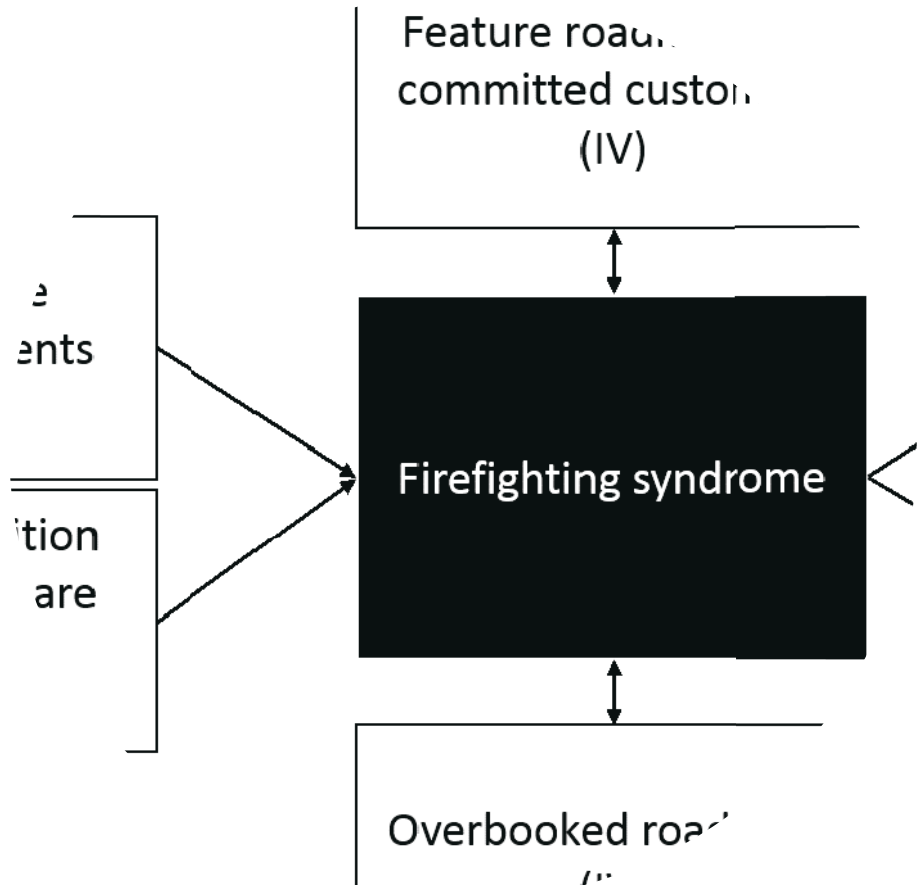# Solution Planning from the Perspective of Customer Value

Marko Komssi

Solution Planning from the Perspective of Customer Value

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A doctoral dissertation completed for the degree of Doctor of Science (Technology) to be defended, with the permission of the Aalto University School of Science, at a public examination held at the lecture hall TU1 of the school on 21 August 2020 at 12.

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Printed matter
4041-0619

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Name of the doctoral dissertation
Solution Planning from the Perspective of Customer Value

Publisher School of Science

Unit Department of Computer Science

Series Aalto University publication series DOCTORAL DISSERTATIONS 109/2020

Field of research Software Engineering

Manuscript submitted 8 May 2019	**Date of the defence** 21 August 2020
Permission for public defence granted (date) 16 June 2020	**Language** English
☐ **Monograph** ☒ **Article dissertation**	☐ **Essay dissertation**

Abstract

A long-range solution planning in turbulent business environments is a crucial challenge for software product companies. These companies have a tendency to invest in new technologies and the development of individual features to survive in those challenging environments. However, the investments often do not produce the desired results. To address the challenge, researchers have introduced a service logic in which customer value is created in customers' everyday activities and software solutions have no value until the customers perceive them to be beneficial. This logic of customer value enables companies to better understand how to develop and extend solutions through assisting customer activities relevant to their businesses.

The goal of this dissertation was to study the role of customer value in solution planning in software product companies. The focus was to analyse the problems of solution planning from the viewpoint of customer value and to identify means that emphasise customer value in software companies. This thesis provides findings from two Finnish software product companies. The findings are based on longitudinal and qualitative research that utilised action research and case study research methods.

The solution planning of software product companies suffered from a feature-driven mindset and a lack of holistic thinking. Furthermore, customer knowledge was fragmented and firefighting around short-term issues complicated long-term thinking in the companies. These customer value problems were cultural and difficult to change.

This dissertation introduces practical means for software companies to describe and prioritise customer activities as part of solution roadmapping. As customer activities do not typically change that often, they provide a longer horizon for solution planning than do software features. In addition, the dissertation initiates hackathons as a means to validate customer value in an early phase of solution planning and development. The main findings of this thesis emphasise that the holistic and early analysis of customer activities increases the role of customer value in solution planning. The analysis of customer activities would have a stronger impact in solution planning if the strategic processes and culture of companies emphasised customer value.

Tiivistelmä

Pitkäjänteinen ratkaisusuunnittelu on haastavaa ohjelmistoyrityksille alati muuttuvassa liiketoimintaympäristössä. Haasteisiin vastatakseen ohjelmistoyritykset panostavat tyypillisesti uusiin teknologioihin ja tuoteominaisuuksiin siinä toivossa, että nämä tuottaisivat mahdollisimman nopeasti liiketoiminta-arvoa yritykselle. Panostukset eivät kuitenkaan usein tuota toivottua lopputulosta. Ratkaisuksi ongelmaan on ehdotettu asiakaslähtöistä ajattelutapaa, jossa arvo syntyy asiakkaan tehtävissä ja jossa ohjelmistoratkaisuilla ei katsota olevan arvoa ennen kuin asiakas kokee ne hyödyllisiksi. Tässä asiakasarvoksi kutsutussa ajattelutavassa ohjelmistoyritys voi osallistua asiakkaan omaan arvonluontiin tarjoamalla asiakkaan tehtäviä tukevia tuotteita ja palveluja.

Tässä tutkimuksessa selvitettiin asiakasarvon roolia ohjelmistoyritysten ratkaisusuunnittelussa. Tutkimuksessa analysoitiin suunnitteluun liittyviä ongelmia asiakasarvon näkökulmasta ja tunnistettiin käytännön keinoja, jotka painottavat asiakasarvoa yritysten toiminnassa. Tutkimus perustuu kahdessa suomalaisessa ohjelmistoyrityksessä tehtyyn laadulliseen pitkittäistutkimukseen, joka toteutettiin tapaus- ja toimintatutkimusmenetelmiä käyttäen.

Väitöstutkimuksen tuloksena havaittiin, että ohjelmistoyritysten ratkaisusuunnittelu kärsii asiakasarvon kannalta liian tuoteominaisuuslähtöisestä ja kapeakatseisesta ajattelusta. Lisäksi syvä ymmärrys asiakkaiden eri tehtävistä oli hajautunut eri ihmisille. Myös "tulipalojen sammutustyö" hankaloitti toistuvasti pidemmän aikavälin suunnittelua. Nämä asiakasarvoon liittyvät ongelmat vaikuttavat olevan kulttuurillisia ja sellaisina vaikeita muuttaa.

Tässä tutkimuksessa esitellään konkreettisia käytäntöjä, joiden avulla asiakkaiden tehtäviä voidaan kuvata ja priorisoida tiekarttapohjaisessa ratkaisusuunnittelussa. Koska asiakkaiden tehtävät eivät tyypillisesti muutu kovin usein, ne mahdollistavat pidemmän aikavälin näkymän ratkaisusuunnitteluun kuin tuoteominaisuudet. Täydentävänä keinona tutkimus esittelee hackathon-menetelmän, jonka avulla ohjelmistoyritykset voivat arvioida ideoidensa mahdollista asiakasarvoa jo ratkaisusuunnittelun varhaisessa vaiheessa. Väitöskirjassa esitetyt tulokset painottavat, että asiakkaan tehtävien holistinen ja aikainen analysointi lisää asiakasarvon roolia ratkaisusuunnittelussa. Analysoinnilla olisi voimakkaampi vaikutus ratkaisusuunnitteluun, jos yritysten strategiset prosessit ja kulttuuri korostaisivat asiakasarvoa.

Preface

When I was a kid, my mother used to call me "professor". I think my mother was trying to emphasise the fact that I did not hear or react to anything. My mother has been always such a positive person that she even found a nice term for my weakness. Perhaps she had also noticed that I did like to study things.

The journey to a doctoral dissertation in the field of software engineering and business has been long and has included many transformations. Actually, when I was a teenager, I did not have any plans in the direction of software engineering or business studies. I was interested in physiology, music and the Bible. I studied the latter in secret. I decided to apply to the school of pharmacy. However, it required reading of over 500 pages of boring text and I preferred to invest my time in more creative things, such as composing and arranging songs or playing bass in a band. Naturally, I did not pass the entrance exam.

Luckily, I was good enough at mathematics and I was accepted by the University of Helsinki to study mathematics without any more reading of boring books. I thought that would later reapply to the school of pharmacy after my military service. That never happened, and I started studies in mathematics as Plan B. Later, I ended up changing my major studies from mathematics to computer science as my grades in mathematics were just good enough to do so without an exam.

In the late nineties, there was a huge need for software developers and bass players. I did not join a band but was recruited to a nice company, Lingsoft, while travelling on a bus. Lingsoft was a language technology partner for Microsoft and grew relatively fast employing talented people with different nationalities. The company growth involved challenges, however. In fact, the challenges were similar to many other growing technology software companies. For instance, the software development process was pretty ad hoc and the software code had many maintainability issues.

I noticed being more interested in the process and practices of developing and commercialising software products than actual programming. I was lucky to meet Mr. Tom Gilb, who provided a lot of material and coaching on incremental and iterative software development and quality control. Based on his work, we started to apply and further develop his principles in the company. With a great colleague, Mr. Jaakko Vuolasto, we also made start-up and business plans to apply these principles. However, we never founded an actual start-up.

At Lingsoft, I also learned how crucial it is to define the customer the hard way. I was in a team that developed spell checkers for several languages for Microsoft. A product manager asked me about the difficulty to make a special configuration for a customer. I thought the term "customer" meant a home user, as I was currently developing installation software for the consumer market. It did not. The customer was a large publisher with hundreds of intended product users. If I had only asked "who is the customer?" we would have avoided a lot of extra work.

Unfortunately, the Internet bubble hit Lingsoft in the early 2000s. The company had grown in terms of employees but the revenue had declined. The layoffs hit most of the employees and I soon found myself working at F-Secure. In the new workplace, maybe the best thing was to meet and co-work with Mr. Mika Eloranta. On the first day, I talked with many nice and professional people. Mika came to work later that day. The first meeting with Mika was unlike the others. After a few minutes, we were already talking about cooking and how banana is a perfect ingredient for creamy bacon-tomato chicken. Soon I also found out that Mika has a deep, creative and holistic understanding of software development and business. His contribution to my professional growth and happiness was very high at F-Secure and has been after it, as well.

In addition to the routine work, I liked to study new topics and participated in a few practitioner seminars. At one seminar, Mrs. Maaret Pyhäjärvi was a speaker. She was an emerging guru in software testing and I found her teaching stimulating. Maaret encouraged me to participate as a speaker at national and international practitioner conferences and events. As a result, I was accepted to attend a large international conference as a speaker, in addition to national conferences. I presented lessons learned from software quality practices at Lingsoft and F-Secure at the conference. I felt like a newbie, but was surprised at the positive reaction. For instance, Mrs. Dorothy Graham, co-author of five books (also with Tom Gilb), commented on the practices as the best idea for years in its domain. I also received the best speaker evaluation. I am very thankful to Maaret for her contribution to my first steps as a speaker and author of research papers.

Soon after, we had a public event at F-Secure where Professor Marjo Kauppinen and I were speakers. We did not know each other beforehand. After the event, we ended up having a very stimulating discussion. I later joined her team at SoberIT (TKK / Aalto University). I was excited.

Soon after, I met Mr. Risto Siilasmaa, Chair of the Board of Directors at F-Secure. During the discussion, we ended up talking about my research topics at TKK. For instance, I mentioned to him the title of our research project, "*Providing Value with Flexible Requirements Engineering*". Risto immediately asked, "What value?" I was new to the research project and could not give a good answer. I felt like a noob and the question bothered me afterwards. Later, I realised the excellence of Risto's question. I found out that not just I but both researchers and practitioners often used the term "value" vaguely. And the perspective of CUSTOMER value eventually became the heart of my doctoral thesis.

I thought that writing a doctoral thesis was an easy job. I was arrogant because I had received positive recognition at the practitioner events. I thought that my "great ideas" would be easily accepted in the research community as well. I was so wrong. In the first two years, I only got rejections from the research community. I also ended up in a very long and multi-step major revision process in a journal that eventually led to rejection. I was very frustrated.

Luckily the people at SoberIT were really nice and helped me to overcome the frustration. Mrs. Jonna Lehtola was the heart of the organisation. She really made it shine. I was also very happy to get to know Professor Reijo "Shosta" Sulonen, who was the founder of SoberIT. He is a true leader. We shared one research interest: wines. In fact, Shosta started a tradition of regular wine-tasting events at SoberIT that built the unity and collaboration there. The poker boom was also well-adopted at SoberIT. I am particularly thankful to Professor Mika Mäntylä, Mr. Kristian Rautiainen and Mr. Mikael Runonen for nice sessions and talks with or without poker.

We worked with Doctor Sari Kujala for only a short time but she really made an impact on me. I enjoyed some educative lunches with her, for instance, on the negative influence of milk fat on the body. Indeed, I had not lost my interest in physiology. We belonged to the PREAGO research group with Doctor Varvana Myllärniemi. I have always admired her devotion to teaching, research and non-work-related topics, such as cooking and home renovation. I really miss the stimulating talks with her. The workroom of Mrs. Erika Leinonen was next to me and we also participated in a few courses together. She became a very good friend to me. Nowadays, we mainly meet on a fitness social media platform to share our passion for endurance sport, such as cross-country skiing and running.

Mr. Eero Uusitalo became a very close colleague and friend to me during the project. We shared so many interests and even ended up playing a few gigs in a temporary covers band. Eero is a genius and special person. With Eero, even reviewing students' exams was a special event. Similarly, Mr. Juho Heiskari became a very close colleague and friend. At the very beginning, I admired Juho's working skills and talents. Moreover, his special characteristic is empathy, which I appreciated a lot, especially in frustrating times.

If I wrote the story of all the nice people at SoberIT, it would become another book. But I have to briefly mention a few more. Professor and bassist Marko Nieminen: always a pleasure to meet him with or without our instruments. Doctor Jarno Vähäniitty: not just a guitarist and singer, who plays Ace of Spades, but also a professional who transformed his doctoral thesis into a software start-up. Doctor Juha Tiihonen: always a very friendly person with whom I have had many encouraging talks. Quite often we have found ourselves talking about wine and cycling.

During my doctoral studies, I participated in courses in software business and engineering as well as industrial engineering and management. On one of those courses I wrote a case study of F-Secure's transformation into an SaaS business. To deepen the findings, I asked for help from Mr. Matti Ropponen at F-Secure. Professor Marjo Kauppinen and Mr. Juho Heiskari joined us to extend the case

study to a research paper. The paper had nothing to do with the original topic of my doctoral thesis; I just wanted to submit the study as it was so interesting. Surprisingly, the research paper was accepted immediately. I was happy but confused. I had not mastered the topic and I had spent a relatively short time on the paper. I continued my doctoral studies and reading interesting books. I wrote another study that was built on the research framework of those studies and books. I asked for help from Mr. Matti Ropponen and Mr. Pirkka Palomäki. And the same story again. The research paper was accepted again.

I faced a dilemma. On one hand, I felt that I had an excellent empirically proven "research product" on quality practices that the research market just did not understand. On the other hand, I had another topic that I had not mastered but which the research market seemed to appreciate. It was a hard decision to shift from the original topic to the new one after investing so much in the original. Now, I believe that the decision was right. Here, I want to thank Matti and Pirkka for their unique insights and co-operative spirit in writing those first research reports that led me to a new research journey.

With the guidance of Professor Marjo Kauppinen, the new research topic led me closer to that of Doctor Laura Lehtola. Actually, Laura and I had already worked in the same research project, jointly collecting and analysing research data before she moved from research into the software industry. Laura is such a multi-talent and good writer. I said to her several times, "Please, remember me when you're famous". Not surprisingly, she is currently publishing her third novel. Yet she is so humble and I am most thankful for her ability to listen and be present. Laura's contribution to my doctoral work is important as we made joint efforts in the beginning and I was able to build my research on her findings.

Later, Mr. Harri Töhönen joined our research group. Harri has had an impressive career in the industry and co-working with him has always been very constructive. I learned a lot and really enjoyed working with him. Harri's contribution to my doctoral thesis was very important. Jointly facilitating the research on solution roadmapping was very educative. Outside the actual research, Harri also invented weird and funny terms and physical challenges. "Karmipumppaus" is one such example. We have also shared a common interest in endurance sport with only one exception: he is so much more talented, dedicated and better than me. Actually, just a few minutes ago I witnessed his 300+ kilometre cycling trip on a very hot day on a fitness social media platform and a jump into a lake after the trip. I only hope that his mobile phone is water-resistant.

I am greatly honoured to have Professor Alan M. Davis as a co-author on my doctoral thesis. He is not just a founder of the requirements engineering research field, a professor, successful entrepreneur and author of several books, but also one of the most fascinating people I have ever met. But what do you think of the following comment on his webpage, "I have successfully tasted and evaluated 6000+ beers over the years, and would order every one of them again"? What is even more, he is a very warm person who makes the people around him feel very special.

There is typically a critical moment on any journey and a person or thing that determines how the moment evolves. For me, that person is Doctor Timo

Asikainen. I always remember when I first met Timo at a gathering of research-ers. I immediately perceived that he is a very special kind of person. My first instinct did not fail me. Timo has an ultimate combination of sharp humour, intelligence and integrity. But what was the critical moment? I was asked to do a revision on an invited paper with a tight deadline. My life was full of things. For instance, the kids were young, I had just been invited back to F-Secure and I was building our new house. I was mainly able to do edits occasionally in the evenings and weekends and the deadline was approaching. Fortunately, I completed the work just before the deadline very late on a Saturday night (that is very early on Sunday morning). Timo Asikainen stayed awake and supported me until the finish with numerous emails and chats. Timo was not just helping me mentally but also to write things more wisely and not in poor English as I was under pressure and tired. I always become emotional when I think of his friendship and sacrifice. Nowadays, the occasional lunch meetings with him luckily no longer include hectic tasks. They are very special moments for me. I am not worthy of having a friend like you, Timo: thank you once again. Thank you!

I have learned to trust my instincts, but sometimes they fail. When I first met Mikko Raatikainen, I could not get his thinking and humour. I thought that we were not likely to work closely together and become epic friends. I was so wrong. In fact, our friendship later started with bikes. I had just bought a bike and started to pedal to my work trips. I was a noob with the bikes and Mikko was always willing to help the noob. Later, we ended up riding mountain bikes together in Riva del Garda over the weekend just before a research conference in Trento. I learned to know him better as a very kind and caring person. Once I got to know him, I also started to understand and appreciate his humour (with Mikko you are a co-actor in Aki Kaurismäki reality). Although he never stopped torturing me with his endurance stunts, they have become nice memories after a long recovery. Furthermore, Mikko not just became a good friend but also an important co-author. Currently, we are co-authoring six research papers. I really enjoy working with Mikko. His strengths complement my weaknesses.

I am also privileged to have Mrs. Danielle Pichlis and Mr. Vittorio Dal Bianco as co-authors on this dissertation. Both are extremely talented and even more extremely nice people. If I had to choose one word to describe our joint efforts, I'd say, "pizza". With them, the work has been really fun and successful at the same time – and maybe "fun" is the secret of our success? With Mr. Klas Kindström, I have co-authored two research papers of this dissertation and worked in three different teams at F-Secure. If I had a start-up, I would hire Klas and pay him more than myself. Klas has a perfect mixture of people and technical skills. I am really happy that we can continue going to the gym (hopefully soon after Covid-19), arguing about bands (Kingston Wall, right?) and working together (and luckily someone other than me is paying him). Thanks, Klas, for co-creating my happiness!

The role of Doctor Janne Järvinen in my doctoral thesis is huge. He invited me back to F-Secure to join his team to lead and manage research projects. They led us to study many things, for example, hackathons with him and Klas

Kindsröm. Janne also continuously encouraged me to continue and finish the doctoral dissertation. Over the years, Janne has become a very close friend. He is a true leader with a strategic understanding of important things. He leads with great humility. As we are now working in different companies, we mainly meet at the golf course. Unlike me, Janne is a good golf player. However, almost without exception, I have played my best golf rounds with him. I think this characterises his impact on others very well. Thank you, Janne, very much!

There are numerous people who have contributed to my doctoral dissertation either directly or indirectly. Here, I use the opportunity to thank Doctor Kaisa Still, Doctor Tanja Suomalainen, Doctor Topi Järvinen, Mr. Petri Viima and Mr. Juha Käki. For instance, Juha's great thoughts have had a positive influence on the Discussion section and the brilliant comments of Topi revealed to me, for instance, a threat to the construct validity. In the very final phase, Mrs. Leena Lujamaa-Reisner had a really important role helping me to address the pre-examination statements. With Leena, the work was not just fun and refreshing but also forced me to finish the work. Leena, I owe you a lot!

Next, I want to acknowledge Professor Sjaak Brinkkemper and Professor Daniel M. Berry for their review of this doctoral dissertation and the pre-examination statements. I was not in a hurry to finish the dissertation and wanted to pay special attention to the statements. Each of you took a unique approach to the review and addressing the corresponding pre-examination statement was such an intelligently stimulating process. Thank you both for your precious time!

I also want to acknowledge Professor Pekka Abrahamsson, who has accepted the invitation to act as an opponent in the Thesis Defence. While I am writing these sentences I cannot naturally thank Professor Abrahamsson for a nice scientific debate yet. I can only say that I am very privileged to "battle" with you. Indeed, I have followed your work over fifteen years and seen you a few times on stage. Your contribution to both research and practice has been impressive. I am really looking forward to finally meeting you on the same stage. Game on!

Doctoral dissertations do not happen without supervisors. Next I want to acknowledge my dear supervisors, Professor Tomi Männistö and Professor Marjo Kauppinen. I will start with Tomi. He is a very smart and noble person. Tomi has been able to help me with the most difficult topics that I have not mastered myself. For instance, he has guided me in addressing the most difficult issues in the journal revisions and in Part 1 of this dissertation. In particular, Tomi has shed light on the topic of validity threats. Throughout my doctoral studies I have been annoyed by the topic. Because of Tomi, I can almost say that I have fell in love with construct validity. Albert Einstein said, "You do not really understand something unless you can explain it to your grandmother". Tomi has such an understanding of many difficult topics as he has been able to explain them to me in a way that the books cannot. Tomi is also a very noble person. For instance, he has helped me a lot in journal revisions that he has not even been co-authoring. This special quality also makes him such an excellent research leader, as he genuinely looks for the best for others. I hope that I can co-author a "*Construct Validity for Noobs*" article with you some day.

It is difficult to find superlatives that describe Professor Marjo Kauppinen well enough. With you, this has not been a journey of doctoral dissertation; this has been a journey of life! We both have strong opinions and sometimes even conflicting ones. Over time, I have found that you have been right most of the time. For instance, you have been right that research methods and validity threats are very, very, important topics. I do agree, finally! But, you have given me freedom to disagree and debate. You really believe in people. You have believed in me! You also believe in justice and are ready to fight for it. I also admire your ability to sense what is important now and in the future in our research field. You have also built connections and I have been able to meet and learn from world-class gurus in many fields. Together, we have gone through many things together. The more I know you, the higher regard I have for you. You have valued me as a true friend who really cares both professionally and in private life. This dissertation was just a minor milestone. We have built such a strong relationship as researchers and friends. Or should I already call the relationship a higher-level platform? I really hope that we can continue the journey together. Thank you Marjo, so, so, so much!

There are also many colleagues and friends who I want to thank: Doctor Matti Aksela, Mr. Tomi Verkkomäki, Mrs. Annina Verkkomäki, Mr. Tommy Colin, Mrs. Jatta Turunen, Mr. Lauri Hallila, Mr. Antti Miettinen, Mr. Harri Susi, and Mr. Markku Kutvonen. Thank you for your friendship and supportive attitude. I am sorry to all of you whose names I have not mentioned. I still wanted to keep this section a bit shorter than the actual dissertation.

Finally, I want to give thanks to my family. My parents, Taisto and Elina, you have always believed in me even when I did not earn it. Without hesitation, I can say that I have by far the world's best parents. Some people may argue that that is what they all say. Yet many people who have met you have to agree with me that actually, I really have the world's best parents. You have given me a model of how to treat and respect people. My sister, Marja, you are also the world's best sister. Sometimes, due to busy life, we do not see each other that often any more. But when we meet, it is like being kids again. I feel the connection with you immediately when we meet and we can start "playing". You are really special to me. My aunt, Mrs. Raili Luoma-aho, you are like a second mother to me. And not just to me but also to my kids. You have really helped me, a country boy, to survive here in a large city. My dear wife Soile, there are no words like "Agape" and "Phileo" in English and Finnish. And, even those two words are not enough to describe my love for you. Thank you for your understanding, support and love. Emma and Manu, please notice that "Muumipapan muistelmat" will be finally published. You've grown together with "Muumipapan muistelmat". Thank you for your patience. You are my loving lights! For all of you, my family, I am so sorry that I often forget to say how important you are to me and how much I love you. Therefore, I have used the opportunity to write it here. You may always find it here if I forget to say it in the future, too. I will love you all always!

After the hard work, what are the conclusions from the process? It is better to quote Ecclesiastes (KJV), "*And moreover, because the preacher was wise, he*

still taught the people knowledge; yea, he gave good heed, and sought out, and set in order many proverbs. The preacher sought to find out acceptable words: and that which was written was upright, even words of truth. The words of the wise are as goads, and as nails fastened by the masters of assemblies, which are given from one shepherd. And further, by these, my son, be admonished: of making many books there is no end; and much study is a weariness of the flesh. Let us hear the conclusion of the whole matter: Fear God, and keep his commandments: for this is the whole duty of man. For God shall bring every work into judgment, with every secret thing, whether it be good, or whether it be evil." What is the future research for me then? The Gospel of John identifies Jesus as the Logos (in Greek). I see Logos as a meta-science that includes all the wisdom of psycho**logy**, bio**logy**, theo**logy**, etc. Therefore, I will keep on studying meta-science first, to better understand the logic of those singular sciences, too.

Contents

List of publications

This doctoral dissertation consists of a summary and of the following publications, which are referred to in the text by their Roman numerals:

I Komssi, M., Kauppinen, M., Heiskari, J., & Ropponen, M. (2009). Transforming a software product company into a service business: Case study at F-Secure. In 33rd International Computer Software and Applications Conference (COMPSAC'09), 61-66.

II Komssi, M., Kauppinen, M., Ropponen, M., & Palomäki, P. (2011). Transformations of a solution strategy: A case study. In 2nd International Conference on Software Business (ICSOB 2011), 140-153.

III Lehtola, L., Kauppinen, M., Vähäniitty, J., & Komssi, M. (2009). Linking business and requirements engineering: Is solution planning a missing activity in software product companies? *Requirements Engineering*, 14(2), 113-128.

IV Komssi, M., Kauppinen, M., Töhönen, H., Lehtola, L., & Davis, A. M. (2015). Roadmapping problems in practice: Value creation from the perspective of the customers. *Requirements Engineering*, 20(1), 45-69.

V Raatikainen, M., Komssi, M., dal Bianco, V., Kindström, K., & Järvinen, J. (2013). Industrial experiences of organizing a hackathon to assess a device-centric cloud ecosystem. In 37th International Computer Software and Applications Conference (COMPSAC'13), 790-799.

VI Komssi, M., Pichlis, D., Raatikainen, M., Kindström, K., & Järvinen, J. (2015). What are hackathons for? *IEEE Software*, 32(5), 60-67.

Author's contribution

Publication I: Transforming a software product company into a service business: Case study at F-Secure

The author of this thesis was the principal author, performed the main body of data collection and analysis, and documented the results. The other authors contributed to the data collection and analysis with the author of this thesis, and participated in the validation of the findings and writing and reviewing the paper.

Publication II: Transformations of a solution strategy: A case study

The author of this thesis was the principal author, performed the main body of data collection and analysis, and documented the results. The other authors contributed to the data collection and analysis with the author of this thesis, and participated in the validation of the findings and reviewing the paper.

Publication III: Linking business and requirements engineering: Is solution planning a missing activity in software product companies?

The author of this thesis was the fourth author and participated in the research activities with the first and second authors. The main contribution of the author of this thesis was the development of the solution concept with these two authors. The solution concept guided the further research in Publication IV and is the main contribution of this paper in this thesis. This publication was included in the doctoral thesis of Lehtola-Karttunen (2015), in which the main contribution of this paper was larger to present the state of practice in long-term planning and several supportive practices. All the authors contributed to writing and reviewing the paper.

Publication IV: Roadmapping problems in practice: Value creation from the perspective of the customers

The author of this thesis was the principal author who jointly conducted the action research activities with the second and fourth authors at F-Secure and with the second and third authors at Tekla. After these research activities, the author of this thesis performed the main body of final data analysis and documentation of the results. The other authors participated in the validation of the findings and writing and reviewing the paper.

Publication V: Industrial experiences of organizing a hackathon to assess a device-centric cloud ecosystem

The author of this thesis was the second author. He performed the research design, including data collection protocol and interview questions, together with the first author. He acted as the interviewer in all interviews with the other authors. The author of this thesis contributed to the main body of analysis and documenting the results. All the authors contributed in the writing and reviewing the paper.

Publication VI: What are hackathons for?

The author of this thesis was the principal author. He performed the research design, including the data collection protocol and interview questions, together with the third author. He performed the main body of the data collection and analysis, and documented the results, which included writing the first version of the paper jointly with the second and third authors in a hackathon-like setting. The other authors contributed to the data collection and analysis with the author of this thesis. They also contributed in validating the findings and writing and reviewing the later versions of the paper.

1. Introduction

Surviving in fast-paced and turbulent business environments is a crucial concern for high-tech companies (Christensen et al. 1998). Solution life cycles seem to be very short in software industries (Karakaya & Kerin 2007). In a fast-paced business environment, even a successful software solution strategy soon becomes outmoded. Moreover, Giachetti and Marchi (2010) point out that mobile phone manufacturers have radically transformed their solution/product strategies over the industry life cycle. They reported that the key drivers for change have been the intense competition and rapid changes in technology and mass consumer preferences. According to Stockport (2000), strategic transformation is "*about the ability of an organization to transform itself to ensure long-term survival*". In fact, there are recent examples of successful strategic transformations in several industries, such as offshore wind, water tech, and renewable fuel (Anthony et al. 2019).

Roadmapping is a flexible technique that is used to support strategic and long-range solution planning (Kappel 2001). The basic purpose is to explore and communicate the dynamic linkages between markets, products, and technologies over time (Albright & Kappel 2003). In practice, however, the exploration and communication of markets and customers is not obvious in roadmapping. According to Straus and Radnor (2004), the roadmapping team may shift the focus from the needs of the customers to the eloquence of the technology, in particular, when they lack explicit assumptions concerning future needs.

Customer value creation offers long-term benefits for software companies. Marketing researchers, in particular, have argued that the customer's role is central in value creation; the value is realised in the customer's everyday use context (Grönroos 2008; Vargo & Lusch 2008). Based on this logic, a software solution has no value until a customer perceives it as beneficial. This logic enables companies to better understand how to develop and extend solutions through assisting customer processes relevant to their businesses (Grönroos 2011). In particular, customer processes do not likely change as often as software features and new technologies. Finally, customer knowledge and relationships are very hard to copy, which is often not the case with technology.

Aurum and Wohlin (2007) emphasise that a crucial challenge for software developers is to understand and determine when and how customer value is created, measured, and managed. Customer value is, however, a complex value perspective that has received scant attention in the research field of software engineering. This calls for scientific theories and practices to assist software and

other industries in general and software developers in particular, in advancing the perspective of customer value in solution planning.

According to Payne et al. (2008), a customer's value-creation process can be defined as a series of activities performed by the customer to achieve a particular goal. They suggest a company develops its capacity to influence the customer process in such a way that the customer is able to utilise the available resources more efficiently and effectively. They call such an undertaking value co-creation and highlight that there is relatively little guidance from the existing literature on how this process should be undertaken. Moreover, they suggest a company does not just develop the co-creation process, but also appropriate metrics and the concept of prototyping when it is implementing a co-creation strategy.

Evaluating customer value becomes even more challenging when a software company decides to scout new strategic options and invest in new solution development. For instance, a software company may aim at new business fields of education or health with completely new solutions. As the value creation occurs in the customer's use context, how can the software company evaluate the customer-perceived value of an idea early enough? One option for the company is to use a hackathon method. This is an intensive and time-limited group activity aimed at producing a working software prototype that can be tested in the customer's daily activities.

Based on the related work, this thesis builds on the notion that the emphasis on customer value offers benefits for software product companies. The main research question of this thesis is to investigate **what the role of customer value is in solution planning in software product companies**. The main research question is addressed with two specific research questions:

- RQ1: What kind of problems do software companies have in solution planning from the perspective of customer value?
- RQ2: How can a software product company emphasise customer value in solution planning?

This thesis provides empirical findings from two Finnish software product companies in the context of requirements and software engineering as well as software business (See Section 5.2 that discusses threats to validity). A large proportion of the prior studies on solution planning and roadmapping have been analysed and disseminated in the context of management science and studies on customer value in the context of marketing. Moreover, scientific publications on hackathons have been scarce in any research fields until recently.

A qualitative research approach was chosen to study the research questions. The research methods used were the case study and action research (See Section 3.2). They were chosen because both research methods are capable of addressing the research problems, which are hard to study in isolation. They also foster the participatory role of researchers in solving real-life research problems.

This dissertation consists of six publications and a summary. Section 3.2 further explains and illustrates how the six articles contribute to answering the two research questions of this dissertation. In short, the first research question is addressed in Articles I, II, and IV and all six articles contribute to the second research question.

In the first part of this thesis, the dissertation summary, Section 2 presents the related work on each of the key themes of this thesis, while Section 3 introduces the research design. Section 4 presents the results and Section 5 discusses the findings. Finally, Section 6 presents the main scientific contributions and conclusions of this thesis and proposes future work. The second part of this thesis is made up of the research articles.

2. Related work

2.1 Solution planning

The literature introduces several definitions for the terms 'product', 'service' and 'solution'. For instance, Ebert and Brinkkemper (2014) define these terms as follows: "*A product is a deliverable which delivers a value and an experience to its users. It can be a combination of systems, solutions, materials and services delivered. A service is an intangible, temporary product that is the result of co-creating value by at least one activity performed at the interface between the supplier and customer and that does not imply a change of ownership. A solution is a customer-specific product created from different products, processes and resources and tailored to serve a specific business or customer need.*" In the articles that this thesis consists of, product components refer to software that can be a software platform, portal, or application. Service components refer to customer activities in which the company has a significant role. A solution refers to a bundle of service and product components.

Solution roadmapping is a key activity in solution planning. It plays a key role when recognising the main defining parameters of the markets, products (or solutions), and technologies for one part of the business beyond the typical "next release horizon" (Kappel 2001). Roadmapping helps an organisation to focus on long-term planning and on the highest-priority topics (Albright & Kappel 2003). In this thesis, solution roadmapping is defined as the set of long-range planning activities undertaken in a company directed towards creating and updating a roadmap. It takes a longer planning horizon than release planning, which focuses mainly on one software release at a time.

Suomalainen et al. (2011) propose in their study a definition for a roadmap from a practitioner perspective: "*A roadmap is a plan about the company's future actions*". According to their study, a roadmap contains essential information about where the company is going with its solutions and provides a clear focus for solution development. There are, however, many roadmap types. For instance, Phaal et al. (2004) have identified eight technology roadmap types that differ in their objectives and eight that differ in their formats. According to them, product planning is by far the most common type that links markets and technologies into products. This thesis uses the term solution planning instead of product planning to emphasise the statement that customers look not only for products, but also for solutions they can use to create value (Grönroos 2007).

In software companies, product management is typically in charge of creating roadmaps. According to Kittlaus & Fricker (2017), product management involves planning and coordinating all relevant areas of a product inside and outside the company with the aim of sustainably optimising product success. Product management can include both technology and marketing representatives who use roadmaps to describe the long-range plans for a software solution throughout its life cycle. However, product management typically does not have authority over the development team and, therefore, may require support for knowledge-sharing and decision-making involving many stakeholders (van de Weerd et al. 2006).

Solution planning has an important role in linking business strategy to solution development and tactics. The terms 'strategy' and 'tactics' are common management science concepts. Typically, the term 'strategic' characterises, for instance, a longer-term time span, more invested resources, and higher senior management involvement than the term 'tactical'. However, according to Casadesus-Masanell & Ricart (2010), the field of strategy has evolved substantially in the past decades. They distinguish 'strategy' and 'tactics' through the notion of business model. They state that "*Strategy refers to the choice of business model through which the firm will compete in the marketplace; while tactics refers to the residual choices open to a firm by virtue of the business model it chooses to employ.*" Cull (2009) distinguishes the terms differently: "*Tactical is something you're willing to change to meet local conditions and Strategic is something you won't change to meet local conditions*". However, companies may take a very pragmatic approach to their strategies. For Philips, for instance, the term strategy simply means "*where we invest*" (Philips 2017).

The term strategy is used in different contexts and abstraction levels. For instance, companies use higher- and lower-level strategies in their planning processes. Company strategy determines the businesses in which the company will be (Chaffee 1985). A typical company has several businesses and each business's strategy presents the means by which the company competes in this business (Chaffee 1985). Business strategy entails pulling together every aspect of a business to create value for the company's stakeholders. Business strategy is also strongly related to the competition in a market environment. Yet again, each business can develop one or more solutions and each solution can have a lower-level strategy. A solution strategy provides the details by which to implement a higher-level strategy and, in turn, the solution roadmap translates the solution strategy into an action plan for implementing the strategy over the strategic timeframe (Kittlaus & Fricker 2017). However, solution strategies are presented with critical challenges in high-tech companies, as the fast-paced environment forces repeated strategic decisions (McGrath 2001). Therefore, solution strategies have an important role in handling how core products and services are produced, designed, distributed, promoted, and innovated over time (Giachetti & Marchi 2010). This thesis explicates solution strategy between existing and potential customers and between existing and new services (Scheuing & Johnson 1989).

2.2 Customer value and value creation

Customer value is considered central to the competitive advantage and long-term success of business organisations (Khalifa 2004). The term 'customer value' has been used in a variety of contexts (Payne & Holt 2001); these include (1) how companies can create and deliver value; (2) how customers desire and receive value at purchase and in use; and (3) how companies capture the value of the customer over time. As explained in Section 1., the focus of this thesis is (2), that is, customer-perceived value.

The concept of customer value is difficult to understand and apply (Holbrook 2006). There are many reasons for the complexity of customer value. Firstly, customer value factors in both the benefits (tangible and intangible) that the customer perceives and the sacrifices/costs (tangible and intangible) incurred in the purchase and use context (Ravald & Grönroos 1996; Woodruff 1997). Secondly, perception or judgement is relative to the personal values and expectations that customers hold, and other market offerings or standards. Overall, customers seem to value products and services varyingly by industry (Almquist et al. 2016). In particular, the customer's personal values in this context indicate the criteria by which value realisation is evaluated or judged (Holbrook 1999). Thirdly, perceiving or judging value is context-dependent and occurs dynamically at different stages, such as before and during purchase, or during use (e.g., Zeithaml 1988; Woodall 2003). Finally, the empirical study of Karlsson et al. (2006) also found that practitioners overestimated customer value in release planning. The practitioners also had challenges concentrating only on customer value without simultaneously considering development costs.

Several means have been proposed to analyse customer value. Robertson and Robertson (2006) approach the analysis of customer value in terms of customer satisfaction and customer dissatisfaction. Their approach is to analyse customer value as a ratio (satisfaction divided by dissatisfaction). However, perceived benefits seem to mean more than just customer satisfaction. According to Sánchez-Fernández and Iniesta-Bonillo (2006), customer satisfaction mainly measures a post-purchase stage in the present marketing offering, while customer value can be holistically measured in customer activities even in the pre-purchase stage (2006). Moreover, customers who describe themselves as satisfied are not necessarily loyal (Reichheld 1994). However, it is considered impossible to measure complex customer value accurately (Smith & Colgate 2007). Therefore, a simple formulation, in which customer value is either summative (benefits minus sacrifices) or a ratio (benefits divided by sacrifices), is preferred for customer value analyses (Smith & Colgate 2007). The summative formulation enables even negative end results when customers perceive sacrifices as higher than benefits.

A large number of value dimensions, such as shareholder, project, product, business, relationship value, have been introduced in the literature. In addition to customer value, here we focus on the value dimensions of product and business. Product value stems from customer and market requirements, while business value stems from product sales (Barney et al. 2008). Business value is the

value of a product for a business and depends on customer value (Ebert & Brinkkemper 2014).

Explicating when and where value is created, and who is the value creator, helps to distinguish the differences between product, customer, and business value (see Table 1). Product value is the market value of the product influenced by the quality attributes of the software product (Aurum & Wohlin 2007). Product value is created during product development and maintenance. Value creation of a product can occur as early as when a software team successfully selects the right set of features for an upcoming software product release (Mohamed et al. 2008). Barney et al. (2008) state that the value creation of a software product is contextual and, therefore, difficult to comprehend. They found that many factors, such as the maturity of the product, the market situation, and the company's development practices, influence the decision on whether a requirement is included in a specific project or release.

Table 1. Explication of value creation from the three value perspectives.

Value perspective	Who creates?	When and where?
Product value	Software company (team)	In a 'software factory' before and over the life cycle of a product/service
Customer value	Customer	In the customer's every day activities (in use)
Business value	Customer and software company	In the activities of both software company and customer

When taking the perspective of customer value, a customer is the fundamental value creator and a software product or solution can represent only potential value or utility for the customer (Grönroos 2011). Accordingly, value is created in customers' everyday activities or processes (Normann & Ramirez 1993; Ravald & Grönroos 1996), and the provider can only facilitate or co-create this value by providing resources or knowledge (usually packaged into products or services) for the customer (Grönroos 2008). Therefore, the relationship value between the provider and customer is part of customer value. In the relationship, the customer can perceive benefits and sacrifices arising from the interaction with the provider that are beyond product-related issues (Ritter & Walter 2012).

According to Aurum and Wohlin (2007), business value can be created in three ways. First, the customer creates business value for the company by paying for the product or service. Business value is typically measured in terms of revenue (Mc Elroy & Ruhe 2010). Each customer has a lifetime value for the company that is usually measured as the period of time from the first transaction up until the present or a future time (Shahin & Shahiverdi 2015). Second, a company itself creates business value when it succeeds in developing an offering that is more appealing to new customers or increases average revenue per an existing customer (Aurum & Wohlin 2007). In this case, business value is created by the product value. Third, a company can also add business value, which is accounted in terms of return-on-investment of a software product, by improving its business and development activities (Aurum & Wohlin 2007).

2.3   Analysis of customer processes

This thesis considers value creation from the customer perspective. The emphasis on the customer perspective requires a software company to take an outside-in view, in which the customer processes are the essence of value creation (Kauppinen et al. 2009). The initial step for a company in changing its view from inside-out to outside-in is to gain a deep understanding of the customer value-creation processes (Payne et al. 2008). Then, the company can start evaluating how to actively influence the flow and outcome of the customer value-creation processes (Grönroos 2011). The cross-functional approach is essential, as it aligns organisational functions that articulate the customer promise with those that deliver the customer promise (Payne et al. 2008).

The value-creation processes of business customers are often referred to as business processes. Process mapping techniques have been suggested to redesign or incrementally improve the business processes. The purpose of process mapping is to construct a map of the selected process and to show the relationships between the activities, people, data, and objects involved in the production of a specified output (Biazzo 2002). The process mapping techniques include several activities, such as establishing management commitment and vision, documenting and analysing the existing process as well as defining, implementing and deploying the new process (Kettinger et al. 1997; Biazzo 2002). Patrício et al. (2008) introduce a service design approach that draws attention to consumers and multi-channel service experiences. The approach highlights customer experiences in different moments of contacts and customer value through effective customer acquisition, retention, and development. Payne et al. (2008) refer to those contacts as encounters that are in a key position when reviewing and developing the interactions between the customer and provider, which ensures a successful customer experience.

A company's long-range and strategic solution planning typically includes identification of new points to differentiate the company from the competition. MacMillan and McGrath (1997) claim that this thinking focuses too often only on the company core products or services. As the customer process involves a chain of activities, MacMillan and McGrath encourage companies to gain customer insights by appreciating the context within which each activity in the chain unfolds. Consequently, they introduced a practical two-part approach to analyse the entire experience that a customer has with a solution and to brainstorm new ideas (see Figure 1). The essence of the two-part approach is both mapping and evaluating the consumption chain. The consumption chain denotes the entire customer process from the time customers realise that they need a product to the time they decide to dispose of it. Mapping concentrates to identify all the stages through which customers pass from the time they first become aware of the company's solution to the moment when they have to dispose of it or discontinue using it (MacMillan & McGrath 1997). To evaluate the customer's experience of the solution, the authors propose using "what", "where", "who", "when", and "how" questions in order to better understand and describe the customer's consumption activities.
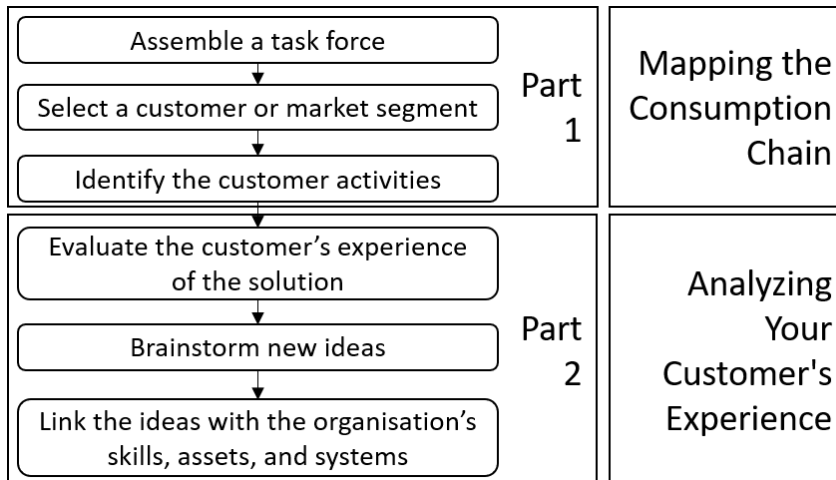
Figure 1. An illustration of the two-part approach to identify new points of differentiation (constructed based on MacMillan & McGrath 1997).

2.4   Customers

Customers are the ones who make the ultimate decision whether to make the purchase (Ots 2009). According to Ivory and Alderman (2009), however, it is not always easy to identify and define who the customer is. In their study, the most critical customer changed over time and ambiguities and uncertainties about the customer existed between the teams who participated in the solution development. In this section, the term 'customer' includes potential customers, partners with shared offerings, and two distinct groups of a software ecosystem.

Solution planning needs to accommodate offerings to various customers over time. Accordingly, a *new service strategy matrix* (Scheuing & Johnson 1989) simplifies the four options in solution planning (See Table 2). By following a *share building* strategy, the company intends to sell more existing services to existing customers. A *market extension* strategy guides the company towards offering existing services to new market segments. The company endeavours to market new services to existing customers under a *line extension* strategy. Under a *new business* strategy, the company enters a new market with a new solution.

Table 2. New service strategy matrix in solution planning (Scheuing & Johnson 1989).

Markets / Offering	Existing customers	Potential customers
Existing services	Share building	Market extension
New Services	Line extension	New Business

To further model those potential customers (i.e., noncustomers), the schema known as three tiers of noncustomers (Kim & Mauborgne 2005) is presented in Figure 2. The first tier represents the potential customers who pay for an industry's offering but are not loyal to any existing solution. The second tier stands for potential customers who currently refuse to purchase the industry's offerings. The third tier represents potential customers who have never thought about the industry's offerings.

Anderson and Wouters (2013) state that working with customers to modify offerings and business models is a standard business practice. Accordingly, they propose that critical new product insights come from the *customers' customers*. These indirect customer relationships are important, because working with the customers' customers will lead to financial success (Homburg et al. 2014). While a focus on the customers' customers is not yet a standard business practice, there seem to be several component suppliers that actively manage this type of indirect customer relationship (Dahlquist & Griffith 2014).

A software company can provide products and services to customers' customers through the customers that may already have large existing customer base. In this case, the customers will also become partners. For instance, the software company can develop a software solution that can be bundled with the existing offering of the customers. However, the bundled solution presents new challenges to the solution strategy. For instance, the bundling and pricing models will become strategic topics (Rao et al. 2018; Sainio & Marjakoski 2009).

A software company can also start providing a solution for two distinct customer groups that offer each other network benefits. The network of these two groups, which comprises network effects, is called a two-sided network or two-sided market (Parker & Van Alstyne 2005). Products and services that bring together these groups of users (or customers) into two-sided networks are platforms (Eisenmann et al. 2006). In turn, a platform ecosystem refers to the network of innovation to produce complements that make a platform more valuable (Gawer & Cusumano 2002). Small technology firms may initiate an alliance or join a platform ecosystem to achieve technology compatibility with a platform (Ceccagnoli et al. 2012). Thereafter, this thesis uses the term ecosystem to refer
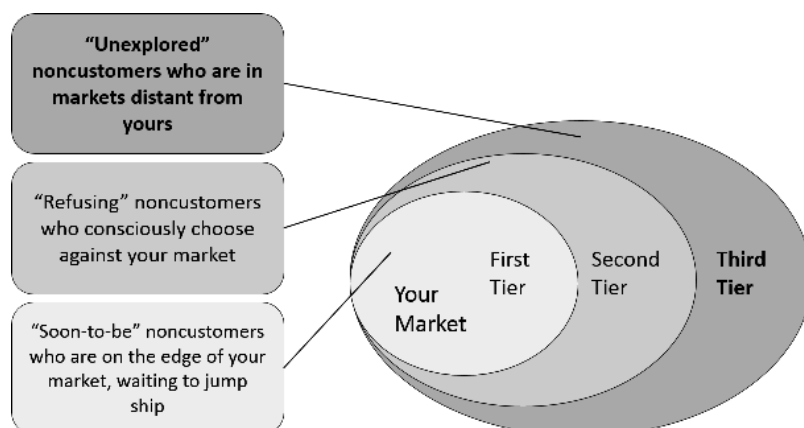

Figure 2. The schema known as *three tiers of noncustomers* (Kim & Mauborgne 2005).

to software ecosystems, instead of platform ecosystem, to specifically focus on software solutions.

While there is no agreed definition of software ecosystem (Manikas & Hansen 2013), typical characteristics of software ecosystems can be identified. Firstly, there is a common software platform or assets that enable, support, and even automate development software and services (Bosch 2009; Jansen et al. 2009). For instance, a particular kind of ecosystem, namely a keystone-centric (Hanssen 2012) one, emerges when a company opens up a successful product line to third-party development (Bosch 2012). The design of the customer experience is a foundational element of such an ecosystem (Poppendieck & Cusumano 2012).

2.5 Hackathons

Software product companies need methods to evaluate customer value as early as possible. A hackathon method offers a means for a software company to turn ideas into software prototypes that can be tested in the customer's daily activities. Indeed, Davis (1995) states that the best way to assess what users need is to provide them with a working system. Software prototyping endeavours to create a closer link between prototypes and the customer's voice, stakeholders' viewpoints, and business goals (Hofmann & Lehner 2001). Several companies use prototyping to assess market potential (Payne et al. 2008).

In this thesis, hackathon refers to a highly engaging, continuous event where people in small groups participate in intensive activity aimed at producing a working software prototype in a limited amount of time. At a hackathon event, the participants almost exclusively write software (Lapp et al. 2007). A demo session at the end of a hackathon pushes the participants to develop software prototypes that are easily demonstrable for the audience. Intensity, collaboration, and result-orientation are typical characteristics of a hackathon that distinguish it from routine prototyping.

Facebook is probably the most well-known software company for its culture of continuously organising hackathons. Dickey (2013) in fact provokes that almost every major feature on Facebook started as a hackathon project. According to her, there is just one rule for a Facebook hackathon: *"You can't work on the same thing that you work on during the day"*. One example of such a major feature is Facebook Timeline, which began in late 2010 as a hackathon project (Dickinson 2012). The development of the feature characterises the intensity of a hackathon as it only took only one night for two full-time engineers, an intern, and a designer to build a demo. Facebook also uses hackathons, for instance, for establishing collaboration with student teams at universities (Fagerholm et al. 2014).

Lately, there have been an increasing number of scientific reports on the use of hackathons in several business domains. Hackathons have particularly become popular in the health and medical sectors. For instance, hackathons are used for spurring on medical innovations in low- and middle-income countries (Angelidis et al. 2016; Berger 2017) as well as developing mobile apps to monitor

aspects of health and guide drug usage (Day et al. 2017). Hackathons are also employed to develop new kinds of applications that utilise open and/or big data. One such example is civic hackathons that are used to leverage open data to innovate for the purposes of governments and societies (Johnson & Robinson 2014). Furthermore, hackathons have been used in emerging business domains, such as the Internet of Things (IoT) and wearables (Byrne et al. 2017).

Hackathons vary wildly in their purpose and execution but generally have common characteristics. The use of hackathons provides an interdisciplinary approach to overcoming social barriers to innovation (Chowdhury 2012). The hackathon event provides a unique forum for diverse participants to share facets of a specific workflow (Walker & Ko 2016) and even promote a specific career (Byrne et al. 2017). On the other hand, there are also growing concerns about their usefulness (Irani 2015; Olson et al. 2017).

Another method similar to a hackathon is a Jam: this, however, is a much larger distributed event and is typically applied in ideation and service design development (Bjelland & Wood 2008; Römer et al. 2011). More recently, however, Jam has also been adopted in software game development (Musil et al. 2010; Global Game Jam 2015).

Two other similar methods to hackathon are code camps and hackfests. It seems that the term hackfest is a synonym for hackathon but is seldom used in practice. In fact, there have been only a few systematically reported studies on code camps and hackfests. The purpose of a hackfest is to spend a day (or longer) using software development skills to collaborate on a particular software project and, hopefully, bring the project to reality (Shujan 2013). Code camps, on the other hand, are used more for educative purposes than hackathons or hackfests. A code camp is a short, intensive collaborative learning event in which participants work in groups (Porras et al. 2007).

2.6 Summary

To address the research goal, this section presented five key themes that are summarised as follows:

1. *Solution planning* aims at mapping a business strategy into a solution development. A solution strategy is specific to one solution within a business that can have several solutions. A key activity of solution planning is solution roadmapping.

2. The role of *customer value* is different from the role of other value perspectives, such as product value and business value. Explicating when and where value is created, and who is the value creator, helps in illustrating the differences between these three value perspectives.

3. Customer value is created in customer processes. A customer process involves a chain of customer activities. A software company can advance the solution planning when it starts *analysing* how to influence the flow and outcome of the *customer activities*.

4. For software companies, knowing and determining who the *customers* are is not a simple topic. Not just the direct customers, but also third-

party partners, potential customers (noncustomers), and customers'
customers, for instance, are considered in solution planning.

5. Customer value is difficult to investigate, especially in the early phase
of solution development. A software company can use *hackathons* as a
method to test customer value early in customer activities by means of
software prototypes. The method promotes external participation
(e.g., third-party partners) and the evaluated prototypes are strategic
options for the new solution development of a software company.

3. Research methods

The aim of this thesis is to investigate the role of customer value in solution planning in software product companies. The thesis investigates the topic in two software product companies.

This section describes the research approach and methods used. It also presents contextual information for the case study companies in which the research work was conducted.

3.1   Case study companies and solutions

The findings of this thesis were from two Finnish companies (F-Secure and Tekla) that develop software solutions for international markets. During the study, each company was medium-sized and represented one or more different application domains. F-Secure addressed turbulent and large markets of antivirus and intrusion prevention. Tekla developed sophisticated model-based software solutions for top experts in the construction, infrastructure, and energy industries. Here, a solution refers to a bundle of service and product components. An example of a product component is a mass calculation application that allows Tekla's customers to estimate the amount of soil materials needed in construction. An example of a service component is marketing support, in which F-Secure develops marketing material and campaigns together with the partners.

The study was primarily conducted at F-Secure. The study started in the end of 2006 and took a historical perspective up until 1999 when F-Secure became a publicly traded company. F-Secure was founded in 1988 under the name Data Fellows. F-Secure has been a growth-oriented company. In 1996, F-Secure employed fewer than 50 employees. In 1999, the company's revenue was 23.3 million Euros and it employed approximately 300 people. In 2007, the company's annual revenue was 50 million Euros and it employed approximately 550 people. In 2011, annual revenue was almost 150 million Euros and the staff exceeded 900 people. During the study, the company had three business units: operators, consumers, and corporate.

F-Secure's Protection Services for Consumers was selected as a primary solution to study solution planning. The solution was selected based on a purposeful sampling strategy for four reasons (Patton 2002). Firstly, the solution was a result of a strategic shift by the company. Secondly, the solution was novel in 2001 and its commercialisation created a new market. Thirdly, the new market grew very quickly and all the major competitors copied the business idea rapidly. Finally, the revenue from the solution continued to grow steadily, despite the

tough competition in the mass consumer market. In 2010, the solution had more than 200 customers/partners in over 40 countries with an addressable market of over 70 million broadband consumer customers. Accordingly, the case was information-rich, and this provided the researchers with a great deal of data about issues of central importance to the purpose of the study.

Based on the findings at F-Secure, three researchers performed a continuation study at Tekla in 2009—2010. The aim of the study was to further increase the understanding of roadmapping problems and develop solutions to overcome them. Tekla was founded in 1966. In 2010, net sales amounted to nearly 58 million Euros and more than 80 per cent of net sales came from international operations. Tekla had offices in 12 countries and also had a worldwide partner network. Tekla's software products and services were used in more than 100 countries. During the study, the company employed approximately 500 people.

Tekla employees selected a solution called Xstreet for the study. The customers of this solution were engineering offices and municipalities, and through the interoperability of Tekla's solutions, water utilities. A strategic aim for Xstreet was to address international markets and explore new customer segments. In addition, the current market was changing as municipalities had begun to outsource activities related to Xstreet to engineering offices. Therefore, this study focused on the solution used by engineering offices and a new target market segment, infrastructure constructors. The company recently renamed the solution Tekla Solutions for Civil Engineering. The present and potential customers are organisations and actors that work with roads, streets, railroads, bridges, and water and sewer networks. The solution supports customer processes such as infrastructure design tasks, both in the office and in the field, construction support, and water and sewer network management.

The final part of the study was conducted at F-Secure when the revenue growth of Protection Service for Consumers had begun to slow down in 2011. The situation led the company to increasingly find new ways to explore and validate new business initiatives. Secondly, the development of Storage as a Service had originally started as line extension for the Protection Service for Consumers to sell new services to the existing customers. The commercialisation of *younited*, a private file (content) hosting service, was aimed to cannibalise the Storage as a Service business. The commercialisation also aimed to address the two-sided market: (1) the customers of the software platform and (2) independent software developers/vendors. F-Secure adopted a hackathon method to address the challenges of the two-sided market and rapidly exploring new business initiatives. The research on the use of hackathons was performed in 2012—2013.

3.2   Research approach and design

The main research question of this thesis is to investigate what the role of customer value is in solution planning in software product companies. This thesis describes and addresses the problems that software product companies face regarding solution planning from the perspective of customer value. As introduced in Section 1, the thesis has two specific research questions:

- RQ1: What kind of problems do software companies have in solution planning from the perspective of customer value?
- RQ2: How can a software product company emphasise customer value in solution planning?

A qualitative research approach was chosen to reach a deep understanding of those problems and means. Qualitative research aims to improve the understanding of contemporary phenomena within their real-life context (Yin 2003; Runeson & Höst 2009). Accordingly, the study assumed that the problems and means represent contemporary phenomena which are hard to study in isolation. The research methods used were case study and action research. Each method fosters the researcher's participative role, and, action research, in particular, allows the researcher's intervention when solving practical problems. In this thesis, an iterative action research process suggested by Avison et al. (1999) was used. This process involved the researchers and the personnel of the case study companies that were acting together on a particular cycle of activities. These activities are summarized in Table 3.

Table 3. Action research activities of this thesis

Activity	Description
Problem diagnosis	Analysing the current situation and defining the problem
Action intervention	Planning improvement actions and implementing the planned actions
Reflective learning	Analysing the effects of the improvement actions and identifying what was learnt

The results for RQ1 are covered in three articles included in this thesis. First, a case study (I) was conducted to study the problems in the strategic business transformation from the company level. Second, to study the problems from the solution level, a case study (II) was conducted to focus on the transformations of the solution strategy. Third, to discover the problems that software product companies face regarding solution roadmapping, an action research study (IV) was conducted in two software product companies. Regarding RQ1, the original research questions of those articles were as follows:

- I: What are the challenges for the company in its transformation from product orientation to service orientation over time?
- II: How did the solution strategy evolve during the life cycle of the software solution?
- IV: What kind of problems do software product companies encounter during roadmapping?

Figure 3 illustrates the linkage of RQ1 and the three articles. The original results of those articles were iteratively synthesised further and streamlined from the perspective of customer value, resulting in three different answers for RQ1.

The results for RQ2 are covered in six articles included in this thesis. The two case studies, I and II, were utilised to investigate the success factors in the strategic transformations. Two action research studies, III and IV, were carried out to address problems in solution planning, in particularly, solution roadmapping. Finally, a case study, V, and its extension ,VI, were conducted to study experiences of organising hackathons within a software company.

In I and II, a case study method (Yin 2003) was used to increase the understanding of the strategic changes over a rather long period of time. The method was selected to gain rich understanding from the changes of important variables, such as the market, technology, competition, and company strategy. The method reveals richly detailed information that emphasises the important contingencies that exist among the variables. Moreover, the method allows researchers to study historical descriptions and events dealing with a full range of evidence sources, such as documentation, archival records, interviews, and observations. The method also promotes the researchers' own learning process with respect to the social phenomenon that is being observed.

In III and IV, action research was selected to discover and address the problems that software product companies face regarding strategic and long-range planning. Action research aims to solve current practical problems while expanding scientific knowledge (Baskerville & Myers 2004). It combines theory and practice through change and reflection in a real-life situation (Avison et al. 1999). According to Myers (2008), the distinctive feature of action research is that the researcher deliberately intervenes while also investigating the effect of that intervention.

In V and VI, a case study method was used again to gain understanding of hackathons as a means to emphasise customer value in a software product company. This time, the case study method had an explorative role to capture a
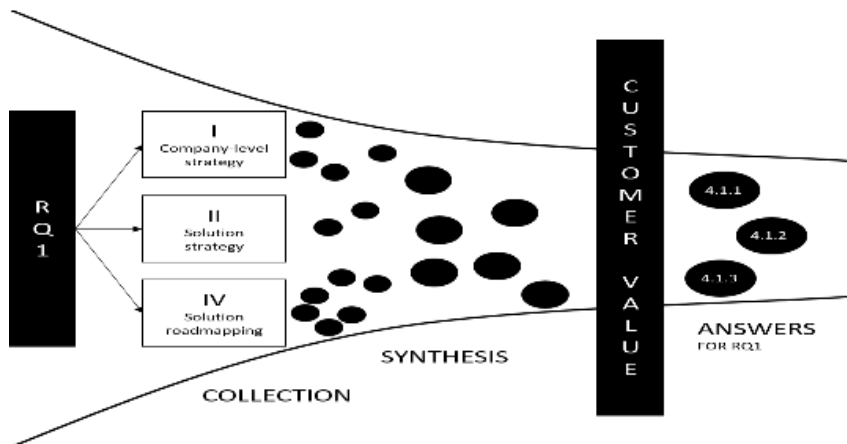

Figure 3. Illustration of the original results' mapping and evolution from the three articles to the three final answers of RQ1 (referring to the corresponding sections).

thorough understanding of a multifaceted phenomenon. In particular, the method allowed the researchers to act as practitioner-researchers who were closely involved in organising the hackathon events. As the investigation was explorative in nature, this participatory role of researchers was aimed at enriching data collection and analysis.

Figure 4 summarises the mapping of RQ2 and the six articles in this thesis. To address RQ2, the original findings from the six articles were collected, synthesised, and grouped. The final findings were grouped into four topics to emphasise customer value in solution planning. As illustrated in Figure 4, each topic was presented in a separate section. Two of the topics were based on the action research study and were further reflected on in a separate section.
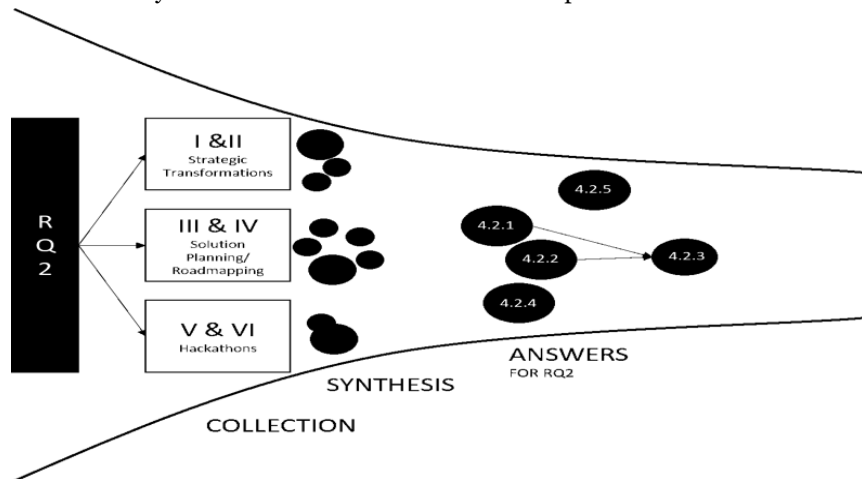

Figure 4. Illustration of the original results' evolution and mapping from the six articles to the four final answers of RQ2 (referring to the corresponding sections).

3.3   Data collection

Figure 5 summarises the mapping of the key data sets and the six articles included in this thesis. The corresponding data collection techniques used in this thesis are summarised in Table 4. In this section, the use of the data collection techniques is explained following the structure of Table 4, not chronologically.

Interviews were carried out twice at F-Secure. First, three researchers conducted nine interviews at F-Secure in 2006–2007. The goal of the interviews was to investigate the current state of solution planning in the company and gain information about how the interviewees would improve the existing practices of solution planning. The key criterion for selecting interviewees was that they had knowledge about the current planning activities. Two of the interviewees were executive team members and the other seven were vice-presidents, directors, and managers of various functions, such as R&D, customer advocacy, and service development. Three researchers conducted interviews in pairs. The interviews were open-ended and semi-structured. Three researchers defined five topics for the interviews as follows: (1) long-term planning activities, (2) customers and customer groups, (3) benefits gained by customers, (4)

components of the solution, and (5) RE activities and Agile approach. All of the nine interviews were transcribed on the basis of the recordings.

Table 4. Summary of data collection techniques and key data

Technique	Data
Interviews	9 participants, transcription, 70–90 min, semi-structured, 2006–2007, F-Secure; 12 participants, transcription, 60 min, semi-structured, 2012, F-Secure.
Collaborative workshops	5 sessions, 4–8 participants, transcription, 2–3 hours, 2007–2008, F-Secure; 6 sessions, 3–11 participants, 2–4 hours, Tekla.
Observation	Researcher notes (participation), videos, photos, chat log, meeting notes and emails, 2012–2013, F-Secure.
Collection of external documentation; Wayback Machine (WBM)	Financial and corporate news, external product information, 2000–2010, F-Secure; 2006–2011, Tekla.
Collection of internal documentation	Internal company documents and confidential product information, F-Secure and Tekla.
Questionnaires	Continuum questionnaire at F-Secure in 2007 and at Tekla in 2010; Two sets of questionnaires at two hackathons at F-Secure.

The second round of interviews was conducted in 2012. Hackathon participants were interviewed to investigate the first hackathon at F-Secure. The goal of the interviews was to gain information about how the interviewees perceived the hackathon. The interviews focused on two aspects: assessing the third-party API and learning about a hackathon as a new product development practice. Three researchers conducted 12 hour-long semi-structured interviews in pairs in the weeks following the hackathon. The interviews were open-ended and semi-structured. Nine of the interviewed hackathon participants were software developers. Three of the interviewees were hackathon support persons, of which two were the main organisers. All of the twelve interviews were transcribed on the basis of the recordings.

Collaborative workshops were carried out at both F-Secure and Tekla. Their purpose was to create a dialogue among the practitioners and the researchers. The role of the three researchers was to facilitate workshops, make observations, take notes, present the findings from the data gathered during the previous workshops, provide knowledge from the literature, and make suggestions for solution planning. The role of the practitioners was to provide knowledge about the current situation, give feedback about the findings and suggestions presented by the researchers, and make their own proposals.

Five collaborative workshops were organised at F-Secure in 2007 and 2008. The number of practitioners at the workshops at F-Secure varied from four to eight. The practitioners represented middle and senior management, with one or two senior executives present at three of the five workshops. Three out of the five workshops were recorded and the recordings transcribed. In the first two workshops at F-Secure, the researchers took notes but the workshops were not

recorded because the researchers believed recording them might reduce participants' candour.

Six collaborative workshops were performed at Tekla in 2009. The subject of the workshops was solution planning. A senior manager at Tekla decided the subject and set the goal of improving the current roadmapping practices in a pre-meeting with two researchers. All the workshops were recorded and the recordings transcribed. The researchers also took notes during all the workshops. The number of workshop participants at Tekla ranged from three to eleven specialists, managers, and directors.

In addition to the interviews and workshops, the researchers were able to collect data by observing informal events and situations. Primarily, the researchers participated in eight meetings, of which five were at F-Secure and three at Tekla, between and after the workshops. The researchers took notes from the meetings. The purpose of the meetings was to get the latest and detailed information about the solution planning of the case study companies and prepare workshops. Moreover, two employees participated in complementing and validating the data sets as illustrated in Figure 5 (person A in Article I and persons A and B in Article II). Both employees had closely participated in solution planning during the study period.

Observation was a primary data collection technique in the study of hackathons. One to three researchers observed each of the five hackathons. Observations were recorded in the researchers' notes. At the first hackathon, the researchers also videotaped the common sessions, i.e., the opening, morning briefings, and the closing demo session, and audio-recorded an informal discussion after the hackathon. In addition, the researchers stored the slides of the presentations in common sessions and an online chat log and documented the key findings and results on the company intranet pages.

The webpages of the companies were used for historical analysis and to get an external view of solution planning. First, one researcher focused on collecting data concerning the solution strategy and related influencing factors, such as
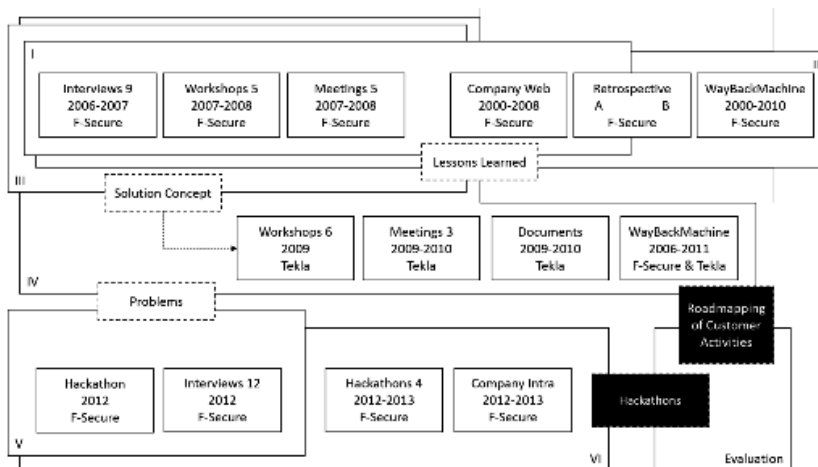

Figure 5. Mapping of the key data sets and the six related articles in this thesis.

the market, competition, revenue, profit, customers, and partners, from a ten-year period. Archival records were the primary data source. From the beginning of 2000 to 2010, the researcher copied the relevant content from the 43 interim reports, 10 annual reports, and the relevant parts of the news archive on the F-Secure website into separate text files for further analysis. He also read and listened to the multimedia package "20 years of reliability" produced by the company. Six parts of the audio were transcribed for further analysis as they explained historical events and contexts regarding the case study solution and the company strategy. In addition, he used an Internet archive called Wayback Machine (WBM) to collect marketing messages for the solution from the company Web pages from different points in time. The focus was on material that contained information related to the solution and deals made with partners and customers. Wayback Machine was also used to collect descriptions of Tekla solutions to gather marketing messages before and after the action research study.

To complement the collaborative workshops, the researchers received confidential information on the solutions and future plans of Tekla. The information was received in PowerPoint and Pdf files. In the study of hackathons, the researcher, as a company employee, had access to the company intranet at F-Secure. Relevant material was collected and shared among the researchers with F-Secure's permission.

At each of the first and third hackathons, additional data were gathered from retrospective sessions: the participants were asked to complete a retrospective questionnaire twice, during lunch on the second and third days. The questionnaire was a paper with 'keep', 'drop', and 'fields', referring to practices that should be kept similar, practices that should be abandoned, and new practices that should be tried, respectively. Immediately after the first hackathon, a questionnaire was used to collect general satisfaction or happiness levels felt during the hackathon. These feelings were measured by drawing a trend of the happiness levels over three days. The researchers also asked the participants to record what happened and the reasons, especially in cases of changes in feelings, on the questionnaire. These notes were specifically addressed in the 12 interviews. The service-orientation questionnaire was also used to complement nine interviews at F-Secure and collect information from the workshop participants at Tekla. Finally, a questionnaire was used to collect the perceptions of participants from the solution concept template before the actual workshops. This information influenced the selection of the topics for the collaborative workshops.

3.4 Data analysis

The data analysis was carried out in multiple iterations, which made it possible to verify the early observations and findings during the study. The iterative analysis followed the industry-as-laboratory approach in which the researchers identify problems through close involvement with industrial projects and then create and evaluate solutions that address these problems (Potts 1993). The researchers were also able to incrementally construct the findings through iterative cycles of preunderstanding and understanding. Gummesson (2000)

describes preunderstanding as researchers' insights into a specific problem and social environment before they begin a research iteration: it is an input. According to him, understanding refers to the insights gained during the research iteration: it is an output. This output can act as preunderstanding for the next research iteration.

The data analysis had two key phases. In the first phase, the collected data sets (see Figure 5) were analysed against the specific research questions in the six articles (I—VI). In the second phase, the findings from those articles were harmonised to match the two research questions of this thesis (RQ1 and RQ2).

The data analysis was grounded in the nine interviews. Three researchers separately analysed and coded the transcripts. The researchers determined themes from the codes, identified quotations related to the themes and marked these quotations with colour codes and comments in the transcripts. The researchers shared the findings with each other and prepared a presentation on the basis of the findings. The preliminary findings were presented and evaluated at two workshops attended by F-Secure personnel. Between these two workshops, the researchers further elaborated on the findings.

The findings were further analysed in articles I, II, III, and IV. In I, the study focused on the company's service orientation, customers and customers' customers and how the company analyses the customer data. In II, the viewpoint was on the value proposed (and created) for the existing and potential customers and customers' customers. In III, the analysis concentrated on the current state of solution planning in the company and the interviewees' ideas about improving the existing practices. In IV, the researchers investigated the perceived problems in the solution planning and roadmapping. The data from the follow-up workshops and meetings were used to evaluate the customer value-creation logic as part of solution planning and roadmapping (III & IV). The evaluation also increased understanding of the role of customers' customers (I & II).

Historic and retrospective analysis were performed in both I and II. The order of the analysis was as follows: historical analysis (I), retrospective analysis (I), retrospective analysis (II), and historical analysis (II). The understanding gained in I was an input for the retrospective analysis of II that was performed a year later. Two F-Secure employees participated in the retrospective analysis. The selection criterion for the employees was that they had closely participated in solution planning throughout the study period. Employee A was an executive member of the company. Employee B was a director and had participated in the business development of the selected case solution from the beginning.

In the historic analysis of I, 33 financial reports were analysed to assess the company's perceptions of the software service business between 2000 and 2008. The corporate news was also analysed. One researcher analysed material that contained the launches of the service solutions and the contracts made with partners and customers. He identified success factors related to both launches and contracts. He investigated other factors than software features that would explain the success. He analysed the six transcripts from the multimedia package "20 years of reliability" that were related to the study. These findings were further analysed with the other two researchers. The researcher documented the

findings and prepared a presentation to illustrate them. Two researchers and Employee B performed a retrospective session with the presentation. The findings were enhanced on two occasions on the basis of corrections suggested by Employee B.

In II, two F-Secure employees retrospectively analysed F-Secure's history in separate sessions with one researcher. The findings of the retrospectives were structured using two research schemas. Firstly, the three tiers of noncustomers (Kim & Mauborgne 2005) were used to describe the case study market in 2001 and 2010. Potential customers of the intrusion prevention and content security solutions were categorised into three groups to describe the market and competition at these two times. Secondly, the strategy matrix (Scheuing & Johnson 1989) was used to identify and describe the types of solution strategies followed by the company during 2001 and 2010. Finally, one researcher investigated 43 financial reports during 2000 and 2010 to discover the factors affecting the solution strategy at different points of time. The researcher also analysed the marketing messages for the solution collected using Wayback Machine (WBM) over the 10-year period. Finally, the employees validated the findings.

In III, the researchers aimed at improving the solution planning practices of F-Secure. First, the findings of the current state were introduced in the first collaborative workshop. The practices were iteratively developed together with F-Secure employees in the following collaborative workshops and meetings. After each workshop, the researchers investigated the perceived problems and improvement ideas proposed by the workshop participants. Based on the observations, the researchers studied the relevant research literature and planned the following workshop with one to three F-Secure employees. As a result of the workshops, the findings were depicted in the form of a solution concept. The content of the solution concept was processed and evaluated with different stakeholders in the workshops.

IV was a continuation study for III. First, two researchers initially investigated the current state at Tekla and agreed to continue the study with the company's process owner. At the first collaborative workshop, two researchers presented the solution concept with the lessons learned at F-Secure. After the workshop, three researchers analysed the transcribed workshop data and the questionnaire which the participants had completed in the workshop. Based on the analysis, the scope of the collaborative workshops was agreed in email discussions and informal meetings with Tekla personnel. The analysis of the collaborative workshops followed a similar process to III, except that in IV, the data analysis focused more on RQ2 at Tekla. A reason for this was the knowledge gained and solution planning practices developed at F-Secure.

After the workshops, the analysis and presentation of the results were carried out in several iterations. First, one researcher reanalysed all the data collected from the previous interviews and workshops. He identified preliminary thematic categories based on the two research questions. Secondly, the researcher evaluated and further complemented the preliminary findings with two other researchers in several iterations. Third, two key workshop participants from F-Secure and Tekla validated the final descriptions of the problems and lessons

learned. Validation was performed twice, in 2011 and 2012. During the first validation, a workshop participant from each company was interviewed to evaluate the impact of the study on the companies. To study the impact, the researchers also analysed the marketing messages for the solutions from the companies' Web pages (by using the Internet archive Wayback Machine) at two points of time, before and after the study. They concentrated on material that contained information that described the benefits for customers. The final presentation of the paper was validated for a second time with the same persons from F-Secure and Tekla.

The use of hackathons was investigated in V and VI. In V, three researchers focused on two main topics: the quality of the third-party API (to be offered to third-party developers) and the practices of the hackathon. One researcher refined both these topics with appropriate codes to determine the central findings. He used the Atlas.TI tool for transcripts of the relevant material, such as interview data and questionnaires. Two other researchers (including the author of this thesis) participated in complementing and restructuring the findings. The three researchers also compared the findings against the collected material, such as questionnaires and company documents. Finally, two F-Secure employees validated the findings.

In VI, the research extended the previous study of hackathons. The main focus of the research was to investigate hackathons as a company's means for exploring new business initiatives rapidly. Three researchers determined eight categories, such as purpose, challenges faced, and outcome, to evaluate and compare the hackathons. Subsequently, they added key findings for each category for the five hackathons. They primarily investigated the context and outcome of each hackathon and then compared them to discover commonalities. The researchers paid special attention to the perceived benefits and challenges by the participants and business owners. The researchers also investigated factors such as organisation structure, culture, and supporting methods, other than the actual hackathon, to explain these benefits and challenges. Finally, one F-Secure employee validated the findings.

In the second key phase of data analysis, the findings from the six articles were harmonised and delimited to match the two research questions of this thesis (RQ1 and RQ2). The second phase consisted of four stages as illustrated in Table 5.

In Stage 1, the researcher identified preliminary topics from the six articles to address the two research questions. As a result, ten problem areas were identified in regard to RQ1 and fourteen topics, which emphasised customer value, were identified in regard to RQ2. Five of those fourteen topics were practices or actions that F-Secure had applied without the researchers' participation or intervention and nine of were interventions that were applied at F-Secure and/or Tekla during the study.

In Stage 2, the researcher divided the preliminary topics into individual findings using Microsoft Excel. Each finding was named and commented. As a result of the partition, 20 findings were coded in regard to RQ1 and 33 (10+23) to RQ2.

As in Stage 1, the findings which addressed RQ2, had two streams in regard to the participation of researchers.

Table 5. Summary of data analysis in the second phase

Stage	Description
Stage 1: Collection of relevant topics	Identification of preliminary topics from the six articles to address RQ1 and RQ2 • 10 problem areas (RQ1) • 14 topics regarding customer value (RQ2)
Stage 2: Partition and coding	Partition, naming and description of the topics • 20 findings (RQ1) • 33 findings (RQ2)
Stage 3: Clustering	Clustering the lower-level findings and determining the higher-level themes • 3 sets of findings (RQ1) • 4 sets of findings (RQ2)
Stage 4: Impact analysis	Identification of dependencies, causes, and effects of the findings • 3 illustrations (RQ1) • lessons learned (RQ2) • 2 evaluations of industrial diffusion (RQ2)

Stage 3 focused on clustering the individual findings into the higher-level themes. In this stage, the researcher first identified unified themes from the 20 coded topics (RQ1). As a result, he determined three high-level themes and clustered the original findings into those three themes. While doing so, he reprocessed and also marked off some of the original findings. Finally, he visualised the relationships of the findings. Next, the researcher determined four topics to address RQ2. The original 33 findings were reprocessed and then either clustered as part of a higher-level theme or marked off.

Stage 4 was impact analysis. In regard to RQ1, the researcher discovered relationships within the clustered findings of each of the three themes. He identified dependencies between these findings and whether the particular finding was either a cause or an effect within the theme. In regard to RQ2, two of the four themes were further reflected on. A main reason for this was that the findings of those two themes were based on the interventions in the action research studies. The themes were presented as lessons learned. Finally, the evaluation of industrial diffusion for a means to roadmap customer activities and hackathons was carried out.

4. Results

This section summarises the main research results. The results are structured in accordance with the two research goals: (1) "What kind of problems do software companies have in solution planning from the perspective of customer value?" and (2) "How can a software product company emphasise customer value in solution planning?"

4.1 Three problem areas of solution planning

The first objective of this thesis was to investigate the problems of solution planning from the perspective of customer value. The findings are presented under three problem areas: (1) feature-driven mindset; (2) fragmented customer knowledge; and (3) firefighting syndrome.

4.1.1 Feature-driven mindset

Figure 6 illustrates the phenomenon of a feature-driven mindset. According to the action research study (IV), the feature-driven mindset reduced the development teams' ability to see the holistic picture of the desired solution from the perspective of customers.

The company's history of developing software products seems to be a reason for the feature-driven mindset. F-Secure developed the first heuristic scanner for antivirus products in 1991 and, at Tekla, the focus was on software development in structural engineering, road building and earth-moving as early as in 1968. In study IV, the workshop participants in each company admitted that its history of developing software products and novel technologies had blinded them to examining customer activities in their entirety.

According to study IV, the organisational culture of each company has valued software features. In particular, it has assumed that new features increase customer value. In this assumption, the value is embedded in the software product. The early phase of Agile transformation even enforced the assumption. The software teams frequently released a set of small-sized features that reduced their ability to see the holistic picture for the time being.
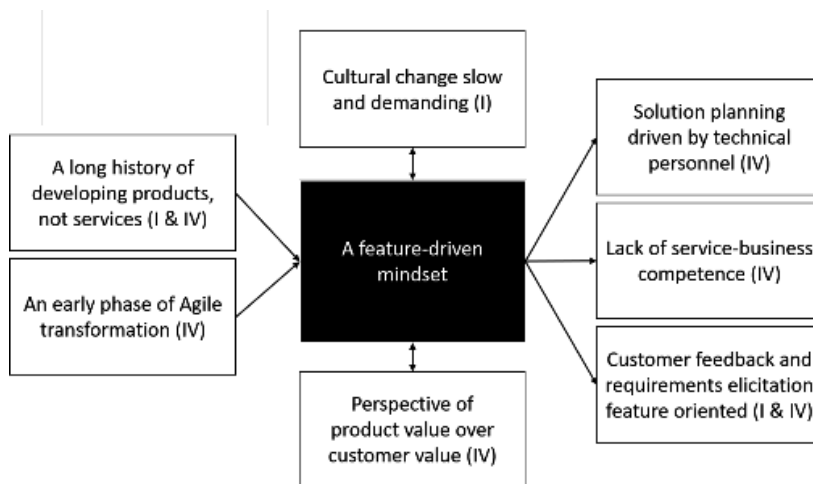
Figure 6. The feature-driven mindset in regard to solution planning.

The action research study also revealed that the term 'value' was ambiguous in each company. For instance, the term 'added value' was a common expression of value in both companies. Company personnel who were involved in the study, typically denoted either product value or business value when using the term 'added value'. The term referred either to the improvement of a solution that would be more useful to customers or to the willingness of customers to pay more for the solution. Each company preferred the perspective of product or business value over customer value as their logic of value creation.

The case and action research studies recognised three implications of the feature-driven mindset. First, the participants in solution planning were driven by technical persons and product management. Second, the solution planning teams lacked service business competence. Practitioners in both companies found articulating the content and value of services for customers and partners to be a complicated process. Third, requirements elicitation and customer feedback were mostly feature-oriented in each company. For instance, the action research study revealed that Tekla elicited mostly software-related requirements from its customers. During the case study, F-Secure's customers mainly asked for software corrections and feature enhancements. F-Secure received very little feedback about the service processes themselves.

Finally, the case study (I) emphasised that cultural change from products to services can be slow and demanding. One of the interviewees highlighted that cultural change towards services is one of the main and most critical issues for the company. He also pointed out that this cultural change requires a new mindset from the personnel. Thus, every employee should understand that F-Secure offers services, not just software and software features, for customers. However, many an employee still saw F-Secure as a software product company.

4.1.2 Fragmented customer knowledge

Figure 7 illustrates the phenomenon of fragmented customer knowledge. In each company of study IV, customer knowledge was fragmented, which meant that different employees were knowledgeable about different areas of their customers' activities: and not just customers' activities but also customers' customers activities.

According to study I, two reasons for the fragmented customer knowledge were organisational change and the growth of the customer base. A solution was originally developed by a company subsidiary that was merged with the parent company after having developed valuable partnerships with service providers. While the consolidation aimed to strengthen competitiveness, the new organisation became slightly disoriented. Accordingly, the scaling of the solution, which included service components, led to many-to-many relationships in sharing customer information in the company. While the number of customers increased significantly, also the amount of customer feedback increased, and processing the feedback thus became more challenging. Likewise, also the number of employees who participated in co-operation with the customers increased. As a result, there were several informants who got feedback from customers.

Another reason seemed to be the lack of attention between customers and customers' customers. In the case study, the interviews with two executive team members and seven vice-presidents, directors, and managers revealed that the F-Secure people had fairly different views on who the key customer was in the SaaS business for consumers. An interviewee either (1) considered that the operators were the most important customer group, which drove the development of solutions; (2) highlighted the importance of consumers (i.e., customers' customers); or (3) argued that both operators and consumers are equally important.

Study IV also pointed out the lack of practical guidance on business strategy from the customer perspective. The business strategy did not provide clear
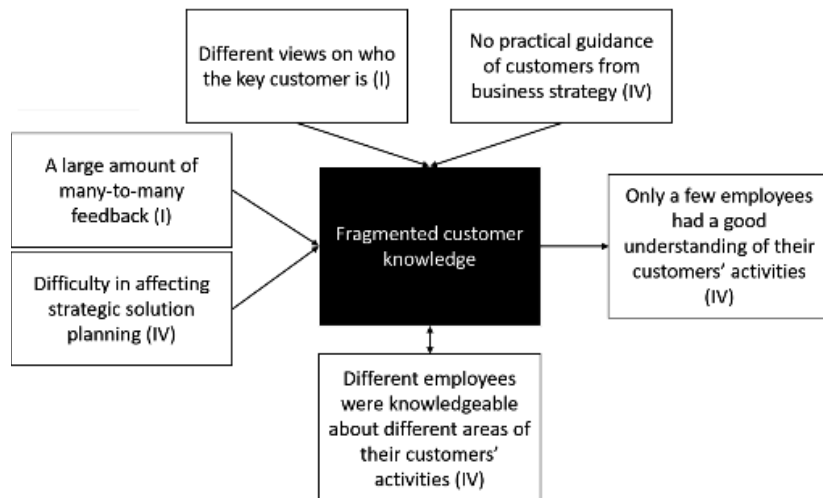

Figure 7. Fragmented customer knowledge in solution planning.

guidance regarding how to define the target customer at a given time and how to elicit, analyse, and prioritise the corresponding requirements. One Tekla employee concretised the problem as the difficulty of mapping the business strategy onto a solution roadmap. Moreover, the business strategic statements did not have the same level of detail or type, for instance, strategic issues related to areas such as the solution's look and feel and target countries.

Study IV highlighted that units other than product and R&D management had difficulty participating in and affecting solution planning. The role of other functions, such as marketing, sales, support, and documentation, seemed to be overlooked in discussions about future plans. Interestingly, marketing was not seen as representing the voice of customers and was typically not participating in solution planning. For instance, neither company's marketing department was represented at the workshops of the action research study. At Tekla, a marketing person participated only in the final workshop, although this person noted that she would have been interested in contributing to the previous workshops.

Each company faced challenges in terms of sharing customer knowledge between key personnel. In particular, the study found that only a few employees had a good understanding of their customers' activities. Indeed, lack of involvement of various units in solution planning led to challenges. Since people from these units did not get information early enough, for instance, training materials and product documentation were constantly out of date.

4.1.3   Firefighting syndrome

Figure 8 illustrates the firefighting syndrome. This makes customers' role tactical rather than strategic in solution planning. Here, the term tactical indicates the short-term and custom-made actions of the company to develop or maintain a solution mainly based on customer complaints and requests. In contrast, the strategic actions focus more on future perspectives, e.g., weak signals, than reacting to current situations.

According to study IV, the diversity of customers caused extra challenges in solution planning. During the study, F-Secure had over 200 operator customers that varied in size, location, the length of customer relationship with F-Secure, and tolerance for mistakes. The operators had millions of customers, i.e., consumers, who were even more heterogeneous.

A customer's role in solution roadmapping focused on a company's short-term actions. In each case study organisation, in study IV, key customers' urgent needs and the pressure of short-term sales had overrun long-term plans on several occasions. F-Secure suffered overbooking of roadmaps that typically led to firefighting. Indeed, the Tekla people admitted that roadmapping was tactical rather than strategic. The roadmaps mainly consisted of features that a set of existing customers was willing to commit to and pay for. The roadmaps lacked new strategic parts to extend the new markets or domains.

The case study (II) presented that competition was a reason for the firefighting. In 2001, F-Secure successfully launched a novel security solution to the third-tier consumers through operators. Less than two years after the launch,
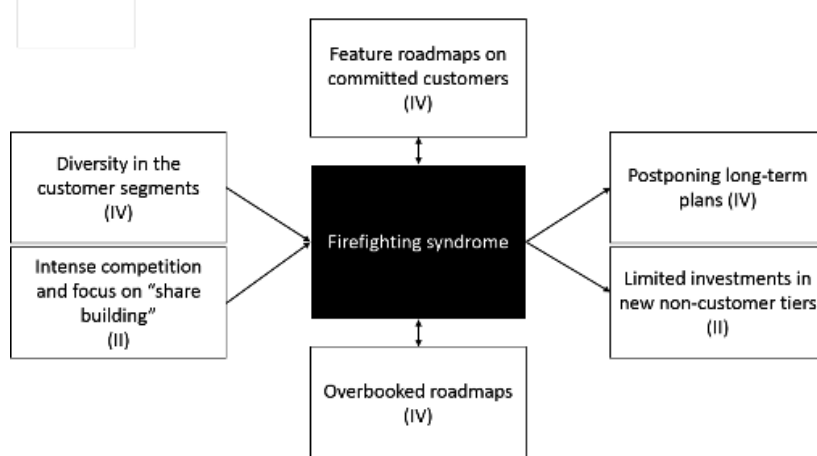
Figure 8. Firefighting syndrome in solution planning.

the third tier was the fastest-growing business area in the field of software security. Not surprisingly, competitors had noticed the business area and had begun to address the same market segment. As a result, the characteristics of the original third tier began to resemble the original first tier. In other words, the original unexplored noncustomers in the third tier were soon known to every security vendor and competition rapidly increased. The competitors were bridging the gap, and this made it more difficult for the company to get partnership deals with new operators. The company focused on keeping the existing customers happy and on growing with them. A new third tier was not recognised and defined during the study.

Focus on the first tier limited investments in service and business development on the second and third tiers. During the case study (II), the second tier consisted of consumers who did not pay for security solutions. The case study stated that the second tier may grow in the future, to the detriment of the paid solutions. In particular, the study emphasised that the vendors of existing security products had difficulties in finding a business model to profitably leverage the second tier. Providing security solutions for free might have cannibalised their current business. As a result, the case study company did not take strategic action to scout a new and uncertain second-tier market with a security solution.

4.2 Emphasising customer value in solution planning

The second objective of this thesis was to investigate how a software product company can emphasise customer value in solution planning. This section presents findings under four themes: (1) emphasis on customer activities; (2) solution concept and customer activity roadmap; (3) hackathons; and (4) customers' customers. It also presents lessons learned from the two first themes in Section 4.2.3.

4.2.1 Emphasising customer activities as part of solution planning

This section summarises the means which were introduced in the action research study (IV) to analyse customers' entire experience with a solution for solution-roadmapping purposes. In the study, MacMillan and McGrath's two-part approach was selected to provide a methodical background (see the left column of Figure 9). However, the original two-part approach needed to be modified in order to specifically fit it to solution-roadmapping purposes from the perspective of value creation. The adapted approach consisted of six steps, performed in two parts (see the right column of Figure 9). Thereafter, the adapted approach is known as "the six-step approach".

The following three steps were considered important to perform before the actual analysis of a customer process (Part 1): (1) Form a cross-functional team, (2) examine the business strategy associated with a software solution, and (3) select the appropriate customer segment of the software solution for each analysis. In Part 2 of the approach, the actual analysis of the customer process and how it linked into solution roadmapping was performed iteratively in a series of workshops. Correspondingly, Part 2 of the approach consisted of three main steps: (4) identifying the customer activities that are related to the company's solution (5) analysing the identified customer activities, and (6) linking the business potential of the important customer activities into a solution roadmap.

Analysing the customer activities (i.e., Step 5 of the six-step approach) was a subjective task. In the action research study (IV), emphasis was placed on promoting the logic in which value is created in the customer's daily processes, rather than embedded in the product. A subtraction formula, 'customer value = benefits – sacrifices' aimed at helping the workshop participants to evaluate how customers perceive the solution in their consumption chain. The thinking tool was not used to explicitly calculate the customer value. Rather, it was established to assist each workshop participant in changing their mindset from a feature perspective to a customer perspective.
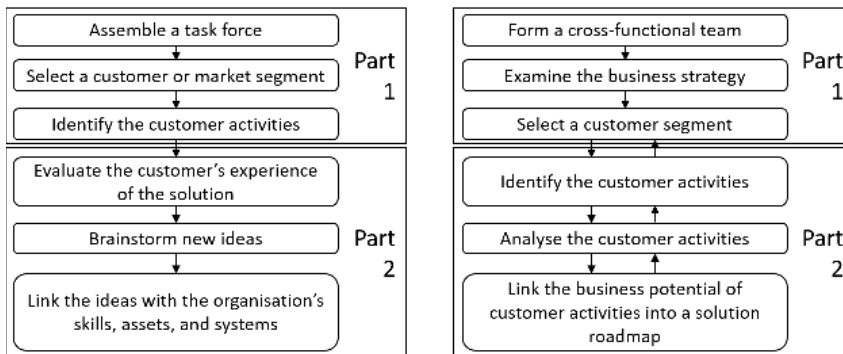

Figure 9. The original two-part approach (MacMillan & McGrath 1997) and its adapted version known as the six-step approach.

To make the analysis more concrete and less subjective, two simple metrics were used to analyse customer activities in the workshops, as illustrated in Figure 10. The first metric, "involvement", was intended to evaluate whether the company or the customer is responsible for performing the activity. A four-point scale was chosen in order to help the workshop participants determine the responsibility and support level between the two (the solution and the customer). In practice, as a group, the workshop participants selected numbers from 0 to 3 in order to explain the degree to which the company's current solution dealt with each customer activity. The second metric, "ability", measured the solution's ability to meet the customer demands on the particular involvement level. The workshop participants assessed the solution's "ability" for each customer activity as "low", "medium", or "high". However, these two metrics were applicable to an evaluation of only the existing solution. Therefore, the "readiness" metric later replaced the two metrics in new solution planning at Tekla (see Figure 11). The readiness metric enables the required development effort to support a customer activity to be determined.

In addition to the "readiness" metric, Figure 11 illustrates also two complementary metrics – "business potential" and "priority" – which were later defined for Tekla. The purpose was to align both the customer activities and the business strategy into solution roadmapping (i.e., Step 6 of the six-step approach). In practice, the workshop participants assessed "business potential" and "priority" for each customer activity as "low", "medium", or "high" in order to distinguish the business potential and priority of each customer activity.

Step 4: Identifying the customer's process activities		Step 5: Analysing the customer activities	
Operator's activities with the solution		**Involvement**	**Ability**
Awareness of security solutions for consumers		2	Low
Evaluating needs/capabilities associated to the solution		1	Medium
Choosing the solution		1	Medium
Purchasing the solution		1	Low
Building the entire service infrastructure		2	Medium
Marketing for consumers		1	Low
Selling and order processing		0	–
Installing security solutions for consumers		2	Low
Invoicing the consumers		1	High
Updating protection for the consumers		3	High
Updating service infrastructure		3	Medium
Supporting (call centre) for consumers		1	Low
Handling operator's problems related to the solution		2	Medium

Figure 10. Example of identifying and analysing customer activities (the example consists of imaginary values that are not related to the solution in question for confidentiality reasons).

4.2.2 Generating a solution concept and customer activity roadmap

This section illustrates two visualisations to promote the perspective of customer value and the corresponding value-creation logic in solution planning. It presents a solution concept and a customer-activity-based view of the solution

Constructor's activities	Readiness	Potential	Priority
		Step 6: Linking business potential into a roadmap	
Finding, analysing, and choosing a competitive bidding	Low	Low	Low
Analysing the initial material and road plan	Medium	Medium	Medium
Planning the offer stage (e.g., mass calculations)	Low	High	High
Choosing the team	Low	–	–
Calculating the construction period	Low	Low	Low
Bidding an offer	High	Low	Low
Selecting a main constructor	Low	Medium	Low
Designing the project specification	High	Medium	Medium
Construction management	Low	Medium	Medium
Change planning and management	Medium	Medium	High
Planning of temporary construction arrangements	Medium	Medium	High
Monitoring work and output	Low	Medium	Low
Controlling the quality of production	Medium	Medium	Medium
Accounting and billing	–	Low	–
Delivering with guarantee and final checks	Low	Low	–
Maintenance	High	Medium	Medium

Figure 11. Example of evaluating and prioritising customer activities for a new customer segment (the example consists of imaginary values that are not related to the solution in question for confidentiality reasons).

roadmap (called here the "customer activity roadmap") that were introduced in the two action research studies, III and IV, respectively.

In study III, the researchers proposed solution concepts for the case study company. The purpose of the solution concept's descriptions was to communicate a big picture of the solution for all employees and guide requirements for engineering activities like solution roadmapping. Therefore, the study emphasised that solution concepts should be short and visual.

The template for solution-concept descriptions is a one-page poster that includes five elements. The first part of the solution concept describes the customer segments of the solution. In study III, the business potential of customers was suggested as a basis of segmentation to divide them into smaller categories. The second part of the solution concept illustrates the value-creating process of customers related to the solution. The value-creating process comprises the high-level view of customer activities. The third part of the solution concept visualises the actual solution as a set of high-level components. The study proposes categorising and visualising the components from the perspective of customer segments. The fourth part of the solution concept presents value propositions to determine and communicate the main reasons why customers want to purchase or use the solution. In the study, value propositions were visualised not just for direct customers but also for customers' customers. Finally, the fifth part of the solution concept is a business slogan that is a market-driven statement summarising the business idea as effectively as possible. According to the study, a business slogan should be self-descriptive and should crystallise the primary business rationale of the solution for different stakeholders such as product management, development, documentation, marketing, and sales personnel.

Study IV introduced the customer activity roadmap. Correspondingly, Figure 12 illustrates the customer activity roadmap generated at Tekla. The roadmap illustrates which customer segments and customer activities Tekla would focus

on after the study. The figure has been partly modified for simplicity and confidentiality.
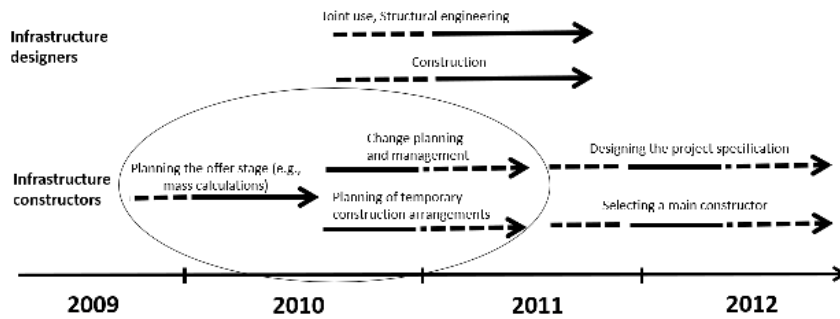

Figure 12. Example of customer activity roadmap (partially reduced and modified for confidentiality reasons).

4.2.3 Lessons learned on identifying, analysing and visualising customer activities

This section summarises the lessons learned from the analysis of customer activities and visualisation of those activities as part of the solution roadmap.

Identifying the activity chains of customers was a helpful way to gain a holistic view of customers' entire experience with the solution. The participants in the workshop determined the main activities through which customers pass, from the time they first become aware of the solution to the time they either renew the contract or stop using the solution. This work provided the workshop participants with new insights and, in particular, helped them to see customer activities in a more holistic manner that, in turn, facilitated a shift from a product perspective to a customer perspective. Identifying and determining customer activities also promoted knowledge-sharing among the companies' personnel. Identifying and determining customer high-level activities triggered an important discussion between the workshop participants. Explicitly structuring customer high-level activities and their mutual links enabled tacit knowledge to be made more explicit.

Analysing the customer activities provided shared understanding on the customer's current situation with the solution. In each company, the practitioners found it useful to evaluate how the current solution supported each customer activity. The workshop participants used two simple metrics: "involvement" and "ability" in those evaluations. The workshop participants found the first metric to be particularly useful for illustrating the current situation. Furthermore, the evaluation of the customer activities revealed opportunities for service development in both companies. The evaluation of the current situation revealed shortcomings in each company's solutions. Holistically examining customer processes required identifying and determining customer activities that the solution did not support. Those shortcomings enabled the workshop participants to discuss new service offerings immediately.

The analysis of the business potential and priority of each customer activity provided a new perspective for solution roadmapping, solution development, and marketing. At the beginning of the study, Tekla's Web site promoted the technical abilities of Xstreet. The Web site focused on the architectural view of the solution and the related key functionalities. At the start of 2012, the Web site had a different tone. Instead of marketing features or functionalities, it emphasised that the solution facilitates key customer activities and enables the customer value creation. The key focus of the marketing message was to advertise how the solution supports the construction work of infrastructure constructors. In particular, the Web site promoted support for change management, mass calculations, and planning of temporary construction arrangements that had been recognised as important customer activities in the collaborative workshops during the study. The Web page not only promoted customer activities but they were also communicated at the same level of abstraction as they had been defined in the solution roadmap during the study. The three customer activities are highlighted with an oval in a solution roadmap in Figure 12.

Linking the business potential into a roadmap was a complex task. For instance, the business potential metric did not provide enough support for prioritisation. The customer activities were not independent and dependencies between the customer activities were determined. Moreover, prioritisation required discussing the issues of business strategy and the company's development capability, but metrics for these issues were not defined.

A methodology transfer, that is, the adoption of action research interventions, was only partially unsuccessful. Techniques and tools introduced in III and IV were not adopted as such in the case study companies after the study. For instance, one workshop participant at Tekla commented in the post-study interview that the techniques and tools used in the study were not the key to learning. Instead, he said that they learned to allocate their common time to examining and deciding the strategically important customer activities. Regardless of the learnings, marketing did not participate in the new solution development for potential customers in the business unit of the interviewee.

4.2.4 Using hackathons

A hackathon is an event in which people in small groups participate in intensive activity aimed at producing a working software prototype in a limited amount of time. This section explains the use of hackathons regarding customer value. It first explains the roles of hackathon demos and prototypes and, then, the benefits and key challenges for a company. It summarises a case study at F-Secure that was presented in Articles V and VI.

The culmination of each hackathon is a demo session, in which the hackathon teams have a few minutes in front of an audience to demonstrate their prototype. According to VI, a demo aims to illustrate the concept and its benefits. A successful hackathon demo is the one that is easy for the audience to understand, and it demonstrates the key aspects of a novel idea. As a result, the demo fosters communication of the benefits of the prototype for various stakeholders.

According to the case study (V), approximately forty people attended the demo session and, in particular, the business owners appreciated the results. The popularity of the hackathon demo led to an additional demo session for a larger group of people (approximately 130).

According to the case study (VI), a concrete prototype offers a concrete means to assess its potential for customer value. For instance, some of the F-Secure hackathon prototypes were shown to the company's country offices, as well as being introduced to some customers and partners. In one case, the customer reacted unexpectedly, becoming highly interested in one prototype which was 'accidentally' created during the hackathon, and less so in the 'planned' prototypes. Indeed, the prototype provides a proof of concept which increases not just the level of confidence in technical terms but provides support for decision-making bodies in terms of customer value.

As a solution to a firefighting syndrome, a hackathon offers an opportunity to explore strategic options that have high market uncertainty. The case study (VI) stated that a strength of hackathons lies in complementing routine development, addressing the need for exploring alternatives to existing product roadmaps and backlogs. One of the hackathon participants stated the strength nicely: "*it brings several new ideas and an environment to implement those ideas with a very strong, dedicated team*". As the ideas are often built from scratch to demonstrable prototypes, a hackathon enables software developers to explore ideas that involve high market uncertainties. For instance, one hackathon team developed a prototype aimed at the mass-consumer market in the field of sport. Typically, this kind of idea would never become a candidate for a roadmap item at F-Secure.

According to VI, a hackathon enable also the building of a community of users and strategic networks. For instance, the third and fourth hackathons at F-Secure focused on external collaboration. Furthermore, the results of case study (V) indicate that the hackathon was a realistic, efficient, and effective means of holistically testing the ecosystem, including technical details but especially the overall design and developer experience. The developer experience of the third-party API has a central role in the ecosystem to engage independent software vendors. According to the case study, the hackathon acted as a validation process for the requirements and design of the third-party API. While most members of the three hackathon teams did not have prior knowledge of the API, each team simulated the behaviour of a third party. As a result, the study discovered that the ecosystem seemed to be targeted to a too limited set of use cases and from a very technical perspective. The ecosystem scarcely supported, for instance, device authentication independent of humans or authentication using a device with limited input and interaction means such as in the case of a device without a keyboard. Accordingly, the hackathon contributed in identifying bottlenecks, and it provided future directions for the development of the ecosystem.

Despite the benefits and popularity of hackathons, long-term adoption of the hackathon method seems to be challenging. In the case study (VI), it is called a paradox. Immediately after each hackathon, the participants and audience, including business leaders, were very satisfied with the outcome, with it typically

exceeding all expectations. On the other hand, the results were rarely utilised in a commercial manner. Only a handful of applications were released as a result of hackathons. In particular, they had not yet generated significant business value. Therefore, the return on hackathon investment was increasingly questioned after a series of hackathons. Regardless of the challenges, the study concluded that the adoption of hackathons can be a means for guiding organisational culture in a more rapid, responsive, and innovative direction.

4.2.5   Focusing on customers' customers

This section summarises the findings on the role of customers' customers in the solution strategy. It primarily sums up the case study (II) on the role of customers' customers in the different stages of a solution strategy as illustrated in Table 6.

Table 6. Role of customers' customers in the solution strategy between 2001 and 2010.

Markets / Offering	Existing customers	Potential customers
Existing services	Share building: Helping customers to increase sales to their existing and potential customers (2005)	Market extension: Using operator partners' brand in internationalisation (2003)
New services	Line extension: Selling new solution to existing customers by leveraging existing and potential customers' customers (2008)	New Business: Novel business model and chain of customers (2001)

According to the case study (II), the company developed a new solution for entering into the mass-consumer market with a novel business model in 2001. The new solution involved a different pricing model and chain of customers than traditional consumer products. In the business model, the customers' customers were potential broadband users (noncustomers) who just wanted to use a network safely. In practice, the market was a very large set of households potentially purchasing their first broadband connections in 2001. These households typically did not include advanced users. These consumers valued convenience over technical details and product features. A large proportion of these consumers were not even aware of security threats. The optimal moment to increase their awareness of security threats and solutions seemed to be while they were negotiating broadband services with an operator (internet service provider).

The operator was a direct customer and also a partner in the business model. In the market extension, the strategic focus was primarily to gain operator partners globally, and then to help them sell a complementary solution to their new customers. The solution was co-branded to correspond to the operator's brand. The customers' customers were able to subscribe to both the broadband connection and security solution and, later, receive support from their local

operator. Ari Hyppönen, the former CTO, recalled: "*It is not really a technolog-ical innovation but a business model innovation and this is where I would say that F-Secure's strategic advantage has been. We have been able to innovate in the way we provide the solution, not only in the way the solution works.*"

By 2005, the competition had become intense and it was more difficult for the company to get partnership deals with new operators. The role of customers' customers became more important in increasing revenue. The company in-vested in actions that increased customer loyalty and the revenue shared with the customer. The key value proposition of the solution was to increase the loy-alty of customers' customers while maximising profits. The strategic focus pushed to develop and improve sales processes and marketing support, with the aim of increasing sales by customers to their customers. The company also be-gan to pay more attention to understanding why some of the customers' cus-tomers were disloyal. These investments in the implementation of the value proposition also promoted an increase in the number of operator partners.

In 2008, the company strategy directed the transformation of the solution strategy from share building to line extension. The company invested in acquir-ing new technology and in the development of new solutions to provide storage as a service, such as online backup, to existing customers. The company pro-claimed to its investors that the current customer base, including customers' customers, was a valuable asset for the line extension strategy that provides growth opportunities. The company's financial report from the third quarter of 2010 states, "*The company currently has more than 200 partners in over 40 countries with an addressable market of over 70 million broadband consumer customers*".

According to IV, F-Secure was mainly reactive to customers' customers at the beginning of the study and did not directly elicit requirements from them. Dur-ing the case study, F-Secure started collecting data directly from customers' cus-tomers to advance the customer value creation. According to one F-Secure ex-ecutive, these investments have provided in-depth knowledge, facts, and figures from customers' customers that the company has been able to utilise, for in-stance, for solution planning and for marketing the solution to potential cus-tomers. F-Secure has been able to utilise this knowledge in advancing its cus-tomers' value creation.

5. Discussion

The first part of this section discusses the answers to the research questions and compares them with the results of the previous research. In the second part of this chapter, threats to the validity of the study are discussed.

5.1 Answers to research questions

The research of this thesis consists of two research questions which were presented in the introduction. This section discusses the answers to the research questions.

5.1.1 RQ1: What kind of problems do software companies have in solution planning from the perspective of customer value?

To tackle RQ1, three problems related to solution planning were identified. Firstly, an overly feature-driven mindset culminated in roadmapping that focused on prioritising low-level software features. Secondly, only a few employees had good knowledge of their customers' activities, and they were knowledgeable about different areas of their customers' activities. Finally, firefighting syndrome made the customers' role tactical rather than strategic in solution planning.

The first problem was the **feature-driven mindset**. All of the interviewees and workshop participants at F-Secure and Tekla agreed on the disadvantage of a feature-driven mindset and on the corresponding need to transform from feature orientation towards service and customer orientation. Straus and Radnor (2004) offer an explanation for the mindset. According to them, employees may lack clearly stated assumptions concerning customers' future needs and behaviour. The lack of strategic customer information may shift the focus from the needs of the customers to the eloquence of the technology. In other words, when the roadmapping team perceives the customer needs and future trends to be elusive, they feel more comfortable focusing on technological issues and features instead. As a result, the roadmapping team's focus on features can lead to pitfalls that even decrease customer value (Kauppinen et al. 2009). Adding too many features to the product or treating customers and users as one big group are examples of such pitfalls.

Overproduction of extra features, or feature creep, is a known problem, for instance, in the Lean literature (e.g., McConnell 1997; Poppendieck 2011). In

feature creep, a team develops features that are more complicated than necessary or not needed or used by the customer. The corresponding pitfalls are, for instance, project schedule overruns and unnecessary product complexity (McConnell 1997). However, feature creep and a feature-driven mindset are not identical. In feature creep, the team may develop unnecessary features, whereas in the feature-driven mindset, the team's ability to see the holistic picture of the desired solution is reduced. In the latter case, the team may even determine and develop necessary low-level product features but fail to negotiate and address important product-related services with the customers.

The thesis's findings indicate that the feature-driven mindset is a cultural issue and difficult to change. They point out that a feature-driven mindset can be identified, for instance, in the companies' value-creation logic, terminology, organisational structure, and competences. A recent study of value has also introduced the mindset of people as a barrier to achieving perceived quality, because employees tend to take perceived quality as granted (Alahyari et al. 2017). The study recognises the mindset of as a large organisation problem. The findings of this thesis emphasise that the long history of developing software products was a reason for the feature-driven mindset. One of the interviewees specifically aspired to cultural change throughout the company to shift the focus from product to services. The topic of cultural change is important, as Tian et al. (2018) point out that organisational culture is a critical factor in the success of any organisation. However, they state there is no commonly accepted definition of culture in the literature. The definitions include certain elements that can be, for instance, a patterned way of thinking, feeling and, reacting, or values, beliefs, behaviours, and attitudes that are collectively shared, interpreted, and transmitted over time. Specifically, they state that organisational culture forms the management principles and the way in which a company conducts its business.

The second problem was **fragmented customer knowledge**. The findings of this thesis reveal that only a few employees in the case study companies had a good understanding of certain customer activities, whereas employees in non-technical functions, such as marketing, sales, support, and documentation, had difficulty participating in and affecting solution planning. Ryals and Holt (2007) identify several reasons for information gaps and inaccuracies in customer knowledge. For instance, they discuss overlooking or modifying customer information as well as cultural and system barriers. In fact, the feature-driven mindset can be one such cultural or system barrier that may fuel the problem of fragmented customer knowledge. Indeed, one such barrier for customer knowledge is a tendency of roadmapping teams to overlook certain non-technical functions of the company. The thesis's findings particularly stress that marketing was not actively invited to the solution planning and not seen as a voice of the customer. Moreover, roadmaps are not necessarily updated according to new customer needs (Lehtola et al. 2005), which may even further limit the employees' understanding of customers activities.

Overcoming the challenging problem of fragmented customer knowledge is important. According to Ryals and Holt (2007), a company could use accurate customer knowledge to provide more efficient services to customers. They also

identify that a clear view of customer profitability information provides a competitive advantage for the company. In other words, fragmented knowledge, particularly on the customer activities that have a big impact on profitability, may significantly limit the company's facilitation of customer value creation. However, Suomalainen et al. (2011) emphasise that the literature lacks empirical evidence, not just opinions, on how widely and in what role relevant stakeholders should participate in the roadmapping process as well as what kinds of problems and challenges have been met in practice. They also found that sharing information, communicating, and making a roadmap agreement were among the most problematic areas of roadmapping.

In the case studies of this thesis, the problem of fragmented customer knowledge seemed to become even more challenging in the scaling phase of solution development. The scaling phase made some-to-some relationships into many-to-many relationships that made processing and sharing customer information more challenging, which is, however, quite a typical situation in any growing and turbulent business environment. In fact, the new organisational structure may explain the problem. In the case study, the solution was originally developed by the company's subsidiary which was merged with the parent company. Accordingly, the findings point out that the new organisation became slightly disoriented after the consolidation. The findings, however, do not allow concluding that the new organisational structure was the only reason for the disorientation. Another potential reason might have been the introduction of a different incentive mechanism. However, the organisational structure seems to influence how employees share customer knowledge. Killebrew (2003) states that organisational structure dictates how parties will work together.

The third problem was the **firefighting syndrome**. The findings of this thesis reveal a few symptoms of the syndrome. One such symptom is that the case study companies suffered from overbooked roadmaps and postponing of long-term plans. The study's informants emphasised the urgent needs from the various customers and the pressure of short-term sales as a cause. Under pressure, the customers' role turned tactical rather than strategic in solution planning. However, both case study companies kept focusing on the customers under these firefights. Similarly, Sánchez-Fernández and Iniesta-Bonillo (2006) explain that by focusing on how customers are doing with the current marketing offering is a tactical orientation that primarily provides guidelines of action for improving current products and service. Therefore, they emphasise a strategic orientation of consumer or customer value that points at future directions to both attract and retain customers.

Indeed, a company's focus on existing customers does not necessarily mean that the company is focusing on customer value, relative to the competition, for instance. A competitor may offer a new solution or business model that will influence the perception of existing and potential customers. Therefore, an extensive and narrow focus on existing customers or markets may even hurt the business over time. In the case study, the company did not take strategic action to invest in a new and uncertain 'free' market with a security solution that could have cannibalised the existing business. The traditional security brand leaders,

Symantec, McAfee and Trend Micro, also failed in their strategic move to the free-to-use and freemium market of security solutions that resulted in a relatively small market share (Dunn 2011). In fact, the freemium model is an example of how to successfully influence customer value. Customer value is a trade-off between perceived benefits and sacrifices, and the freemium model dilutes the perceived sacrifices (Niemand et al. 2015).

This type of problem in responding to shifts in the market is associated with the literature of the *innovator's dilemma* (ID). The original ID theory explains how very successful companies are operating seemingly very well but fail surprisingly as new, unexpected competitors rise and take over the market (Christensen 1997). A key principle of the theory is *resource dependence*, in which current customers drive a company's use of resources. By focusing on current customers, the company does not see other opportunities. In the case study company, however, the competitors and the rise of a new market were not unexpected. Nevertheless, the case study company decided to continue with the existing market and existing customers to avoid cannibalisation. Indeed, deciding not to respond to disruptive innovation may also be a completely rational choice, as suggested by Henderson (2006). She claims that responding appropriately requires building competencies a company is ill-equipped to acquire, and not because the company focuses too much on existing customers and high-margin opportunities. In an established company, it is much easier and more reliable to understand customer behaviour in existing markets. The rejection of the freemium model by the case study company seems to be associated also with recent developments of the theory that propose ID as a business-model challenge. The required business-model shift involves incompatibility with the existing preferences, incentives, and competencies of actors in a company's value network, and thus may be met with resistance (Sandström et al. 2014). Therefore, future studies on solution planning should involve business models as part of customer value analyses.

One solution to overcoming the problem of firefighting syndrome could be to adopt an entrepreneurial mindset, i.e., precepts of entrepreneurial leadership (Siilasmaa & Fredman 2018). According to Siilasmaa and Fredman, Nokia focused on short-term results, instead of aiming at long-term sustainability and nearly went bankrupt. The precepts were utilised to lead the transformation at Nokia and save the company. Siilasmaa and Fredman suggest that the precepts can be adopted at several levels of the organisation, for example, in solution planning, but cultural transformation requires commitment from senior management. However, getting such commitment for cultural change may not always be easy. Furthermore, the adoption of an entrepreneurial mindset does not necessarily imply that the company adopts a logic or mindset of customer value.

The findings of this thesis present three problems that have some similarities. On one hand, the problems seemed to have been anticipated; on the other hand, they were difficult to overcome in practice. The problems were cultural and had roots in the history of the case study companies, which caused the problems to persist. Furthermore, solution planning was highly dependent on the company strategic processes and the input of business strategy. The findings particularly

highlighted that employees who participated in solution planning lacked strategic guidance from the perspective of customer value. To conclude, the thesis's findings imply that these kinds of problems are persistent in solution planning when a company's strategic processes and culture are not consistent with customer value.

5.1.2 RQ2: How can a software product company emphasise customer value in solution planning?

To address RQ2, this thesis first introduces practical means to identify and analyse customer activities. The means were developed based on the assumption that customer value is created in the customer activities and the customer is the ultimate value creator. Subsequently, this thesis advises how these customer activities can be prioritised and then placed in the solution roadmap at a higher level of abstraction than software features. This set of means is called the six-step approach. The approach is able to tackle a previously recognised need for a high-level priority view in product management (Lehtola et al. 2004). The thesis also presents the hackathon method to evaluate customer value at an early stage of new solution planning. The hackathon is a novel method of prototyping – prototyping is seen an important tool in implementing value co-creation strategy in a company (Payne et al. 2008). Finally, the thesis's findings indicate that customers' customers are an important source of facilitating customer value creation throughout the solution's life cycle.

The findings of this thesis show that by **emphasising customer activities in solution planning** the software company can gain a better understanding of the sources of customer value creation. The six-step approach was developed to get a holistic view of customer activities and experiences in an organised manner. With the six-step approach, the cross-functional team is able to effectively share customer knowledge in collaborative workshops and thus address the problem of fragmented customer knowledge. According to the thesis's findings, the immediate benefit was the identification of customer activities that the existing solution did not support. Those shortcomings were a source of new service business opportunities.

Researchers have suggested several comparable approaches for identifying and analysing customer activities. For instance, Christensen et al. (2016) introduce the theory of *jobs to be done* (JtBD), which supports the thesis's findings. According to the authors, JtBD is the progress that the customer is trying to make in a given circumstance. The term 'jobs' matches the term 'customer activities' of this thesis. Both JtBD and the findings of this thesis highlight that poorly performed or supported 'jobs' are the key sources of customer value creation. Christensen et al. (2016) specifically highlight that successful innovators design produces, experiences, and processes around those jobs. However, JtBD and the six-step approach have slightly different emphases. JtBD mainly focuses on identifying jobs to be done, for instance, with a set of five questions and a few principles, whereas the six-step approach starts with the existing but fragmented customer knowledge of cross-functional team members and focuses more on identifying and analysing the customer activities.

Another close example is the conceptual framework of Payne et al. (2008) for understanding and managing value co-creation, hereinafter "co-creation framework". For instance, the identification of customer activities is similar in the co-creation framework and the six-step approach. Moreover, both approaches particularly emphasise a holistic view and the use of cross-functional teams. However, the analysis of co-operation (co-creation) between the company and customer is done differently in the co-creation framework and six-step approach. In addition to customer activities, the former maps the company's (supplier's) activities and then encounter activities where the interaction takes place within the customer and company. The latter, on the other hand, studies customer activities and their connection to the solution in a few phases with a set of metrics.

Indeed, the role of metrics seems to be an important topic when analysing customer activities. Payne et al. (2008) particularly suggest that developing appropriate metrics is a key issue for a company to meaningfully assess the value co-creation potential of customer relationships. During the case studies of this thesis, a set of simple metrics was developed in the case study companies. An aim was to make the analysis of customer activities more concrete and less subjective. The thesis findings suggest that the metrics are useful for illustrating the current situation in customer relationships. For instance, a metric to evaluate the degree to which the company's current solution deals with each customer activity was found to be insightful. It helps to evaluate the responsibility and support level between the company's solution and customer in each customer activity.

The thesis's findings emphasised the importance of taking a holistic view in solution planning. The findings included visualisations that enabled a big picture of the solution to be communicated. **Generating a solution concept and customer activity roadmap** demonstrated the context of the solution and prioritised customer activities. Indeed, the thesis's findings pointed out that specifically analysed customer activities enabled a cross-functional team to perform the prioritisation at a high level of abstraction and from the perspective of customers. This had an impact, for example, on how the solution was marketed to customers. The thesis findings presented that the marketing of the previous solution focused on features and functionalities in a technical manner. Instead, the new marketing message concretely emphasised how the solution facilitates key customer activities and enables customer value creation. Interestingly, the marketing message advertised the customer activities at the same level of abstraction as they had been determined in the solution roadmap earlier. This indicates that solution planning and roadmaps can have a major impact on how the solution is marketed to customers. A reason for the impact is that marketing personnel often get input from the solution management team. Therefore, solution planning and even roadmaps should include elements that propose and facilitate the value creation of the intended customer segments concretely.

In the research field of requirements engineering, related approaches have been introduced to evaluate customer value. The level of abstraction and the perspective of the customers are two key characteristics that distinguish the six-step approach from the cost—value approach introduced by Karlsson and Ryan

(1997). Unlike the cost—value approach, the six-step approach does not focus on the prioritisation of the candidate's requirements of the software solution. Instead, it provides a roadmap of prioritised customer activities that act as basis for performing lower-level RE activities. Furthermore, Kim et al. (2008) propose a value-based requirements engineering approach specifically to address potential customers and new markets. They present a process called VIRE (Value-Innovative Requirements Engineering) to help software companies to create new markets based on new product values, or the dimensions of product value, for potential customers. The VIRE process includes the prioritisation of customer values, or the dimensions of customer value, and the elimination of requirements that create low value as well as the selection of requirements that create high value. From a value-creation perspective, the six-step approach and the VIRE process have one significant difference: the six-step approach prioritises customer activities while the VIRE process prioritises the dimensions of customer value. A roadmapping team might find customer activities a more concrete object for prioritisation and solution development than the abstract dimensions of customer value.

Williamson (1999) urges companies to develop competencies to evaluate new strategic options for the future. The findings of this thesis propose **using hackathons** to enable early and rapid testing of an idea in regard to customer value. In particular, the findings indicate that hackathons enable a software company to explore strategic options that have high market uncertainty. Similarly, scenario planning is a recognised method for solution planning in turbulent environments that consist of high market uncertainty (Ramírez & Selsky 2014). Williamson (1999) proposes scenario planning as a technique to develop needed alternative capabilities and to understand market environments or customer behaviour. This thesis's findings indicate that hackathon prototypes offer more tangible means to evaluate the interest of a customer segment as well as technical implementation in software markets than does scenario planning. While the hackathon is a concrete method for evaluating customer value early, it does not necessarily offer a holistic or high-level perspective to solution planning like scenario planning or the analysis of customer activities. Therefore, the hackathon can be seen as a complementary method for new solution planning that can be used together with the scenario planning method, for instance.

Hackathons seem to enable a software company to evaluate customer value in situations and environments in which evaluation would be difficult to carry out otherwise. For instance, hackathons can be efficiently and effectively used to test third-party APIs that have a crucial role when developing a software ecosystem. The thesis's findings suggest that the hackathon provides a very realistic setting for assessing a third-party API. Similarly, the evaluation of APIs was also a development target of a hackathon in a study by Lapp et al. (2007).

Big data, data analytic methods and machine learning offer means to evaluate or even predict customer value. For instance, predictive analytics is a big data analytical method that can predict future outcomes based on historical and current data and be applied to practically any discipline (Gandomi & Haider 2015). According to Vidgen et al. (2017), however, organisations face problems in

building their data analytics capabilities that are similar to the findings of this thesis. Vidgen et al. emphasise that organisations often view and tackle big data and analytics purely as an IT departmental issue. To address the issue, a data-oriented culture and strategic alignment are crucial topics in building data analytics capability.

The thesis's findings also indicate that hackathons can have a role in guiding organisational culture in a more rapid, responsive, and innovative direction. Similarly, a recent study points out that a key goal of corporate hackathon organisers is to change the organisational culture to one that better encourages creativity and outside-the-box thinking (Pe-Than et al. 2019). Moreover, Frey and Luks (2016) propose using hackathons to facilitate transforming a bureaucratic organisational culture towards a flexible way of working. However, they also emphasise that hackathons can only partially address organisational issues in a cultural shift.

The thesis's findings also highlight that customers' customers were a source of both new business and competitive solution strategies over the life cycle of a solution. On one hand, the findings emphasise that customers' customers were a source of innovative and very successful business models and drove the new business forward. On the other hand, a cross-functional team kept focusing on customers' customers that later helped the company to survive against heavily increased competition. **Focusing on customers' customers** seems to lead to both solution planning and marketing activities in a direction that is important to customers. Indeed, the thesis's findings imply that customers' customers are a fundamental source for a software company to emphasise customer value in solution planning. For instance, a software company can increase investments in developing services to support its customers' sales and marketing activities in preference to feature development of the core product.

It seems that customers' customers are a useful source to facilitate the value-creation of customers that have not been fully acknowledged either in theory or practice. The findings of thesis as well as the management and marketing literature (e.g., Anderson & Wouters 2013; Dahlquist & Griffith 2014; Homburg et al. 2014) encourage further studies on the topic. The findings of this thesis introduce a few practical insights and examples to inspire such studies.

5.1.3 Linkage between RQ1 and RQ2

The thesis presents three problems of solution planning. The illustration of those problems is aimed to help companies to understand the symptoms and negative consequences arising from the fact that the solution planning lacks the perspective of customer value. However, fixing these three problems is not easy in practice. For instance, a feature-driven mindset is a cultural problem and the thesis's findings indicate that cultural change is slow and demanding.

This thesis's findings instruct companies to emphasise customer value in solution planning within four themes (RQ2). However, the four themes are not explicit antidotes to the three problems (RQ1), while being linked to them. For instance, systematically identifying and analysing customer activities as well as

generating a solution concept and customer activity roadmap help companies to overcome the problems of a feature-driven mindset and fragmented customer knowledge. Hackathons offer an opportunity to explore strategic options and are a potential remedy for firefighting syndrome. Hackathon demos also foster communication of the benefits of prototypes. Focusing on customers' customers is a cure for a feature-driven mindset and reduces the negative effects of fire-fighting syndrome.

The findings of this thesis also reveal a paradox. On one hand, to emphasise customer value, the four proposed solutions were found promising in the thesis. For instance, identifying, analysing and prioritising high-level customer activities, and hackathons were found useful in the articles in this thesis. On the other hand, only one hackathon was organised after the submission of VI and no new hackathons had been publicly informed at the case study company. Finally, the means to analyse customer activities were adopted only partially at the other case study company. This phenomenon is called industrial diffusion (Kaindl et al. 2003).

In general, the diffusion of innovation is a well-known topic. According to Rogers (2003), for instance, the QWERTY keyboard is still a dominating keyboard method for computers while more efficient keyboard methods exist. The original QWERTY was particularly designed to slow typists down in order to prevent key jamming of ancient typewriters in the late 1800s. Rogers concludes that new methods, or innovations, are not necessarily adopted and diffused even when the method has obvious and proven advantages. The keyboard case is a paradox. A faster keyboard, which is a relatively easy to learn, should clearly create value in the daily activities of a consumer or business user when the user is using the computer.

The thesis's findings on the use of hackathons, for instance, characterise the challenge of industrial diffusion. Accordingly, the return on hackathon investment was increasingly questioned after a series of hackathons, while the participants and audience, including business leaders, were very satisfied with the outcome, with it typically exceeding all expectations. A potential reason for this was that the focus of investments emphasised short-term commercial results and business value over other perceived benefits. Chowdhury (2012) states that the impact of hackathons on entrepreneurship and creating lasting businesses is difficult to measure. Nevertheless, there is growing interest in hackathons among corporates and venture capitalists (Leckart 2012; Chowdhury 2012).

This thesis calls for further studies on methodology transfer and industrial diffusion in the field of software engineering and business. An agenda for improving the current situation was already proposed over ten years ago (Kaindl et al. 2003). Ivarsson and Gorschek (2011) state that the most significant way to aid technology transfer seems to be to promote research relevant to industry. Gorschek et al. (2006) propose a practical six-step model for the transfer. In particular, long-term adoptions are missing in empirical software engineering (Höfer & Tichy 2007). The study by Kauppinen et al. (2004) presents how to combine a literature review with a longitudinal study. Moreover, this thesis contributes with some insights on data collection over a longer period of time. One

such insight is the use of Wayback Machine for collecting historical data from the Web pages of case study companies.

Customer value is a complex concept and the thesis's findings indicate that overcoming these kinds of problems is complicated, too. The three problems (RQ1) seem to have roots in a company's strategic processes and culture. If the company's strategic processes and culture are not consistent with customer value, the three problems cannot be solved within the solution planning level alone (RQ2).

Therefore, new studies on cultural change and strategic processes, which are linked to customer value, are needed. These studies should include the comparison and criteria of different mindsets, such as data-oriented and entrepreneurial. In fact, Killebrew (2003) highlights that while cultural changes often fail, many companies in several industries have successfully recreated themselves by developing new mini-organisations. This encourages studies on startup-like initiatives, such as internal startups and subsidiaries, inside the company. Such a mini-organisation could be founded on a hackathon team.

5.2 Validity threats

This section discusses the main validity threats to the study results. Here, the term *validity* refers to the approximate truth of a knowledge claim (Shadish et al., 2002). There are several validity categorisations, or worldviews, to evaluate threats to validity (Petersen & Gencel 2013). This thesis uses the validity categorisation which consists of construct validity, internal validity, external validity, and reliability (Runeson & Höst 2008). This validity categorisation is accepted in and used by the software engineering research community and applicable for case studies.

5.2.1 Construct validity

Construct validity describes the extent to which the research methods used to collect the research data and draw out the conclusions describe the desired answers to the research questions (Runeson & Höst 2008). Construct validity is particularly concerned with the validity of the building blocks as well as the way to put those blocks together and abstract them to higher-order constructs (Maxwell 1992; Shadish et al., 2002). In this thesis, the concept of customer value is particularly challenging as a higher-order construct because, for instance, it is dynamic, context- and time-dependent, and individually perceived.

One potential threat is the selection of an unrepresentative sample for the interviews and collaborative workshops. To reduce the threat, the key criterion for selecting the first set of interviewees at F-Secure was that they had knowledge about the current activities of solution planning. The criterion was based on the interview goal to study the current state of solution planning in the company and gain information about how the interviewees would improve existing practices. The interviewees' access to strategic information was also paid attention to. The interviewees represented roles from middle managers to senior

executives. Two were part of the leadership team. The latter set of interviewees were hackathon participants and organisers at F-Secure. The perspective on these interviews was to gain knowledge on the role of hackathons in validating software platform and prototypes. The main topics of the collaborative workshops were the solution concept, analysis of customer activities, and customer value. The collaborative workshop participants covered adequately a wide range of roles regarding solution planning at F-Secure and Tekla. However, important stakeholders in solution planning, such as customers, partners, and the marketing department, did not participate in the collaborative workshops. The limited roles of the workshop participants might have biased the findings. One reason for the limitation is that a representative from each case study company selected the workshop participants. Interestingly, however, the selections of workshop participants revealed important information on the culture of the case study companies. Moreover, the workshop participants reached a consensus on the discovered solution planning problems and improvement ideas in both companies. Taken together, including external people, such as partners and customers, in the interviews and workshops would have enriched the data.

The study resulted in three themes, i.e., problems, to address RQ1. To address RQ2, the study introduced four themes, i.e., solutions. Regarding RQ2, the first theme was "Analysis of customer activities as part of solution planning" and the second was "Solution concept and customer activity roadmap". A threat to construct validity is that the solution concept was not evaluated as such in the six articles of which this thesis consists. A reason was that the continuation study (IV) focused on the particular element of the solution concept, customer activities. In future studies, the process of solution-concept generation and its linkages to the topics of analysis of customer activities and the customer activity roadmap are required.

A potential threat to construct validity concerns the selection of the two-part approach of MacMillan and McGrath (1997) and the hackathon method that were used as the research background. Firstly, selecting, for instance, the framework of Payne et al. (2008) instead of the two-part approach might have resulted in a slightly different end. The former focuses mainly on customer activities whereas the latter particularly emphasises encounter activities between customer and provider. Emphasis on encounter activities might have produced different insights related to customer involvement in solution planning, development, and delivery. However, choosing Payne et al.'s framework would not have addressed the drawbacks of the study's solution. For instance, it would not have solved the firefighting problem in which short-term sales overrun long-term plans. Secondly, selecting an alternative method to hackathon, such as hackfest or jam, would have likely led to additional challenges concerning the early adoption of the method. The selection of hackathons was appropriate because of the positive reports from partners and other software companies.

The selection of the two-part approach of MacMillan and McGrath (1997) for the research background also poses another threat to construct validity. The validity threat concerns whether this type of approach is able to investigate customer value with respect to how customers desire and receive value at purchase

and in use. Indeed, the two-part approach does not specifically encourage involving customers in the workshops. However, the two-part approach was chosen and further developed to leverage and share the existing customer knowledge that employees already had. The hackathon method, on the other hand, was selected as a research theme to enable companies to investigate customer value in use and to mitigate the threat to construct validity.

5.2.2 Internal validity

Internal validity describes the extent to which incorrect causal relationships between the constructs are mitigated (Yin 2003). When a research result claims that Construct A affects Construct B, there is a risk that Construct B is also affected by Construct C (Runeson & Höst 2008). In this thesis, we were interested in how to emphasise customer value. In addition, we were also interested in problems that can negatively affect customer value.

Regarding RQ1, the data analysis resulted in three constructs, each with sub-constructs. For instance, one such construct is the *feature-driven mindset* that has two sub-constructs, for example, "a long history of developing products, not services" that seemed to explain the reasons for such a mindset. Accordingly, the feature-driven mindset had implications that were explained with the three sub-constructs, such as, "customer feedback and requirements elicitation is feature-oriented".

These types of causal explanations involve threats to internal validity. First, it is likely that there are more than the three sub-constructs that are affected by and more than two sub-constructs that affect the feature-driven mindset. Therefore, internal validity is not fully mitigated. In general, Construct A affected Construct B but there is a risk that Construct B is also affected by Construct C. Moreover, there is a risk that Construct B also affected Construct A. On the other hand, causalities within each of the three constructs aimed to address the specific part of the research question, "what kind of problems?". The purpose of the identified causalities was to illustrate the context of the problems, not to develop a theory of the problem phenomena. Second, the sub-constructs are not clearly either causes or implications. For instance, it is possible that the sub-construct, "customer feedback and requirements elicitation is feature-oriented" was not only affected by but also affected the feature-driven mindset. Yet again, the causal relationships were not the focus of the data analysis but were rather constructed to explain the characteristics of the problems. These explanations were created to help find means to improve solution planning in software product companies.

Regarding RQ2, analysing the effects of the improvement actions suggested by the study cannot be isolated from other factors that cause changes in the case study companies either. Moreover, it can be deduced that the use of the six-step approach was not a key reason for the changes in the companies. Instead, the workshop participants' involvement in the discovery of problems and improvement ideas gave them new knowledge that might better explain the effects.

There is also a threat to internal validity regarding the researchers' involvement in the lessons learned on identifying, analysing and visualising customer activities and from hackathons. It is possible that the researchers' active participation biased the lessons learned. Section 5.2.4 discusses the reliability of the results and further considers potential bias caused by researcher involvement.

5.2.3 External validity

External validity describes the extent to which it is possible to generalise the findings (Shadish et al., 2002). It is also concerned with the extent to which the findings are of interest to other firms outside the investigated case (Runeson & Höst 2008).

Part of the study's results (e.g., Sections 4.2.4, 4.2.5 and 4.2.6) are based on a single case, which is a main threat to external validity. Therefore, the generalisability of the result to other software companies and business domains can be considered only on a theoretical level in a single-case-study research (Yin 2003). To mitigate the threat, however, this thesis paid special attention to disseminating and reporting the context of F-Secure to allow comparisons with other software companies.

Another part of the study's results was based on the action research study at F-Secure and Tekla. Here, collaborative workshops had an important role in developing and evaluating practices to address RQ2. However, the collaborative workshops did not follow the same procedures at both companies; a key reason for this was that new ideas were tried and reflected based on the needs of the companies. In addition, the workshops were first performed at F-Secure and then at Tekla. The researchers were able to learn as the study progressed, which made them better equipped to facilitate workshops in the latter case. The different procedures and moderator skills limit the generalisability. On the other hand, the incremental and iterative way of improving the practices made them more usable in real-life situations.

5.2.4 Reliability

Reliability describes the extent to which data collection and analysis are independent of specific researchers (Runeson & Höst 2008). In other words, would the findings be the same if other researchers carried out the same study (Yin 2003)?

Regarding the data collection, the main threat to reliability concerns the data collection methods of collaborative workshops and participant observations. The researchers facilitated the collaborative workshops and had a key role in organising three of the five hackathons. The active participation caused two kind of subjectivity challenges. First, different researchers might have observed different things in the workshops and hackathons. Second, the contribution of the researchers might also have influenced the participants of the workshops and hackathons. To mitigate the threat, most of the collaborative workshops and important events of hackathons were recorded. Moreover, at least two researchers participated in each collaborative workshop and two of the three hackathons to

reduce single-researcher bias. One of the three hackathons was organised in Malaysia and only one practitioner-researcher was able to participate. Furthermore, the researchers used several data collection techniques to triangulate the data.

There is also a potential threat to reliability concerning the data analysis. The fact that the three researchers were active participants and facilitators in the workshops affected the subjectivity of the results. To reduce the subjectivity, the research was conducted in an iterative manner. In the collaborative workshops, the researchers presented intermediate results from the earlier phases to the workshop participants for validation. Finally, at least, one person from Tekla validated the final results of Articles III and IV, and at least one person from F-Secure validated the final results of each article in this thesis.

In conclusion, each reader must decide themselves whether to believe these results. Additional similar studies must be concluded by different people in different companies and in different domains, and with different variations of the research methods to see if the results hold up.

6. Conclusions

In this thesis, the role of customer value in solution planning has been studied using empirical research methods in two Finnish software product companies. This section states the contributions and conclusions of this research, as well as outlining directions for future work.

6.1 Contributions of the research

This section states the contributions and conclusions of this research. The four main contributions are:

- *Clarification of important differences between product value and customer value in solution planning.* This thesis explicates how the differences can be clarified by answering where and when value is created, and who is the value creator. This explanation simplifies the complex concepts of product value and customer value as well as explaining their impacts on business value. The thesis proposes that product value is created by companies in their business activities whereas customer value is created by customers in their daily activities.
- *Identification of three essential problems in solution planning.* This thesis identifies the problems of a feature-driven mindset, fragmented customer knowledge and firefighting syndrome that software product companies face in solution planning. The results of the thesis indicate that these problems of solution planning are persistent and difficult to overcome because they are cultural.
- *Creation of a novel approach to the process of solution roadmapping.* This thesis contributes a novel creation process to roadmapping that places customer activities as a source of value creation. It offers a means to identify, evaluate and prioritise customer activities and generate customer activity roadmaps. The findings of the thesis suggest that customer activities provide a longer horizon and more holistic view into solution roadmapping than software features.
- *Use of hackathons as a method of evaluating customer value early.* For this thesis, we conducted one of the first studies that has systematically investigated hackathons. The hackathon offers a tangible means to evaluate the interest of a customer segment and technical implementation in software markets. The findings of the thesis

indicate that hackathons provide a role in guiding organisational culture in a more rapid, responsive, and innovative direction from the viewpoint of customer value.

The main findings of this thesis indicate that solution planning lacks a perspective of customer value in software product companies. The absence of this perspective seems to have roots in companies' strategic processes and culture. The holistic and early analysis of customer activities increases the role of customer value in solution planning. The analysis of customer activities would have a stronger impact on solution planning if the strategic processes and culture of companies emphasised customer value.

6.2 Future work

The findings of this thesis imply that companies' strategic processes and culture impact on solution planning. Therefore, it would be important to discover the strategic and cultural aspects that are consistent with customer value. Moreover, this thesis stresses the importance of further studies on industrial diffusion. Indeed, most new ideas diffuse at an insufficiently slow rate in industry (Rogers 2003). This thesis particularly encourages longitudinal studies on the industrial diffusion of new research ideas. For instance, it would be beneficial to study the compatibility requirements of the companies' existing culture, value and practices for these ideas.

This thesis points out that cultural change is slow and demanding and business model shifts involve resistance. Therefore, it would be interesting to study the role of internal startup-like initiatives, such as internal startups and subsidiaries, in cultural transformations and development and validation of new business models from the perspective of customer value. Those studies would contribute to the scientific domain of intrapreneurship. This thesis acknowledges that business models shifts seem to have a major role in such business moves, and future studies on solution planning and customer value should give further emphasis to business modelling.

Finally, this thesis highlights that customers' customers are an useful source to facilitate the value-creation of customers. The topic opens a new research avenue to study how to operate directly with customers' customers both with and without the customers. The latter case will also enable studies of the customers of potential customers as a means to new customer acquisition.

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