UNIVERSITY OF TWENTE.

Faculty of Behavioural, Management and Social Sciences

Influencing factors on knowledge sharing processes in an inter-organisational context in the high-tech industry

Jorn van Faassen
Master Thesis
December 2017

Supervisors:

dr. Mireille Hubers

dr. Maaike Endedijk

Kees Stokla

Thales Netherlands

Educational Science and Technology

Acknowledgement

The final project is the last element of the master's program Educational Science & Technology at the University of Twente. Without the support of many people it would not have been possible to write this thesis. Therefore, I would like to thank several people for their guidance and support.

First, I would like to thank Kees Stokla, my external supervisor at Thales Hengelo. I liked our conversations about this study and several other topics. Because of these conversations and the given feedback finishing this study was possible. I also appreciate the participation in experiment 2.3 'conditions for knowledge sharing' and collaboration with the participants.

Second, I would like to thank the organisation Thales for providing me with all the required tools, space and opportunities to finish this project.

Besides that, I would like to thank Martin Arens, project manager of the E-PLM project, for involving me by meetings and introducing me by experiment leaders.

Furthermore, I would like to thank all participants in the E-PLM project for participation in this study. Writing this thesis would not have been possible without interviews with experiment leaders and completed questionnaires by participants.

I would also thank my supervisors, Mireille Hubers and Maaike Endedijk, for their guidance, feedback and advice by writing this thesis.

Finally, I would thank my parents for their support and use of their car to drive to Hengelo. My girlfriend, Kristel, for her support, patience and listening to my frustrations and Nils van Luik for reading the thesis and correcting my English.

Summary

In the rapidly changing world of industries, flexible responding to changes is needed, because of technological developments. Inter-organisational knowledge sharing could increase organisations' knowledge bases and the ability to respond to changes and stay competitive. This study focussed on inter-organisational knowledge sharing in manufacturing industries. In order to guide this study three research questions were defined. 'How do characteristics of knowledge and individual, group and organisational factors influence inter-organisational knowledge sharing in the high-tech industry?', 'What results are experienced through knowledge sharing?' and 'What influence do social network characteristics and shared knowledge types have on the results of inter-organisational knowledge sharing?'. This exploratory mixed methods research answered the research questions using six existing teams with 27 employees. First, experiment leaders were interviewed about all influencing factors at the individual, group and team level on knowledge sharing. Additionally, all participants filled in a questionnaire focussed on knowledge sharing, social networks, extraversion and identification. By combining the data, analysing the influencing factors and the benefits experiment groups experienced, the degree of influence for different factors is known. Also, influence of social network characteristics on the results were determined. Positive effects on inter-organisational knowledge sharing have been found for trust, shared goals, regularly face-to-face meetings and motivation. Furthermore, group identification was found as positive predictor for inter-organisational knowledge sharing. In future experiments knowledge sharing will be improved if experiment groups take these factors into account.

Key words: Knowledge sharing, inter-organisational, parallel teams, Horizon 2020, identification, extraversion

Contents

1. Introduction

The world is changing rapidly, in particular through technological developments, and if Dutch industries want to survive, flexible response to changes is needed. Organisations that continuously look for knowledge increasement are better prepared for uncertainty in the organisational environment, such as market dynamics. These organisations stay sustainable and competitive (Almeida & Soares, 2014). Thus, inter-organisational knowledge sharing could increase organisations' knowledge bases.

After the economic crisis the European Commission supported knowledge sharing, research and innovation with the *Horizon 2020* plans (COM, 2011). One of the pillars is mentioned as 'Smart growth', which means developing an economy based on knowledge and innovation. One of the targets for Horizon 2020 is that 75% of the population aged 20-64 should be employed. Innovation among products and services, and creation of growth and jobs in Europe could be supported by knowledge sharing (COM, 2010).

The 21st century is the era of high technology and the knowledge economy. Especially for the high-tech sector knowledge sharing is needed to maintain competitiveness and knowledge sharing activities can be used to increase innovation success and organisations performances (Lu, Wang & Mao, 2007).

For inter-organisational knowledge sharing activities participants from several organisations are needed. Balkundi and Harrison (2006) defined groups wherein members are associated with different work units, that work occasionally as a team, as parallel teams. In the high-tech sector parallel teams are suitable to share knowledge about specific contexts in small groups of people. To make knowledge sharing activities more successful for parallel teams in the high-tech sector, more research is needed.

Therefore, this study contributes to a solution in this challenge by investigating which factors affect inter-organisational knowledge sharing in the high-tech industry. These factors will be investigated with use of parallel teams to compare the effect of influencing factors over multiple groups. Also, results of sharing processes in participating parallel teams are determined concerning development of products, materials and processes, composed insights, prerequisites and checklists, and future collaborations. Furthermore, comparing shared knowledge types and social network characteristics to the results of the different parallel teams gives insight in the effect these factors have on knowledge sharing results. In the end, the success of future inter-organisational collaborations in the high-tech sector could be increased by stimulation of affecting factors for knowledge sharing processes.

2. Theoretical framework

First of all, a definition of knowledge (2.1), and knowledge sharing (2.2) will be given. Second, the purpose of knowledge sharing will be discussed (2.3). Thereafter, the influencing factors on the knowledge sharing processes will be explained (2.4).

2.1 Knowledge in parallel teams

Groups wherein members are associated with different work units, and work occasionally as a team, are defined as parallel teams (Balkundi & Harrison, 2006). Therefore, knowledge is defined as: "a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information" (Davenport & Prusak, 2000, p. 5). Knowledge can have several meanings and also be subject to several classifications (Ipe, 2003). Balkundi & Harrison distinguished three types of knowledge in parallel teams: technical knowledge (for example, practical use for online platforms to present content and joint output for groups), procedural knowledge (for example, business secrets and agreements relating to disclosure of knowledge), and knowledge about the content (this includes all the substantive knowledge about subjects covered in teams).

2.2 Knowledge sharing

Knowledge sharing has been identified as the process through which individuals mutually exchange knowledge and create knowledge on a voluntary base, wherein at least two parties are involved and these parties have shared goals (Davenport & Prusak, 2000; Lin, 2007). One of these parties communicates the knowledge and the other assimilates it, whereby the receiver interprets the knowledge in his or her own background (Paulin & Suneson, 2012). According to Connelly and Kelloway (2003) the sharing of knowledge has a positive influence on the innovativeness of organizations. This process is important for the competitive and economic value of organizations by maximizing the organizations ability (Hendriks, 1999; Lin, 2007). According to Chen, Lin and Yen (2014) inter-organizational knowledge sharing is a strategic tool to stay competitive in quick chancing business environments. Inter-organizational knowledge sharing refers to exchange of information across various organizations to concentrate on supply chain activities, product lifecycle management, and/or identify market opportunities. The inter-organizational supply chain relationship will be reinforced by similar goals, policies and strategies (Morgan & Hunt, 1994).

2.3 Purpose of knowledge sharing

Knowledge sharing was determined to be important in order to stay competitive, be innovative and maximize the organisations' ability in high-tech business environments (Almeida & Soares, 2014; Chen, Lin & Yen, 2014). These organisations are more innovative, because they combine activities and share resources (Cummings & Teng, 2003). In knowledge sharing processes both parties should benefit from the relationship. This could be in terms of, identification of market opportunities, innovation, process development, product development, and in the long run money must be provided (Dasi, Pedersen, Gooderham, Elter & Hildrum, 2017; Morgan & Hunt, 1994).

Three possible results from knowledge sharing processes could be derived. First, development of products, materials and processes (Dasi et al., 2017). According to this result, outcomes of the knowledge sharing processes are directly usable in practice. Second, sometimes development of product, materials and processes is not immediately possible. Therefore, participants need more insights in the contents or the parties compose prerequisites and checklists for future developments. Also, procedural knowledge, the understanding of how to apply concepts learned in any problem-solving situation, is part of the insights, prerequisites and checklists. With use of procedural knowledge these checklists and prerequisites could be developed. In the end, the prerequisites and

checklists could be used for development of products, materials and processes (Surif, Ibrahim & Mokhtar, 2012). Third, all parties should benefit from the relationships in knowledge sharing processes. Therefore, Abdul-Jalal, Toulson and Tweed (2013) defined knowledge sharing success as the extent to which participants obtain commitment to, and satisfaction with shared knowledge. Satisfaction could possibly lead to future collaborations with other participants.

2.4 Affecting factors in the knowledge sharing process

Influencing factors, both mediators as barriers, were found by studying research on knowledge sharing and related fields as knowledge management, human resource development, social networks, and team development (Wang & Noe, 2010). Based on the studied literature and the interpretation of the researcher on these articles Figure 1 was composed. The factors are subdivided in individual factors, group factors, organisational culture and values, and nature of knowledge.

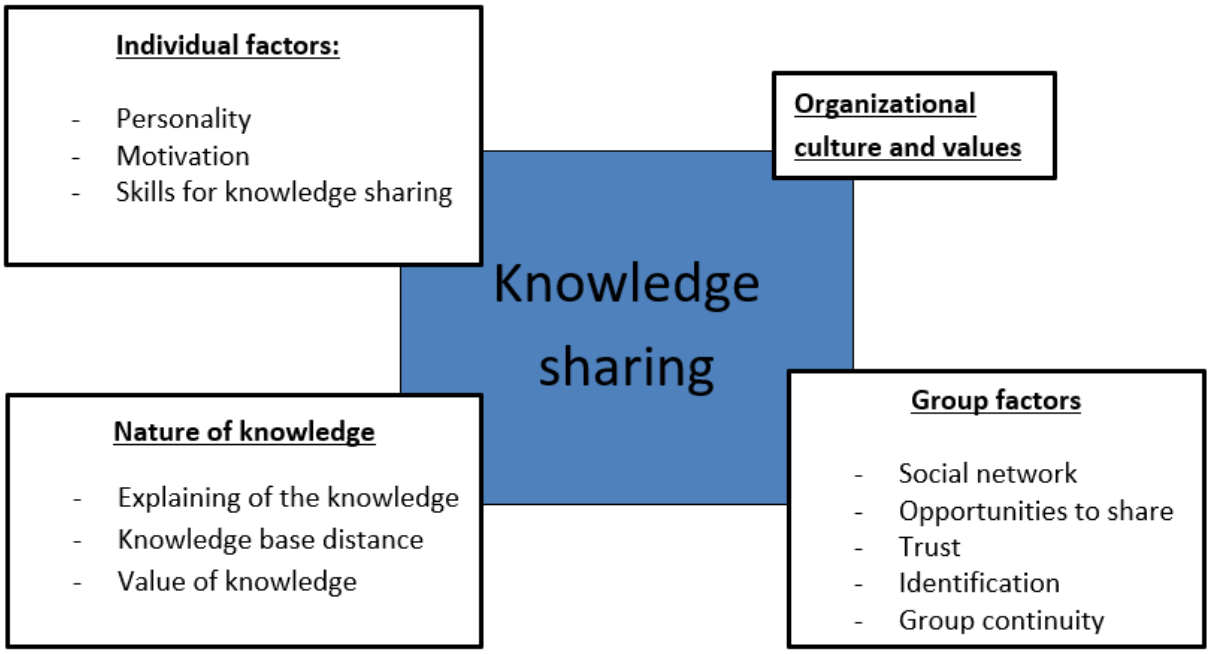

Figure 1. Affecting factors in knowledge sharing processes.

2.4.1 Individual factors

According to Wang & Noe (2010) and Razak et al. (2016) a small amount of researchers empirically investigated the role of individual factors in knowledge sharing. The role of personality, motivation and required skills to share knowledge were identified as influencing factors for knowledge sharing at the individual level.

2.4.1.1 Personality factors

Personality could be explained by basic factors in the HEXACO model or the Big-Five trait taxonomy and each factor could have an influence on the willingness to share knowledge. Five of the six factors in the HEXACO model are more or less equal to the Big-Five trait taxonomy. The sixth basic factor in the HEXACO model is called 'Honesty-Humility'. The other five are 'Emotionality' (in the Big Five taxonomy known as 'Neuroticism'), 'Extraversion', 'Agreeableness', 'Conscientiousness', and 'Openness to experience' (Dinger et al., 2015; John & Srivastava, 1999). Four of these factors will be discussed concerning the influence on knowledge sharing.

First, higher levels of 'Openness to experience' leads to curiosity about both inner and outer

worlds, willingness to consider new ideas, positive attitudes towards learning new things, engagement in learning experiences, and therefore more willingness to engage in knowledge sharing (Matzler, Renzl, Müller, Herting & Mooradian, 2008). Second, individuals with high scores on 'Agreeableness' are sympathetic, benevolent to help others, and they rather look for cooperation than competition (Matzler et al.). Therefore, inter-organisational knowledge sharing could be seen as a cooperation between individuals (Liao & Chuang, 2004; Bartram, 2005). Also, positive influences on knowledge sharing were found for the factor 'Conscientiousness' (Stewart & Nandkeolyar, 2006; Matzler et al., 2008). Furthermore, "team 'Extraversion' is positively and significantly related to eagerness to share knowledge" (de Vries, van den Hooff & de Ridder, 2010, p.124) and a positive association between extraversion an knowledge sharing behaviour was reflected in the study of Anwar (2017). The influence of 'Extraversion' in inter-organisational knowledge sharing is unclear and will be measured in this study.

2.4.1.2 Motivation

Motivation can be divided into extrinsic and intrinsic motivation (Dasí, Pedersen, Gooderham, Elter & Hildrum, 2017; Ryan & Deci, 2000). Extrinsic motivation implies that a reward affects an individuals' behaviour resulting in satisfaction (Dasí et al., 2017), while intrinsic motivation is valued for its own sake and refers to doing something because it is enjoyable and inherently interesting (Ryan & Deci). Enjoyment in helping others is strongly associated with the willingness to share knowledge, because the process of sharing could be seen as a cooperation with the others (Lin, 2007). Moreover, Osterloh and Frey (2000) argue that motivation is not a goal in itself, however, motivation should serve to support knowledge sharing. Without strong motivation, people are not likely to share knowledge and they would certainly not give knowledge away without concerning for what they may lose by doing so (Stenmark, 2001).

2.4.1.3 Skills for sharing knowledge

Lacking communication skills are often barriers for knowledge sharing (Riege, 2005). Therefore Williams (2006) stated that social skills, as the ability to communicate and collaborate with others, are needed for knowledge sharing. Social interaction aims to create, obtain, share and mobilize knowledge within a social network (Yang & Wan, 2004).

2.4.2 Group factors

According to Wang and Noe (2010) several studies investigated the effect of team characteristics on knowledge sharing, and these team characteristics will be mentioned as group factors. Social network, opportunities to share knowledge, trust, identification and group continuity were identified as influencing factors for knowledge sharing at the team level.

2.4.2.1 Social network

A social network is a social structure of individuals, made up of dyadic ties, and social interactions among individuals (Wasserman & Faust, 1994). The social interaction consists of knowledge sharing between the individuals, for example by collaboration or helping (Borgatti & Ofem, 2010). Social networks may provide opportunities for the actions of individuals, for example by tangible and intangible resources in the network. However, social networks may also constrain these actions, when many individuals are disconnected from the flow of resources (Moolenaar, 2012).

2.4.2.2 Opportunities to share knowledge

Knowledge sharing can be both formal and informal in nature, whereby formal interactions include training programs and informal interactions include social networks and interpersonal relationships (Ipe, 2003). For the sharing of knowledge multiple techniques could be used, such as conversation and

dialogues, electronic devices, training sessions, and social activities (Yang & Wan, 2004). According to Johnson, Suriya, Yoon, Berrett and La Fleur (2002) most studies compare face-to-face interactions in knowledge sharing teams with teams using technology to communicate, where face-to-face communication is more effective (Cummings & Teng, 2003). Face-to-face teams have better coordination and internal leadership than technology based virtual teams (Johnson et al.), and (informal) face-to-face contact strengthens the trust in teams (Connelly & Kelloway, 2003; Ipe, 2003).

2.4.2.3 Trust

Grandison and Sloman (2001) defined trust as: "the firm belief in the competence of an entity to act dependably, securely and reliably within a specified context" (p. 4). When relationships are high in trust the participants in an environment are more willing to share their knowledge (Connelly & Kelloway, 2003; Renzl, 2008). Lack of trust in other group members is found as knowledge sharing barrier, because individuals could fear that their knowledge will be misused (Matschke, Moskaliuk, Bokhorst, Schümmer & Cress, 2014). On the other hand, Bakker, Leenders, Gabbay, Kratzer and van Engelen (2006) stated that a positive effect of trust on knowledge sharing is not necessary, however, absence of trust may hinder the knowledge sharing process.

2.4.2.4 Identification

The process wherein individual team members see themselves as part of that group of people is called identification and affects the motivation to share knowledge between team members (Nahapiet & Ghoshal, 1998). Besides the mediating effect on knowledge sharing identification has also a positive and significant impact on trust in groups (Ho, Kuo & Lin, 2012). If group identity is felt more strongly, individual team members share more knowledge, and individuals feel more responsibility and we-ness at the team level (Cabrera & Cabrera, 2002).

2.4.2.5 Group continuity

According to Tuckman (1977) small groups develop in five stages, namely forming, storming, norming, performing and adjourning. Forming means the establishment of relationships between group members by orientation and testing. Storming serves as resistance to group influence, marked by conflict and polarisation around interpersonal issues. In the stage of norming, resistance is overcome to develop group cohesion, resulting in adopting new roles and generating new standards. Performing means the interpersonal structure supports task performance, because energy in the group is task related through flexible and functional distribution of roles. Therefore, teams that work together in the same composition for a certain amount of time, will probably be more willing to share knowledge than teams that changed the composition. Furthermore, the longer a group has been formed and the higher the level of cohesion in the group, the more likely it is for group members to share knowledge (Wang & Noe, 2010).

The latest stage, adjourning, involves termination of the group. Participants end their tasks in the group and most times say personal goodbyes to each other at a planned conclusion. Concluding a group can create some apprehension at personal level. Individuals give up their responsibility as participant in this group and realize the collaboration in the current form is over. The effects for individuals are more thorough when groups worked together well and with pleasure.

2.4.3 Organisational culture and values

Organisational culture is a critical driver for knowledge sharing behaviour (Lin, 2007). Individuals would see knowledge sharing as natural and share knowledge regularly in an organisation with a knowledge sharing culture (McDermott & O'Dell, 2001). Organisational values affect the behaviour of individuals towards acceptable behaviour for the organisation (Dasí et al., 2017), because culture and values set norms about knowledge sharing in organisations (Ipe, 2003).

Furthermore, organisational cultures and values could differ with regard to internal and inter-organisational knowledge sharing. The spread of knowledge inside the organisation could be more important than inter-organisational knowledge sharing for several organisations. Most companies in the research of Ahmad and Daghfous (2009) are concerned about confidentiality of their knowledge, and the competency and trustworthiness of partners in knowledge sharing processes.

However, organisations would participate in inter-organisational knowledge sharing programs with the expectation of achieving their own goals (Dawes, 1996). All different organisations would take advantage in this process and therefore common goals in the experiments are needed. When experiments do not match the purpose of an organisation, this organisation will probably not participate in the experiment.

2.4.4 Nature of knowledge

In addition to individual and organisational factors also the nature of knowledge is an interesting affecting factor concerning knowledge sharing. The extent to which knowledge can be explained, knowledge base distance and the value of knowledge were identified as influencing factors for knowledge sharing.

2.4.3.1 Explaining of the knowledge

The extent to which knowledge could be verbalised, written or otherwise communicated affects the success of a knowledge sharing process (Bresman, Birkinshaw & Nobel, 1999). The transferability of articulable knowledge is easier than for less articulable knowledge (Cummings & Teng, 2003). Therefore, a common language has an important function in this process, because it facilitates the ability to share knowledge (Nahapiet & Ghoshal, 1998) and Welch and Welch (2008) mentioned a common language as a strong base for effective communication among teams which improves knowledge sharing and flow of information.

2.4.3.2 Knowledge base distance

Cummings and Teng (2003, p. 47) defined knowledge base distance as: ‘the degree to which the source and recipient possess similar knowledge’ and they stated that the knowledge base distance between two parties cannot be too great for effective knowledge sharing. The lack of knowledge about a certain topic could be seen as knowledge sharing barrier (Paulin & Suneson, 2012). Therefore, knowledge sharing processes would be more effective when all participants possess to a certain extent knowledge about their content.

2.4.3.3 Value of knowledge

The willingness to share knowledge is greater when individuals believe their knowledge is valuable. The value of knowledge grows by given feedback, asked questions, and modifications for the knowledge sender (Cummings & Teng, 2003). Individuals are more likely to share knowledge if their contribution feels unique and specific goals are given (Hew & Hara, 2007). Therefore, knowledge about the content will be shared more often than procedural knowledge, because knowledge about the content is rather unique and more valuable than procedural knowledge.

2.5 Research questions

The present study focusses on the process of knowledge sharing between participants from high-tech organisations in inter-organisational parallel teams. Therefore, influencing factors for this knowledge sharing process will be investigated. According to previous research on individual factors positive effects on knowledge sharing are expected from the personality factors ‘openness to experience’, ‘agreeableness’, ‘conscientiousness’ and ‘extraversion’, and the factors motivation and identification. At the group level, face-to-face communication is expected to be the most successful interaction

method for inter-organisational knowledge sharing. Also, positive effects on knowledge sharing are expected from the factors trust and group continuity. At the organisational level common goals are expected as prerequisite for successful knowledge sharing and confidential knowledge as knowledge sharing barrier. Concerning the nature of knowledge, articulable knowledge and a common language are expected as prerequisite for knowledge sharing and knowledge base distance as sharing barrier. The specific context of this study, concerning inter-organisational knowledge sharing in parallel teams between parties in the high-tech industry, will be interesting to investigate. The extent to which influencing factors, according to previous studies, are relevant to parallel teams in the high-tech sector will be investigated this study.

Furthermore, the results of parallel teams will be useful in this study. The results of the experiments could identify the influence of typical factors for that parallel team. Results could be products, materials and processes, which are directly usable in practice. Also, insights, prerequisites and checklists (procedural knowledge) could be a result of the knowledge sharing process. Third possible result, satisfaction with the knowledge sharing process, would result in participation in future experiments. Therefore, future collaborations will also be seen as a result of the knowledge sharing processes in parallel teams.

In the end, social networks may provide opportunities for the actions of individuals. However, social networks may also constrain these actions when many individuals are disconnected from the flow of resources (Moolenaar, 2012). Therefore, social network analyses will be employed to compare parallel teams and the outcomes of these teams. Teams could differ in social network characteristics such as density and centralisation and the shared type of knowledge, for example technical knowledge and procedural knowledge. Comparing shared knowledge types and social network characteristics to the results of the different parallel teams gives insight in the effect these factors have on knowledge sharing results.

The following research questions were set for the present study:

1. How do characteristics of knowledge and individual, group and organisational factors influence inter-organisational knowledge sharing in the high-tech industry?
2. What results are experienced through knowledge sharing?
3. What influence do social network characteristics and shared knowledge types have on the results of inter-organisational knowledge sharing?

3. Method

This section consists of the used method for the study. First of all, the context for the study will be given (3.1). Thereafter, the methodology (3.2), respondents (3.3) and used instruments (3.4) will be described. Furthermore, the used procedure (3.5) is given and in the end analyses of the data are elaborated (3.6).

3.1 Context

In accordance with the Horizon 2020 plans *Smart Industry* was founded to develop innovative networking projects, new ways of production, and new business models through extensive digitalisation (Processingprofs, 2014).

Currently 29 Smart Industry Field Labs are active and one of these Field Labs is called 'the Garden', launched in spring 2016. 'The Garden' focuses on cybersecurity and secure online collaboration and consists of three projects wherein 21 organisations are involved. One of the projects is called 'Extended – Product Lifecycle Management (E-PLM)', wherein nine companies are involved and 11 different experiments were set up.

One of the experiments in 'the Garden' is called: 'conditions for knowledge sharing', whereby themes as Intellectual Property, juridical aspects, and internet security were elaborated. However, communication and collaboration between these organisations proceeds via people. Therefore, participants in this experiment are curious about influencing factors in the knowledge sharing process to improve future inter-organisational collaborations. Experiment groups could be seen as parallel teams, whereby the term 'experiment group' will be further used in accordance with the context.

3.2 Research methodology

An exploratory mixed-methods approach (Creswell, 2009) was applied in this research to answer the three research questions. The questionnaire and interviews combined answered the first research question, only the interviews were used to answer the second research question, and social network analyses combined with the interviews were used to answer the third research question (Figure 2). Therefore, the influence of different characteristics on knowledge sharing, the results of knowledge sharing, and the influence social network characteristics and shared knowledge types had on the results were examined by use of interviews, questionnaires and social network analyses.

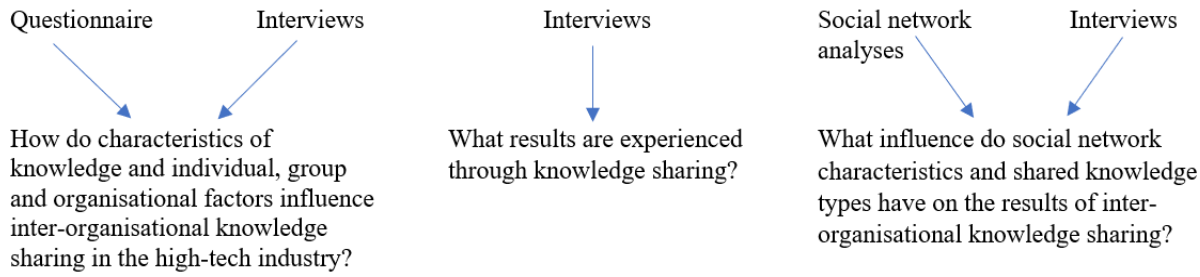

Figure 2. The used research methods for answering the three research questions.

3.3 Respondents

It was possible to send the questionnaire to 32 participants in experiments groups of the E-PLM project. Four experiment groups were excluded from participation in this study, otherwise multiple participants should filled in the questionnaire for four or five experiment groups. Exclusion of these four experiment groups led to a maximum of two different groups per participants, except for one individual. This person was asked for participation in person and filled in questions about three

experiment groups. Other participants in the E-PLM project were invited on voluntary bases via e-mail to participate in this study.

Analyses showed that 27 participants in the E-PLM project, working for nine different organisations, and distributed over seven experiments, filled in the questionnaire. Data was gathered in spring/summer 2017 and reflected a response rate of 84.4%. From the 27 participants the majority is male (96.3%), and only one participant is female (3.7%). The average age of the respondents is 44.4 years (SD = 8.9). The average work experience of participants is 20.6 years (SD = 8.9), and participants work on average 11.2 years (SD = 9.7) for their current employer. Four individuals joined two experiment groups, one individual took part in three experiment groups, and one group member in each experiment was in charge (experiment-leader).

For five of the seven experiment groups, a 100% response rate was achieved (all group members filled in the questionnaire) and these five groups were fully used for social network analyses. One group had a 67% response rate (4 out of 6 members filled in the questionnaire) and the last group only had a 40% response rate (2 of the 5 members filled in the questionnaire). The responses coming from this last group were too unilateral and therefore excluded from the social network analyses.

3.4 Instruments

3.4.1 Semi-structured interview

Semi-structured interviews were conducted with nine experiment-leaders in the E-PLM project. In the interviews characteristics of knowledge, individual factors, group factors, organisational factors and the experienced results were questioned. Interviews were focusses on influencing factors and experienced results in knowledge sharing processes. Experiment leaders were asked on forehand to mention characteristics of knowledge and individual, group and organisational factors that influenced knowledge sharing processes in their experiment. After that, factors described in the theoretical framework that were not mentioned by the experiment leaders, were adressed to find out the influence on knowledge sharing of these unmentioned factors according to the experiment leaders. Interview guidelines are attached in Appendix A. The interviews were summarized and validated by using member checks (Creswell, 2009).

3.4.2 Social networks

Another part of the online questionnaire was developed to determine the network structures in experiment groups of the E-PLM project. This study focussed on social network structures related to knowledge sharing. In accordance with the social network research of Moolenaar (2012) the following procedure was set. For each question in the questionnaire, respondents could select one or more group members from a list of all possibilities and it was also possible to select none of the group members. The questions concerning social network structures were; ‘which group members did you exchange knowledge about the experiment with, in the past month?’, ‘which group members did you exchange technical knowledge with, in the past month?’, ‘which group members did you exchange procedural knowledge with, in the past month?’, ‘which group members did you exchange other knowledge with, in the past month?, and ‘If you select one or more group members in the previous question, how would you define this kind of knowledge?’. The questionnaire is attached in Appendix B and social network questions are numbered from 7 to 11.

Most interesting knowledge types in this study were general, technical and procedural knowledge about the experiment. Social network values, such as density and centralization were used to indicate the shared knowledge types in experiment groups and which group members were involved in these knowledge sharing processes.

3.4.3 Questionnaire

All participants in the research filled in the online questionnaire consisting of questions about knowledge sharing, the personality factor 'Extraversion', knowledge base distance, and identification. These constructs were questioned to answer the first research question: *"How do characteristics of knowledge and individual, group and organisational factors influence inter-organisational knowledge sharing in the high-tech industry?".* The factors represent one element from the different entrance angles mentioned in Figure 1. Extraversion was part of the personality factors at the individual level, knowledge base distance was part of the nature of knowledge factor, and identification was part of the group factors. Therefore, three factors from different angles were quantified and analyses about their influence on knowledge sharing were possible. The factor knowledge sharing indicated the amount of knowledge an individual shared, mentioned by the person himself. This factor was used for analyses about the influence of the other factors on knowledge sharing.

Questions concerning knowledge sharing were based on the questionnaire of Bednall, Sanders, and Runhaar (2014). Questions concerning the personality trait extraversion were adopted from the Big Five trait taxonomy (John & Srivastava, 1999), and questions about knowledge base distance were developed by Cummings and Teng (2003). The items on these constructs were measured on a five point Likert scale, ranging from 'totally disagree' to 'totally agree'. Questions about identification were developed by Chiu, Hsu, and Wang (2006) and items on this construct were measured on a seven point Likert scale, ranging from 'totally disagree' to 'totally agree. All questionnaire items were translated, whereby back-translation is used as method of translation. Hereby, the English questions were translated to Dutch questions and then back into English question to ensure that the Dutch translation is equivalent to the original questions. The questionnaire is attached in Appendix B.

In further analyses the questionnaire items were used for factor analyses examining the constructs measured in the questionnaire. For reliable constructs linear regression analyses were conducted to examine prediction levels of independent variables for knowledge sharing. The independent questionnaire variables were the factors extraversion, knowledge base-distance and identification. The dependent variable from the questionnaire was the factor knowledge sharing.

3.5 Procedure

Experiment leaders were contacted in person during a meeting with all experiment leaders and asked for participation in this research, also communication about this study in their experiment groups was asked. The experiment leaders were interviewed about individual factors, group factors, knowledge factors, organisational factors, and the results of knowledge sharing, taking about 45 minutes per interview. Furthermore, other respondents were contacted by e-mail, explaining the research, and asked for participation on voluntary bases. The link to the questionnaire (Appendix B), in Qualtrics, was added in this e-mail.

According to Meijer, Verloop and Beijaard (2002) two applications of triangulation were applied in this mixed-methods approach. First, triangulation by data source, because both the participants and the experiment leaders were involved. Second, triangulation by data type, because the qualitative and quantitative analyses were, partly, directed to the same factors. Combining both analyses increased the reliability of research outcomes.

3.6 Data analysis

3.6.1 Semi-structured interviews

For coding of interviews a coding scheme was made to analyse the data from different perspectives (individual factors, group factors, organisational factors, knowledge factors, and the results of knowledge sharing) and to compare groups in the E-PLM project on processes of knowledge sharing.

The interviews were used as input for all three research questions and divided in two parts. First part of the coding scheme was aimed at the first research questions: *"How do characteristics of knowledge and individual, group and organisational factors influence inter-organisational knowledge sharing in the high-tech industry?".* Therefore, all mentioned factors concerning the nature of knowledge and individual, group and organisational factors were classified on their influence on knowledge sharing. For each factor the degree of influence on knowledge sharing could be 'little influence', 'average influence' and 'much influence'. This made it possible to distinguish factors with a lot of influence and factors that barely influenced knowledge sharing processes in the E-PLM project. Factors that were indicated as positive factors with 'much influence' by at least seven of the nine experiment leaders were considered as affecting factors for knowledge sharing processes. On the other hand factors that were indicated as negative factors with 'much influence' by at least seven of the nine experiment leaders were considered as knowledge sharing barriers.

The second part of the coding scheme was aimed at the second research question: *"What results are experienced through knowledge sharing?",* and also used for the third research question: *"What influence do social network characteristics and shared knowledge types have on the results of inter-organisational knowledge sharing?*. In accordance with the purpose of knowledge sharing (2.3) possible results of knowledge sharing processes were; 'development of products, materials and processes', 'development of insights, prerequisites and checklists', and 'future collaborations'. On forehand all experiment groups set goals that they wanted to achieve in this E-PLM project. Therefore, the results of the experiments were compared. The results could be labelled as; 'does not meet expectations', 'meets the expectations', and 'exceeds expectations'. This made it possible to check the results experiments delivered compared with the set goals. The coding scheme is attached in Appendix C.

For coding of interviews Atlas.ti was used to link quotations to codes from the coding scheme. To validate the coding scheme 20% of the used codes in interviews were coded by a second coder, whereby the coders should have an agreement rate (Cohens Kappa) $\kappa > 0.70$ (Grimmer, King, & Superti, 2015). The agreement rate was calculated to be $\kappa = .73$, which means the coding scheme was used in a reliable way.

3.6.2 Social network analyses

Experiment groups participating in the E-PLM project were studied with use of social network analyses. Therefore, density and centralization for different types of knowledge were examined and calculated with UCINET 6.0. The different knowledge types were general, technical and procedural knowledge about the experiment. Outcomes of the social network analyses were further elaborated in the results.

Network density refers to the proportion of actual relationships in groups relative to the maximum amount of possible relationships, calculated by the sum of the ties divided by the number of possible ties. The value of density can vary between 0 (no connections) and 1 (all possible connections). Participants shared their knowledge with all the other participants more , when the network was more dense (Hanneman & Riddle, 2005).

Network centralisation reflects the (un)equal distribution of relationships among individuals in a team. The value of centralisation can vary between 0 and 1, whereby the maximum value of 1 was reached when all participants in a group only shared their knowledge with one 'central' person in this group. Thus, a high value of centralisation indicated one or more individuals had a central role in this team and were highly important for the network. While, a low value on centralisation meant (nearly) all participants were more or less equally important. (Hanneman & Riddle, 2005).

Also, in-degree centralisation values for individuals in experiment groups were calculated. These scores can vary between 0 (none of the participants share knowledge with this person) and 1 (all

participants share knowledge with this person), which indicated the importance an individual has in the experiment group concerning general, technical and procedural knowledge. In-degree centralisation values concerning general, technical and procedural knowledge were further used as constructs for knowledge sharing. Reliability scores on the three items revealed Chronbach's $\alpha = .89$, indicating a strong correlation between the in-degree centralisation values. Further correlation analyses showed significant correlations between in-degree centralisation values for general, technical and procedural knowledge.

The last question from the questionnaire was an open-ended question, concerning 'other' knowledge. Answers on this question were collected in a document to compare the answers and the shared contents. Less than half of the participants filled in this question and most times the answers on the open-ended question belonged to procedural or technical knowledge. Also, the selected names on these questions, concerning 'other knowledge' and 'procedural/technical knowledge', were in accordance. One time, the answer on this open question was not related to knowledge about the experiment. Therefore, the answers on the open-ended question and the previous question about 'other knowledge' did not have much added value for this study.

3.6.3 Questionnaire

Data from the questionnaires was transferred to IBM SPSS22 after five weeks and prepared for analyses. Exploratory factor analyses (EFA) based on principle axis factoring (PAF) with Direct Oblimin rotation were performed on all 21 items in the questionnaire. Bartlett's test of sphericity $\chi^2 (253) = 476.18$, $p < .001$, indicated that the correlations between variables were significantly different from zero and sufficiently large for PAF (Field, 2009).

Multiple items exposed low factor scores (< 0.4) and decreased the reliability of the scales, which led to the exclusion of 7 items from the questionnaire. EFA demonstrated that 3 factors could be extracted from the 14 remaining items, all with Eigenvalues > 1.00, explaining in total 55.48% of the variance. These factors were labelled as Knowledge Sharing (1), Identification (2) and Extraversion (3). Reliability scores of the factors were acceptable, whereby Field (2009) stated that Cronbach's alpha values around .8 are good, Knowledge Sharing (1) Cronbach's $\alpha = .86$, Identification (2) Cronbach's $\alpha = .92$, and Extraversion (3) Cronbach's $\alpha = .81$.

Independent questionnaire variables extraversion and identification were found as two different factors. The relationships between both factors is not very strong, because correlation was calculated as .07.

To perform regression analyses assumptions of normality should be met. Inspections of histograms and q-q plots revealed some skewness of technical knowledge centrality, knowledge sharing and identification. However, since the skewness values did not exceed -2 it can be assumed that there is a normal distribution (Field, 2009).

4. Results

This section starts with mean scores and correlations of used factors in the study (4.1). Second, social network analyses have been conducted to show differences between experiments concerning different types of knowledge (4.2). Third, linear regression analyses were performed to investigate predicting factors for knowledge sharing in experiment groups (4.3). Furthermore, qualitative data was used to compare the outcomes and determine the influence of other factors from the theoretical framework (4.4). In the end, the results of the experiments have been elaborated to answer the second research question and investigate differences between experiments to answer the third research question (4.5).

4.1 Mean scores and correlations

Mean scores for extraversion, identification and knowledge sharing showed that participants defined themselves on average as slightly extravert individuals, that share knowledge above the theoretical average and that can identify themselves well with the group. Mean scores for in-degree centrality factors showed some differences; most participants received general knowledge about the experiments, less than half of the participants received procedural knowledge of the experiments, and even less participants received technical knowledge of the experiments (Table 1).

Thereafter, the influence of independent variables on knowledge sharing factors was analysed. Knowledge sharing consisted of the factors 'knowledge sharing' and in-degree centrality factors concerning general, technical and procedural knowledge of experiments. Findings suggested that identification has a relatively strong positive correlation with most knowledge sharing factors, meaning that individuals with high scores on identification also had high scores on knowledge sharing. Correlations of extraversion and knowledge sharing factors were quite low and not significant.

Table 1
Descriptive statistics and correlations at the individual level.

		N	*M*	*SD*	Min	Max	1	2	3	4	5	6
1.	Extraversion	31	3.61	.62	2.17	4.67	1.00	.07	.28	.00	.06	-.11
2.	Identification	31	4.98	1.28	2.00	6.75		1.00	.43*	.35	.38*	.38*
3.	Knowledge sharing	31	3.90	.96	1.00	5.00			1.00	.24	.25	.27
4.	In-degree centrality general knowledge	33	.61	.25	.17	1.00				1.00	.75**	.86**
5.	In-degree centrality technical knowledge	33	.31	.30	.00	1.00					1.00	.65**
6.	In-degree centrality procedural knowledge	33	.45	.29	.00	1.00						1.00

Notes: **p < .01, *p < .05 (1-tailed).

4.2 Social networks

Social network analyses were used to answer the third research question: *What influence do social network characteristics and shared knowledge types have on the results of inter-organisational knowledge sharing?".* In this section the network characteristics are elaborated and the influence these characteristics have on the results will be answered in a later section (4.5.4).

Social network analyses were performed on six experiment groups in the E-PLM project. All experiment groups set their own goals in the E-PLM project (Table 2). To achieve these goals knowledge sharing was needed. However, different types of knowledge contents, such as technical and procedural knowledge, were expected for the participating experiment groups. On forehand, it was expected that experiments 1, 4 and 5 mainly shared procedural knowledge, because the aims of these experiments were to determine insights, prerequisites and find generic components. For experiments 7, 9 and 11 both procedural and technical knowledge sharing were expected, because the aims of these experiments were to two-sided. First, the experiments aimed to determine insights and prerequisites. Afterwards, these experiments aimed to develop products, materials and processes on the basis of the

determined insights and prerequisites. Therefore, technical knowledge sharing was especially expected for the development of products, materials and processes.

Table 1
Number of group members, titles and aims of participating experiment groups.

	N	Title	Aim of the experiment
Exp. 1	5	Requirements for data exchange	Collect requirements for data exchange and infrastructure.
Exp. 4	7	Diversity in configuration methods (CM)	Determine generic: concepts and terminology in the CM process; insight into each other's CM process and methods; CM tooling that is used to facilitate the above processes.
Exp. 5	5	Conditions for data exchange	Investigate and create conditions in which knowledge exchange is stimulated and can take place without barriers.
Exp. 7	6	Technology portal	Determine requirements for sharing technical information, where secrecy and confidential information play a role; Create a portal wherein these information can be shared.
Exp. 9	6	Information exchange based on models	Determine which technical knowledge must be transferred; Investigate whether generating drawings can be eliminated or minimized by using 3D models.
Exp. 11	4	Service management KPI	Configure service management generically based on KPIs; Test an implementation in an operational situation.

Note: Aims of experiments were conducted from project plans of the E-PLM project.

Network density was calculated concerning general, technical and procedural knowledge of experiments. As showed in Figure 3 shared contents differed greatly among the various experiments. The higher the density score was the more group members shared their knowledge with other group members (Hanneman & Riddle, 2005). Participants in experiments 4, 5 and 7 hardly shared any technical knowledge. Contents in these experiments were considered as non-technical, and more procedural knowledge. Experiments 9 and 11 contained both technical and procedural knowledge.

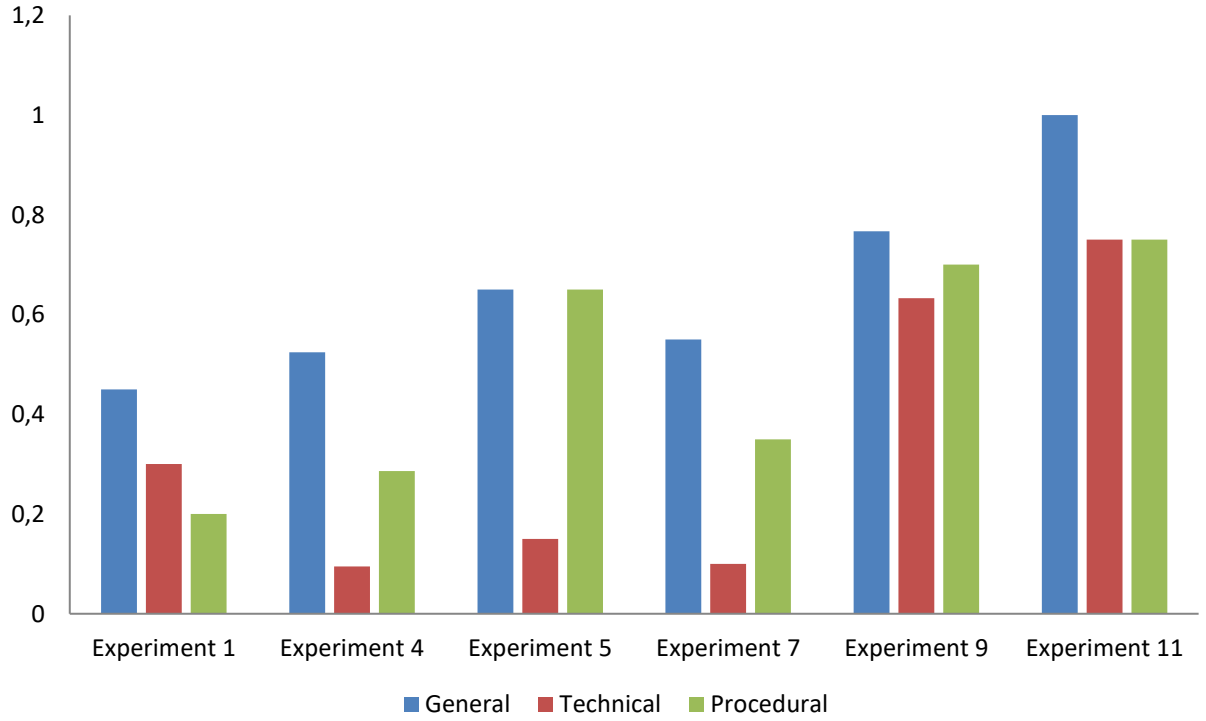

Figure 3. Density of different experiments concerning general, technical and procedural knowledge.

Also, centrality was calculated concerning general, technical and procedural knowledge of the experiment (Figure 4). Hereby, in-degree centrality was used, which gave insights in the centrality in receiving knowledge. Because of validity issues in-degree centrality was preferred over out-degree centrality. According to Zemljic and Hlebec (2005) reliability increased when in-degree centrality was used by nominating group members you shared knowledge with.

The higher the centrality score was, the more central one or two individuals were in this experiment group. Most knowledge was shared via these central individuals in the experiment group. For example, in experiment 4 the score for centrality on procedural knowledge was relatively high in comparison with other centrality values, which meant that one or two individuals had a more central position in this experiment concerning procedural knowledge. However, the centrality value of .45 was the highest in all experiment groups, which made clear that most teams did not possess a central person of great importance. Because the centrality range could differ between 0 and 1, this highest value was still under the average of the highest possible centrality value.

For some teams, such as experiments 4 and 11, the centrality values differed for the different knowledge types, which indicated a more central role in knowledge sharing for some group members concerning that type of knowledge. In other groups, like experiment 5, 7 and 9, the centrality values were more or less equal for different knowledge types.

The bar chart for general knowledge in experiment 11 is equal to 0, thus not visible in Figure 4. Because density (Figure 3) was calculated as 1, all participants were of equal importance in this group concerning general knowledge.

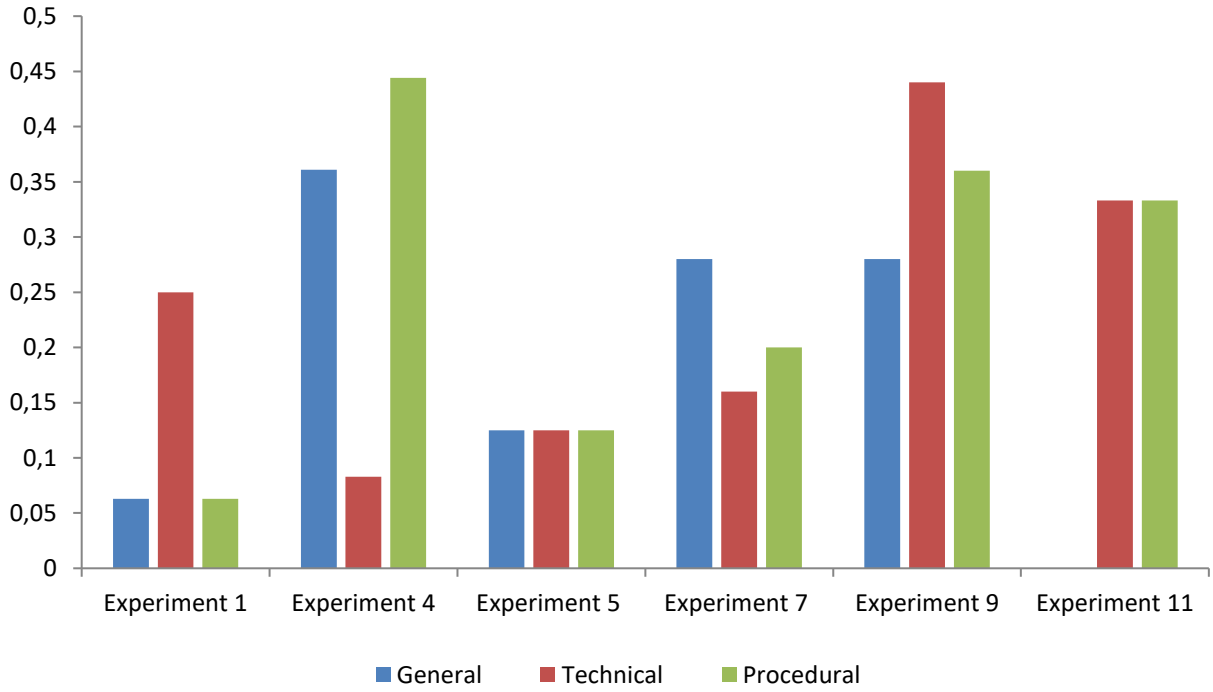

Figure 4. In-degree centrality in different experiments concerning general, technical and procedural knowledge.

Differences in centralisation between the experiments also became clear in social network graphs. In experiments with high scores on centralisation, one or two individuals literally had a central position. Figure 5 showed the connections between participants in experiment 4 concerning procedural knowledge. In this group two individuals had a relatively more central position and were a little more connected than the other group members. This meant that procedural knowledge was more often

shared with these two participants than the other team members. Concerning procedural knowledge these two individuals had a more central position and were well involved in the sharing processes.

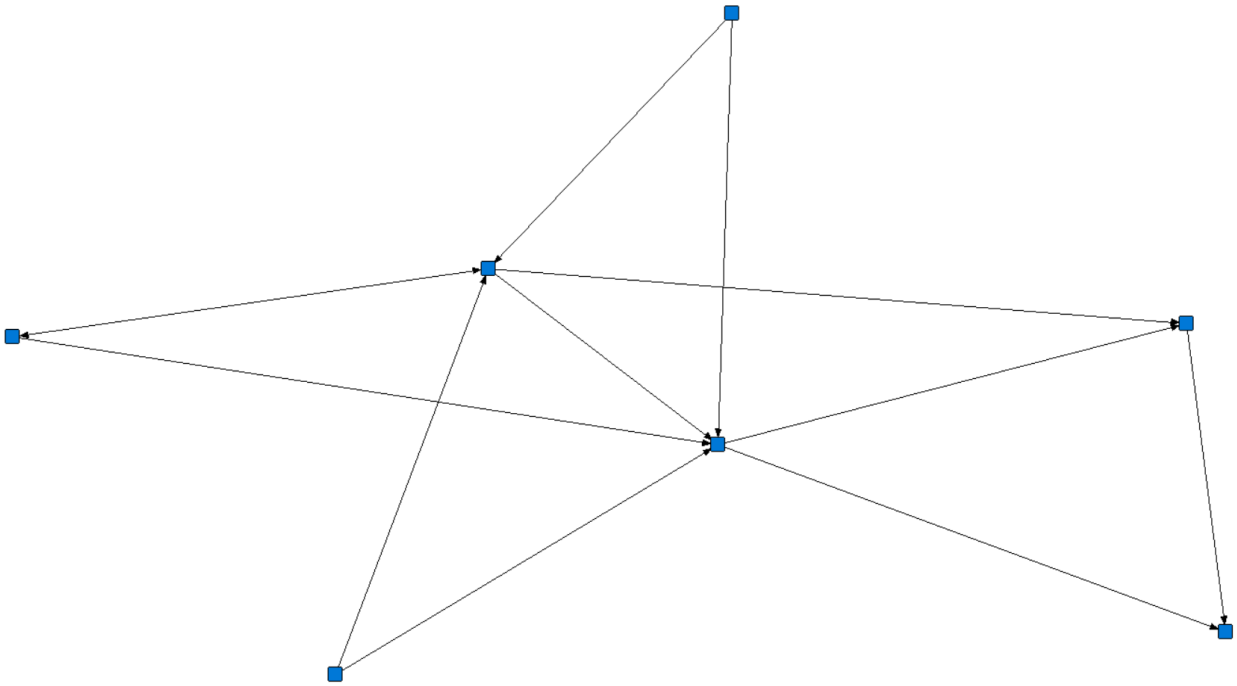

Figure 5. Social network graph of experiment group 4 concerning procedural knowledge.

However, Figure 4 also showed teams with low scores on centrality and the comparison of both social network graphs made the distinction clearer between centrality in experiments. Figure 6 showed the connections between participants in experiment 5 concerning general knowledge. Hereby, one of the participants barely shared knowledge with the other team members. The other four people were all connected with each other, thus none of the participants had a central role.

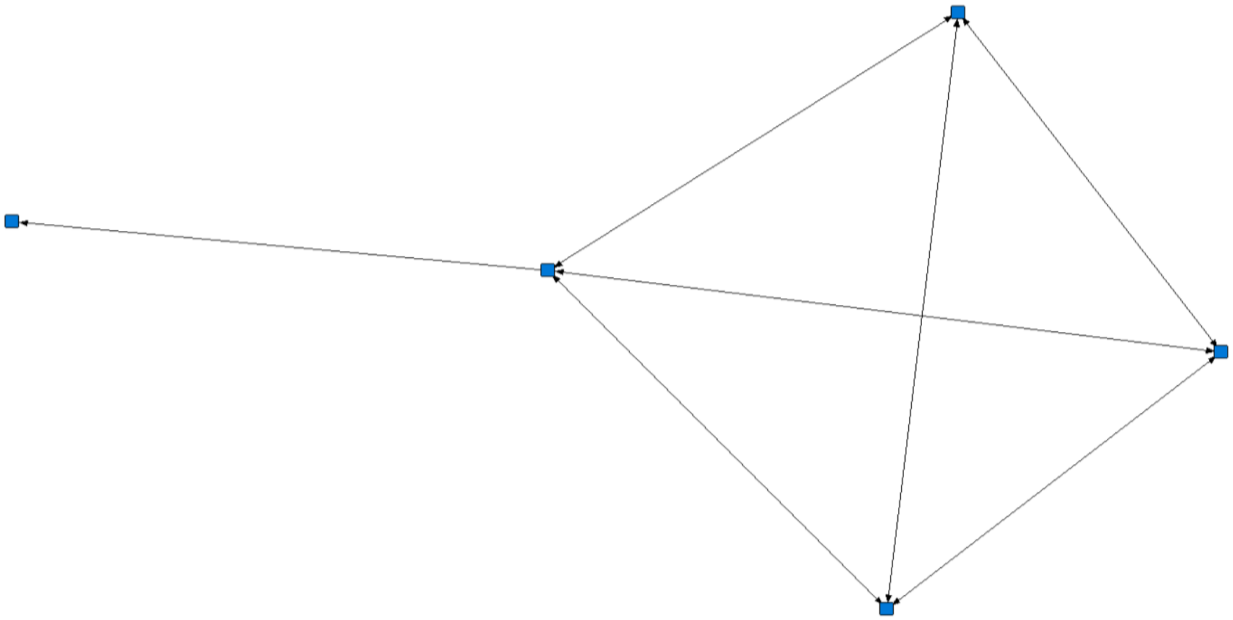

Figure 6. Social network graph of experiment group 5 concerning general knowledge.

4.3 Linear regression

The first research question was: “How do characteristics of knowledge and individual, group and organisational factors influence inter-organisational knowledge sharing in the high-tech industry?”.

To answer this question multiple linear regression analyses were performed including variables mentioned in Table 1. Identification and extraversion were used as independent variables that possibly predict the dependent variable knowledge sharing. The dependent variable knowledge sharing consisted of the factor knowledge sharing from the questionnaire and in-degree centrality values concerning general, technical and procedural knowledge. The values of in-degree centrality indicated the extent to which individuals received and shared (general, technical or procedural) knowledge in their experiment group. Therefore, four analyses were performed to identify relationships between independent and dependent variables, which made it possible to discover differences in the influence independent variables had on shared knowledge types. The effects of independent variables on knowledge sharing were determined, whereby the other independent variable was held constant. By doing so, only the unique influence independent variables had on knowledge sharing was measured.

Regression analysis with the construct ‘knowledge sharing’ as the dependent variable and both identification and extraversion as independent variable revealed identification as significant predictor for knowledge sharing, $R^2 = .24$, $F = 4.48$, $p = .021$. Investigation of the parameters showed a significant positive impact for identification on knowledge sharing, $b = .31$, $SE = .12$, $t = 2.47$, $p = .020$. The positive impact of extraversion was not significant, $b = .38$, $SE = .26$, $t = 1.50$, $p = .145$. Meaning that identification was a predictor for knowledge sharing, where high scores on identification led to high scores on knowledge sharing. However, extraversion did not predict the level of knowledge sharing.

The second regression analysis with the construct in-degree centrality for general knowledge as dependent variable and both identification as extraversion as independent variable revealed both variables to be non-significant for knowledge sharing, $R^2 = .12$, $F = 1.93$, $p = .16$. Investigation of the parameters showed that the impact of both identification, $b = .07$, $SE = .04$, $t = 1.97$, $p = .059$, and extraversion, $b = -.01$, $SE = .07$, $t = -.14$, $p = .887$ were not significant, meaning that both variables could not be seen as predictor for knowledge sharing according to in-degree centrality values for general knowledge.

The third regression analysis with the construct in-degree centrality for technical knowledge as dependent variable and both identification as extraversion as independent variable revealed identification as significant predictor for knowledge sharing, $R^2 = .15$, $F = 2.38$, $p = .11$. Investigation of the parameters showed a significant positive impact for identification on knowledge sharing, $b = .09$, $SE = .04$, $t = 2.15$, $p = .040$. The positive impact of extraversion was not significant, $b = .02$, $SE = .09$, $t = .20$, $p = .842$. Meaning that identification was a predictor for knowledge sharing, where high scores on identification led to high scores on in-degree centrality values for technical knowledge. However, extraversion did not predict the level of knowledge sharing concerning technical knowledge.

The last regression analysis with the construct in-degree centrality for procedural knowledge as dependent variable and both identification as extraversion as independent variable revealed identification as significant predictor for knowledge sharing, $R^2 = .17$, $F = 2.78$, $p = .079$. Investigation of the parameters showed a significant positive impact for identification on knowledge sharing, $b = .09$, $SE = .04$, $t = 2.26$, $p = .032$. Negative impact of extraversion was not significant, $b = -.07$, $SE = .08$, $t = -.82$, $p = .421$. Meaning that identification was a predictor for knowledge sharing, where high scores on identification led to high scores on in-degree centrality values for procedural knowledge. However, extraversion did not predict the level of knowledge sharing concerning procedural knowledge.

All in all, it has become clear that the positive influence of identification on knowledge

sharing could be defined as significant. Therefore, identification could be seen as a predictor for knowledge sharing. In three of the four analyses the influence was significant, whereby the non-significant value was only little above $p = .05$. However, the influence of extraversion on knowledge sharing was considered to be small and non-significant. None of the analyses showed a significant prediction of knowledge sharing through extraversion.

4.4 Qualitative data

To answer the first research question *"How do characteristics of knowledge and individual, group and organisational factors influence inter-organisational knowledge sharing in the high-tech industry?"* also data from interviews was used. In accordance with the findings in linear regression analyses seven out of nine experiment leaders mentioned the positive influence of identification on knowledge sharing. The influence came clear in statements as*: "I had the feeling every participant could share his ideas, because all group members fitted well in the group and everybody could identify with the group".* However, some experiment leaders stated that identification could be improved: *"for the real group feeling you have to do something more, because the real contact in physical meetings is just too little".* Therefore, the relation between identification and knowledge sharing was already clear, only the degree of identification could be further improved. Furthermore, experiment leaders noticed that identification had impact on the motivation and sense of responsibility of participants. Participants that were able to identify with the experiment groups showed higher levels of motivation and felt more responsibility for their tasks.

Moreover, experiment leaders mentioned that shared goals, motivation, sense of responsibility, skills for knowledge sharing, trust and face-to-face meetings were positive influencing factors on knowledge sharing.

In general, the influence of organisations was considered as a more important factor for successful inter-organizational knowledge sharing than individual factors by all experiment leaders, whereby common expectations were described as most important prerequisite for successful knowledge sharing between multiple organisations. If this condition was met the individual and group factors determined the success of experiments.

At the individual level, motivation was mentioned as an important influencer by eight experiment leaders and the following was stated: *"the more motivated participants were, the more knowledge was shared".* Another influencing factor at the individual level was sense of responsibility, because teams where every participant was responsible for the part he led mutual dependence had arisen. As a result, distribution of tasks in experiment groups was recommended by seven experiment leaders.

At the group level trust was mentioned as influencing factor for knowledge sharing by all experiment leaders. One experiment leader even stated: *"the basis for cooperation is trust, so you must be able to trust each other"*.

Concerning the opportunities to share knowledge all experiment leaders preferred face-to-face meetings. One of the experiment leaders stated: *"It is a must that meetings take place in a face-to-face setting, because everyone can react on each other, it is effective for determining the direction, handling goals together and come to conclusions"*. The regional nature of this project facilitated the face-to-face meetings and one of the experiment leaders stated: *"because all participants came from the same region it was easy to come together, within fifteen minutes you could be with the other team members".*

However, personality factors were not identified as positive influencers for knowledge sharing processes. In accordance with the findings in linear regression analyses all experiment leaders considered the influence of extraversion on knowledge sharing as small and one of them stated: *"I do not think there is a relationship between extraversion and the degree of knowledge sharing".* Besides

extraversion none of the personality characteristics were mentioned as affecting factor in interviews. Some quotes from the interviews were: *'I can not name any personality characteristic that really affected the process"*, and *"I think the impact of personality factors is not very big".*

Furthermore, experiment leaders had various visions about the factors group continuity and knowledge base distance. Four of the experiment leaders mentioned positive elements for these factors and five experiment leaders mentioned negative elements. Thus, on the one hand absence and group changes were mentioned as inhibitory factors in knowledge sharing processes: *"a change of occupation causes disturbance in the knowledge sharing process"* and *"if someone is absent often, you do not come further in the group process than getting to know each other and with this, absence has indirect influence on trust".* On the other hand, some experiment leaders declined that absence of a participant or change of occupation did not negatively influenced the knowledge sharing process: *"the absence had just little influence, because this person's content has been the least important and he was present while we needed his input"* and *"replacement of a participant barely influenced the knowledge sharing process, because transfer of tasks was done very well"*. As a result, the way groups handled replacements determined the influence this replacement had on knowledge sharing processes.

Lastly, experiment leaders noticed little influence concerning knowledge base distance. Four experiment leaders mentioned differences in knowledge as a cconditon for interesting discussions and the other experiment leaders mentioned the difficulty for discussions about some contents because of knowledge base distance. All in all the influence of knowledge base distance was considered as small by eight of the experiment leaders.

4.5 Experienced results through knowledge sharing

The second research question was: *"What results are experienced through knowledge sharing?".*

To answer this question data from the interviews was used that was coded with the second part of the coding scheme. Results of experiments in the E-PLM project were divided over three possible outcomes. First of all, experiments could have yielded materials, products and processes. Second, experiments could have delivered insights, prerequisites and checklists. Third, possible future collaborations between participants or organisations in the experiments could arise from the experiments.

4.5.1 Materials, products and processes

Six experiment leaders explained that the outcomes were different than the intentions of the experiments. Some quotes of experiment leaders were; *"when it comes to concrete implementation the outcomes do not meet our intentions"*, *"we did not meet our objectives because of certain restrictions as technical bumps"*, and *"only one of the sub-experiments has been successful".* For example experiments 4 and 7 aimed to deliver tooling for configuration methods and a technology portal. These sub-goals in the experiment group were not achieved.

A possible cause of the disappointing results with a view to the intentions could be the ambitious objectives: *'some experiments aimed a kind of standardisation, however in this kind of experiments standardisations were far-reaching objectives and hardly reachable across multiple organisations"*. This led to the situation that most experiments delivered other or less materials, products and processes than aimed.

However, in spite of the possible disappointing results experiment leaders were quite satisfied with the outcomes of the experiments. Some objectives were delayed as part of follow-up experiments in E-PLM 2.0. The satisfaction of experiment leaders was expressed as follows; *"I am very excited about the outcome of this experiment",* and *"the experiment resulted in a technical environment for all experiment groups and meets most of the intentions"*.

4.5.2 Insights, prerequisites and checklists

All experiment leaders were satisfied with the gained insight, prerequisites and checklists in experiments. Their satisfaction came clear in statements as; *"learning from each other has been stronger than I thought in advance"* and *"the inventory and exchange were meaningful and successful".*

In contrast to the difficulties concerning materials and products, the insights, prerequisites and checklists were all fully elaborated. The experiment leaders stated; *"the project has delivered a process description and a checklist", "the experiment delivered a template to compare methods and tools that different organisations use, therefore it yielded knowledge about other organisations and their methods",* and *"the purpose of the experiment was to gain insight into collaborative processes, which was achieved by the composed and used checklists".*

However, in one of the experiments, experiment 1, requirements for a digital environment all derived from one organisation. Other organisations had a lower level concerning these requirements and all accepted the requirements one of the organisations proposed. Therefore, this experiment had to deal with quite unilaterally input. This was also visible in Figure 3, whereby experiment 1 possessed the lowest density value concerning procedural knowledge with a value of .2.

Concerning insights, prerequisites and checklists no difference was discovered between experiments with technical knowledge and experiment without technical knowledge. All experiments contained this type of results that matched the original goal.

4.5.3 Future collaborations

Participating in E-PLM experiments could be useful for organisations in the east of the Netherlands. One of the experiment leaders stated; *"it worked very well to connect organisations from the region, because you easily get in touch with other organisations, which you otherwise had little to no contact with, thus it was good for the company's network".*

Most organisations saw the benefits of participating in E-PLM experiments and will join one or more experiments in E-PLM 2.0. Next to the current organisations, several other organisations will participate in those new experiments. However, one of the organisations stopped as a participant in the experiments, probably because of a disagreement with another organisation in their experiment.

4.5.4 Influence of network characteristics on results

The third research question was: *"What influence do social network characteristics and shared knowledge types have on the results of inter-organisational knowledge sharing?".* To answer this question data from the interviews were used that was coded with the second part of the coding scheme and a comparison with social network characteristics and shared knowledge types was made.

A difference was discovered between experiments that shared technical knowledge and experiments that barely shared technical knowledge (Figure 3). The output of experiments 4, 5 and 7 wherein technical knowledge barely was discussed, also provided hardly any materials, products and processes. Experiments 9 and 11 shared technical knowledge, whereby materials, processes and products were provided.

The values for in-degree centrality (Figure 4) differed for all experiments and knowledge types, except for experiment 5. It was not clear whether shared technical or procedural knowledge with high or low centrality values produced other outcomes in experiment groups. Therefore, no relationship was found between the in-degree centrality values and results of experiment groups.

Concerning the density values (Figure 3), nearly all experiment groups shared more procedural knowledge than technical knowledge. Therefore, output of all experiments consisted mainly of insights, prerequisites and checklists. The influence of network characteristics and shared knowledge types on the results of inter-organisational knowledge sharing, was mainly explained by shared

knowledge types according to the density values. Teams that barely shared technical knowledge provided insights, prerequisites and checklists. However, teams that shared much technical knowledge also shared procedural knowledge and provided both insights, prerequisites and checklists, such as materials, products and processes.

5. Discussion

This section starts with reflections on the findings, where the findings are related to studied articles (5.1). Second, theoretical (5.2) and practical implications (5.3) will be discussed. Third, limitations of the study (5.4) will be described. Thereafter, suggestions for future research will be given (5.5). In the end, a final conclusion will answer the research questions (5.6).

5.1 Reflection on the findings

Identification, the process wherein individual team members see themselves as one with their team (Nahapiet & Ghoshal, 1998), is found as predictor for inter-organisational knowledge sharing. This finding is in accordance with the qualitative research of Nahapiet & Ghoshal, which stated that identification affects the motivation to share knowledge between team members. Also, findings of Cabrera and Cabrera (2002) are in line with this study, because individual team members share more knowledge, and individuals feel more responsibility and we-ness at the team level if identification is felt more strongly.

Extraversion was not found as predictor for inter-organisational knowledge sharing. Besides extraversion none of the personality characteristics were mentioned as affecting factor in interviews. These findings are not in line with studied articles, whereby extraversion is mentioned as significantly related to eagerness to share knowledge" (de Vries, van den Hooff & de Ridder, 2010, p.124). Also, positive influences on knowledge sharing were found for the factors 'Conscientiousness', 'Agreeableness', and 'Openness to experience' (Stewart & Nandkeolyar, 2006; Matzler et al., 2008). A possible explanation could be the character of the experiments. In general, experiment leaders considered the influence of organisations as a more important factor for successful inter-organizational knowledge sharing than individual factors. Organisations choose consciously for participation in experiments for certain reasons, whereby participants from these organisations actively participate in the experiments. The experiments are needed for organisations to acquire knowledge from sharing processes, thus all participants are in this experiment to share knowledge. Therefore, personality may have less influence in this setting. Adler and Weiss (1988) stated that personality factors have the most impact in 'weak' situations. In 'strong' situations that consists of more defined roles, rules, goals and contingencies, personality factors should have less impact on knowledge sharing processes. Because roles, rules and goals are well defined in experiment groups this context will be defined as a 'strong' situation. If the nature of experiments is more free for participants and obtaining information for their respective organisation is not necessary the personality characteristics possibly have more influence on knowledge sharing than in these experiments, because the situation will be 'weak(er)'.

Trust is found as an important factor in knowledge sharing processes and even mentioned as basis for cooperation. According to the studied articles the influence of trust is expected, which stated that participants are more willing to share their knowledge when relationships are high in trust, because trust reduces the fear of losing ones' unique value in knowledge sharing processes (Connelly & Kelloway, 2003; Renzl, 2008). Therefore, Trust was mentioned as the most important factor for sharing processes by the experiment leaders concerning specialised and confidential knowledge.

Moreover, motivation is mentioned as an important influencer by all experiment leaders, which meets the studied articles. These articles stated that enjoyment in helping others is strongly associated with the willingness to share knowledge (Lin, 2007) and without strong motivation, people are not likely to share knowledge and they would certainly not give knowledge away without concerning for what they may lose by doing so (Stenmark, 2001).

Furthermore, knowledge base distance is not mentioned as influencing factor for knowledge sharing by experiment leaders. In contrast to studied articles no influence is found, however Cummings and Teng (2003, p.47) stated that the knowledge base distance between two parties cannot be too great for effective knowledge sharing. The lack of knowledge about a certain topic could be

seen as knowledge sharing barrier (Paulin & Suneson, 2012). A possible explanation for this finding could be that participants in the experiments all possessed prior knowledge about the particular topics. According to Nonaka and Takeuchi (1995) it is believed that overlapping areas of expertise facilitate knowledge sharing between organisations. In this study organisations were further interested in several topics and considered the topics as useful for their future. In practice all participants possessed prior knowledge and are willing to further develop their knowledge about certain topics, which made the possible knowledge base distance smaller and less influential.

In the end, density values (Figure 3) for experiment 1 showed higher values for technical knowledge, than for procedural knowledge. Concerning the aim of the experiment: *'Collect requirements for data exchange and infrastructure',* mainly procedural knowledge was expected. A possible explanation for this contradiction is that experiment 1 was a preparation for experiment 2: '*Realisation of the E-PLM environment'.* Both experiments had the same experiment leader and three of the five group members from experiment 1 formed experiment 2. Therefore, it was possible that the participants from experiment 1 in this study filled in the sharing processes for both experiments. Resulting in more technical than procedural knowledge sharing at the time participants filled in the questionnaire.

5.2 Theoretical implications

In studied articles about the influence of personality factors a positive association between extraversion and knowledge sharing behaviour was reflected in the study of Anwar (2017). Furthermore, de Vries, van den Hooff and de Ridder (2010, p.124) stated: "extraversion is positively and significantly related to eagerness to share knowledge". In the study of Anwar participants filled in 7 questions about knowledge sharing and extraversion was measured with the Big-Five personality dimensions. In the study of de Vries, van den Hooff and de Ridder participants filled in four questions about knowledge donating and four questions about knowledge collecting as indicator for knowledge sharing behaviour, and extraversion was measured with the HEXACO self-test.

This study measured knowledge sharing both with questionnaire items, whereby participants indicated their own knowledge sharing behaviour, as with social network analyses, whereby other group members indicate sharing connections with the individuals in their experiment group. Questions concerning the personality trait extraversion were adopted from the Big Five trait taxonomy (John & Srivastava, 1999).

No significant correlations were found between extraversion and knowledge sharing constructs in the present study. However, correlation between extraversion and the knowledge sharing construct from the questionnaire (.28) was much higher than correlations between extraversion and knowledge sharing constructs from social network analyses (between -.11 and .06). Therefore, the influence of extraversion on knowledge sharing was possibly considered as too high in previous research because of self-serving bias in the self -reports.

5.3 Practical implications

Identification, the process wherein individual team members see themselves as one with that group of people (Nahapiet & Ghoshal, 1998), is identified as predictor for knowledge sharing and therefore important for future experiments in the E-PLM project. For future experiment, creation of an atmosphere that enhanced the level of identification is advised and group efficacy was found as affecting factor for group identification (Illia, Bonaiuto, Pugliese & van Rekom, 2011). Prerequisites for group efficacy are supervisors that exert some effort to interact with their team members in a positive way, whereby communication in the group is clear and all participants know what their task is (Lin, Lin, Huang & Wang, 2014). This will lead to groups wherein every participant could identify himself well with the other team members. According to Cabrera and Cabrera (2002), these groups are

more likely to be successful, because more knowledge is shared, and individuals feel more responsibility and we-ness at the team level (Cabrera & Cabrera, 2002). Hendriks (1999) stated that individuals share more knowledge because of a sense of responsibility and this matches the outcomes in this study. Therefore, positive interaction, clear communication and distribution of tasks are recommended for future experiments to increase the likelihood of a successful experiment.

5.4 Limitations

Although this study was carefully prepared, there were some unavoidable limitations. First, not all experiment groups were part of this study, making this sample incomplete. Because some participants were part of multiple experiment groups it was decided to select seven out of the eleven experiment groups. Otherwise, some individuals had to fill in the questionnaire for five different experiment groups, which makes it difficult to distinguish all different groups, and participants are more likely to respond on shorter questionnaires (Sahlqvist et al., 2011). This made it possible to achieve a response rate of 84.4% in this study, whereby the used sample is an excellent representation of the real-world situation and is said to be a good fit (Field, 2009). The study used complete experiment groups including both groups that shared technical knowledge and groups that barely shared technical knowledge. Furthermore Miller and Kunce (1973) suggested that a substantial subject to predictor ratio of 10 to 1 is sufficient. In this study two possible predictors were measured, making the sample of 27 participants suitable for the linear regression analyses. The small sample size only measured two predicting variables, however initially the intention was to measure the influence of three predicting variables. Because of the small number of participants, only big effects on knowledge sharing could be measured, since bigger effects are easier to detect than smaller effects. Thereby, large samples of participants offer greater test sensitivity than small samples. In this study it was not possible to detect smaller effects on knowledge sharing, thus it could be possible that extraversion had an (small) effect on knowledge sharing, while the conclusion was there was no effect (Ellis, 2010).

Second, because self-reports were used in the questionnaire the outcomes could contain self-serving bias. Therefore, factors from the questionnaire were also questioned in interviews with experiment leaders. According to Meijer, Verloop and Beijaard (2002) two applications of triangulation were applied, namely triangulation by data source and triangulation by data type. Combining both analyses increased the reliability of research outcomes. Moreover, the mentioned influences in interviews were in accordance with the questionnaire. Therefore, the outcomes from the questionnaire were considered as reliable.

Third, participants described the knowledge sharing processes in their experiment group. Thus, the actual amount of shared knowledge in the experiments was not measured or checked. However, the success of knowledge sharing processes does not depend on the amount of shared knowledge. Gessler (2009) described that satisfaction of participants at the end of a process indicates the success of this process. Therefore, the knowledge sharing process could be defined as successful, because the experiment leaders were satisfied with the outcomes of the experiments and nearly all organisations will join one or more experiments in E-PLM 2.0

Fourth, social network analyses were performed concerning different knowledge types, namely general, technical and procedural knowledge. Reliability scores on the three items revealed Chronbach's $\alpha = .89$, indicating a strong correlation between the in-degree centralisation values. Further correlation analyses showed significant correlations between in-degree centralisation values for general, technical and procedural knowledge. Therefore, the three knowledge types could not be seen as separate constructs. However, this study considered the three knowledge types as separate constructs in line with the study of Balkundi and Harrison (2006). In their study Balkundi and Harrison distinguished three types of knowledge in parallel teams: technical knowledge (for example, practical use for online platforms to present content and joint output for groups), procedural

knowledge (for example, business secrets and agreements relating to disclosure of knowledge), and knowledge about the content (this includes all the substantive knowledge about subjects covered in teams). Because this study was partly built on these outcomes, it was decided that knowledge types were considered as separate constructs.

5.5 Future research

Future research could further investigate influencing factors in experiment groups as in the E-PLM project. First suggestion for future studies is to examine the influence of leadership on knowledge sharing. Also Wang and Noe (2010) suggested to examine the influence of leadership characteristics on knowledge sharing. In the E-PLM project each experiment group has an experiment leader that is in charge, however every experiment leader has his own leadership styles. Therefore, it would be interesting to measure the influence of different types of leaders in experiment groups. Insights from these studies could further develop the experiments in successfully sharing knowledge. It could be possible that experiment leaders should meet the criteria for a suitable leader in these experiments.

Second, organisational values affect the behaviour of individuals towards acceptable behaviour for the organisation (Dasí et al., 2017), because culture and values set norms about knowledge sharing in organisations (Ipe, 2003). In this research it became clear that the influence of organisations was bigger than individual influences. Therefore, it would be useful to further investigate which influencing factors at the organisational level have positive influence on inter-organisational knowledge sharing. In accordance with future research suggestions of Wang and Noe (2010) organisational culture and norms should be further investigated concerning the influence on inter-organisational knowledge sharing in the high-tech industry.

5.6 Conclusion

The aim of this study was to investigate the influence of various factors on knowledge sharing in an inter-organisational context. Therefore the following research question was set: *"How do characteristics of knowledge and individual, group and organisational factors influence inter-organisational knowledge sharing in the high-tech industry?".* First, it was found that identification was a predictor for knowledge sharing in experiment groups. Furthermore identification influenced motivation of individuals and the sense of responsibility. Therefore, the influence of identification on knowledge sharing was both direct and indirect.

Second, face-to-face meetings were considered as highly important for successful inter-organisational knowledge sharing. This also affects levels of trust between individual participants and trust could be seen as the basis for cooperation.

Third, common goals and expectations of experiments were considered as most important prerequisite for successfully sharing knowledge between several organisations. This common goal is the basis from which the participants work together.

The second research question was: *"What results are experienced through knowledge sharing?".* Experiments mainly delivered insights, prerequisites and checklists, because all experiments searched for insights and composed checklists to compare organisations. These checklists clarified methods, prerequisites and insights whereby participants had a shared language.

Furthermore, the third research question was: *"What influence do social network characteristics and shared knowledge types have on the results of inter-organisational knowledge sharing?".* Experiments that contained sharing of technical knowledge delivered both insights, prerequisites and checklists, and materials, products and processes as output. Whereby, materials, products and processes arose from the set insights and prerequisites in the experiments.

All in all, nearly all participating organisations were satisfied with the outcomes of these experiments. Therefore, most organisations continue their participation in future E-PLM (2.0) projects.

The projects in E-PLM 2.0 will be more successful when all experiments have shared goals, team members who are able to identify themselves well with the group and teams that regularly appoint face-to-face meetings. Stimulation of these influencing factors will lead to even more satisfaction with the processes and outcomes in inter-organisational knowledge sharing processes in the high-tech industry.

Reference list

Abdul-Jalal, H., Toulson, P., & Tweed, D. (2013). Knowledge sharing success for sustaining organizational competitive advantage. *Procedia Economics and Finance 7*, 150-157. doi:10.1016/S2212-5671(13)00229-3

Adler, S., & Weiss, H. M. (1988). Recent developments in the study of personality and organizational behavior. In C. L. Cooper and I. Robertson (Eds.), *International Review of Industrial and Organizational Psychology*, New York: Wiley.

Ahmad, N., & Daghfous, A. (2009). Knowledge sharing through inter-organizational knowledge networks: Challenges and opportunities in the United Arab Emirates. *European Business Review, 22*(2), 153-174. doi:10.1108/0955534101123506

Almeida, M. V., & Soares, A. L. (2014). Knowledge sharing in project-based organizations: Overcoming the international limbo. *International Journal of Information Management, 34*(6), 770-779. doi:10.1016/j.ijinfomgt.2014.07.003

Anwar, C. M. (2017). Linkages between personality and knowledge sharing behaviour in workplace: Mediating role of affective states. *Ekonomie a Management 20*(2), 102-115. doi:10.15240/tul/001/2017-2-008

Bakker, M., Leenders, R.T. A. J., Gabbay, S. M., Kratzer, J., & van Engelen, J. M. L. (2006). Is trust really social capital? Knowledge sharing in product development projects. *The Learning Organization, 13*(6), 594-605. doi:10.1108/09696470610705479

Balkundi, P., & Harrison, D. A. (2006). Ties, leaders and time in teams: Strong inference about network structure's effects on team viability and performance. *Academy of Management Journal, 49*(1), 49-68. doi:10.5465/AMJ.2006.20785500

Bednall, T. C., Sanders, K., & Runhaar, P. (2014). Stimulating informal learning activities through perceptions of performance appraisal quality and human resource management system strength: A two-wave study. *Academy of Management Learning & Education, 13*(1), 45-61. doi:10.5465/amle.2012.0162

Borgatti, S. P., & Ofem, B. (2010). *Overview: Social network theory and analysis.* Cambridge: Harvard University Press.

Bresman, H., Birkinshaw, J. M., & Nobel, R. (1999). Knowledge transfer in international acquisitions. *Journal of International Business Studies, 30*(3), 439–462. doi:10.1057/jibs.2009.56

Cabrera, A., & Cabrera, E. F. (2002). Knowledge-sharing dilemmas. *Organization Studies, 23*(5), 687-710. doi:10.1177/0170840602235001

Chen, Y. H., Lin, T. P., & Yen, D. C. (2014). How to facilitate inter-organizational knowledge sharing: The impact of trust. *Information & Management, 51*(5), 568-578. doi:10.1016/j.im.2014.03.007

Chiu, C., Hsu, M., & Wang, E. (2006). Understanding knowledge sharing in virtual communities: An integration of social capita land social cognitive theories. *Decision Support Systems, 42*(3), 1872-1888. doi:10.1016/j.dss.2006.04.001

Connelly, C. E., & Kelloway, E. K. (2003). Predictors of employees' perceptions of knowledge sharing culture. *Leadership & Organization Development Journal*, *24*(5), 294-301. doi:10.1108/01437730310485815

Creswell, J. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches.* London: SAGE.

Cummings, J. L., & Teng, B. S. (2003). Transferring R&D knowledge: The key factors affecting knowledge transfer success. *Journal of Engineering and Technology Management*, *20*(1), 39-68. doi:10.1016/S0923-4748(03)00004-3

Dasi, A., Pedersen, T., Gooderham, P. N., Elter, F., & Hildrum, J. (2017). The effect of organizational separation on individuals' knowledge sharing in MNCs. *Journal of World Business 52*(3), 431-446. doi:10.1016/j.jwb.2017.01.008

Davenport, T. H., & Prusak, L. (2000). *Working knowledge: How organizations manage what they know*. Boston: Harvard Business School Press.

Dawes, S. S. (1996). Interagency information sharing: Expected benefits, manageable risks. *Journal of Policy Analysis and Management*, 377-394.

de Vries, R. E., Van den Hooff, B., & De Ridder, J. A. (2006). Explaining knowledge sharing: The role of team communication styles, job satisfaction, and performance beliefs. *Communication Research, 33*(2), 115-135. doi:10.1177/0093650205285366

Dinger, F. C., Dickhäuser, O., Hilbig, B. E., Müller, E., Steinmayr, R., & Wirthwein, L. (2015). From basic personality to motivation: Relating the HEXACO factors to achievement goals. *Learning and Individual Differences, 40*(1), 1-8. doi:10.1016/j.lindif.2015.03.023

Ellis, P. D. *The essential guide to effect sizes: Statistical power, meta-analysis, and the interpretation of research results.* Cambridge: Cambridge University Press.

European Commission. (2011). From challenges to opportunities: Towards a common strategic framework for EU research and innovation funding (COM 48). Brussel: EC.

Field, A. (2009). *Discovering statistics using SPSS.* London: Sage publications.

Gessler, M. (2009). The correlation of participant satisfaction, learning success and learning transfer: An empirical investigation of correlation assumptions in Kirkpatrick's four-level model. *International Journal of Management in Education 3*(3-4), 346–358. doi:10.1504/IJMIE.2009.027355

Grandison, T., & Sloman, M. (2001). A survey of trust in internet applications. *IEEE Communications Surveys and Tutorials, Fourth Quarter 2000.*

Grimmer, J., King, G., & Superti, C. (2015). *The unreliability of measures of intercoder reliability, and what to do about it.* Retrieved from http://web.stanford.edu/~jgrimmer/Handbib.pdf

Hanneman, R. A., & Riddle, M. (2005). *Introduction to social network methods.* CA: University of California, Riverside.

Hendriks, P. (1999). Why share knowledge? The influence of ICT on the motivation for knowledge sharing. *Knowledge and Process Management, 6*(2), 91-100. doi:10.1002/1099-1441

Hew, K. F., & Hara, N. (2007). Knowledge sharing in online environments: A qualitative case study. *Journal of the American Society for Information Science and Technology*, *58*(14), 2310-2324. doi:10.1002/asi.20698

Ho, L. I., Kuo, T. S., & Lin, B. (2012). How social identification and trust influence organizational online knowledge sharing. *Internet Research, 22*(1), 4-28. doi:10.1108/10662241211199942

Illia, L., Bonaiuto, M., Pugliese, E., & van Rekom, J. (2011). Managing membership threats through collective efficacy. *Journal of Business Research, 64*(6), 631–639.

Ipe, M. (2003). Knowledge sharing in organizations: A conceptual framework. *Human Resource Development Review*, *2*(4), 337-359. doi:10.1177/1534484303257985

John, O. P., & Srivastava, S. (1999). The Big Five trait taxonomy: History, measurement, and theoretical perspectives. *Handbook of personality: Theory and research, 2*, 102-138

Johnson, S. D., Suriya, C., Yoon, S. W., Berrett, J. V, & La Fleur, J. (2002). Team development and group processes of virtual learning teams. *Computers & Education*, *39*(4), 379-393. doi:10.1016/S0360-1315(02)00074-X

Liao, H., & Chuang, A. (2004). A multilevel investigation of factors influencing employee service performance and customer outcomes. *Academy of Management Journal, 47*(1), 41-58. doi:10.2307/20159559

Lin, C. W., Lin, C. S., Huang, P. C., & Wang, Y. L. (2014). How group efficacy mediates the relationship between group affect and identification. *Journal of Business Research*, *67*(7), 1388-1394.

Lin, H. F. (2007). Knowledge sharing and firm innovation capability: An empirical study. *International Journal of Manpower*, *28*(3/4), 315-332. doi:10.1108/01437720710755272

Lu, I., Wang, C., & Mao, C. (2007). Technology innovation and knowledge management in the high-tech industry. *International Journal of Technology Management 39*(1-2), 3-19. doi:10.1504/IJTM.2007.013437

Matschke, C., Moskaliuk, J., Bokhorst, F., Schümmer, T., & Cress, U. (2014). Motivational factors of information exchange in social information spaces. *Computers in Human Behavior 36*, 549-558. doi:10.1016/j.chb.2014.04.044

Matzler, K., Renzl, B., Müller, J., Herting, S., & Mooradian, T. A. (2008). Personality traits and knowledge sharing. *Journal of Economic Psychology, 29*(3), 301-313. doi:10.1016/j.joep.2007.06.004

McDermott, R., & O'Dell, C. (2001). Overcoming cultural barriers to sharing knowledge. *Journal of Knowledge Management*, *5*(1), 76-85. doi:10.1108/13673270110384428

Meijer, P. C., Verloop, N., & Beijaard, D. (2002). Multi-method triangulation in a qualitative study on teachers' practical knowledge: An attempt to increase internal validity. *Quality and Quantity, 36*(2), 145-167. doi:10.1023/A:1014984232147

Miller, D. E., & Kunce, J. T. (1973). Prediction and statistical overkill revisited. *Measurement and Evaluation in Guidance, 6*(3), 157-163.

Moolenaar, N. M. (2012). A social network perspective on teacher collaboration in schools: Theory, methodology, and applications. *American Journal of Education, 119*(1), 7-39. doi:10.1086/667715

Morgan, R. M., & Hunt, S. D. (1994). The commitment-trust theory of relationship marketing. *Journal of Marketing, 58*(3), 20-38. doi:10.2307/1252308

Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. *The Academy of Management Review*, *23*(2), 242-266. doi:10.5465/AMR.1998.533225

Nonaka, I., Takeuchi, H. (1995). *The Knowledge-Creating Company*. New York: Oxford University Press.

Osterloh, M., & Frey, B. S. (2000). Motivation, knowledge transfer, and organizational forms. *Organization Science, 11*(5), 538-550. doi:10.1287/orsc.11.5.538.15204

Paulin, D., & Suneson, K. (2012). Knowledge transfer, knowledge sharing and knowledge barriers: Three blurry terms in knowledge management. *Electronic Journal of Knowledge Management, 10*(1), 81-91.

Processingprofs. (2014, August 18). Smart Industry: Industrie van de toekomst? Retrieved from https://www.processingprofs.nl/nieuws/smart-industry-de-industrie-van-de-toekomst

Razak, N. A., Pangil, F., Zin, M. Z. M. L., Yunus, N. Z. M., & Asnawi, N. H. (2016). Theories of knowledge sharing behavior in business strategy. *Procedia Economics and Finance, 37*(1), 545 – 553. doi:10.1016/S2212-5671(16)30163-0

Renzl, B. (2008). Trust in management and knowledge sharing: The mediating effects of fear and knowledge documentation. *Omega, 36*(2), 206-220. doi:10.1016/j.omega.2006.06.005

Riege, A. (2005). Three-dozen knowledge-sharing barriers managers must consider. *Electronic Journal of Knowledge Management, 9*(3), 18-35. doi:10.1108/13673270510602746

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary educational psychology, 25*(1), 54-67. doi:10.1006/ceps.1999.1020

Sahlqvist, S., Song, Y., Bull, F., Adams, A., Preston, J., & Ogilvie, D. (2011). Effect of questionnaire length, personalisation and reminder type on response rate to a complex postal survey: Randomised controlled trial. *BMC Medical Research Methodology, 11*(62), 1-8. doi:10.1186/1471-2288-11-62

Stenmark, D. (2001). Leveraging tacit organizational knowledge. *Journal of Management Information Systems, 17*(3), 9-24.

Stewart, G. L., & Nandkeolyar, A. K. (2006). Adaptation and intraindividual variation in sales outcomes: Exploring the interactive effects of personality effects of personality and environmental opportunity. *Personnel Psychology, 59*(2), 307-332. doi:10.1111/j.1744-6570.2006.00016.x

Surif, J., Ibrahim, N. H., & Mokhtar, M. (2012). Conceptual and procedural knowledge in problem solving. *Social and Behavioral Sciences 56*, 416-425. doi:10.1016/j.sbspro.2012.09.671

Wang, S., & Noe, R. A. (2010). Knowledge sharing: A review and directions for future research. *Human Resource Management Review, 20*(2), 115-131. doi:10.1016/j.hrmr.2009.10.001

Wasserman, S., & Faust, K. (1994). *Social network analysis in the social and behavioral sciences.* Cambridge: Harvard University Press.

Welch, D. E., & Welch, L. S. (2008). The importance of language in international knowledge transfer. *Management International Review, 48*(3), 339-360.

Williams, A. M. (2006). Lost in translation? International migration, learning and knowledge. *Progress in Human Geography, 30*(5), 588-607. doi:10.1177/0309132506070169

Yang, J. T., & Wan, C. S. (2004). Advancing organizational effectiveness and knowledge management implementation. *Tourism Management, 25*(5), 593-601. doi:10.1016/j.tourman.2003.08.002

Zemljic, B., & Hlebec, V. (2005). Reliability of measures of centrality and prominence. *Social Networks, 27,* 73-88. doi:10.1016/j.socnet.2004.11.010

Appendices

Appendix A – Interview guidelines

Ik ben Jorn van Faassen en volg de studie Educational Science & Technology aan de Universiteit Twente. Als onderdeel van experiment 3.2 'voorwaarden voor kennisdeling' (onder leiding van Kees Stokla) ben ik bezig met mijn scriptie over factoren die invloed hebben op de kennisdeling in experimentgroepen van het E-PLM project. De studie en het onderzoek zijn gericht op het delen van kennis in groepen en gaat niet over de (technische inhoud) zelf. Om een goed beeld te krijgen van de kennisuitwisseling in de verschillende experimentgroepen ga ik de experimentleiders interviewen.

Daardoor ontstaat er een duidelijk beeld van de experimentgroepen en worden overeenkomsten en verschillen, de ervaringen in de groepen en ook de opbrengsten van de experimenten helder.

Het interview zal maximaal een uur duren en ik neem het gesprek op met een recorder zodat ik het zorgvuldig uit kan werken. De uitwerking bestaat uit een samenvatting van het gesprek, bestaande uit de belangrijkste informatie over de opbrengsten, het functioneren van de groep en de invloed van verschillende factoren op de kennisdeling. De uitkomsten worden anoniem verwerkt in de scriptie en alleen gedeeld met begeleiders van de studie en deelnemende partijen in het E-PLM project (E-TOL). Ik stuur je de samenvatting van het interview via de mail, daarmee heb je de mogelijkheid om te controleren of ik antwoorden goed heb opgevat en kun je aanpassingen doen aan deze samenvatting.

Nu laat ik de experimentleider het toestemmingsformulier ondertekenen.

Het kennisdelen en de uitkomsten van dit proces

Algemeen

- Het E-PLM project is bijna afgelopen, wat zijn jouw ervaringen met het project?
    - Wat gaat goed en wat gaat minder goed?
- Wat is het beeld dat je hebt van de experimentgroepen in het algemeen?
    - In hoeverre functioneren deze groepen zoals zou moeten?
    - Wordt er genoeg kennis uitgewisseld in de groep?
    - Welke aspecten gaan goed? Wat is minder goed?
    - Wat kan gedaan worden om kennisdeling en samenwerking in experimentgroepen verder te verbeteren voor de toekomst?
- Wat heb je gehad aan de uitwisseling van ervaringen met andere experimentleiders in de tweemaandelijkse bijeenkomst?
    - Wat voor effect heeft dit gehad op het eigen handelen, werkwijze in de groep?

Op de eigen experimentgroep(en)

- Wat heeft het kennisdelingsproces in dit experiment concreet opgeleverd?
    - Op het gebied van technische kennis? Op het gebied van procedures of procedurele kennis? Op het gebied van samenwerkingen? Met het oog op de toekomst?
    - Zijn dit producten, processen, nieuwe inzichten, toekomstige samenwerkingen, etc.
    - In hoeverre komt dit overeen met de intentie (het doel van het experiment)?
    - Wat is daarvan de toegevoegde waarde voor de deelnemers in dit proces?

- Komt hetgeen het opleverde overeen met de intentie of verwachting?
    - Is het positiever of juist niet en waar kan dit aan liggen?
- Op welke wijze wordt de kennis gedeeld tussen de groepsleden?
    - Is dit face-to-face, via de mail, telefoon, Windchill, E-TOL, etc.
    - Welke wijze van kennisuitwisseling is het meest gebruikt in dit experiment?
    - Welk wijze van kennisuitwisseling wordt als meest effectief gezien?
    - Hoeveel bijeenkomsten heeft uw experimentgroep gehad?
        - Wat gebeurt er tijdens een bijeenkomst in deze groep?
        - Hoe zorg je voor efficientie in de bijeenkomst? Bijvoorbeeld een voorbereidende mail, worden actiepunten verdeeld onder deelnemers?

<u>Groepsfactoren</u>

- Kun je me meer vertellen over de samenstelling van de groep?
- Wat voor uitdagingen en/of ervaringen heb je meegemaakt als experimentleider en wat voor hulp heb je daarbij gebruikt of had je daarbij kunnen gebruiken?
    - Zijn er daarin aanbevelingen voor E-PLM 2.0
- Wat voor invloed hebben eigenschappen van de experimentgroep gehad op de mate waarin kennis gedeeld werd? (*Denk daarbij aan de groepsdynamiek*) en kunt u de invloed uitleggen? (eerst vrije associatie, daarna niet genoemde factoren in 1 zin benoemen: ‘zijn factoren als het verloop binnen de groep, het vertrouwens tussen de groepsleden en de aanwezigheid op bijeenkomsten van invloed geweest op het delen van kennis?
    - Hangt de invloed van deze factoren af van de kennisinhoud? Zijn er bijvoorbeeld andere factoren van belang voor technische kennis dan voor procedurele kennis of samenwerkingsnormen?
- Hoe schaal je het vertrouwen in de groep in?

<u>Organisatiecultuur en waarden</u>

- Ieder bedrijf heeft zijn eigen cultuur en waarden met betrekking tot zijn kennis. Zo bezitten organisaties (soms) gevoelige informatie die niet met derde partijen gedeeld worden.
    - In hoeverre heeft dit kennisdeling in de groep beïnvloed?
    - Voor welke kennisinhoud was dit het meest van toepassing en waarom? Hoe zit het met andere soorten kennis?
    - Wat voor invloed heeft de doelstelling van verschillende bedrijven op het kennisdelen.
        - Deelnemers beginnen wellicht met andere doelstellingen (een andere insteek) aan dit experiment.

<u>Individuele factoren</u>

- Kun je me meer vertellen over de verschillen tussen deelnemers in de experimentgroep?
- Welke individuele factoren hebben een rol gespeeld in de mate waarin kennis gedeeld werd? (eerst vrije associatie, daarna niet genoemde factoren in 1 zin benoemen: ‘zijn factoren als individuele persoonlijkheidskenmerken, motivatie, identificatie met de groep en specifieke vaardigheden/kennis van invloed geweest op het delen van kennis?
    - Bij persoonlijkheidskenmerken kun je denken aan openheid, extraversie, eerlijkheid, plichtsgetrouw/nauwgezet, vriendelijkheid/plezierig, emotionaliteit
- Hangt de invloed van deze factoren af van de kennisinhoud? Zijn er bijvoorbeeld andere factoren van belang voor technische kennis dan voor procedurele kennis of samenwerkingsnormen?

Zijn er nog factoren of onderwerpen niet aan bod gekomen die invloed zouden kunnen hebben op het delen van kennis? Zijn er nog andere zaken die je graag wilt vertellen over het project?

Ik wil je graag bedanken voor je tijd en deelname aan dit interview voor mijn afstudeeronderzoek. Zoals ik heb verteld maak ik een samenvatting van dit gesprek. Hierin zullen ook quotes worden verwerkt uit het interview, maar deze worden vervolgens anoniem in de scriptie verwerkt. De samenvatting stuur ik per mail op en daarbij krijg je de mogelijkheid dit te controleren. Wellicht heb ik antwoorden anders geïnterpreteerd of heb ik belangrijke informatie achterwege gelaten. Daarvoor geef ik een week de tijd om aanpassingen en aanvullingen te doen aan de samenvatting. Mocht ik geen reactie krijgen beschouw ik de samenvatting als goedgekeurd.

Appendix B - Questionnaire

Dag deelnemers van het E-PLM project,

als onderdeel van experiment 3.2 ‘voorwaarden voor kennisdeling’ ben ik bezig met mijn scriptie over factoren die invloed hebben op de kennisdeling in experimentgroepen van het E-PLM project. Deze opdracht doe ik in het kader van mijn studie, de master Educational Science & Technology aan de Universiteit van Twente.

Om een goed beeld te krijgen van de kennisuitwisseling in de verschillende experimentgroepen heb ik een vragenlijst opgezet over factoren die mogelijk van invloed zijn op het kennisdelingsproces. Om goede conclusies te kunnen trekken is het belangrijk dat zoveel mogelijk experimentleden deelnemen. Ik hoop dan ook dat deze vragenlijst uiterlijk 23 juni zou willen invullen. Uw antwoorden worden uiteraard vertrouwelijk behandeld en niet teruggekoppeld aan de E-PLM bedrijven.

Klik op onderstaande link om bij de vragenlijst te komen.

Follow this link to the Survey:
${l://SurveyLink?d=Take the Survey}

Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

Het invullen van de vragenlijst duurt 5-10 minuten
Het kan voorkomen dat ik in de tussentijd een reminder stuur met betrekking tot de vragenlijst, dat kan puur als geheugensteuntje gezien worden.
Ik hoop op uw medewerking te kunnen rekenen en voor eventuele vragen kunt u contact met mij opnemen via mail en telefoon.
j.m.vanfaassen@student.utwente.nl
jorn.vanfaassen@nl.thalesgroup.com
+31 (0)6 14 114 006

Deze vragenlijst gaat over kennisuitwisseling binnen E-PLM experimentgroepen in het kader van de masterscriptie van Jorn van Faassen. Uw antwoorden worden vertrouwelijk behandeld en niet teruggekoppeld aan de E-PLM bedrijven.

De volgende vragen bevatten achtergrond informatie over u als deelnemer van een of meerdere E-PLM experimentgroep(en)

1. Geslacht (man/vrouw)
2. Leeftijd
3. Werkervaring bij huidige werkgever
4. Werkervaring in totaal (in vergelijkbare bedrijven/functies)
5. In hoeveel experimentgroepen bent u actief?
6. Aantal uur per week bezig met het experiment/de experimenten?

De volgende vragen hebben betrekking op experimentgroep …. waar u een van de deelnemers bent. De vragen gaan over het contact met de andere individuen in de groep. Hierbij kunt u meerdere namen selecteren bij de vragen. Het is ook mogelijk geen namen te selecteren wanneer dit het geval is.

7. Met welke collega/collega's uit uw experimentgroep heeft u de afgelopen maand kennis uitgewisseld over experiment …?
8. Met welke collega/collega's uit uw experimentgroep heeft u de afgelopen maand technische kennis uitgewisseld?
9. Met welke collega/collega's uit uw experimentgroep heeft u de afgelopen maand procedurele kennis uitgewisseld?
10. Met welke collega/collega's uit uw experimentgroep heeft u de afgelopen maand 'overige' kennis uitgewisseld?
11. Indien je bij de vorige vraag een collega (of meer collega's) geselecteerd hebt, hoe zou je deze kennis dan definiëren?

Hieronder staan verschillende stellingen. Deze hebben allemaal betrekking op de kennisdeling in experimentgroep …. waar u deel van uitmaakt.

Per stelling kunt u aangeven in hoeverre u het er mee eens bent, variërend van 'helemaal mee eens' tot 'helemaal mee oneens'.

12. Ik deel mijn kennis regelmatig met mijn collega's.
13. Ik bespreek met mijn collega's wat ik belangrijk vind in het experiment.
14. Ik bespreek mijn problemen en knelpunten met collega's om van hen te leren.
15. Ik vraag mijn collega's regelmatig om advies.

Hieronder staat een korte inleidende tekst ter verduidelijking van de vijf stellingen. Per stelling kunt u aangeven in hoeverre u het er mee eens bent, variërend van 'helemaal niet mee eens' tot 'helemaal mee eens'. Deze hebben allemaal betrekking op experimentgroep … waar u deel van uitmaakt.

In het proces van kennisoverdracht wordt gesproken van een zender en een ontvanger. Daarbij is de zender de persoon die informatie inbrengt en daarmee zendt naar de overige groepsleden. De ontvangers nemen deze informatie tot zich en kunnen het wellicht koppelen aan de huidige kennis. Daarmee vergroten zij de eigen 'kennisbasis', waarmee de kennis die een individu in het bezit heeft wordt bedoeld. Hierbij hebben alle individuen andere specialistische kennis, maar ook de hoeveelheid aan kennis verschilt per individu.

16. In mijn experimentgroep beschikken alle deelnemers over dezelfde inhoudelijke kennis omtrent het experiment.
17. In mijn experimentgroep beschikken de ontvangers over de benodigde (voor)kennis om overgedragen inhouden te begrijpen gebruiken.
18. In mijn experimentgroep weten de verzenders hoe de ontvangers overgedragen kennis willen gebruiken.

19. In mijn experimentgroep is er een groot verschil in kennisbasis tussen de groepsleden.
20. In mijn experimentgroep vinden de groepsleden het moeilijk met elkaar te discussiëren.

Hieronder staan verschillende stellingen. Deze hebben allemaal betrekking op uw eigen persoonlijkheid. Per stelling kunt u aangeven in hoeverre u het er mee eens bent, variërend van 'helemaal mee eens' tot 'helemaal niet mee eens'.

Ik zie mijzelf als iemand die...

21. spraakzaam is.
22. doorgaans stil is.
23. veel enthousiasme opwekt.
24. hartelijk, een gezelschapsmens is.
25. terughoudend is.
26. soms verlegen, geremd is.
27. vol energie is.
28. voor zichzelf opkomt.

Hieronder staan verschillende stellingen. Per stelling kunt u aangeven in hoeverre u het er mee eens bent, variërend van 'helemaal mee eens' tot 'helemaal niet mee eens'. (Dit onderdeel heeft al enige 7 keuzemogelijkheden).

De volgende stellingen hebben allemaal betrekking op de experimentgroep … waar u deel van uitmaakt.

29. Ik voel me verbonden met de experimentgroep waarvan ik deel uitmaak.
30. Ik ondervind een gevoel van saamhorigheid in de experimentgroep.
31. Ik heb een sterk positief gevoel over de experimentgroep.
32. Ik ben trots om deelnemer te zijn in deze experimentgroep.

Hartelijk dank voor uw deelname. Mocht u nog vragen of opmerkingen hebben kunt u deze hieronder weergeven:

Appendix C – Coding schemes

OZvraag 1: How do characteristics of knowledge and individual, group and organizational factors influence knowledge sharing?

	Minste invloed op kennisdeling Het gaat hier over factoren waarvan gezegd wordt dat ze weinig invloed hebben op de kennisdeling. Ook om factoren waarvan de experimentleider niet kan zeggen wat de invloed is	**Middelste invloed op kennisdeling** Het gaat hier om factoren die invloed hebben gehad op de kennisdeling in experimentgroepen. De experimentleider geeft aan dat deze invloed hebben, maar er zijn factoren met meer invloed	**Hoogste invloed op kennisdeling** Het gaat hier om factoren die volgens experimentleiders de sterkste invloed hebben op de kennisdeling. Deze invloeden zijn belangrijker dan de meeste factoren.
Individuele factoren Het gaat hier over de factoren 'persoonlijkheid', 'motivatie', 'vaardigheden om kennis te delen' en 'identificatie/verantwoordelijkheid'. Woorden als 'geen invloed' of 'weinig invloed' komen in het eerste vak te staan. Woorden als 'van belang', 'heeft invloed gehad' of zonder waarde oordeel over de invloed komen in het tweede vak. Woorden als 'duidelijk merkbaar' of 'sterke invloed' komen in het derde vak.	*Individueel weinig* 'Op individueel niveau heb ik weinig invloed gemerkt op de kennisdeling'	*Individueel gemiddeld* 'Vaardigheden om kennis te delen zijn waarschijnlijk wel handig. Als je niet kunt overleggen wordt het delen van kennis ook wel lastig'.	*Individueel veel* 'Het is heel erg belangrijk om gemotiveerd te zijn, want zonder motivatie is er ook geen kennisdeling'
Overig individueel Het gaat hier om individuele factoren die in interviews naar voren zijn gekomen, maar geen onderdeel zijn van het theoretisch kader Woorden als 'geen invloed' of 'weinig invloed' komen in het eerste vak te staan. Woorden als 'van belang', 'heeft invloed gehad' of zonder waarde oordeel over de invloed komen in het	*Overig individueel weinig* "ik heb geen hinder ondervonden van de afkomst van groepsleden'	*Overig individueel gemiddeld* 'De leeftijd van mensen heeft invloed gehad, want ik heb het idee dat oudere mensen onderling meer delen dan met jongere mensen'.	*Overig individueel veel* 'Het is heel belangrijk om een brede interesse te hebben in allerlei verschillende onderwerpen in dit gehele projecten'

tweede vak. Woorden als ‘duidelijk merkbaar’, ‘heel belangrijk’ of ‘sterke invloed’ komen in het derde vak.			
Groepsfactoren Het gaat hier om de factoren ‘manieren om kennis te delen’, ‘vertrouwen’, ‘samenstelling van de groep’, ‘aanwezigheid op bijeenkomsten’ en ‘groepscontinuïteit’. Woorden als ‘geen invloed’ of ‘weinig invloed’ komen in het eerste vak te staan. Woorden als ‘van belang’ ‘speelt een kleine rol’, ‘heeft invloed gehad’ of het ontbreken van duidelijke oordelen komen in het tweede vak. Woorden als ‘duidelijk merkbaar’, ‘maak ik me zorgen over’ of ‘sterke invloed’ komen in het derde vak.	*Groep weinig* Een van de deelnemers is later vaker afwezig geweest, maar dit heeft amper invloed gehad op het proces, omdat hij in zijn rol de invloed al gegeven heeft in een eerder stadium.	*Groep gemiddeld* De samenstelling van de groep was erg divers, dit maakte een duidelijke discussie soms lastig, omdat er veel invalshoeken waren. Hett was inhoudelijk wel van belang om deze invalshoeken te hebben.	*Groep veel* Vertrouwen kan wel gezien worden als de basis van alle samenwerkingen, dus dat moet goed zijn tussen de verschillende deelnemers.
Overig groep Het gaat hier om groepsfactoren die in interviews naar voren zijn gekomen, maar geen onderdeel zijn van het theoretisch kader Woorden als ‘geen invloed’ of ‘weinig invloed’ komen in het eerste vak te staan. Woorden als ‘van belang’, ‘heeft invloed gehad’ of zonder waarde oordeel over de invloed komen in het tweede vak. Woorden als ‘duidelijk merkbaar’ ‘van groot belang’ of ‘sterke invloed’ komen in het derde vak.	*Overig groep weinig* ‘De sfeer in een groep is totaal niet van belang. Het gaat er om dat men de inhoud met elkaar bespreekt’.	*Overig groep gemiddeld* Het is van belang dat deelnemers in een groep elkaar respecteren zoals men is.	*Overig groep veel* ‘Een veilige sfeer in de groep is van groot belang om mensen bereid te krijgen kennis te delen met elkaar’.
Organisatorische factoren Hierbij gaat het over de verschillende culturen en waarden van betrokken organisaties. Wat is de invloed van de overkoepelende organisaties op het delen van kennis, bijvoorbeeld op het gebied van vertrouwelijke informatie die niet gedeeld mag worden met andere partijen of de intenties/doelstellingen vanuit verschillende partijen. In hoeverre hebben deze verschillen invloed gehad	*Organisatie weinig* In onze groep hebben gevoelige informatiestukken geen invloed gehad op het proces. Gevoelige inhoudelijke informatie was niet nodig om de inhouden goed te kunnen bespreken.	*Organisatie gemiddeld* Ik heb gemerkt dat er in een experiment verschillende belangen speelden bij deelnemers bij deelname aan dat experiment. Deze verschillende prioriteiten hebben daarmee een invloed gehad op het	*Organisatie veel* Vanuit het bedrijf waar ik werk hebben we bijna geen details gedeeld. Dat kunnen we ook niet doen in verband met contracten met andere klanten. Dit valt onder de geheimhouding.

op het delen van kennis. Woorden als 'geen invloed' 'niet aan de orde geweest' of 'weinig invloed' komen in het eerste vak te staan. Woorden als 'van belang', 'heeft invloed gehad' of zonder waarde oordeel over de invloed komen in het tweede vak. Woorden als 'duidelijk merkbaar' of 'sterke invloed' komen in het derde vak.		kennisdelingsproces.	
Kenmerken van de kennis Hierbij gaat het om de verschillen in kennisinhoud in de groep. Gaat het bijvoorbeeld om technische/inhoudelijke kennis of over procedurele kennis. Wat zijn hier de verschillen in en wat is voor de twee verschillende factoren belangrijk. Daarnaast is de waarde van de kennis van belang, wat voor waarde wordt gehecht aan de kennis en wat is daarvan de invloed op kennisdeling. Woorden als 'geen invloed' of 'weinig invloed' komen in het eerste vak te staan. Woorden als 'van belang', 'af en toe merkbaar', 'heeft invloed gehad' of zonder waarde oordeel over de invloed komen in het tweede vak. Woorden als 'duidelijk merkbaar' of 'sterke invloed' komen in het derde vak.	*Kenmerken weinig* Ik denk niet dat er veel verschil zit tussen het delen van verschillend soorten kennisinhouden en de mate waarin men gemotiveerd is.	*Kenmerken gemiddeld* Een verschil in kennisbasis maakt het af en toe lastig om met elkaar te discussiëren. Daardoor word je soms iets teruggeworpen in het proces om een gemeenschappelijke basis te creëren.	*Kenmerken veel* Je ziet dat een verschil in kennisinhoud van de deelnemers het voeren van discussies erg lastig maakt.

OZvraag 2: What results are experienced through knowledge sharing?

	Voldoet niet aan de insteek Het opgeleverde werk komt niet overeen met de intentie van het experiment. De bedoeling was om er meer uit te halen	**Voldoet aan de insteek** Het opgeleverde werk komt overeen met de intentie van het experiment. De uitkomst is (vrijwel) gelijk aan de doelstelling van het experiment.	**Overtreft de insteek** Het opgeleverde werk is meer dan de intentie van het experiment. De uitkomst is breder en groter dan de doelstelling van het experiment.
Concrete materialen, systemen, producten en/of processen Hierbij gaat het om concrete onderdelen die direct praktijk ingezet kunnen worden. Hoe worden deze ingeschaald ten opzichte van de doelstelling van het experiment. Woorden als 'iets heel anders' of 'niet bruikbaar' komen in het eerste vak te staan. Woorden als 'in overeenstemming met' of 'gelijk aan' komen in het tweede vak. Woorden als 'als aanvulling op' of 'meer dan verwacht' komen in het derde vak.	*Concreet materiaal, systeem, product, proces voldoet niet* De opbrengst is anders dan we voor ogen hadden in het begin. Het bleek in de praktijk nog niet mogelijk te zijn met de middelen die we tot onze beschikking hadden een geheel systeem te bouwen.	*Concreet materiaal, systeem, product, proces voldoet* Het experiment heeft opgeleverd wat de bedoeling was en dit is een systeem dat al direct in gebruik is genomen door betrokken partijen binnen dit experiment.	*Concreet materiaal, systeem, product, proces overtreft* Het experiment heeft niet alleen maar opgeleverd wat we voor ogen hadden, maar gedurende het proces hebben we nog een nieuw systeem ontwikkeld wat hier mooi op aansloot.
Inzichten, voorwaarden en checklists Hierbij gaat het om uitkomsten die niet direct ingezet kunnen worden, maar wel van belang zijn voor (toekomstige) samenwerkingen. Dit kunnen voorwaarden of checklists zijn die daarbij kunnen helpen. Woorden als 'iets heel anders' of 'niet bruikbaar' komen in het eerste vak te staan. Woorden als 'in overeenstemming met' of 'gelijk aan' komen in het tweede vak. Woorden als 'als aanvulling op' of 'meer dan verwacht' komen in het derde vak.	*Inzichten, voorwaarden, checklists voldoet niet* Het experiment had als voornemen een om een systeem te creëren, maar de uitkomst is uiteindelijk een overzicht geworden van de huidige situaties, hierdoor is inzicht gekomen in de werkwijzen van de verschillende bedrijven.	*Inzichten, voorwaarden, checklists voldoet* Het experiment heeft een procesbeschrijving opgeleverd in de vorm van een checklist. Dit was ook het doel van dit experiment en dat stemt ons positief over het resultaat.	*Inzichten, voorwaarden, checklists overtreft* Ik denk dat we meer hebben opgeleverd dan we van tevoren hadden gedacht.
Nieuwe samenwerkingen Hierbij gaat het om nieuwe samenwerkingen van	*Nieuwe samenwerkingen voldoet niet*	*Nieuwe samenwerkingen voldoet*	*Nieuwe samenwerkingen overtreft*

deelnemers die zijn voortgekomen uit het experiment. Daarnaast vervolgexperimenten voortkomend uit het huidige experiment. Zijn dit zaken die vooraf verwacht werden of een 'extra' uitkomst voor de deelnemers. Woorden als 'iets heel anders' of 'niet bruikbaar' komen in het eerste vak te staan. Woorden als 'in overeenstemming met' of 'gelijk aan' komen in het tweede vak. Woorden als 'als aanvulling op' of 'meer dan verwacht' komen in het derde vak.	Wij wilden vanuit het experiment verder samenwerken met de andere partij, maar deze staat hier verder niet meer voor open. Dat is erg jammer.	Zoals wij zelf al voor ogen hadden zetten we de samenwerking met andere partijen na dit experiment door. Zo gaan we samen aan de slag in een nieuw E-PLM project om onszelf verder te ontwikkelen.	We hadden niet verwacht dat deze samenwerking een vervolg zou gaan krijgen, maar door de positieve ervaringen die we hebben gaan we verder samenwerken met elkaar.