on beforehand answered the final survey, which gave an outcome in the four-quadrant model on how knowledge was transferred within the group. This outcome deviated from the ambition, and was used to let the participants individually, during three minutes, formulate ideas on how to work to bridge this gap. The ideas were then brought up in discussion and listed on a whiteboard.

After this, causes and improvement suggestions derived from the overall data collection of observations, interviews and workshops during the thesis project were presented by the thesis writers. The purpose was to validate the identified causes and to reject those not considered correct according to the group.

Lastly, an exercise was held around the group's skills matrix. This was presented in a modified way so that the most experienced person's numbers were missing, and showed a scenario where the remaining group didn't reach the level formulated as the group's desired level. Discussions covered whether this was a problem, and how one could work to collectively always reach a desired level, regardless of situations where one person was missing. The purpose was to question how the skills matrix was used, and examine whether it was possible to used it to steer the employees' competence development in a more systematic way. The workshop lasted about four hours and was held on November 22.

2.7 Analysis

Gap analysis and the KJ method were used to continuously compile and reflect over the knowledge gathered during literature studies, interviews and workshops throughout the process of the thesis project. Lastly, the gathered empirical data was analyzed in relation to the theoretical frame of reference gathered in the literature study.

Gap analysis is a way of formulating current state and ambition level in firms and organizations in general. Gap analysis of processes identifies gaps between existing results of existing processes, desired results, and includes the development of means and demands for bridging that gap. Addagada (2012) sums it up in two main questions: *Where are we?* and *Where do we want to be?* Using the quantitative data gathered in the survey, in conjunction with ambition levels formulated by the managers, the gap could be determined, after which it was determined how the groups could bridge the gaps.

Silverstein et al. (2009) describes the KJ method as a way to categorize and prioritize qualitative data. The KJ method was used in this thesis project in analyzing qualitative data gathered in interviews and workshops. The method was used after interviews and workshops contributing qualitative data, to discover trends in the answers provided by the respondents. By using Post-it® notes where qualitative data was written down and placed on a whiteboard, clusters of similar data could be created.

2.8 Concept generation

Following the structured interviews, a concept generation was started to examine how to make the most out of the data gathered in relation to the theoretical frame of reference. Through several brainstorming sessions, the thesis writers came up with the idea of distributing the questions along two dimensions, where one consisted of the two knowledge management strategies of personification and codification, and the other of two knowledge transfer motivational factors – push and pull. The basis for the model is illustrated in Figure 4.

	PUSH	PULL
PERSONALIZATION	"I have knowledge – I will present it"	"I need knowledge – I will ask for it"
CODIFICATION	"I have knowledge – I will publish it"	"I need knowledge – I will search for it"

Figure 4. The basis for the proposed model

Since most questions in the structured interviews were based on a scale, an average could be obtained for each questions, but also a mean value of questions related to one another. This lead to the development of a four-quadrant model, which at the time only described amounts in each respective quadrant.

Further brainstorming lead to two main concepts: a radar chart and a fourquadrant with pie wedges, illustrated in Figure 5 and Figure 6 respectively. The model was further developed in workshop 2 and workshop 4, as previously described.
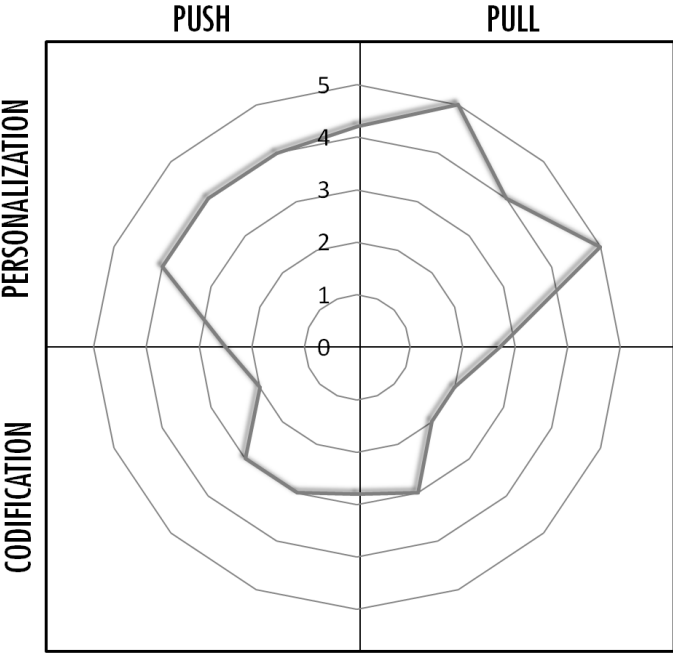
Figure 5. Radar diagram concept
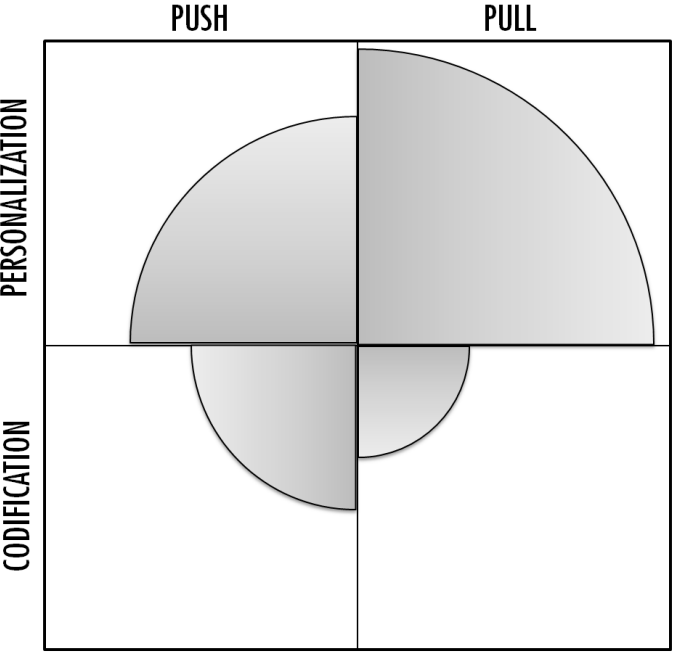
Figure 6. Pie concept

2.9   Survey

A survey was designed coupled with each quadrant in the fourquadrant model developed in the concept generation. This was designed to be generic enough to be used in contexts outside of the thesis project, and be applicable in organizations outside of Scania as well. The survey was sent out to the same respondents that participated in the structured interviews, gathering the data used to produce each group's respective outcome in the fourquadrant model. The survey is attached in Appendix O.

2.10   Reliability and validity

A large portion of the theoretical frame of reference was proposed by supervisors at Scania and KTH, while others were considered credible and usable by the same people. The reliability was considered satisfactory since sources were selected with this supervision. The interview designs were adapted according to the examined issues, which is considered crucial in method selection according to Holme and Solvang (1997). High reliability is according to these authors obtained when different measurements give the same results, and was ensured by interviewing every employee separately. The respondents consisted of virtually all employees of the examined groups, and two main interview rounds were conducted. The questions were not given out on beforehand, which eliminated the risk of respondents discussing the questions and answers with each other. Questions were reviewed in conjunction with supervision before any interviews or surveys were conducted, which secured the validity by making sure the right questions were asked (ibid). The same applies for method selection, which was discussed with supervisors both at the company and at KTH before execution. The final proposed model can be viewed as valid since the sources and interviews are considered reliable. This was presented to individuals with an insight in the subject and was validated as a model applicable in many types of organizations.

3. THEORETICAL FRAMEWORK

This section contains a compilation of previous research, and constitutes the foundation of the study conducted within the limits of this thesis project.

3.1 The concept of knowledge

There exists a number of ways to describe what knowledge really is. A common theme is that knowledge can be seen as refined information. Davenport et al. (1998) describes knowledge as information combined with experience, context, interpretation and reflection, and as something that can be generated by adding value to information. Alavi and Leidner (2010) also describe knowledge as something more than information, by describing knowledge as authenticated information, where information is processed data, and data is raw material and facts. Nonaka (1994) writes that knowledge is created by the flow of information in conjunction with the commitment and conviction of the bearer. Nonaka defines information as a flow of knowledge or messages (ibid). Serban and Luan (2002) describes knowledge as information in practice, and as the last step of a decision making process. The first step in this process is data, which when put in a context, is transformed into information. Knowledge is created when information is combined with the experience and judgment of the individual, group or organization at hand, to serve as a decision support (ibid).

3.2 Knowledge management

Knowledge management is described by Johnsson (2012) as a field that has grown to become an umbrella term for a number of things. The cornerstone is a systematic and organized way of handling explicit and tacit knowledge, which in turn leads to the generation of new knowledge (Serban & Luan, 2002). By enabling usage of the capacity and abilities within an organization in a systematic and organized way, efficiency and competitive advantages can be obtained, while at the same time promoting innovation (ibid). This has become a strategy for organizations to improve their processes and becoming more competitive (Chua & Lam, 2005). Alavi and Leidner (2010) write that no single knowledge management system can be developed to be optimal – different approaches must be used to handle the large quantity of knowledge types. Corbit (2005) writes that companies that posses valuable knowledge, also meaningful to competitors, must take action to protect the knowledge both internally and externally.

Most knowledge management projects aim at three things according to Davenport and Prusak (1998). The first is to make visible knowledge and its role within an organization. The second is to develop a knowledge-intensive culture and encourage knowledge sharing and proactive knowledge seeking. The third is to build a knowledge infrastructure and encourage individuals to interact and cooperate. According to Alavi and Leidner (2010), the common focus in knowledge management is aimed at four processes: creating, retrieval and storing, transfer, and application of knowledge. Corbit (2005) gives a similar picture of what knowledge management consists of: all processes connected to identifying, sharing and creating knowledge, which can be explicit or tacit in nature.

Shankar et al. (2012) describes three phases for knowledge management and causes of knowledge losses in these, from an individual's perspective:

Capture Taking in or absorbing previous and existing information, data and experiences. Main reasons for knowledge losses in this stage is lack of communication, lack of thorough planning, and poor identification of important knowledge.

Process Transformation of absorbed knowledge for own use. Knowledge losses at this stage is mainly due to: 1) Work climate. Teams with fully defined goals, roles and responsibility, along with individual freedom, leads to fewer knowledge losses. 2) Poor information revision. 3) Department change.

Transfer Knowledge transfer between a division or person to another. Main reasons for knowledge losses in this stage is waiting for information, poor data handoffs, and inefficient transfer media. (Shankar et al., 2012)

The authors claim that creating a long-term intelligence within an organization, where knowledge is preserved and knowledge losses are minimal, is only made possible through a strong collaboration network. Idea and information exchange with internal and external parts of an organization is key to reusing old experience to create new knowledge (ibid).

Chait (1999) highlights the importance of discussing three important factors within an organization before implementation of knowledge management initiatives: 1) *Vision and connection.* As with a lot of things within a firm, knowledge management must too clarify a vision in line with the goals and strategy of the organization. 2) *Handle content, work culture, processes and infrastructure.* 3) *Create an effective plan*, where these questions are asked: What knowledge bases are to be started with? What platform should be used? What roles and governance processes should be established?

3.2.1 Factors for success

Corbit (2005) writes that organizations that are successful in their knowledge management, see knowledge as an asset. These organizations strive to develop the norms and values to support the creation and sharing of knowledge (ibid). The author further claims that firms making use of knowledge management initiatives usually assigns a manager for the entire project, responsible for all steps of the way – creating, capturing, spreading, sharing, using, developing and evaluating initiatives for knowledge management. Hansen (1999) claims that knowledge management should not be isolated from HR and IT departments. Processes for creating, storing, acquisition, sharing and application of organizational knowledge can be supported by IT systems (Davis et al., 2006). Serban and Luan (2002) write that knowledge transfer works best when a powerful and user-friendly technology is available.

According to Chait (1999), firms successful in their knowledge management are so because of their *knowledge capital*. By that, the author means knowledge about: 1) their employees, which helps the seeking of knowledge and expertise with colleagues, 2) their customers, which helps in support and service, 3) own methods and tools, which makes possible the contribution of a consistent and efficient service, 4) own routines and groups, which keeps colleagues posted on each other even though they often don't have the time to meet.

The foundation of knowledge management is that knowledge that is taken in is documented, but to a limit. Leaders and managers tend to exaggerate documentation, which often leads to overloading. The costs in terms of time and maintenance can overweigh the advantages, which in term then makes the knowledge management a waste. When knowledge is organized and easy to find, it also increases in value. Standardization in an organization contributes to fewer knowledge losses, as illustrated in Figure 7. A successful strategy is based on the organization's ability to link its business strategy to its knowledge demands, and distribute resources for knowledge utilization. (Shankar et al., 2012)

Standardized work methods have also been shown being able to be positively related to creativity (Lund, 2012).
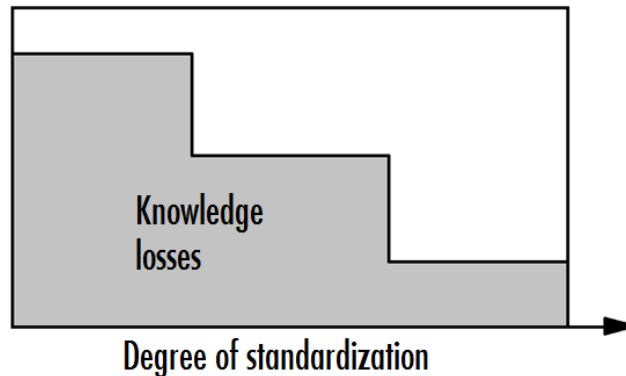
Figure 7. Knowledge losses by degree of standardization (adapted from Shankar et al., 2012)

Chua and Lam (2005) examined successful knowledge management projects, and identified the following factors for success:

- An increase of project resources, for example people and budget
- An increase of knowledge content and usage (number of usable documents, access to databases or the knowledge of colleagues)
- Projects not being tied to individuals
- Evidence of economic returns regarding the knowledge management activities or for larger parts of the organization

To make use of knowledge from these initiatives, examining failed projects is important as well, since it provides an opportunity to learn from mistakes. Failures in knowledge management are often based in technology, culture, content and project management. (ibid)

Go and see

Ward (2007) advices managers to leave the office and *go and see* real things, data and events, and not just take in information through progress reports. By talking to customers and walking through knowledge, you learn better. Further, the author suggests that managers should fill in as backup in times of resource scarcity, since this helps managers maintaining their technical competence, see where problems are and motivates employees to keep the schedule. (ibid)

3.2.2 Types of knowledge transfer

Nonaka (1994) presents a model describing how organizational knowledge is developed through an alternating dialog between tacit and explicit knowledge, called the *SECI model of knowledge dimensions*. New knowledge is developed by individuals, but organizations play a critical role in articulating and amplifying the knowledge. The model is presented as a 2x2 matrix with tacit and explicit knowledge on each axis, with the conversion type in between – *socialization, externalization, combination* and *internalization,* as depicted in Figure 8.

	Tacit knowledge	To	Explicit knowledge
Tacit knowledge	Socialization		Externalization
From			
Explicit knowledge	Internalization		Combination
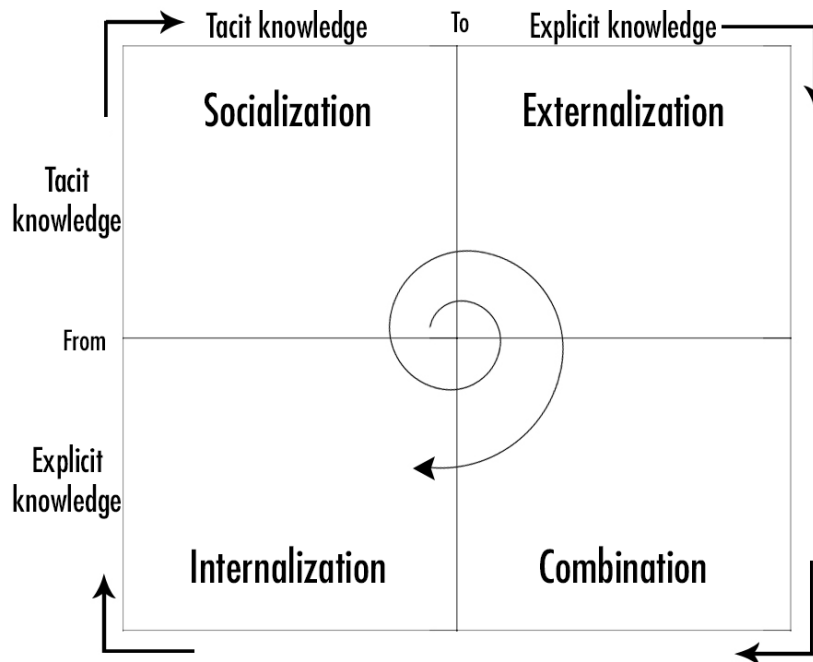
Figure 8. Types of knowledge transfer (Nonaka, 1994)

Explicit knowledge is knowledge that is codifiable, and transferrable through formal and systematic language. Tacit knowledge is more difficult to formalize and communicate. This can consist of cognitive elements, such as mental models of the surrounding world, or technical elements, such as knowing, craftsmanship and skills within specific contexts. (ibid)

Knowledge transfer from tacit to explicit (socialization) is exemplified through an apprentice learning their craft through observation, imitating and practicing. Explicit to explicit (combination) is about combining different units of explicit knowledge by for example meetings of phone conversations. Tacit to explicit (externalization) is about articulating tacit knowledge and involves the use of metaphors. This is by nature a difficult process, since tacit knowledge is hard to articulate. Explicit to tacit (internalization) means learning through action – *learning by doing* – and is encouraged by experiments. (ibid)

Nonaka also gives a number of strategies for promoting knowledge creating, including redundancy, fast access to existing knowledge and information, and so called *middle-up-down management* (ibid). Redundancy is mentioned as a way of promoting sharing of tacit knowledge. As part of that, strategic rotation is proposed, especially between different parts of technology and between functions such as R&D and marketing, as a way of building redundancy and helping employees in understanding the firm from different perspectives. Fast access to information and knowledge means everyone should be given access to necessary information with a minimal number of steps (Numangami et al, 1989, in Nonaka, 1994). Information availability is also mentioned by Ward (2007), who means that both the physical and electronic environment should be organized to make information available and reliable,

so that employees quickly can find the knowledge and information needed in their work. All information should have an owner responsible for this.

3.2.3 Strategies for knowledge management

According to Johnsson (2012), the literature describes two main types of strategies for knowledge management – codification and personalization. Hansen (1999) provides and overview of these as seen in Table 1.

Table 1. How consulting firms manage their knowledge (adapted from Hansen et al., 1999)

	Codification	Personalization
Competitive strategy	Provide high-quality, reliable, and fast IS implementation by reusing codified knowledge	Provide creative, analytically rigorous advice on high-level strategic problems by channeling individual expertise
Economic model	Reuse economics: Invest once in a knowledge asset; reuse it many times Use large teams with a high ratio of associates to partners Focus on generating large overall revenues	Expert economics: Charge high fees for highly customized solutions to unique problems Use small teams with a low ratio of associates to partners Focus on maintaining high profit margins
Knowledge management strategy	People-to-documents: Develop an electronic document system that codifies, stores, disseminates, and allows reuse of knowledge	Person-to-person: Develop networks for linking people so that tacit knowledge can be shared
IT	Invest heavily in IT; the goal is to connect people with reusable codified knowledge	Invest moderately in IT; the goal is to facilitate conversations and the exchange of tacit knowledge
HR	Hire new college graduates who are well suited to the reuse of knowledge and the implementation of solutions. Train people in groups and through computer-based distance learning. Reward people for using and contributing to document databases.	Hire M.B.A.s who like problem solving and can tolerate ambiguity. Train people through one-on-one mentoring. Reward people for directly sharing knowledge with others.
Examples	Ernst & Young, Andersen Consulting	McKinsey & Company, Bain & Company

Codification strategy

The codification of knowledge means a transfer from person to document. The knowledge is extracted from the developed and becomes independent of the same person in the moment it is documented, after which it can be used by others. This method helps the gathering of knowledge from others without them having to contact the developer of the knowledge. The strategy is used by Ernst & Young among others. (ibid)

Personalization strategy

The personalization strategy is based on dialog between individuals, where no intermediary steps, for example a database, exists. Such knowledge is transferred in meetings, brainstorming and workshops, and through direct personal contact. This strategy provides a deeper understanding, and is used by McKinsey & Company, among others. (ibid)

To make this strategy work, an effort to building networks is required among the employees. Knowledge is transferred not only *face-to-face*, but also through for example phone conversations, e-mails and video conferences. The efforts by McKinsey have resulted in staff being transferred between departments, and norms set up where employees are, for example, expected to get in touch after missed calls. This type of firms can also make use of electronic documentation systems, where the purpose is to quickly find the knowledge one is looking for, and contact the person who contributed with the said knowledge. (ibid)

Selecting knowledge management strategy

In firms working with their own products, the maturity of the product can determine what strategy should be strived for. Standardized and mature products benefit from a codification focus, whereas customized products, and products with a high variance, benefit from a personalization focus. However, one should not shift strategy when products increase in maturity. Focusing on one strategy to 80 % and using the other as a backup is ideal; focusing equally on both runs the risk of both failing. (ibid)

To make use of the systems and ensure their usage, drivers and required. In the codification strategy, a system must be developed with incentives to make employees write down what they know and store it in a knowledge base. Particularly in firms with an emphasis on personalization, the authors clam that strong drivers are a must. (ibid)

3.2.4   Challenges with knowledge reuse

Corbit (2005) describes problems with reusing existing solutions versus developing new ones. If one copies solutions instead of developing them oneself, it can lead to new knowledge not being created. If one tests something new on the other hand, one tends to miss out on documenting what has been done and the profitability, which complicates the potential benefits of others making use of the experiences.

3.2.5 Knowledge transfer preconditions

According to Nonaka and Konno (1998), there exists four types of *Ba* – common places or spaces for knowledge creation: *originating, interacting, cyber* and *exercising ba.* These are connected to the SECI model, and represent the preconditions for knowledge creation. Cross et al. (2002) describe four dimensions critical for relations to be effective regarding knowledge transfer, as described in the following sections.

Knowing what someone knows

When seeking knowledge in an individual, one should know on beforehand how relevant that person's knowledge is in relation to the subject at hand. How well people in a group know of each other's knowledge and skills affect the effectiveness of knowledge transfer and knowledge creation. (ibid)

Gaining timely access to that person

Knowing where knowledge resides is not enough; the person carrying the knowledge also has to be readily available. Availability can be affected by the physical and technological environment. (ibid)

Creating viable knowledge through cognitive engagement

When individuals (knowledge carriers) are willing to understand the other person's problem, a better result in form of knowledge creation is usually generated. This contrasts people who only dump information, without listening and understanding the problem. (ibid)

Learning from a safe relationship

Relationships between employees affect the knowledge transfer. When asking somebody for information, one becomes vulnerable. Asking somebody also means giving power to the person asked. Because of this, employees need to know that this power will not be used against them. Having strong relationships and mutual trust is therefore important for an effective knowledge transfer. (ibid)

3.2.6 Knowledge management from two perspectives – push and pull

Milton (2000) describes knowledge management from two perspectives, or situations – *push* and *pull*, as described in Table 2. Push is about having knowledge and wanting to share it, and pull is about needing knowledge.

Table 2. Perspectives of knowledge sharing (Milton, 2013)

Push	Pull
"I have knowledge – I will publish it"	"I need knowledge – I will go search/ask for it"
An answer, looking for a question	A question, looking for an answer
"Just in case" knowledge capture	"Just in time" knowledge transfer
Re-use not guaranteed	Guaranteed re-use
Big effort, delayed payback	Little effort, instant payback
Builds explicit knowledge	May not build the explicit knowledge base

3.2.7 Barriers

Szulanski (1994) describes four types of barriers for knowledge sharing: ignorance from both parties, lacking absorptive capacity, poor relations between giver and receiver, and slow implementation. Davenport and Prusak (1998) summarizes obstacles and potential solutions in knowledge transfer as described in Table 3.

Table 3. Inhibitors and solutions for knowledge management (adapted from Davenport & Prusak, 1998, p97)

Inhibitor	Potential solution
Lacking trust	Build trust and relations through personal meetings
Different cultures, wordings and references	Create a common ground through education, teambuilding, discussion and job rotation
Lack of time and meeting places	Establish time and place for knowledge transfer through meeting rooms, conference reports etc.
Status and rewards to knowledge owners	Evaluate results and create incentices for knowledge sharing
Lacking ability to acquire knowledge	Educate employees for increased flexibility. Make time for learning and encourage new ideas
Knowledge is seen as a privilege – "it doesn't concern me"	Promote a non-hierarchical attitude toward knowledge. Quality is more important than the source.
Intolerance toward mistakes and help needs	Accept and reward creative mistakes and collaborations. Establish a culture where not knowing everything is OK

Serban and Luan (2002) describes problem areas as reasons for implementation of knowledge management initiatives in firms. Four of these are listed below.

Information overload and chaos	Finding what you need to do your work can be time-demanding unless access is provided to a well-organized and easily available information structure.
Information congestion	Mechanisms targeting specifically the data or information sought for, speeds up networks to their best capacity.
Segmentation	Unlike before, most individuals have a specific expertise in an area or a segment of an area. Project completion often requires access to information from several other areas. Gaining access to the right information in the right time, without being an expert in several fields, will most likely improve individual and organizational efficiency.
Turnover	The average years spent by individuals on the same position has decreased from being lifelong, to ten years, to three years (in the year 2000). When colleagues retire or change jobs, they take with them valuable experience. The author cites a study which showed that while 36% of the knowledge in an average firm resides in paper or digitally, 42% reside in the employees' heads.

Knowledge wastes

Ward (2007) describes knowledge wastes in three categories: *scatter, hand-offs* and *wishful thinking*.

Scatter is about things impeding flow, namely barriers in communication and poor tools. The advice provided by the author to reduce scatter is to reduce the amount of formal structure in the development process, such as tasks, checkpoints and reports. The author warns about process over-standardization, and highlights the importance of thinking lean, and formulating clear areas of responsibilities for results, rather than a focus on strict process following. The focus is on flow and *pull management*, and that each and everyone is responsible for doing things in a way that works. (ibid)

Hand-offs means useless information and waiting. To clarify what in a process that can be seen as useless information, Ward separates information that is *nice to know* from *need to know*, where the former at best serves as a social lubricant, but does not add direct value to the process. All hand-offs slow up the process, similar to transaction costs. The author advocates minimizing hand-offs, and delegating ownership over larger parts or the entire process. Hand-offs also mean responsibilities get separated from action, knowledge and feedback. (ibid)

Hand-offs can also mean knowledge losses if the hand-off is ambiguous or the ownership policy is lacking (Shankar et al., 2012)

Wishful thinking is about unexpected iterations, and knowledge not being taken advantage of from earlier experiences or for future re-use. Examples are testing to specifications rather than testing real use. This would assume that specifications cover all possible use scenarios, and since this is highly unlikely, there is a chance of failure in finding errors that occur outside of testing environments. Knowledge about how the product functions in practice, in real situations, is not generated and can therefore not be re-used in future work. (Ward, 2007)

3.2.8 Criticism of knowledge management

Rubinstein and Firstenberg (1999) mean that one problem with the ideas behind knowledge management is the tendency to neglect individual's will to try things and experiment, and that creativity can suffer as a consequence. Lund (2012) nuances this by showing a possible positive relation between standardized work and creativity, in form of ideation, as long as the organization is open to change of existing routines when needed. Continuous improvements also showed positively related to creativity (ibid).

The SECI model has been criticized in assuming tacit knowledge to be more valuable than explicit, since this is the same as equating the value of knowledge with the inability to express it. Milton (1999) describes knowledge as seldom being purely tacit or explicit. How easy knowledge is formulated in words depends not only on the knowledge itself, but also on the knowledge bearer – people can experience different ease in articulating the same knowledge (ibid).

3.3 Lean product development

Lean is about a number of principles for increase resource efficiency through waste elimination. Implementing isolated lean tools will not lead to sustainable improvements; a holistic approach, a broad organizational culture and sustainability is required. Further, these principles must reach higher up in the organization than the shop floor. Product development at Toyota is lean (even though they do not use this term themselves) – it is customer focused, continuously improved through waste elimination, and integrated up- and downstream in the value chaing. (Liker & Morgan, 2006)

Ward (2007) suggests ways to implement lean in product development. One cornerstone is the value focus, and that value in product development is to create usable knowledge and profitable value streams, rather than a focus solely on profitability. The creation of usable knowledge is seen as the means to reach then end of profitable value streams. The author also notes that little is often done to capture knowledge after projects (ibid).

3.3.1 Lean and knowledge management

Alfredsson and Söderberg (2009) proposed advice and suggestions on how lean tools can be used to bridge formal and informal gaps in knowledge transfer and ease the re-use of knowledge in product development. Among these are Visual Planning boards (VP), A3 reports, trade-off curves, checklists, clear areas of responsibility to promote learning, and so called knowledge owners – suggestions also discussed by Ward (2007). A3 reports are described by Liker and Morgan (2006) as suitable for communicating only the most important information in a simple and visual format.

4. EMPIRICS

To create an overview of how work was done in the examined groups, interviews, observations and workshops were conducted. These involved all groups under UTP, although workshops were held mainly at UTPI. The data collection process is illustrated in Figure 9.
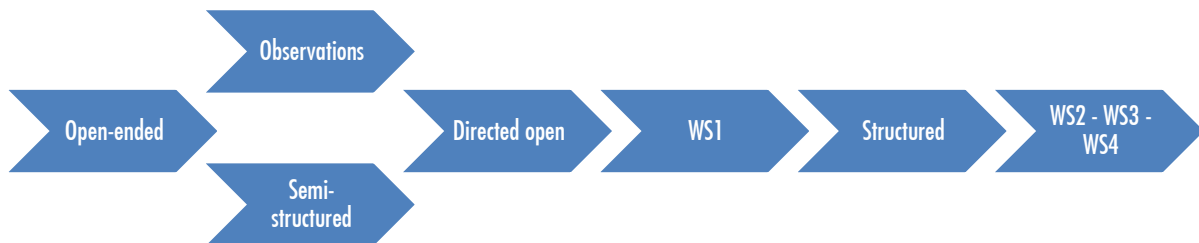
Figure 9. Data gathering process

4.1 Interview empirics

During the process of this thesis project, a number of observations and interviews were conducted with employees of the groups under UTP, aimed at gathering information about how the groups work, what problems they experience, and how knowledge is managed at a group level. This was done in four steps: open-ended interviews, semi-structured interviews, observations, and structured interviews.

4.1.1 Semi-structured interviews

Based on answers from the open interviews, interview guidelines were formulated to everybody at the group UTPI as well as the managers of the other groups. These can be found in Appendix E. The purpose was to gather further knowledge about the problem areas identified in the open-ended interviews.

At UTPL, the issues related to knowledge management consisted mostly of routines that could be updated to a larger extent, since these were not always fully up to date. During the past two years, much had been done to improve efficiency through improved warehousing thanks to compressed inventory, and a closer cooperation with UTPM by periodically letting employees rotate between the groups since their tasks were similar. Some remaining issues were regarded as related to setup times with suppliers, and therefore difficult to resolve.

At UTPM, the manager thought deviations should be handled immediately. Since the work regarding logistics had many similarities with the work of UTPL, these two groups had an exchange regarding handling of deviations. Most recurring problems were considered to be about external deviations, primarily with part orders, but also with scrap flatbeds not being exchanged and parts not getting picked up by customers. To tackle deviations regarding part orders, the manager considered meetings important. Often, problems were about unreasonable time requirements. Standardized work routines meant "every employee knew everything" regarding the work in the group – by working closely and learning from each other, the idea was that all employees should be able to rotate tasks. A *Kanban system*, a system that enables the visibility of material needs, had been implemented. The knowledge possessed by experienced workers in the measurement lab was considered best acquired by potential new employees through courses and working alongside with experienced workers. Routines were written down, wrapped in plastic and made available at a locker, however it was pointed out

that these were not used to a large extent if you were a professional. As with UTPI, UTPM used a skills matrix. The design of a skills matrix is attached in Appendix F.

At UTPW, improvements in managing knowledge were considered regarding documentation of knowledge. Efforts had yet to be undertaken, and the manager thought an experienced employee could write the necessary documents. These should be simple documents, in combination with knowledge transfer by new employees working alongside with experienced colleagues. Problems regarding knowledge transfer with other groups within the company were considered to be mostly about lacking documentation and drawings from design engineers, since these sometimes lacked the knowledge about what was possible to manufacture. Tolerances were sometimes too fine, radiuses too narrow, dimensions were missing, and so on. *Go and see* had been one way of trying to deal with these issues. The manager considered a guide or booklet with things to think about while ordering prototypes, to avoid repeating the most common mistakes. A checklist had been implemented, which had lowered the failure rate. Another idea was to try rotating jobs with clients. *Lessons learned* was used to make employees learn from each other's processes and increase the understanding of each other's tasks. This had also been done with summer workers, to get their perspective. Disturbances were put on an improvement board, and handled by an improvement group.

UTPI used several ways of gathering knowledge. Courses, seminars, learning from colleagues and reading and reflecting over books and standards were mentioned as examples. Written standards were usually designed in a checklist-part and a knowledge part. When no standard was available, employees would turn to the group. The processing of knowledge usually meant generating an A3 report, after the decision to make one had been made in the group. This was described as processing, then verifying with colleagues, and lastly documenting. It was pointed out that a risk here was that one would consider their own knowledge, and miss other's perspectives. It was also pointed out that getting presentation material after lectures and seminars could be hard, and that gathering new knowledge into the group's products immediately, before it would risk being forgotten, was important. The work regarding A3 reports was inspired by lean thinking and work at Toyota, and was considered a good visual format since it hold just about the maximum amount of information a person can digest in a short time. Much of the work was inspired by LAMDA; focusing on needs and to go and see in the organization was considered important.

Knowledge sharing was done through so called knowledge exchange meetings. These were planned and marked on the VP board of the group according to a standardized process. Spreading of knowledge externally was done through meeting with for example the managers coached by the employees of the group. To prepare materials to be used, existing A3 reports and presentations were used.

It was pointed out that information seeking, to prevent work being re-done, could be simplified through for example improvements in the document management system. It was also pointed out that searching for content was not done to a large extent – usually, one would turn to their manager in questions regarding the location of proper documents, since the manager had been working with these issues for many years. Keeping a log was agreed upon within the group, and exactly how notes were taken was up to each person to decide. One coach pointed out that while it could be difficult to obtain an instant overview of what had been done in a certain group coached by them over time, it might also not be needed.

The group also made use of a skills matrix, to provide an overview of what products they worked with and who could perform various elements in each product area. The goal was for the coaches to take on each other's missions. One coach expressed a need for examining how this affected planning, and that it could be updated to a larger extent.

4.1.2 Observations

To sum up, the employees of all examined groups learnt from each other every day, more knowledge was considered to reside in the employees than written down, and colleagues usually provided better answers than written instructions and checklists. Furthermore, employees with the most experience were considered to know where problems lay. At UTPL and UTPM, work tasks were sometimes rotated, to fill in when needed between the groups.

4.1.3 UTPI – Directed open

Based on answers from the semi-structured interviews at UTPI, two areas of interest were identified for further investigation. These were the log and how knowledge flowed between colleagues, the file system, and other knowledge and information sources.

A two-part interview guide was therefore designed, where one part consisted of questions regarding the use of a log, and the other part was formulated as a case question. The latter part of the interview aimed at getting the respondents to reflect upon and describe how they proceeded in gathering knowledge when they were about to carry out assignments. The interview guide is attached in Appendix H.

In describing how the respondents' knowledge gathering was done, the respondents were asked to distribute, in percentages, how much of the knowledge gathering that was done with the file system, a colleague within the group, their manager, internet, and other sources. The answers by the coaches were calculated to a mean value, and separated from the manager's.

These interviews showed that the use of a log differed slightly between the employees. The overall purpose was to help remember things brought up in meetings with customers. Documenting the log was time consuming, and it could sometimes be difficult to get an overview since these were written chronologically. The answers from these interviews formed the bases for the first workshop.

4.1.4 Structured interviews

To further examine how knowledge was transferred within the groups, 48 interviews were conducted with employees of the examined groups, namely three from UTPI, twelve from UTPL, nine from UTPM and 24 from UTPW. The interview guide was made up of two types of questions: questions where answers were given as values on a 1-5 scale, and open-ended following questions. The answers were thus treated in two ways. The quantitative answers were calculated into group averages. The qualitative answers were processed with the KJ method, to identify how learning is done, where spontaneous knowledge spread occurs, and what recurring problems were most common. The interview guide and a summary of the results are attached in Appendix C and Appendix I, respectively.

The most common way to teach was to present orally and in practice. The most common way of learning from their managers was through oral explanations. Spreading knowledge to colleagues within the groups was mainly done orally. The most commonly recurring problems at UTPL and UTPW was poor order documentation. At UTPM, incorrect orders were the most common, and at UTPI some planning issues.

4.2 Workshop empirics

Throughout the execution of the thesis project, four workshops were conducted, aimed at discussing, gathering knowledge and generating ideas. The empirics from these are presented in the following sections.

4.2.1 Workshop 1 – Interferences, knowledge transfer, flow

The three areas discussed in this workshop were knowledge management, knowledge flow and interference management.

Regarding knowledge management, the log, A3 format and skills matrix were discussed. The conclusions in each respective topic were written on a whiteboard during the workshop and summarized in a landscape format A4 paper, attached in Appendix J.

Interferences brought up were meetings not starting on time, standards not being followed and information sometimes being hard to find. The amount of interferences was described as varying. An issue regarding the describing of interferences was also brought up to discussion – depending on who describes an interference, it might be defined and categorized differently.

The skills matrix was mostly used by the manager. During the workshop, an idea for developing the matrix further was proposed. The A3 format was used mainly for problem solving and summarizing books and seminars. At the time, further standardization of the log was suggested.

Based on the case part of the directed open interviews on log and flow, an idea was presented by the thesis writers, who also led the workshop. The idea was that a substantial portion of the knowledge gathering done from manager to employee might be a detour for information already in place in the file system. During the discussion that followed, it was noted that at the time being, the work might have been too dependent on individuals, and that in the future, more work might be needed with the file system. However, it was also pointed out that only pointing to the location of certain information is not to be equated with conveying knowledge about for example the suitability of the information or knowledge at hand. To promote the building of knowledge, the role of the manager should therefore be more similar to that of a teacher rather than a librarian; improving only the searchability in the file system might lead in the wrong direction.

4.2.2 Workshop 2 – Model improvements

Before conducting this workshop, an early version of the fourquadrant model had been developed, describing four scenarios in knowledge transfer divided on two dimensions.

During the brainstorming, the participants were asked to come up with improvement suggestions on the early version of the model presented to them, and later build upon each other's suggestions. This was done according to a method called *The relay baton*, as described by Breiler (2004). The participants were asked to formulate the improvement suggestions on Post-it® notes, and explain their ideas to each other in sequence. In this way, three new main suggestions on the design of the model were generated during the workshop. These were photographed and served as basis for the thesis writers' own continued concept development. Photos with corresponding explanations are attached in Appendix K. One main and common idea was the need for an additional dimension to cover what was to be examined using the model.

A follow-up of the workshop was done a few days later, to capture what worked well and what could improve in the succeeding workshops, and to capture any ideas the participants may have come up with in the days that followed. This was done by using a written evaluation with scales ranging from 1-5. Questions and mean values of their answers are written in Table 4. The questionnaire used is attached in Appendix L.

The final design of the proposed model, along with the associated survey used to gather its input data, was generated by the thesis writers using input from this workshop. The final design is illustrated in Figure 10.

The circle diameter, which can vary from 1-5, shows the extent of knowledge transfer in each field's corresponding knowledge transfer type. The color, which can be red, yellow or green, shows how well knowledge transfer works in each field. Red indicates unsatisfactory, yellow indicates acceptable, and green indicates fully satisfactory knowledge transfer.
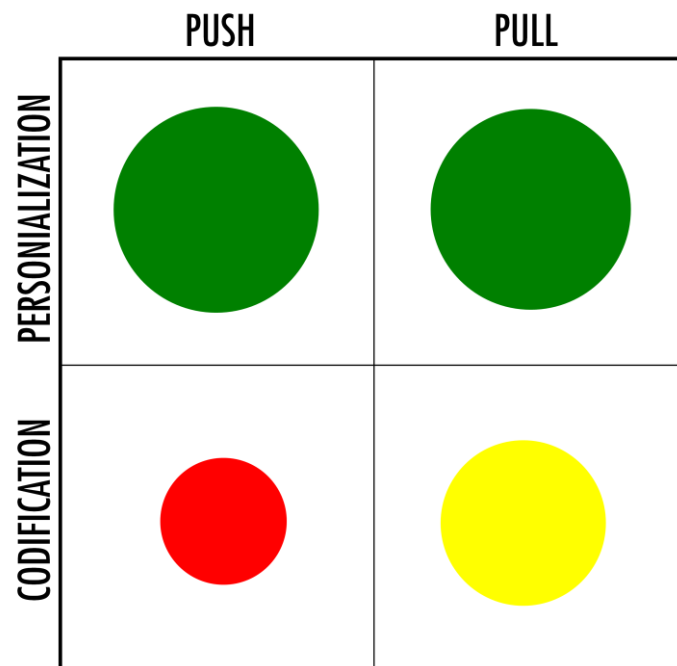
Figure 10. Model outcome example

Table 4. Follow-up of Workshop 2

The workshop clarified the current status of the thesis project	4,33
The workshop clarified the purpose and goal of the thesis project	4
The structure of the workshop felt well thought out	4
There was enough time to conduct the workshop	4,67
During the workshop, I could have my say, and everyone had their voices heard	5
The relay baton work well for brainstorming	4,33
The contents of the workshop felt relevant to UTPI	4,33
The contents of the workshop felt relevant to UTP as a whole	4,33

4.2.3   Workshop 3 – Model test at UTP

A short review of the theory behind personalization, codification, and push and pull was held, after which the model was presented. The managers were asked to formulate current state and ambition by individually writing on Post-it® notes their view on where they had an emphasis, where they wished to have an emphasis, and ideas on how to get there. After that, the results in the model of each group was presented, based on the quantitative data gathered in the structured employee interviews, to show how each group worked today.

It was pointed out that relating to the model could be difficult in formulating an ambition, since the desired way of transferring knowledge might depend on the situation. This led to the insight that ambition levels in push and pull should be formulated in two situations: knowledge spread and knowledge gathering.

4.2.4   Workshop 4 – Ambition level and UTPI improvement suggestions

The first part of the workshop was aimed at formulating an ambition level for the group, in connection to the model. This was done in two ways. First, the participants were asked to individually answer three questions and write their answers on Post-it® notes. The questions were

1. If an employee of this group wants to *obtain* knowledge, should he/she primarily
    a. search in documents, physical as well as electronic
    b. ask a colleague
2. If an employee of this group wants to *spread* knowledge, should he/she primarily
    a. write a document, send an e-mail or publish
    b. tell or present in person
3. Knowledge transfer in the group – should it primarily be
    a. demand-driven
    b. driven by the will to share

After this, the participants were asked to plot in any of the quadrants corresponding to either personalization or codification in the model, first in the situation of needing to obtain knowledge, and thereafter in the situation of wanting to spread knowledge. To obtain an emphasis between the two, additional question was asked. This additional question was the same as question 3 in the above list.

The purpose was to discuss the ambition of the group, and to test how to best set an ambition. After one test round, one of the participants suggested defining a specific and common scenario when setting an ambition, to reduce the risk of thinking in terms of ambition depending on situation. After this was done, a clearer ambition could be set. To visualize the ambition, magnets were used on a whiteboard, where the model's four quadrants were projected. The magnets represented the participants' answers to the previously meantioned questions.

The outcome of the survey differed from the ambition, but was considered to correspond well with the employees' own view on how work was conducted at the time. The participants were asked to individually, in three minutes, write down improvement suggestions on how the group could reach their ambition. The ideas were brought up in discussion and listed on a whiteboard. Ideas brought up were

- Work more with the file structure (store, sort, clean up)
- Good standards that were not always completely followed
- Try document tagging (whole documents or within documents)
- Software for improved searchability in the file structure
- Present search results in a pdf document
- Clear knowledge bank – agree upon it
- *5S* for products
- Reduce "nice to know"

After this, the workshop leaders presented causes and improvement suggestions identified from interviews and workshops during earlier phases of the thesis project. The purpose was to validate causes and reject those not considered correct by the group. These are presented in bullet points below.

- Standards not always being completely followed
  - Increase ease of access, update

The participants agreed on this, and added that steps should be listed.

- It can sometimes be difficult to find things in the file structure
  - Index/tagging/modularize/connect with the skills matrix

This was not seen as a good solution. Instead, training on the file structure was suggested as a first initiative.

- Planning does not always hold up
  - Break down more and consistently

Examples on things that could interfere with the planning were brought up, and some events that affect planning were brought up that simply could not be controlled.

- Interference management
  - Focus on recurring issues. Problem solving more often, in the near future of the emergence of the problems.

This was already done, and was not considered to be a problem to the group.

- Uneven use of logs
  - Standardize use of log

There was already a standardized process for logging, but it was not always completely followed. It was suggested to work together on it, plan its use better, and to discuss and clarify its benefits.

Lastly, an exercise was conducted that regarded the group's skills matrix. This was presented in a modified way, where the person with the highest experience in the matrix was left out. The resulting radar diagram did not reach the desired level. Examples were given on situations where this could happen for different durations. The purpose was to discuss if the current ways of working, where the coaches strived to be interchangeable in between each other, could be questioned and improved. The idea was that if the coaches were to develop similarly over time in relation to the skills matrix, to fill in for each other, one main drawback

occurred: a strong dependence on the most experienced person in the group, not reaching the desired level if that person were to be absent. If, however, different focus areas were to be selected in the matrix for the coaches to develop in, the group as a whole could reach desired level for all areas in the skills matrix faster. It was pointed out that the definitions of competence levels in practice meant that on a daily basis, the work would in most cases be unaffected, due to the nature of the tasks needed to be performed. The participants did however agree that the introduction of focus areas in the skills matrix could improve the ways of working. One other issue regarding the skills matrix, was the question regarding if it covers areas with an adequate enough level of detail, and that formulating it on a product level could make it work better. A summary of the discussions is attached in Appendix M.

A follow-up was conducted a few days later. The questionnaire used was based on the questionnaire used after workshop 2, but was expanded and adapted to the contents of the workshop. The questionnaire is attached in Appendix N. Questions and average scores are presented in Table 5.

Table 5. Follow-up of workshop 4

The workshop clarified the current status of the thesis project	5
The workshop clarified the purpose and goal of the thesis project	5
The structure of the workshop felt well thought out	4,33
There was enough time to conduct the workshop	4,67
During the workshop, I could have my say, and everyone had their voices heard	5
The workshop clarified the purpose of the model	5
The workshop clarified the design of the model	4,67
Formulation ambition with Post-it® notes worked well	4,33
Formulation ambition by answering questions worked well	4,33
Comparing ambition and current state worked well	4,67
Discussion of improvement suggestions worked well and was valuable	4,67
The contents of the workshop felt relevant to UTPI	5
The contents of the workshop felt relevant to UTP as a whole	4,67

4.3 Survey empirics

To obtain answers with a clear connection to the model, all employees of UTP were asked to fill out the survey designed to give an outcome in the model. The results are illustrated in Figures 11 – 14. The survey is attached in Appendix O.

UTPI The outcome for this group was mildly dominated by personalization, with a negligible emphasis on push rather than pull. The only yellow quadrant was pull-codification.

UTPL This group had a slightly stronger dominance in personalization. In codification, push dominated, and in personalization, pull was dominant. The only yellow quadrant was push-codification.

UTPW This group also had a dominance in personalization. In codification, there was an emphasis on push, and in personalization, an emphasis on pull. Both codification fields were marked yellow.

UTPM The outcome for this group had a dominance in personalization. In codification, push dominated, and in personalization, pull dominated. The only quadrant marked yellow was push-codification.
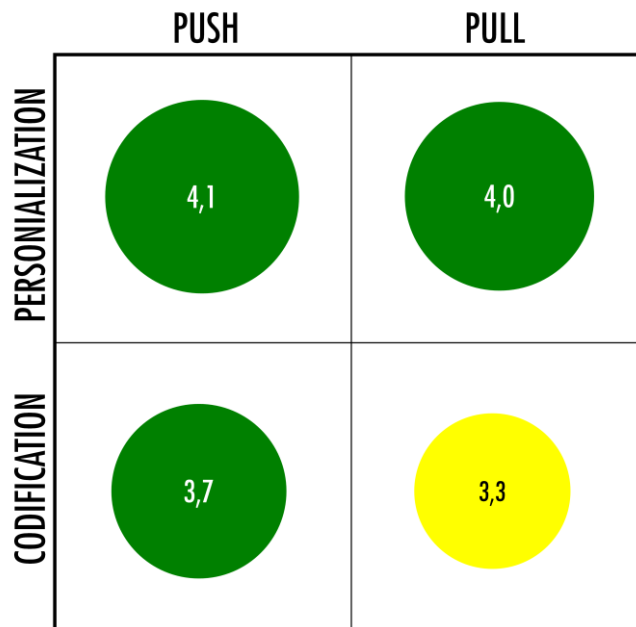
Figure 11. UTPI survey results
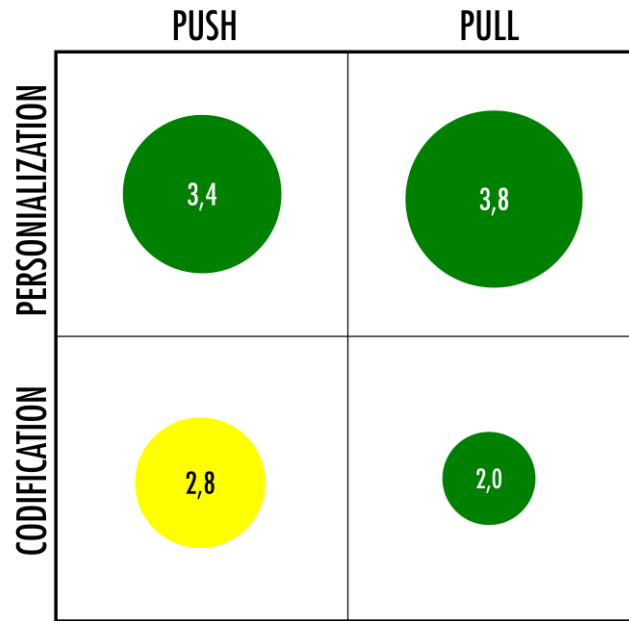
Figure 12. UTPL survey results
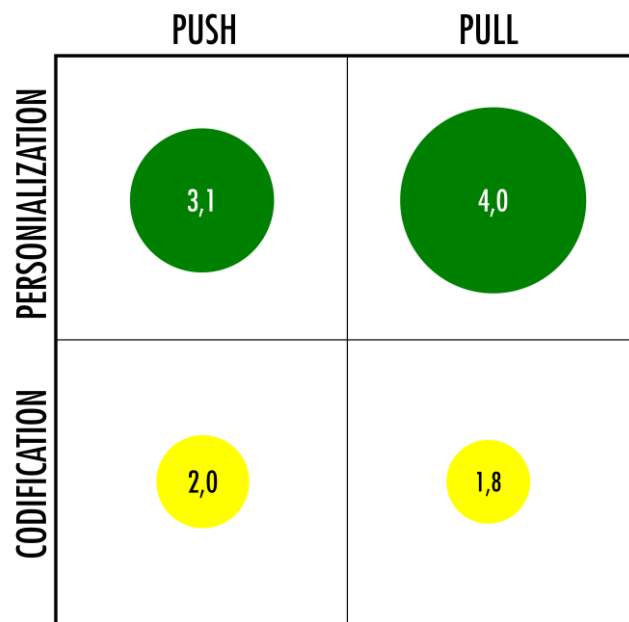
Figure 13. UTPW survey results
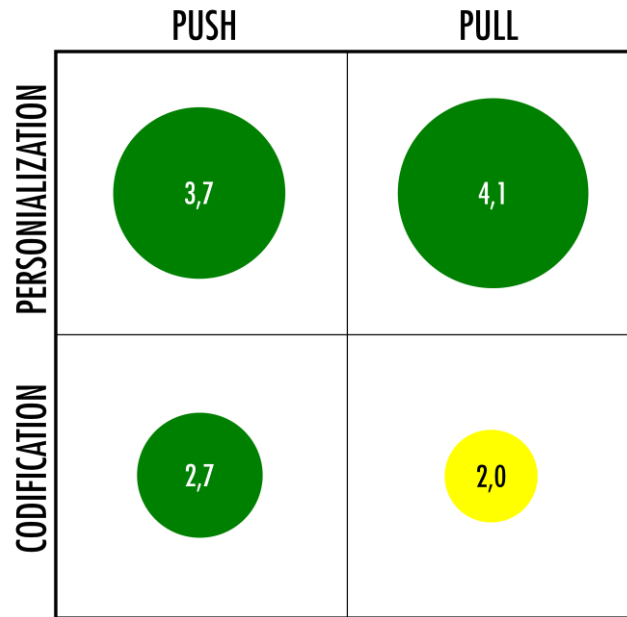
Figure 14. UTPM survey results

4.4   Model validation

These interviews generated mostly positive response in form of opportunities and strengths. All respondents considered the design of the model to be clear and generic enough to be used also outside of Scania. No respondent expressed scepticism in trying out the model themselves, however, two managers would like to have it confirmed through tests on other groups first. Most respondents considered the model's greatest strength its visual format, increasing awareness and contributing to discussions on ways of working. One potential weakness pointed out by two respondents was the honesty in survey answers, and how that could affect the results. One respondent pointed out that the tips, based on theory, might not be optimal for all kinds of operations. Figure 15 shows common answers from these interviews, sorted by strengths, weaknesses, opportunities, and threats, according (SWOT).

Figure 15. SWOT analysis of the proposed model

5. ANALYSIS

In this section, the empirics are analyzed based on the theoretical frame of reference.

5.1 Interview analysis

Respondents from the three groups working with logistics, measurements and mechanical workshop, all considered themselves to know where to turn form knowledge by asking questions to coworkers, in other words knowing who to ask and where to turn in different situations. The respondents also knew to a high degree the methods and routines demanded to carry out their work efficiently. According to Corbit (2005), another dimension in addition to these is required to fully capitalize on relevant knowledge capital, namely knowledge about external parties. This goes both ways; external parties should also have knowledge about the work in the groups since this helps the work. The interviews also showed that most recurring problems according to the respondents, were due to external parties. At UTPW, drawings were sometimes imperfect, and customers expected unreasonable manufacturing lead times. At UTPL and UTPM, articles were sometimes left without being picked up, since customers would order parts long before actual needs, or expected unreasonably short delivery times and did not pick up parts delivered later than desired. Shankar et al. (2012) means that exchange of ideas and information with external parties of an organization is key to knowledge re-use, but also a factor contributing to the creation of new knowledge between the parties. These external deviations were logged, but were still recurring. The knowledge transfer between these groups and external parties can therefore be considered to have potential for improvements.

At UTPI, the use of logs showed to be a positive but time consuming step. It was not completely clear how to best work with this. A standard had recently been formulated, but some differences in the use of log were still apparent. According to Chua and Lam (2005), one of the points for a successful way of knowledge management is to increase the knowledge content. This means increasing the number of usable documents and access to the knowledge of colleagues. The log could be one way of getting access to each other's knowledge. The group had a common knowledge base digitally in a file structure. It was considered sometimes difficult and time consuming to find what one was looking for. To find relevant knowledge residing in the file structure, employees would primarily turn to the person who knew where this was, since this was faster. Poor tools are described by Ward (2007) as a kind of barrier, obstructing the work flow, and as a type of *scatter*. Serban and Luan (2002) mean that knowledge transfer will work best when access is given to powerful and user-friendly technology. The file structure could therefore be improved for example through better software, improving searchability. But only handling these challenges with softer, runs the risk of turning into a shortcut and the wrong path to follow, and might lead to other problems, brought up in workshop 4.

In all groups, standards and routines controlling the daily work existed. These could be found in binders and on the walls. Shankar et al. (2012) states that a high degree of standardization contributes to fewer knowledge losses. However, the empirics show that all groups except the improvement coach group used these routines and written standards to a small extent in the daily work. The reason for this might be that a larger portion of the knowledge transfer were done orally.

At UTPI, a skills matrix was used to visualize the competence level on group and individual levels. It usage was not considered to be completely clear. One precondition for a well-functioning knowledge transfer according to Cross et al. (2002) is knowing what somebody else knows, which is what the skills matrix shows. The reason it was not used in a clearly

defined way might be due to the number of employees in the group was relatively smal, and that they already knew roughly what knowledge their colleagues held. The other groups, with significantly higher numbers of employees, would also benefit from using such a matrix. These groups let employees rotate work duties internally to increase the knowledge levels, which would have an outcome in the skills matrix when this would be updated. In the interviews, it was shown that employees would mostly turn to a person with high level of experience to solve problems, since these held a deep and broad knowledge within several areas. One problem that could arise was that these experience employees did not always have the time to aid others, being busy with their own tasks. Another precondition for successful knowledge transfer is getting timely access to the person being consulted (ibid). This could be done by having experienced employees act *andon* which Staats et al. (2010) describe as Toyota's way of letting experienced employees fill in when something goes wrong or a person needs help.

5.2   Workshop analysis

Workshops were mainly held with UTPI. This was due in part to the fact that the manager of this groups also was head of UTP, and in part due to the fact that knowledge management was one of the areas of work for UTPI and was therefore considered able to contribute substantially with their expertise. In the first workshop, the following of standards was brought up to discussion. VP boards, which were used to a large extent, is one way of reducing such waste (Alfredsson & Söderberg, 2009). Breaking down planning further could also be one way of reducing waiting, according to the workshop participants, since activities other easily forgotten can be included in the planning, such as the time required to physically move between different locations.

In workshop 2, the model generated by the thesis writers was presented, to generate feedback and improvement suggestions with regards to its usability and benefits. The outcome of this was designing the model so that groups would begin with formulating an ambition in relation to the quadrants presented by the model, after which employees are asked to fill out a corresponding survey, which serves as a basis for the outcome and current state in the model. When this has been done, differences between ambition and current state can be compared, and measures needed to be taken to bridge this gap can be formulated. Chait (1999) highlights three important factors for discussion previous to implementing knowledge management initiatives: 1) *Formulate vision and goals*, which is the first step of the model, 2) *handle content, work culture and processes*, which is represented by the situation analysis in form of a survey and outcome in the model, and 3) *create an effective plan*, which includes the final steps, where tips are provided on how to reach ones ambition.

The final workshop treated the results of the thesis project, in part as a presentation of the findings, and in part to give the group the opportunity to reflect upon what in their ways of working affected the managing of knowledge in the group. The results in the model pointed to a need of a larger focus on codified knowledge. Discussions were held around what improvement suggestions and solutions were necessary and reasonably implementable. Hansen (1999) suggests organizations with standardized and mature products should choose a codification strategy, while never losing the knowledge transfer between individuals. Since UTPI works with standardized products when coaching customers from other groups, putting a stronger emphasis on codified knowledge can be considered reasonable, in line with the ambition of the group.

Some of the improvement suggestions discussed in this workshop were considered not suitable, as the implementation of better software for the file structure, since this was

considered running the risk of dealing with the issue from the wrong angle; only simplifying searchability through for example tagging might erode the knowledge on how the contents should be organized, and also runs the risk of overlooking the importance of knowledge of different contents' suitability for different situations. This is backed up by Ward (2007), who states that all information and knowledge should have a responsible owner. The author also states that the electronic environment should be organized to be accessible for everybody, which in this case can hint that some sort of improvements in the work related to the file structure should be implemented. The thesis writers' conclusion regarding this matter is that the work with the file structure should be improved, however not solely with software.

5.3   Survey results analysis

By studying the outcome in the model of the surveys of the examined groups, it became clear that knowledge transfer was done in large through personalization practices, although less pronounced with the improvement coaching group. Hansen (1999) states that a personalization strategy transfers knowledge through meetings, workshops and direct person to person contacts, and that the strategy enables a deeper understanding to the receiver. It was also apparent that these groups all had a larger circle in the push column, in other words to a larger extent transferred knowledge driven by the will to share knowledge than demand it. One interpretation of this would be that more knowledge was documented that what was used in the daily work. Corbit (2005) states that documented knowledge is valuable if up-to-date and relevant. Documented knowledge not being used may be relevant in the case of new employees having a need to acquire needed knowledge, however it should also be examined whether this documented knowledge is in need of more frequent updates.

By examining the model outcomes, it was also apparent that all groups had at least one yellow circle. The design of the model aims to hint that green is always desirable, no matter the ambition. According to Hansen (1999), incentives are required to promote the contribution of codified knowledge. Milton (2013) describes push and pull as supply and demand, and means that demand will motivate the creation of a supply. The groups UTPI and UTPM both had room for improvements in codification-pull, while UTPL should focus on increasing the level of codification-push. The group UTPW was found to have room for improvements in both codification quadrants. By raising the level in these quadrants, the groups will achieve fully satisfactory levels in their types of knowledge transfer according to the model.

6. RESULTS

In this chapter, the results generated during the thesis project are presented. First, the generic model is presented. Secondly, the results from applying the developed model on the examined groups are presented. Lastly, improvement suggestions and proposals for how to reach each group's ambition are presented.

6.1 Model for mapping group-level knowledge transfer

The purpose of the model is to make visible how knowledge is managed at a group level. A base for improvements and follow-ups is created by highlighting any differences between current state and ambition. The intended way of working with the model is described in Figure 16 and in the sections that follow.

Figure 16. Model implementation process

Step 1 involves formulating an ambition in relation to the fourquadrant model, in other words choose where in the model the desired emphasis should lie. This can be done by answering the questions listed below, alternatively by discussion and reasoning around the fields in the model and its inherent meaning to the group. Setting an ambition is done in relation to a predefined and commonly occurring scenario, in order to reduce terminological confusion.

1. If an employee of this group wants to *obtain* knowledge, should he/she primarily
   a. search in documents, physical as well as electronic
   b. ask a colleague
2. If an employee of this group wants to *spread* knowledge, should he/she primarily
   a. write a document, send an e-mail or publish
   b. tell or present in person
3. Knowledge transfer in the group – should it primarily be
   a. demand-driven
   b. driven by the will to share

In step 2, a survey is conducted concerning all employees of the group at hand. The survey consists of twelve main questions with response scales, measuring extent of knowledge transfer related to each quadrant. Supplementary questions in the form of *yes* or *now* measures the level of each quadrant. The survey is attached in Appendix O.

In step 3, data is transferred from the survey to a database, generating an outcome in the fourquadrant model, shown in Figure 10. The diameter can vary between 1-5 and shows the extent of knowledge transfer in each field's corresponding knowledge transfer type. The color, which can be red, yellow or green, indicates how well knowledge transfer in each field works, where red indicates unsatisfactory, yellow indicates acceptable, and green indicates fully satisfactory knowledge transfer.

General tips on how the model outcome should be are:

- *Strive to work according to an 80/20-relation between the extent of codification and personalization. In other words: put an emphasis in one of the rows, with the other as support.*
- *Standardization and re-use benefit from a codification strategy*
- *Customization and high level of variety benefit from a personalization strategy*
- *To control the extent of personalization or codification, begin with demand, and supply will follow. In other words: take measures aiming at increasing the extent in the* pull *columns, regardless of row.*

Step 4 involves overall improvement measures, and are used whenever the outcome of current state differs from the desired state. Key points on how to change extent and raise level of each field are listed in Table 6. These aim to provide guidelines for what kind of measures should be implemented. Step 5 involves implementation and follow-up of specific measures based on the previous four steps. These are formulated by managers knowledgeable in the work done by the group at hand.

Table 6. Improvement measures

Increase codification
- Encourage to document their knowledge continuously, and provide needed incentives
- Standardize documentation to make it more efficient
- Improve searchability and traceability of documented knowledge

Increase personalization
- Support knowledge transfer through personal networks
- Establish knowledge exchange meetings, where employees can share group-relevant knowledge
- Make available time and room where employees can exchange knowledge, in addition to lunch breaks

Raise level of codification
- Standardize documentation in order to create a common understanding of how knowledge is to be documented
- Update written routines and standards continuously and make them readily available

Raise level of personalization
- Clarify competence levels of employees
- Encourage employees in working together in problem solving

6.2 Improvement suggestions

In this section, improvement suggested generated from interviews, workshops, literature and the thesis writers' own reasoning around the groups' outcomes in the fourquadrant model are presented.

6.2.1 UTPI

This group is encouraged to keep documenting more knowledge in their file structure, since that secures a future knowledge bank. This also leads to the need of an improved document management in ensuring fully adequate future searchability and traceability, with an ever growing knowledge base. Since knowledge residing in the file structure is used by all employees of the group, the group should work actively with becoming increasingly comfortable with searching and knowing where different types of documents reside. Standards could be further improved, to ensure their complete usage. Breaking down planning further could benefit the group. Products that are in progress should be connected to a *product roadmap* to plan their completion further. The skills matrix should be further developed to improve its influence on the group's work and the competence development of the employees. This can be done by breaking it down on product level, and introducing focus areas to reach a robust desired level faster.

6.2.2 UTPL, UTPM, UTPW

Since the identified challenges related to knowledge management were similar with these groups, common improvement suggestions are given. All groups has experienced employees with knowledge in most areas covered by the respective groups. These individuals should be given a more free role, enabling them to contribute with knowledge to other employees. They could also fill in when activities are behind schedule. The groups all had plenty of documented knowledge in the shape of written routines, standards and other documents controlling their work. These documents should however be updated to a higher degree. Document owners should be responsible for updating these when needed, that is, when the standards are no longer in line with the current ways of working, or when work methods need to be improved. Most deviations in these groups regarded external parties, such as customers and suppliers. An increased knowledge exchange with external parties is suggested to tackle these issues.

Since all groups had at least one yellow circle in the model outcome, standardizing knowledge documentation is recommended to increase its quality. By updating written routines and standards more frequently and making them increasingly available, the level is increased with regards to codification. Improving the knowledge transfer in personalization activities can be done by introducing knowledge exchange meetings. Time and room should also be provided for spontaneous knowledge transfer.

7. DISCUSSION

In this section, the approach of the thesis project, the developed model and improvement suggestions are discussed.

7.1 Approach

The planning of this thesis project was done in form of a Gantt chart. In the early phases, a VP board was also developed, to visually plan activities and deliverables on an individual and daily level. This was inspired by the VP board used by the improvement coaching group. The VP board done by the thesis writers was not as extensive as that of the improvement coaching group, but rather designed to cater to the planning needs of this project. Further breaking down this planning, for example on an hourly level, could have possibly made the execution more efficient, but would on the other hand have required time estimations of previously untested activities not possible.

No specific research question was proposed prior to the execution of the thesis project, other than examining the reusability of knowledge in the examined groups. As a consequence, a relatively large portion of the work was dedicated to mapping problems, in order to find challenges and areas of improvement, after which the focus could be narrowed down. Another results of this was that the literature study was conducted rather broadly, covering areas that were scrapped later on in the process, not being necessary for the narrowed down focus of the study. It is also plausible that a more specific research question before the execution of the thesis project could have made possible spending more time on for example a pilot study and follow-up of improvement suggestions. On the other hand, a pilot study would probably have needed a follow-up after such a long time that it still would have to be outside the work of this thesis project. In addition, by approaching the subject broadly and identifying issues within the project, a broad understanding was created that would probably have been difficult if done in any other way. It should also be noted that the research questions posed should be considered to be answered.

The approach was based on LAMDA and made possible continuous improvements of the activities done several times during the thesis project, for example interviews and workshops. This was also considered appropriate, being that part of the project aimed at mapping improvement areas, since this method puts an emphasis on understanding problems (Ward, 2007). The project as a whole was planned as one iteration through the LAMDA cycle, and the underlying phases as separate LAMDA cycles. *Look* mostly consisted of looking at results generated from previous phases. *Ask* consisted of conducting interviews and surveys. *Model* involved ideation and workshops, where results from previous interviews and surveys were used, for example the creation of the proposed model. Lastly, the work conducted in each phase was analyzed and discussed in the *Discuss* phases. *Act* on project level involved presentation of final results, and on phase level, the planning of each next phase.

The thesis writers were encouraged by the industry supervisor to used the knowledge acquired in the project as part of their own work. As previously mentioned, a VP board was created for planning and idea management. Workshops were summarized in a format based on the A3 report. Planning was done according to the concept of LAMDA (ibid), and parts of the process were continuously and iteratively improved. A common file structure was set up using the cloud service Dropbox.

One challenge was the somewhat dissimilar work tasks of the examined groups. This made a standardized process challenging, and meant slight modifications were done depending on what groups was to be examined. By doing this, the thesis writers were able to find

improvement areas in each group. The fact that the groups differed was also reason for developing a generic model; by doing this, all groups could be examined in large with the same approach, also making possible a standardized way of interpreting the results and suggesting improvements. The differences between the groups were also reasons for the interviews to be open in the beginning, and eventually led to a survey. Lastly, it should also be pointed out that the importance of implementability of the results contributed to the development of a generic model having a strong dominance in the execution of the thesis project.

7.1.1　Reliability and validity

The foundation of the theoretical frame of reference was laid in consensus through supervision from KTH and Scania, both through direct tips and through confirmation in supervision sessions that the sources were appropriate. The interview guides were customized for their specific purposes, and were based on interview methods found in the theoretical frame of reference, which warrants a good reliability (Holme & Solvang, 1997). Respondents to the fourquadrant model consisted of in large all employees of the examined groups, which ensured a sound validity. The risk of respondents discussin questions with each other, thereby affecting the outcome, was minimized by not handing out any questionnaires on beforehand. The applicability of the proposed model was validated through interviews with individuals knowledgeable in the subject at hand.

7.2　Generic model

Since the focus of the study was knowledge reusability, the thesis writers chose to generate a model that could be reused after the execution of the thesis project. The survey consisted of twelve questions with one or two following questions each, and was found to take about five minutes to answer. The difficulty in designing the survey was to formulate questions in an adequate way. Since the idea was that the survey should be able to be answered without any person explaining the meaning of the questions, a clear wording with little room for interpretation was important. Because of this, the survey was tested multiple times in different groups, to find any ambiguities and wordings that could be misinterpreted. Due to the generic nature of the proposed model, some subjectivity can still occur, which could affect the outcome. In light of this, it was decided that the survey questions should be asked in the context of a pre-defined, group-specific commonly occurring work scenario, as was done in the formulation of group ambition in workshop 4. The number of respondents might also affect the reliability; whether the results are accurate in groups with few respondents is not examined in this project. However, it should be pointed out that for its purpose – serving as a base for improvement work and discussion – this is probably of less importance.

The gathering of survey answers was done through paper surveys, with data manually being registered in a spreadsheet. Whether this activity is value creating or *necessary but non-value creating* is debatable. A web survey would eliminate this step, but would on the other hand mean employees might fill out the survey at different times, thereby being able to discuss questions with each other, which might have affected the results.

The improvement proposals related to the model are generic and designed to be applicable for any group or organization wanting to improve its knowledge management. The step from these general tips to group specific, implementable measures is something that has to be done in each group's own improvement work over time. Since no pilot study examining the implementation of such measures existed within the boundaries of this thesis project, challenges in this step are yet to be examined. A pilot study implementing and following up

measures taken guided by the model is therefore suggested as future work. The suggested tips are still suitable for their purpose.

The advice presented to alter the extent of codification and personalization are meant to work as improvement suggestions, and not fully defined measures. A pilot study examining challenges in this step and evaluating the effects is therefore suggested.

To ensure usability, a review of the underlying theory should be done prior to the use of the proposed model. Formulating ambition should be done both accounting both for what the group manager considers important, and the corporate strategy of the firm at hand. How this is ensured is not examined in this project, however, anchoring improvement measures developed from the model might be done by communicating the initiative is done with management of whole sections or departments with follow-ups over time.

7.3 Improvement suggestions

Full implementation and follow-up of the improvement proposals presented in this thesis project requires work over a longer, sustained period of time, outside the boundaries of this project. A pilot study is suggested for this purpose, and to examine how the management of knowledge changes over time – before and after implementing the proposed improvement suggestions. However, overall research question, along with its sub-questions, are considered as answered through the improvement suggestions and recommendations, and the generic model developed in this project.

7.3.1 UTPI

This group received a stronger focus than the other groups, due to two reasons: it was where the writers of this report were stationed physically, and the topics examined also overlapped with the focus work areas of this group.

One area of improvements found early on was the file structure used internally. One proposition, met with varying opinions during workshop 4, was improving searchability through software solutions. Only dealing with this issue through software runs the risk of heading in the wrong direction, and might lead to other future issues. Relying solely on finding appropriate knowledge in the file structure through simple search might lead to lose one part of the knowledge transfer, when the most person with the most experience on the topic at hand now longer acts as a teacher. Instead, it was proposed during said workshop to working more on getting acquainted with the structure of the file system, and further sorting this using the existing logic. However, what happens when this knowledge base grows remains unexamined. Working only with a conventional file and folder system might become problematic when for example documents can be equally logically placed in different folders. Making copies to solve this runs the risk of inducing problems when these documents are to be updated. The proposed suggestions on further sorting and training on using the file structure, making it easier to find appropriate files, and thus making it more easily available for all employees of the group, should be compared time- and cost-wise with implementing an improved software solution, which would in that case be required to maintain or even improve learning.

Other suggestions that would help the group reach its ambition in relation to the model, going from mostly personalization to further emphasis on codification, was to further improve written standards, ensuring their full usage. The maturity level of products should, according to proposals suggested during workshop 4, be managed with a *product roadmap*. If these suggested improvements will deliver desired outcome over time needs to be examined through using the proposed model to measure before, during and after implementing them.

The benefits, or drawbacks, of further breaking down planning should be examined. Breaking down the skills matrix on products level, and introducing focus areas, could improve its use and induce synergy effects, for example in helping work distribution and choosing who will go to seminars.

7.3.2 Remaining groups

In the remaining groups, a number of common improvement suggestions were generated, since several of the identified challenges were common in all groups. Introducing *andons*, experienced employees filling in and contributing with their knowledge is one solution that could help spread knowledge across the entire groups. One challenge in this is if these employees are tied with tasks hard to let go of. In that case, the groups should begin with training certain employees in taking on these tasks.

Written routines and standards were not always fully updated or adequately available for all employees, and should therefore be updated and made available to a higher degree. One challenge in making employees contribute with knowledge to documents is that it might require clear incentives. What type of incentives appropriate should be examined further. Davenport and Prusak (1989) bring out the example of rewards often solely going to the knowledge owner, which contributes to other knowledge bearers questioning how they could benefit from sharing knowledge – "What's in it for me?" needs to be clear. A solution proposed by said authors is incentives, encouraging knowledge sharing. Along with incentives, time also needs to be freed for digesting knowledge (ibid).

The most common problems mentioned by employees in these groups were results of external parties, such as customers and suppliers. Tearing down these invisible walls would contribute to the parties acquiring knowledge about each other's work methods and routines, which would possibly reduce the numbers of problems. Learning from each other's ways of working would however not automatically mean all problems would vanish entirely. Other changes in the internal approaches in communicating with external parties might be required.

8. CONCLUSION

In this section, conclusions are presented as bullet points, followed by recommendations and future work suggestions. Lastly, a recap with the initial research question is presented.

8.1 Generic model for knowledge mapping on group level

- The model is used to evaluate, visualize and provide a base for improvements
- The model is suitable for any organization
- Implementation and follow-up should be examined in a pilot study

8.2 Improvement proposals UTPI

8.2.1 Improvement proposals generated by the model

- Improve internal file management
  - o Store and sort more
  - o Simplify searchability
  - o Allocate time to work with the existing file structure
- Improve standards, to further increase their usage

8.2.2 Improvement proposals generated by other empirics

- Try further breaking down planning
- Introduce a *product roadmap*
- Develop the skills matrix further
  - o Break down the skills matrix at product level
  - o Introduce focus areas in order to reach a robust and desirable level faster

8.3 Improvement proposals UTPL, UTPM, UTPW

8.3.1 Improvement proposals generated by the model

- Standardize documentation of knowledge in each group
- Written routines and standards should be updated fully and made available to a larger extent
- Introduce knowledge-exchange meetings
- Make available time and place for communication and knowledge sharing

8.3.2 Improvement proposals generated by other empirics

- Free up time for experience employees to transfer knowledge to less experienced employees
- Improve availability of written routines, standards and other documents controlling daily work
- Tear down invisible walls between groups and external parties such as customers and suppliers, through external knowledge exchanges

8.4 Recommendations and future work

A pilot study is recommended to examine implementation and follow-up of improvement work supported by the proposed model. This should be conducted, at least initially, in a smaller number of groups, to examine challenges with the implementation step and refine the methodology of the model. By iterating in this way, the method can be further refined. This could be done as a master thesis, or other studies related to product development processes, improvement work and knowledge management.

Follow-up and using the model over longer periods of time could benefit from using a dedicated project room, where visual methods are used to manage continuous improvements. The visual design of the model makes it suitable for use in conjunction with other visual methods, and a dedicated project room would put a strong focus on improvement work and ensure required follow-ups over time.

The applicability of a visual method such as this should also be examined in relation to improvement work in product development processes in different kinds of groups. Groups involved in a pilot study can therefore benefit from varying in terms of work tasks, organization and line of business, possibly with product development acting as a common denominator. The method should be further refined and made generic enough to be equipped with a self-instructing educational bundle, both in the shape of conventional instructions, and a more easily available A3 format. The work can be done as, or combined with, case studies or action research.

Lastly, implications of using the model with respect to subjects of innovation, product variance, knowledge re-use, standardization and customization should be examined, following the need for innovation combined with standardized work routines.

The proposed improvement suggestions should be implemented strategically. By first evaluating what is most important, and then developing a time plan, the work can be conducted in ways that harmonize with surrounding work. In order to examine the effects, a follow-up should be conducted. A new data gathering can be done after a few months, to see if any differences have arisen as consequence of any changes done as a result of using the proposed model.

8.5 Research question recap

The overall research question has been answered through answering the sub-questions as described below.

SQ 1 This sub-question was answered by conducting interviews and workshops with the examined groups, thereby identifying challenges in knowledge management with help of the analysis backed by the theoretical frame of reference.

SQ 2 A generic model was generated through concept development and further development in workshops, visualizing management of knowledge in groups, providing basis for continuous improvements.

SQ 3 Improvement suggestions regarding knowledge management in the examined groups were proposed by examining found challenges and outcomes in the proposed model.

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APPENDIX A.   PHOTOS OF THE VP-BOARD

II
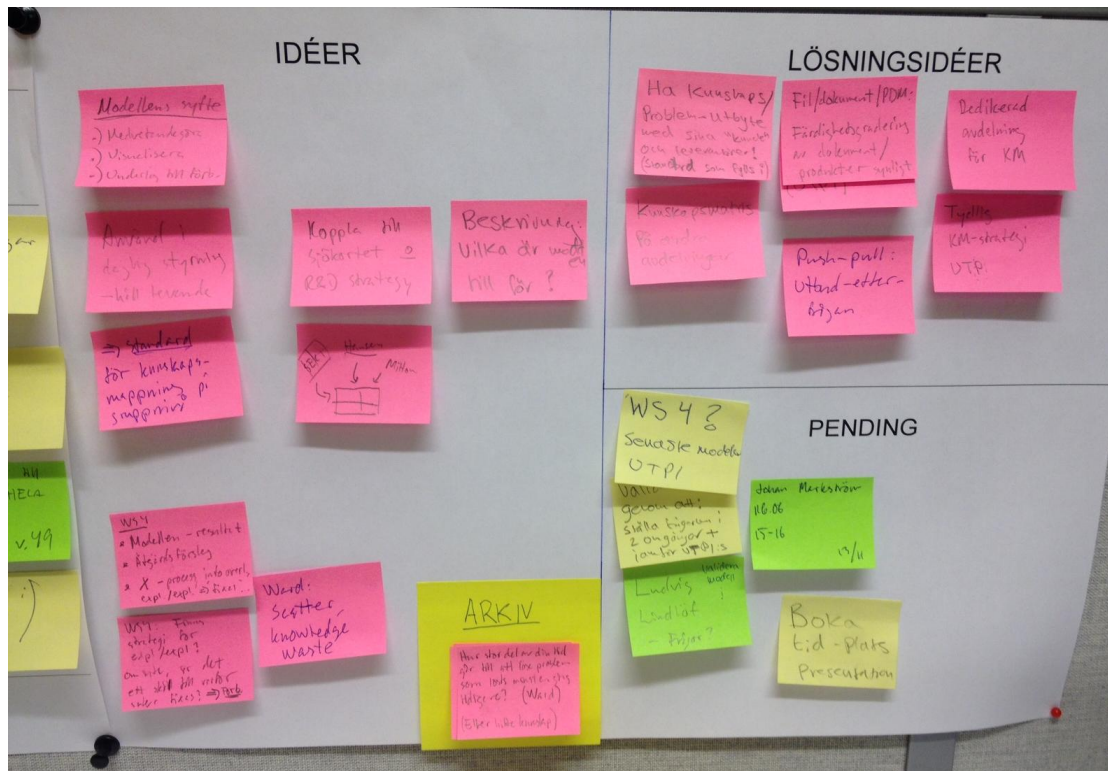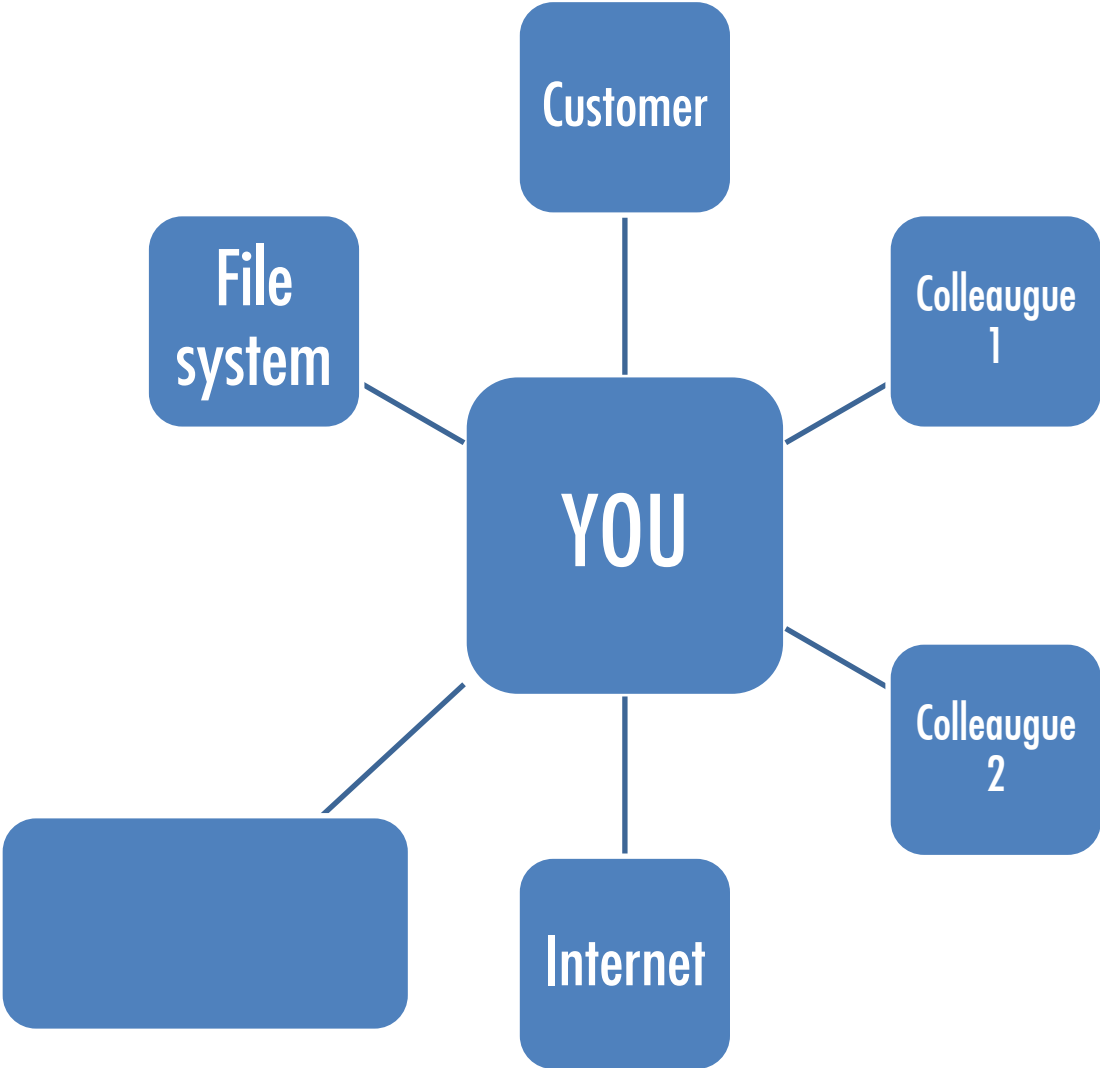
APPENDIX C.   INTERVIEW GUIDE STRUCTURED INTERVIEWS

This questionnaire consists of questions and statements you are to consider by marking the alternative you think best matches your opinion, in discussion with the interviewer.

Age:_____

Group:_____

How long have you had your current position?_____

How long have you worked at this company?_____

1. Is teaching part of your work duties?

   _____
   _____

2. You are good at teaching

   Strongly disagree   *Strongly agree*
   1   2   3   4   5

   Comments:
   _____
   _____
   _____

        a. How do you teach others?

   _____
   _____
   _____

3. Your manager is good at teaching you

   Strongly disagree   *Strongly agree*
   1   2   3   4   5

   Comments:
   _____
   _____
   _____

a. How does your manager teach you?

_____

_____

_____

4. A new coworker would quickly get started with their tasks

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

5. You always have the time and space to help others when they encounter a problem

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

a. You are always there for your colleagues

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

b. Why/why not?

_____

_____

_____

VI

6. You usually share lessons learned with your colleagues without them asking

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

    a. How? To whom?

_____

_____

_____

7. You gather knowledge by communicating with your colleagues

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

8. You gather knowledge by collaborating with your colleagues

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

9. There are easily accessible documents and written standards

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

10. You use knowledge from these documents and standards

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

11. You document things regularly

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

    a. What and why/why not?

_____

_____

_____

12. You often hand over tasks to somebody else

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

13. You feel a knowledge loss when handing over tasks

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

14. You often encounter repeated problems in your work

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

15. You know where to turn when you encounter problems or need to learn something new

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

_____

16. You imitate existing solutions and knowledge to solve tasks

Strongly disagree   *Strongly agree*

1   2   3   4   5

Comments:

_____

_____

X

APPENDIX D. GUIDE FOR INTERVIEWS 3 - VALIDATION

Validation interview

1. Ice breaker: "Tell us a little about how you work with KM"
2. Show the model, the survey and guidance points
3. Explain all the steps for how the model should be used.
4. Start a discussion: let the manager point out where in the model their group is, where they should be and how they can get there

SWOT analysis

5. What are the strengths and weaknesses with the model?
    o   Does the survey give a reliable result?
    o   Is the model clear enough for drawing conclusions?
    o   Is it adaptable everywhere, if not, what makes it specific for Scania?
6. What are the opportunities and threats with the model?
    o   Can one advantage from the model? How?
    o   Can the model be misleading?
    o   Can the model be developed and better? How?
    o   Can one combine the model with other daily tasks?

Interest

7. Would you be willing to use the model in order to get a clear view of how you work with knowledge?
    o   If yes, would you be willing to make changes according to the model?
    o   Would you recommend the model to other groups?

APPENDIX E.   INTERVIEW GUIDE INTERVIEWS 1.2

Questions to manager at UTPW

1) Is it OK to record?
2) What does knowledge mean to you?
3) Do you consider that the knowledge management lacks in your department? If so, where are these flaws?
    a) Have you tried to resolve these? How?
4) Do you consider that the knowledge management have flaws between you and other departments? How?
    a) Have you tried to resolve these? How?

5) You use *lessons learned*. Why? How do you take the results in action?
6) Daily disruptions are documented but the follow up has failed to materialize (Alagic, 2012) Is this still the case? Why?
    a) How do you proceed with disruptions today?
    b) Have you improved in this?
7) Alagic describes that FFF processes take six days of work, but is compressed into five days, which results in uneven workloads.
    a) How do you work with the cycle time?
8) Do you get recurrent inadequate documentation?
    a) Which flaws in the documents are the most recurrent?
    b) Are you trying to educate designers to not get these recurrent flaws?
    c) How do designers take part of your demands on documents?
    d) How is overproduction prevented? Is there a standard for it or do you just keep a dialogue?
9) What is your solution for having a better understanding of UTPW and its customers' processes?
10) Does flaws occur in the processors manufacturing specification? Does the engineering workers detect these flaws?
    a) What is your solution to improve this?
11) What kind of documentation is not necessary from the designers?
12) Can we take part of your department's deviation reports?

Questions to coaches at UTPI

1) Describe your knowledge acquisition?
2) How do you process gathered knowledge?
3) How do you distribute processed knowledge?
4) Do you feel that the knowledge you distribute gets used and does not disappear?
    a) If yes, how do you get it confirmed?
    b) If no, what do you do about it?
5) Please show us an example of one of your products, document for standards etc.
6) How do you confirm that you don't do work on something you already got in the department?
    a) Search for it?

b) How much time is spend on looking for document that you already have?

c) How do you take part of your colleagues documents?

d) How do you share your documents and products with your colleagues?

7) What is in appropriate scale of a standard?

8) A3 – Is it an appropriate format for quick reading through?

a) Where did you get the idea?

b) How much information?

9) Where does your assignments come from?

a) What happens when an assignment come to the department?

b) Do you create assignments?

10) When you have an assignment but need more knowledge about that area, what do you do?

a) Internal or external knowledge gathering?

11) The log

a) Is the documentation of it standardized?

b) Do you take part of each other's logs?

12) How are you assured of what happened at the last meeting etc.? "What did we say" "did we take any decisions"?

a) Standard document…? Visually?

13) Tell us about the flow game

a) To what end is it used?

b) Is the arrangement different from time to time, how do you prepare?

14) How is the skills matrix used

a) How does it affect your work in the short term as well as over the long term?

b) How is it formed?

15) If you were supposed to quit your current position, how would you transfer your knowledge to the substitute

(Knowledge flow figure, Appendix B)

Number the order in which the sources are contacted. Rate the thereafter, in percentages, the amount of knowledge/information gathered from various sources. There should in total be 100%. Flows may have the value zero if you think that this is the case.

Questions to manager at UTPL

1) Is it OK to record?

2) What does knowledge mean to you?

3) Do you consider that the knowledge management lacks in your department? If so, where are these flaws?

a) Have you tried to resolve these? How?

4) Do you consider that the knowledge management have flaws between you and other departments? How?

a) Have you tried to resolve these? How?

5) Items are waiting long periods. Why is that? Is it a problem? What is your solution?

6) Why can't you wait with the purchase when you know that the item will be standing in the shelf's for many months?

7) What have you done to lower the load factor? Have UTPM embraced the lesson?

8) Is it OK to take copies of your visualized process etc.

Questions to manager at UTPM

1) Is it OK to record?
2) What does knowledge mean to you?
3) Do you consider that the knowledge management lacks in your department? If so, where are these flaws?
   a) Have you tried to resolve these? How?
4) Do you consider that the knowledge management has flaws between you and other departments? How?
   a) Have you tried to resolve these? How?
5) Who are your customers and suppliers?
6) What is your solution for the fact that UTPM and the customers should have better knowledge about each others' processes.
7) Is there anything in the department that is not standardized? Why? Can it be standardized?
   a) According to your boss, there are experienced workers in the test room who know how to tackle problems without standards. What can you do to spread that knowledge to future workers?

Questions to manager at UTPI

0) What is the reason for so much work in the area of knowledge management?

1) Describe your knowledge acquisition.
2) How do you process gathered knowledge?
3) How do you distribute processed knowledge?
4) Do you feel that the knowledge you distribute gets used and does not disappear?
   a) If yes, how do you get it confirmed?
   b) If no, what do you do about it?
5) Please show us an example of one of your products, document for standards etc.
6) How do you confirm that you don't do work on something you already have in the department?
   a) Search for it?
   b) How much time is spend on looking for document that you already have?
   c) How do you take part of your colleagues' documents?
   d) How do you share your documents and products with your colleagues?
7) What is in appropriate scale of a standard?
8) A3 – Is it an appropriate format for read through?
   a) Where did you get the idea?
   b) How much information?
9) Where do your assignments come from?
   a) What happens when an assignment come to the department?
   b) Do you create assignments?
10) When you have an assignment but need more knowledge about that area, what do you do?
    a) Internal or external knowledge gathering?
11) The log
    a) Is the documentation of it standardized?

b) Do you take part of each other's logs?
12) How are you assured of what happened at the last meeting etc.? "What did we say" "did we take any decisions"?
   a) Standard document…? Visually?
13) Tell us about the flow game
   a) To what end is it used?
   b) Is the arrangement different from time to time, how do you prepare?
14) How is the skills matrix used
   a) How does it affect your work in the short term as well as over the long term?
   b) How is it formed?
15) If you were supposed to quit your current position, how would you transfer your knowledge to the substitute

(Knowledge flow figure, Appendix B)

Number the order in which the sources are contacted. Rate the thereafter, in percentage the amount of knowledge / information gathered from various sources. There should in total be 100%. Flows may have the value zero if you think that this is the case.

APPENDIX F.   SKILLS MATRIX

Produkter - Status	R&D Factory	Sjökortet	Förbättringsarbete	Ordning och reda	Nyckeltal och KPI	Visuell Planering	Problemlösning	Flöde	Kreativitet	Kunskapshantering	Ledarskap	LPD
	Värderingsspel		Grund		Grund	PDCA	7 Management verktyg	Flödesspelet	Idéspelet	Bok A3	Rollspel dagliga mötet	
	R&D Factory grund					Visuell Planering	7QC	VSM (VFA)	Innovation	A3 metodik		
	Moduler					Daglig styrning	5 Varför	Processbeskrivning	Bird Island	Grund		
							Fiska	Flöde Grund				
							Toyotas 8-stegsmodell					

Left row labels:
- Önskvärd kompetens
- Nuvarande kompetens
  - Chef
  - Medarbetare
  - Medarbetare

Poäng		Kompetenskriterier
0	Saknas	• Formell kompetens saknas • Bristande erfarenhet inom kompetensområdet • Kan ej lösa uppgiften
1	Junior kompetens	• Kompletterande utbildning krävs • Förstår grunden inom området • Kan lösa uppgifter med assistans
2	Baskompetens	• Uppfyller formella kompetenskrav • Behärskar verktyg och kompetens i normalfall • Kan lösa uppgifter självständigt inom kompetensområdet
3	Fullvärdig kompetens	• Har funktionell kompetens - kan värdera frågor inom området • Kan utveckla metodik och ta beslut inom kompetensområdet • Kan ansvara för större avsnitt och helhet inom kompetensområdet
4	Senior kompetens	• Har stor erfarenhet inom sitt arbetsområde • Driver - utvecklar metodik och strategisk inriktning inom området • Fungerar som mentor
5	Tung expert	• Tongivande expert inom sitt ansvarsområde på Scania / externt • Ansvarar för metod, verktyg o strategi inom området (del av) • Kan utbilda andra, internt och externt
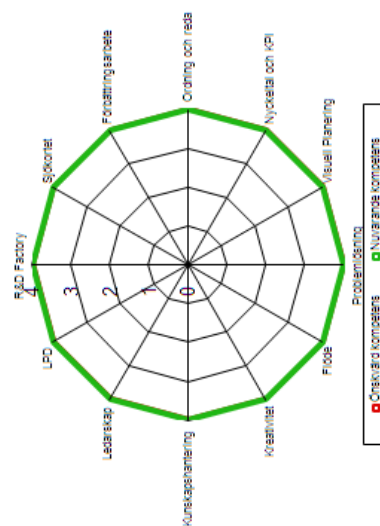
APPENDIX G.   QUESTIONS DURING THE OBSERVATIONS

Questions to workers UTPL/M/W

1) Is it OK to stand here and watch you work?
2) Please tell us what it is you do.
3) How have you learned what you know?
4) How do you learn new things?
5) Do you teach anything, or have you before?
   a) If yes, how do you do it?
6) Do you have any tricks to solve different problems?
   a) Do you share them with your colleagues?
   b) How?

xx

APPENDIX H. GUIDE FOR INTERVIEWS 1.4

QUESTIONS TO COACHES AT UTPI

Case

1. You get a new assignment in a field that you are not very educated in.
   a. Describe step-by-step how you proceed.
   b. How do you know what to do?
   c. How do you know who to turn to with questions?
2. You get a new assignment in a field that you know well.
   a. Describe step-by-step how you proceed.
   b. How do you know what to do?
   c. How do you know who to turn to with questions?
3. How do you proceed with the knowledge you have gathered after the assignment so it doesn't get lost?
   a. Does this step differ depending on the knowledge state before the assignment?
   b. How?
   c. Do you learn something new after every assignment?
   d. Does the group learn something after every assignment?
   e. How do you proceed with new knowledge to be able to use it in the future?

Log

4. Why do you use the log?
5. Mention three good thing about the log.
6. Mention three bad thing about the log.
7. Suppose that the group is going to start document their log in the file system so the rest can take advantage of it.
   a. Do you see a need of it? Why/why not?
   b. How would you proceed with it?
   c. What do you believe will be the biggest challenge with this?

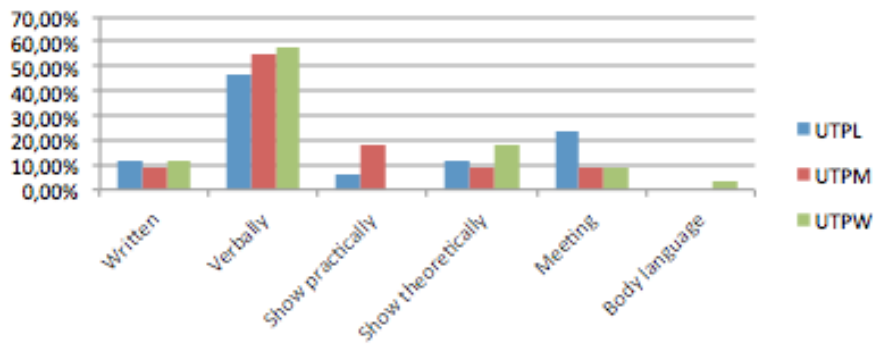# APPENDIX I. AVERAGES OF STRUCURED INTERVIEWS
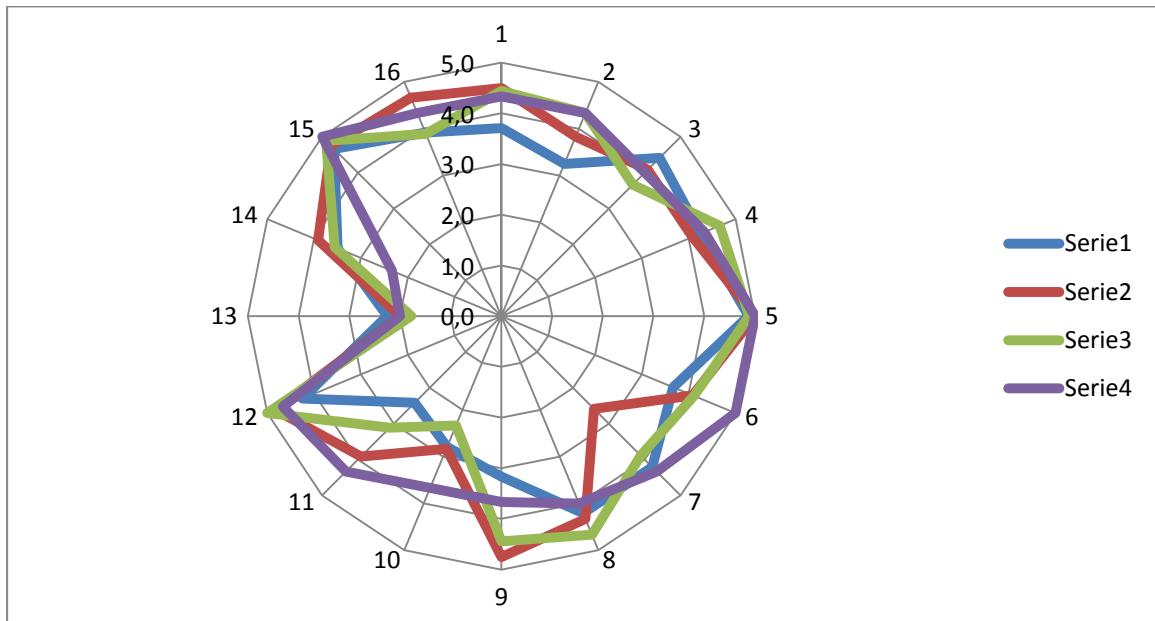
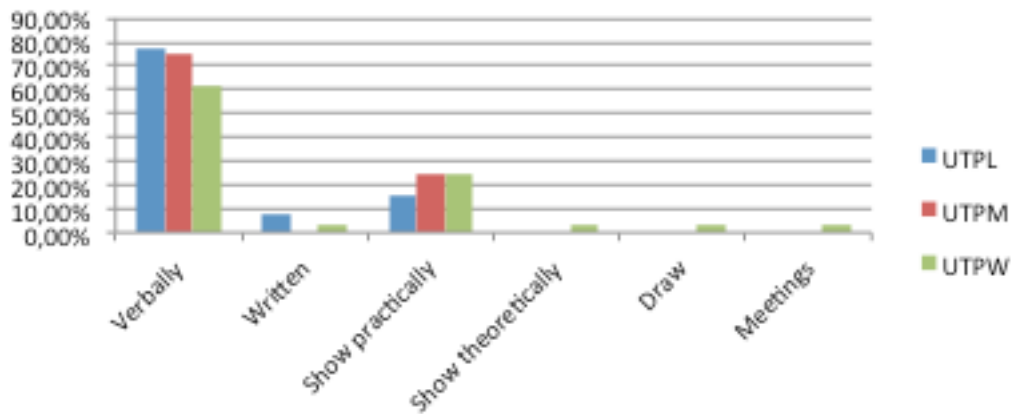Series 1: UTPW

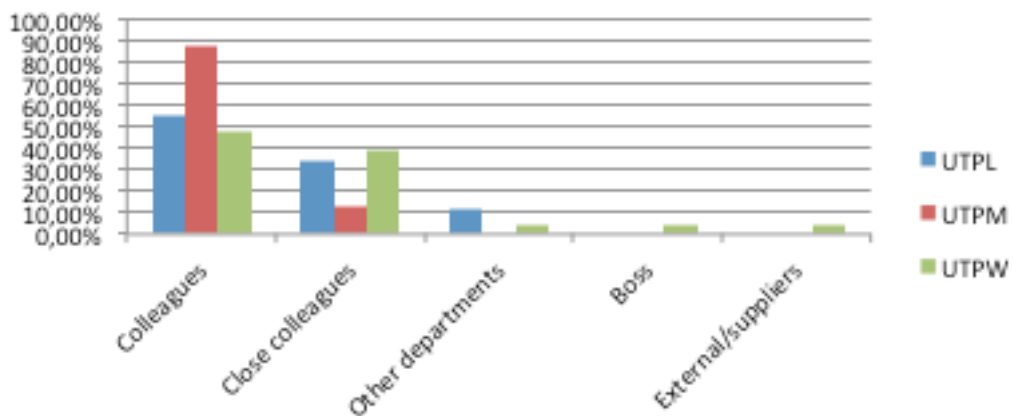Series 2: UTPL

Series 3: UTPM

Series 4: UTPI
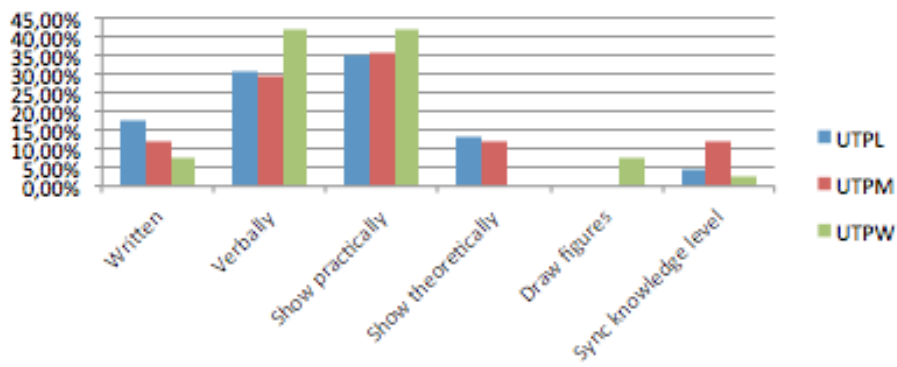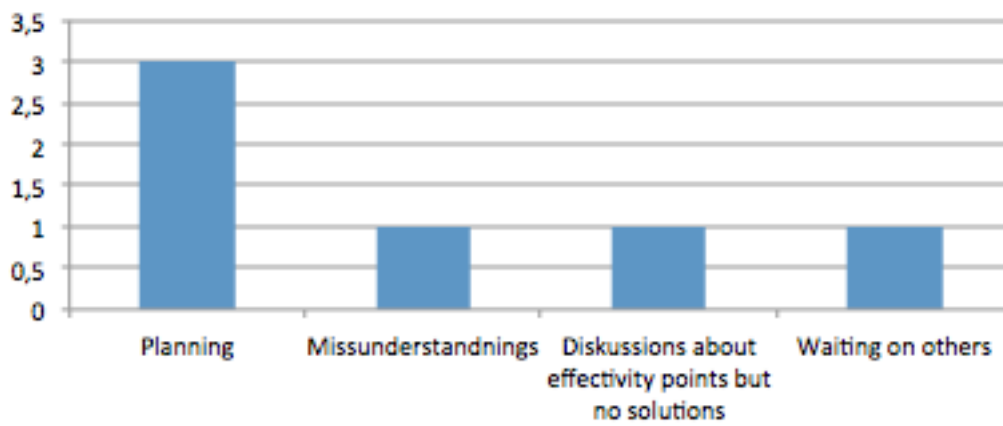
Question 3a

Question 6a - How?

Question 6a - To who?

XXIV

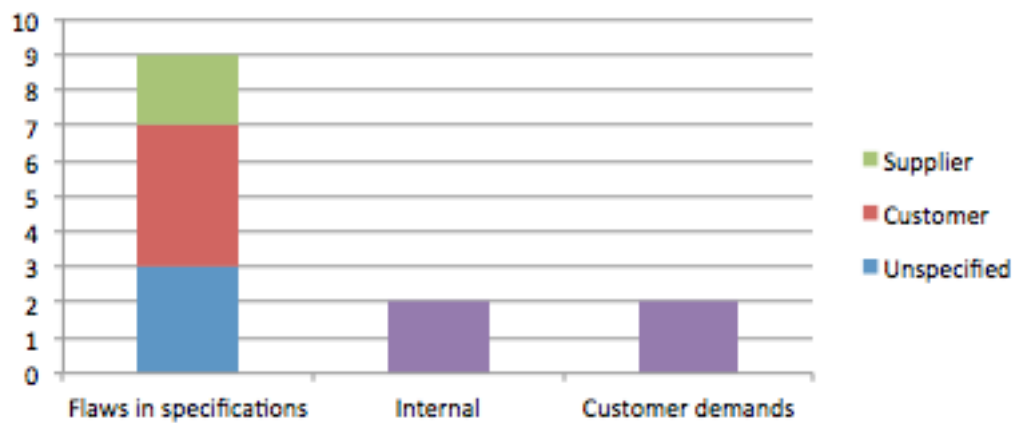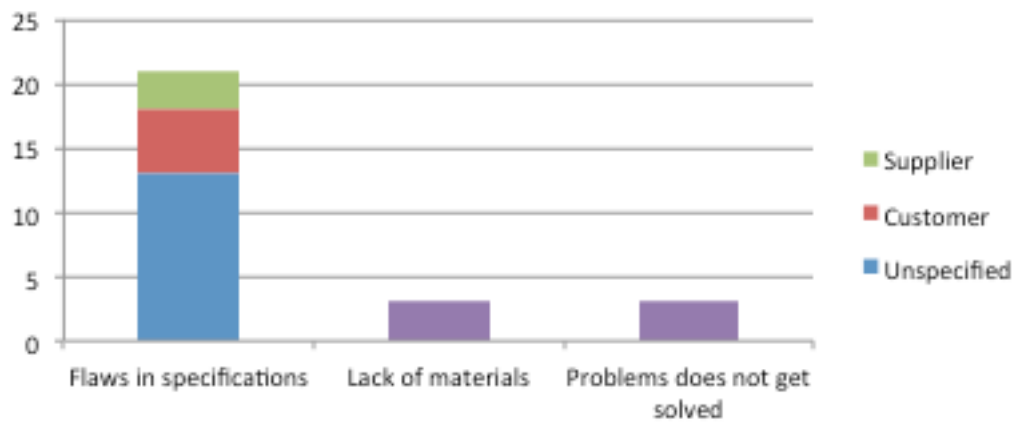## Question 14 UTPM

Question 14 UTPI

Question 14 UTPL

Question 14 UTPW
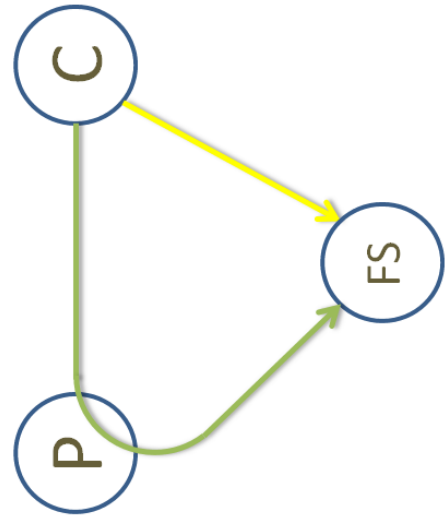
WORKSHOP 1 - UTPI
2013-07-04

Faraz Kuhpai
Johan Bäckström

INTERFERENCES

AMOUNT
- ✓ Too few – especially process related ones
- ✓ Varying amounts – uneven workload
- ✓ Interference definitions
- ✓ Categorization

TYPE
- ✓ Late arrivals
- ✓ Structures not always followed
- ✓ Difficulties finding information

MANAGEMENT
- ✓ Process improvements not done immediately
- ✓ Some short-term "fixes"
- ✓ Acceptance
- ✓ Quarterly follow-ups

KNOWLEDGE MANAGEMENT

- ✓ Learning potential, availability, invitations and needs determine external seminar participation
- ✓ Competency matrix: used mostly by group manager. Unclear purpose. New design suggested
- ✓ Book A3: condensed knowledge
- ✓ Seminar A3: guidance and summary
- ✓ Need for log standardization

FLOW

- ✓ Increased future file structure use, coaches say
- ✓ Teacher vs librarian
- ✓ What is sought: files or knowledge?

XXX
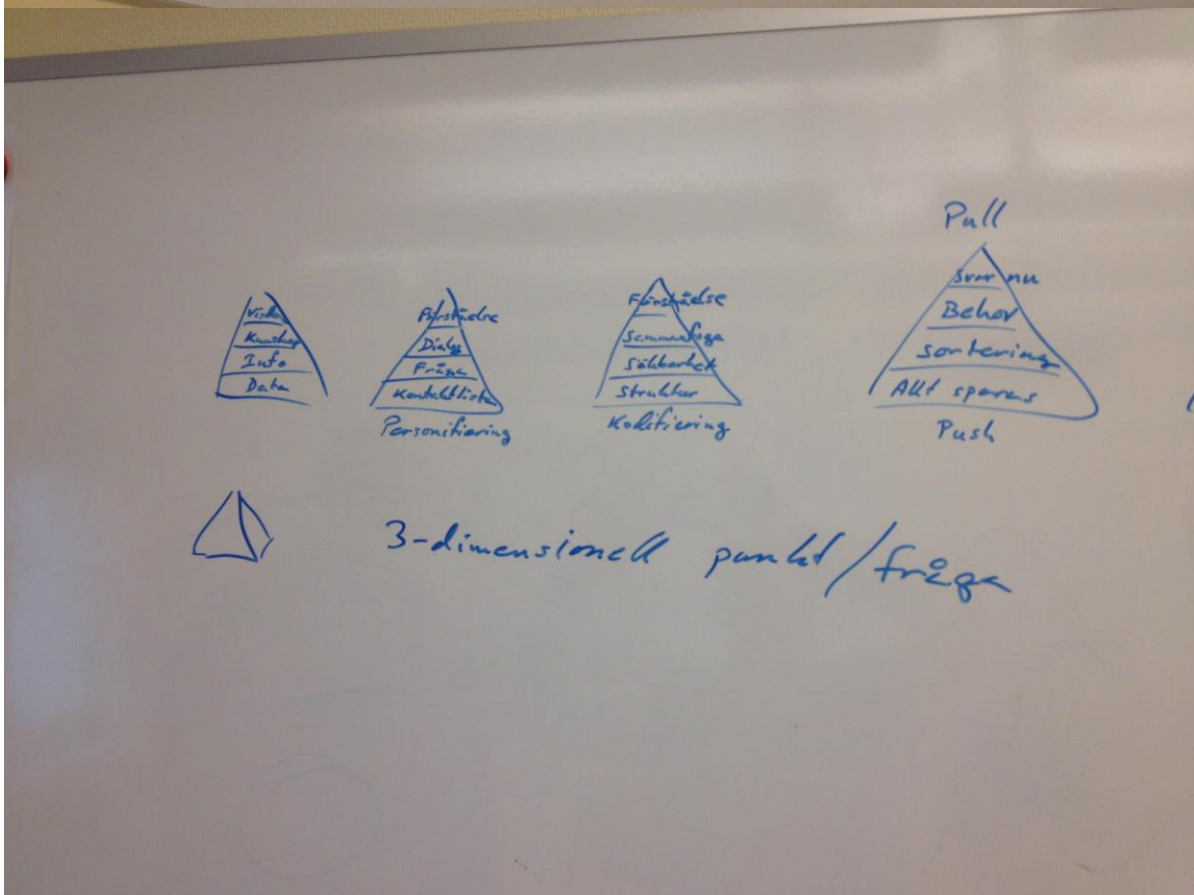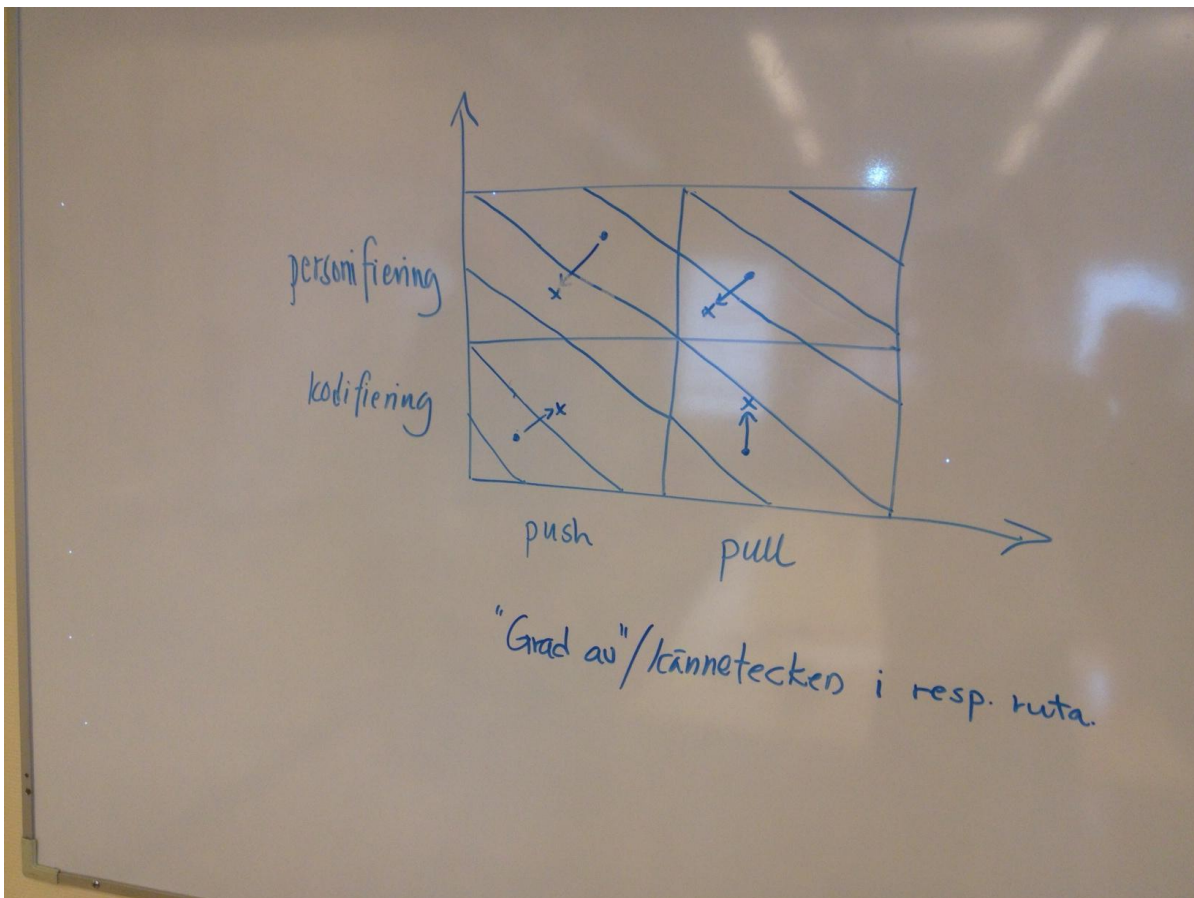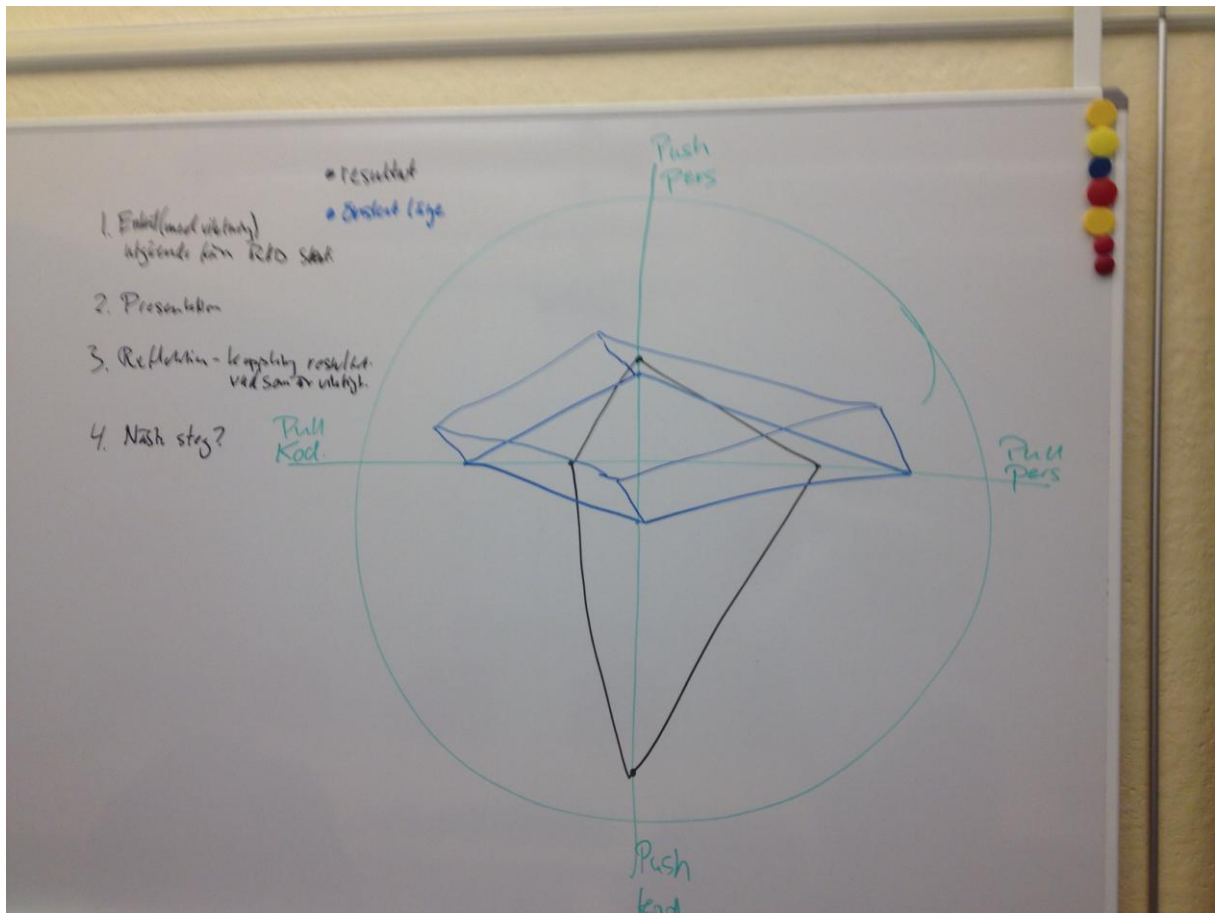
APPENDIX L.   WS 2 FOLLOW-UP

This questionnaire consists of statements you are to consider by marking one number of 1 − 5 you think best matches your opinion.

The workshop clarified the current status of the thesis project

Strongly disagree   *Strongly agree*

            1   2   3   4   5

Comments:

The workshop clarified the purpose and goal of the thesis project

Strongly disagree   *Strongly agree*

            1   2   3   4   5

Comments:

The structure of the workshop felt well thought out

Strongly disagree   *Strongly agree*

            1   2   3   4   5

Comments:

There was enough time to conduct the workshop

Strongly disagree   *Strongly agree*

            1   2   3   4   5

Comments:

During the workshop, I could have my say, and everyone had their voices heard

Strongly disagree   *Strongly agree*

       1   2   3   4   5

Comments:

_____

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The relay baton work well for brainstorming

Strongly disagree   *Strongly agree*

       1   2   3   4   5

Comments:

_____

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_____

The contents of the workshop felt relevant to UTPI

Strongly disagree   *Strongly agree*

       1   2   3   4   5

Comments:

_____

_____

_____

The contents of the workshop felt relevant to UTP as a whole

Strongly disagree   *Strongly agree*

       1   2   3   4   5

Comments:

_____

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_____

If you have any new ideas on how a model can be designed, please write these below.

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Other feedback

Comments:
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XXXIV

APPENDIX M. WS 4 – AMBITION AND ROAD AHEAD

Ambition

Situation and scenario was at first unclear. At first, magnets were put out rather evenly in all quadrants. It was then suggested to restart, and set a pre-defined scenario, which was then done. The chosen scenario was knowledge transfer in early phases of new assignments.

The result was a clear emphasis on codification, with a slight emphasis on pull rather than push. This was in principle the opposite of how they considered themselves working at the time, which gave a clear direction for the ambition of how to work in the future.

It was pointed out that if you do not codify, knowledge will disappear when people leave for other jobs.

Push was considered a necessity – otherwise, one will never learn anything new.

The road ahead

The difference between the survey results on how the group currently worked and how they had set their ambition was visualized, after which the participants were asked to, in three minutes, individually write down ideas on how to get from current state to their ambition. These ideas were then written on a whiteboard, and are described below. There was some disagreement on whether all ideas were appropriate measures, especially around the suggestions related to file structure, searchability and tagging. However, everybody agreed that this area was not working fully satisfactory at the time.

- Work more with the file structure (store, sort, clean up)
- Good standards that were not always completely followed
- Try document tagging (whole documents or within documents)
- Software for improved searchability in the file structure
- Present search results in a pdf document
- Clear knowledge bank – agree upon it
- *5S* for products
- Reduce "nice to know"

APPENDIX N.   WS 4 FOLLOW-UP

This questionnaire consists of statements you are to consider by marking one number of 1 − 5 you think best matches your opinion.

The workshop clarified the current status of the thesis project

Strongly disagree   *Strongly agree*

        1   2   3   4   5

Comments:

The workshop clarified the purpose and goal of the thesis project

Strongly disagree   *Strongly agree*

        1   2   3   4   5

Comments:

The structure of the workshop felt well thought out

Strongly disagree   *Strongly agree*

        1   2   3   4   5

Comments:

There was enough time to conduct the workshop

Strongly disagree   *Strongly agree*

        1   2   3   4   5

Comments:

During the workshop, I could have my say, and everyone had their voices heard

Strongly disagree   *Strongly agree*

          1   2   3   4   5

Comments:
_____

_____

_____

The workshop clarified the purpose of the model

Strongly disagree   *Strongly agree*

          1   2   3   4   5

Comments:
_____

_____

_____

The workshop clarified the design of the model

Strongly disagree   *Strongly agree*

          1   2   3   4   5

Comments:
_____

_____

_____

Formulation ambition with Post-it® notes worked well

Strongly disagree   *Strongly agree*

          1   2   3   4   5

Comments:
_____

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_____

During the workshop, I could have my say, and everyone had their voices heard

Formulation ambition by answering questions worked well

Strongly disagree   *Strongly agree*

           1   2   3   4   5

Comments:

Comparing ambition and current state worked well

Strongly disagree   *Strongly agree*

           1   2   3   4   5

Comments:

Discussion of improvement suggestions worked well and was valuable

Strongly disagree   *Strongly agree*

           1   2   3   4   5

Comments:

The contents of the workshop felt relevant to UTPI

Strongly disagree   *Strongly agree*

           1   2   3   4   5

Comments:

The contents of the workshop felt relevant to UTP as a whole

Strongly disagree   *Strongly agree*

　　　　　1　　　　2　　　　3　　　　4　　　　5

Comments:

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If you have any new ideas regarding the model, skills matrix or any of the improvement suggested discussed, please write these below.

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Other feedback

Comments:

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XL

APPENDIX O. MODEL SURVEY

This survey consists of questions and statements you are to consider by marking the alternative you think best matches your opinion. The survey should be answered with regards to your daily work.

PERSON – PERSON

1. How often do you share knowledge without anybody asking?

   Never   *Monthly*   *Weekly*   *Daily*   *Several times a day*

   a. You usually know who to share with

      No   *Yes*

2. If you run into a problem, how often do you communicate the problem with a colleague?

   Never   *Seldom*   *Sometimes*   *Often*   *Always*

   a. You think the group benefits from this

      No   *Yes*

3. How often do you receive knowledge from others without asking?

   Never   *Monthly*   *Weekly*   *Daily*   *Several times a day*

   a. You think that you often have use for this

      No   *Yes*

4. If you run into a problem or need to learn something new, how often do you ask your colleagues?

   Never   *Seldom*   *Sometimes*   *Often*   *Always*

   a. You usually get answers that fully or partially solve the problem

      No   *Yes*

5. If you run into a problem, how often are there people available to ask?

Never   *Seldom*   *Sometimes*   *Often*   *Always*

    a. You usually know who to ask

         No   *Yes*

6. How often are you available for answering others' questions?

Never   *Seldom*   *Sometimes*   *Often*   *Always*

    a. You usually possess the knowledge needed to answer the question

         No   *Yes*

PERSON – DOCUMENT

7. To what extent are your daily tasks documented in written routines and standards?

None   *A little*   *Partially*   *A large extent*   *Everything*

    a. There is enough documentation for your daily work

         No   *Yes*

    b. Do you use these?

         No   *Yes*

8. How often do you document something that others can take part of?

Never   *Monthly*   *Weekly*   *Daily*   *Several times a day*

    a. You consider what you document to be reusable for others

         No   *Yes*

9. How often do you document something for your own use?

Never *Monthly* *Weekly* *Daily* *Several times a day*

    a. You consider what you document to be reusable for you

       No *Yes*

10. How often do you read written routines and/or standards?

Never *Monthly* *Weekly* *Daily* *Several times a day*

    a. You consider these to be easily accessible

       No *Yes*

11. How often do you take in knowledge from something others have documented, other than written routines and standards?

Never *Monthly* *Weekly* *Daily* *Several times a day*

    a. You consider these to be easily accessible

       No *Yes*

    b. You have a great use of these

       No *Yes*

12. How often do you read or gather knowledge from something you have previously documented?

Never *Monthly* *Weekly* *Daily* *Several times a day*

    a. You consider these to be easily accessible

       No *Yes*