Approaching Wicked Problems in Service Design
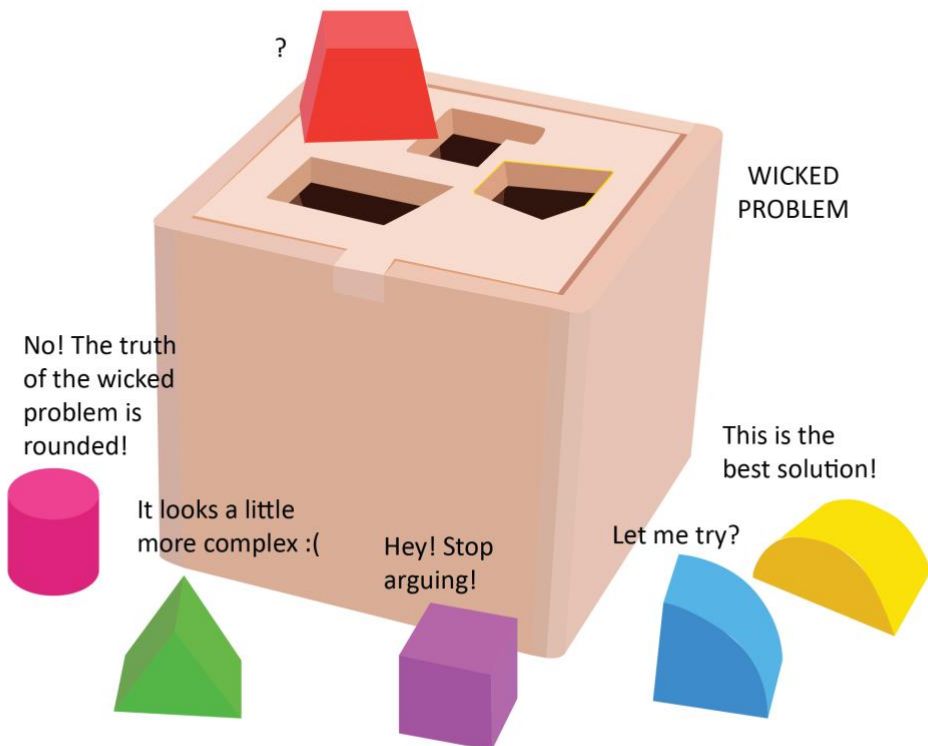
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UNIVERSITY OF LAPLAND
For the North – For the World

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Approaching Wicked Problems
in Service Design

Academic dissertation
to be publicly defended with the permission of
the Faculty of Art and Design at the University of Lapland
in lecture hall three on the 18th of September 2020 at 12 noon.

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UNIVERSITY OF LAPLAND

Rovaniemi 2020

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Abstract

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Approaching Wicked Problems in Service Design

Rovaniemi: University of Lapland, Faculty of Arts and Design, 2020

Doctoral Dissertation, 113 pages, 5 appendices

Acta electronica Universitatis Lapponiensis 286

ISBN 978-952-337-223-8

ISSN 1796-6310

The main aim of this thesis is to examine wicked problems (WPs) as service design challenges. There is an ongoing debate in the field about designers' tendency to oversimplify WPs or complexities. Along with this is another question about the tools, methods and strategies for dealing with these problems as design tools and methods were created for relatively simple problems. According to some authors, WPs should be tamed with the tools designed for them, otherwise the process can be painful. Parallel to this, there seems to be lack of knowledge about WP theory within the design field.

Three sub-studies will answer different questions raised by the research gaps and problematisation exposed in the service design and design fields. Sub-study I seeks to fill the research gap of WPs in the service design field through a systematic literature review and by exploring how the two areas relate and what the role of service design in WPs is. Through a desktop literature review, sub-study II investigates the existing tools and strategies to deal with such problems and how service design can benefit from these tools and strategies. Sub-study III applies one of the selected tools (Mess Map™) in a participatory action research case study by investigating the tool's advantages and disadvantages in the service design context.

The three sub-studies further clarify the relationship to and role of service design in WPs. The sub-studies point to the research gaps and aim to fill them by providing not only theory, but also practice. The main contribution is the "Iceberg Model of Design Problems" from sub-study I, which was created to aid service designers and those from other design fields related to WPs, such as Transition Design, social design and design for sustainability, in comprehending

different levels of complexities. The study also recognises how the borders between disciplines are becoming blurred. This model will aid in approaching each problem level with tools designed for them and help designers embrace the correct mindset or approach. The studies indicate that a collaborative strategy is a key element in dealing with WPs. This thesis argues that moving towards a worldview of complexities within an interpretive (constructivist) paradigm can be essential in dealing with wicked and more complex problems.

The thesis aims to stimulate change in how WPs are approached in the service design field in order to better embrace WPs. It also questions the current funding instruments for research because WPs require more extensive development, possibly lasting for decades, and thus can be difficult to handle simply as research projects. WP development in service design also needs long-term policy-making and collaborative strategies. Finally, the study continues the current academic conversation about how we need to give new students the capacities needed to tackle WPs in the design field.

Keywords: wicked problems, service design, Mess Map™, complexity paradigm with constructivism, collaborative strategy

Tiivistelmä

Väitöskirjan päätavoite on tarkastella ilkeitä ongelmia palvelumuotoilun haasteena. Aihepiiri on ajankohtainen monestakin syystä. Alalla on virinnyt keskustelua siitä, onko muotoilijoille syntynyt tapa yksinkertaistaa ilkeitä ongelmia tai kompleksisia asioita. Tämän lisäksi keskustelua on herättänyt se, miten ilkeitä ongelmia tulisi lähestyä eli mitkä ovat ne työkalut, metodit ja strategiat, joita voitaisiin käyttää. Useimmat muotoilun alan työkalut on tehty suhteellisen yksinkertaisiin ongelmiin. Joidenkin lähteiden mukaan yksinkertaisiin ongelmiin kehitetyt työkalut voisivat vaikeuttaa prosesseja silloin, jos niitä käytettäisiin ilkeisiin ongelmiin. Lisäksi keskusteluista tulee vaikutelma, että palvelumuotoilun alalla on epätietoisuutta, mitä ilkeiden ongelmien teoria tosiasiassa on.

Tässä tutkimuksessa on kolme alatutkimusta. Niissä etsitään vastausta edellä esitettyihin kysymyksiin ja palvelumuotoilun tutkimuksessa ilmeneviin aukkoihin. Ensimmäisessä alatutkimuksessa kuvataan systemaattisen kirjallisuuskatsauksena avulla palvelumuotoilun tutkimuksen roolia ja tilaa ilkeissä ongelmissa. Toinen alatutkimus tarkastelee 'desktop'-kirjallisuuden avulla niitä strategioita ja työkaluja, jotka ovat jo olemassa ilkeiden ongelmien käsittelemiseksi ja sitä, miten palvelumuotoilu voisi hyötyä niistä. Kolmas alatutkimus testaa yhtä palvelumuotoilun kontekstissa löydettyä työkalua, Mess Map™ kartoitusta, joka toteutetaan osallistavana tapaustutkimuksena. Kyseinen tutkimus tuo esiin työkalun hyötyjä ja haittoja palvelumuotoilun käytössä.

Alatutkimukset selkeyttävät palvelumuotoilun roolia ja suhdetta ilkeiden ongelmien kontekstissa. Ne yhtäältä paljastavat tutkimusaukkoja ja toisaalta täyttävät niitä luodessaan teoriaa sekä kehittäessään käytännönläheisiä ratkaisuja. Tutkimuksen tärkein kontribuutio on ensimmäisessä alatutkimuksessa luotu malli, "Iceberg Model of Design Problems". Tämän mallin tarkoitus on auttaa palvelumuotoilijoita ymmärtämään kompleksisuuden eri tasoja. Mallia voidaan hyödyntää laajasti muillakin ilkeiden ongelmien kanssa työskentelevillä muotoilualoilla, kuten muutosmuotoilussa, sosiaalisessa muotoilussa sekä kestävän kehityksen muotoilussa. Malli auttaa valitsemaan viisaasti ne lähestymistavat ja työkalut, jotka on suunniteltu jokaiselle eri ongelmatasolle. Alatutkimukset osoittavat yhteistoiminnallinen strategian tärkeyden käsiteltäessä ilkeitä ongelmia. Nojautuessaan perinteisen konstruktiivisen paradigman ohella myös uuteen kompleksisuuden paradigmaan palvelumuotoilu voisi pystyä nykyistä paremmin käsittelemään ilkeitä ongelmia.

Tämä väitöskirja antaa perusteita muuttaa palvelumuotoilun lähestymistapoja sen pyrkiessä käsittelemään ilkeitä ongelmia. Tutkimus myös kyseenalaistaa nykyiset rahoitustavat siitä syystä, että ilkeät ongelmat vaativat pitkää, jopa vuosikymmenien kehittämistä. Tällöin niitä on vaikea käsitellä vain hankkeina. Ilkeiden ongelmien kehittäminen palvelumuotoilussa vaatii myös pitkäjänteisiä poliittisia päätöksiä ja yhteistoiminnallista strategiaa. Tutkimus haluaa jatkaa akateemista keskustelua siitä, miten voimme kouluttaa uudet opiskelijat kohtaamaan ilkeitä ongelmia muotoilun alalla.

Asiasanat: ilkeät (viheliäiset, pirulliset) ongelmat, palvelumuotoilu, Mess Map™, kompleksisuuden ja konstruktiivisuuden paradigma, kollaboratiivinen strategia

List of Original Articles

This doctoral thesis is based on the following two original journal articles and one original conference paper. I will refer to them as sub-studies, with Roman numerals I–III.

I   Suoheimo, Mari, Rosana Vasques and Piia Rytilahti. 2020. "Deep Diving into Service Design Problems: Visualizing the Iceberg Model of Design Problems through a Literature Review on the Relation and Role of Service Design with Wicked Problems." *The Design Journal*, submitted for review.

II   Suoheimo, Mari, 2019. "Strategies and Visual Tools to Resolve Wicked Problems." *The International Journal of Design Management and Professional Practice* 13 (2): 25–41. https://doi.org/10.18848/2325-162X/CGP/v13i02/25-41, ISSN: 2325-162X.

This article (II) has been translated from Portuguese to English, and it has been adapted, updated, and refocused from an article published in *Educação Gráfica*, ISSN 2179-7374 (Suoheimo 2016).

III   Suoheimo, Mari, and Toni Lusikka. 2020. "Process of Mapping Challenges of Cross-Border Mobility in the Barents Region." Paper presented at the Sixth International Conference on Design Creativity (ICDC2020), Oulu, August 26-28, 170-177.

Articles II and III are reproduced with the kind permission of their original publishers.

Acknowledgements

There have been several important people around me during my journey of writing this thesis. First, I would like to thank Dr Satu Miettinen, my first supervisor, for accepting me into the Culture-Based Service Design doctoral programme and for supervising me along the way. Her advice on service design and design research has had a great impact on my thesis. My second supervisor, Dr Kaarina Määttä, has been encouraging and greatly supportive in helping me to focus and keep on track with the thesis. It is because of these two excellent supervisors that I am graduating.

I also wish to give special thanks to my husband, Jani Ylioja, for the advice he has given me and the discussions we have had. He has been a great support in so many ways along this academic journey. As we are both in same boat of pursuing a Ph.D., there are probably not many people who would be interested in our meal-time discussions about our studies. I also wish to thank my family and friends in Finland and Brazil who have encouraged me along the way. They have helped me keep my head up in difficult times. I especially want to show my gratitude to Dr Rosana Vasques and Dr Noemi Ansay for their comments on my first drafts of my Ph.D. applications in Brazil and. With Dr Vasques, we had an interesting journey, together with Piia Rytilahti, in writing one of the articles for this thesis. My dear colleagues from the doctoral seminar also deserve praise as they have given useful comments on the articles and the thesis structure. Additionally, the writing seminars in Keropirtti were helpful in many ways, where I learned so much from Dr Melanie Sarantou. Special thanks also go to reviewers Dr Professor Mikko Koria and Dr Professor Maria Cecilia Loschiavo dos Santos for their excellent comments on the thesis, which improved the final product a great deal.

Another important person I also wish to thank is Dr Robert E. Horn for his emails exchanging ideas; his comments have provided me with great food for thought. I am also very grateful to Dr Alexandre Pelegrini for giving me my first introduction to the world of wicked problems and the Mess Map™ tool. Finally, I thank the Lapland Regional Fund of the Finnish Cultural Foundation for their one-year grant for the thesis. With this grant, I was able to conduct the cross-border mobility case study and push the thesis and study forward.

Authors' Contributions

This section aims to explain my and others' participation in the thesis sub-studies.

Sub-study I: "Deep Diving into Service Design Problems: Visualizing the Iceberg Model of Design Problems through a Literature Review on the Relation and Role of Service Design with Wicked Problems."

The article was written together with two other authors. Piia Rytilahti helped with the data collection by reading and analysing the articles with me. I worked on the majority of the articles, and I conducted the data analysis alone. We had peer review-style meetings to discuss the selection of articles and the coding for their analysis. I had the original idea for the article, and I wrote a major part of it. Dr Vasques contributed with literature to support the ideas and helped to write the article and elaborate upon its ideas. Rytilahti also took a minor role in writing and gave valid observations on the text and data analysis.

Sub-study II: "Strategies and Visual Tools to Resolve Wicked Problems."

I was the only author of the article. The research, planning, data collection, analysis and conclusions were done solely by me.

Sub-study III: "Process of Mapping Challenges of Cross-Border Mobility in the Barents Region."

In this study, I contributed the original idea for the article, and I planned and conducted the study. In the final stage, Toni Lusikka joined in the writing process and data analysis, which we divided in half. I wrote a majority of the manuscript, and Lusikka contributed in providing literature and doing the data analysis.

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1 Introduction

1.1 Background and Motivation

There is an ongoing dialogue about how the design field needs to evolve in order to better handle complexities (Sangiorgi 2009) and not oversimplify them (Hillgren, Seravalli, and Emilson 2011; Norman and Stappers 2015). Many of the tools and methods in the design field were made for relatively simple problems, and there are questions about making new tools and methods to better attend to complexities and wicked problems (WPs) (Avdiji et al. 2018; Hillgren et al. 2011; Norman and Stappers 2015; Sanders and Stappers 2008).

Moreover, I have been to conferences where people spoke about WPs but did not refer to the theory or use the term "wicked problem" even once. On the other hand, there are articles, such as Ameli's (2017), which claim that all design problems can be wicked, and there is a report claiming that a WP has been solved (Country Brand Report 2010). Tackling terrorism is a WP, and making an envelope is a simple problem. In WP theory, WPs either do not have solutions, or the proposed "solutions" are not "true" or "false" but rather "better" or "worse" (Rittel and Webber 1973). Other authors have also noticed how "wicked problem" as a terminology has become a "buzzword to attract attention", which has weakened its precise conceptual understanding (Termeer, Dewulf, and Biesbroek 2019, p. 10).

Often, Buchanan's (1992) four orders are treated as if they were all WPs, when in fact, the last two (three and four) are more related to WPs and these orders are also more service- and systems- (interaction) related. The four orders of design will be handled in more detail in the literature review. Designers that tend to handle WPs within the mindset of the two first orders will most likely lack the right approach or mindset to deal with WPs, and thus can oversimplify the problems (Westerlund and Wetter-Edman 2017). This was experienced in one group presentation at the Social Work and Research Days Conference in Rovaniemi (2019), where Dr Tarja Juvonen and I ran a workshop called "Service Design for Social and Health Care." In their workshop presentation the social scientists had hired a design agency. In this case, they were trying to develop a service to address a social complexity using a design agency, but felt that the agency's design method was too narrow and

straightforward, and the way the agency wished to deal with a social phenomenon was perhaps too simplistic.

To understand how WPs differ from simple and complex problems, we can use as an example a design for coffee. For a simple problem, we can design a coffee cup; for a complex problem, we can look at how to design a service system for coffee and a network of coffee shops. For a WP, we would look at how to design a sustainable (socially and ecologically) international coffee supply service system. This problem typology of three *simple* (critical; tame), *complex* and *wicked* is supported by many authors (Grint 2010; Head and Alford 2008; Roberts 2000). The wicked type is the most difficult of the three (Grint 2010; Head and Alford 2008; Roberts 2000). Sometimes, it may be difficult to draw the line between a complex problem and a WP, and it is possible that WPs can be composed of several complex problems (Suoheimo, Vasques, and Rytilahti 2020).

I find this research important in order to tackle WPs appropriately, with tools and strategies designed specifically for them. Using an inappropriate mindset or strategy to tackle a WP can decrease the current status quo of a problem, or it may even make it worse by creating spin-off problems. This can damage the service design discipline's image. Using proper strategies and tools, we can bring better change and innovations to service design-related WP processes. This is the motivation that drives my personal research, and as Clough and Nutbrown (2012) stressed, personal questions are also important in explaining what drives the researcher to do the research.

1.2 Research Aim and Problematisation

"If all you have is a hammer, everything looks like a nail" (Maslow 1966, 15).

The main aim of this thesis is to investigate WPs as challenges of service design, and thus to increase capability in the service design field as well as improve the education of new students. My personal interest is in WPs as a theory (Rittel and Webber 1973) to deal with complexities. Chapter two will illustrate how "wicked problem" is one of the most cited terms among other complexity theories. The thesis aims to explore the relationship to and role of service design in WPs and see how the two connect. This is important (connection and

role) so that we can have the correct approaches, strategies and tools to tackle WPs. The thesis will provide new knowledge through an examination of three published sub-studies about strategies and tools.

The Mess Map™ from the policy sciences was selected as a case study to explore its advantages and disadvantages in service design projects. Using tools and strategies designed for WPs in WP cases can yield more effective results than using an ad hoc style of designing tools for the project (Bofylatos and Spyrou 2016). I understand that it may be necessary to adjust the WP tools for each WP context, but researchers and service designers do not need to go into the field empty-handed. There are currently tools designed for simple problems that are also used in WP contexts, and this worries me. According to some authors (Conklin 2006), using tools not designed for WPs can make a process painful. I believe tools designed for simple problems will not deal with the WP itself, but instead will only touch on some superficial parts of it, and the results most likely will not be satisfactory. As Boylston (2019) pointed out, "Band-Aid" solutions are not recommended. Understanding the typology of problems is essential in this context as tools and strategies are different for simple and complex problems and WPs.

The Megatrends 2020 report (Dufva 2020), published by the Finnish Innovation Fund (SITRA), raised the same issue of not simplifying complexities, as has been a tendency previously. The report stresses the need for seeing the connections among complexities. It also discusses how leadership is formed today more as a series of networks, which can be understood as sharing power. Service design education needs updating in this regard, and the findings of this research can help our field to evolve. As our field advances, so do the services created that serve our nation or even people in other countries. People's well-being often depends on the services they are provided, especially services from the public sector.

The thesis is aimed at the design community: service design, social design, Transition Design, design for sustainability and any other field within organizational studies that handle WPs. The overall aim of the thesis is to describe WPs as challenges of service design not only by debating the theory, but also by dealing with issues on a practical level by providing tools and strategies. The next chapter will focus on more specific questions from the three sub-studies of the thesis.

1.3 Research Questions

This thesis consists of two international peer-reviewed journal articles (sub-studies I and II) and an international conference publication (sub-study III). The main objective of the research is to describe **WPs as challenges of service design**.

The aim of the main study is approached through three sub-studies, as follows.

Sub-study I
The aim of sub-study I is to expand on the relationship of service design and WPs and explore the role that service designers play in this interaction. Thus, the research questions of the first sub-study are:

- What is the connection between service design and WPs?
- What is the role of service design in tackling WPs?

Sub-study II
Sub-study II continues the dialogue from the first sub-study, which is how to tackle WPs and what tools and strategies have been created for them. The aims in the second sub-study are to:

a) define what a WP is and what the different types of problems are, according to their level of complexity
b) present and analyse the visual and graphic tools for WP-solving
c) analyse whether authoritarian, competitive, or collaborative strategies best serve the visual tool presented in the article
d) describe the designer's role in visualizing and mediating projects that seek to tame WPs from the perspective of the tools and strategies presented.

Sub-study II asks:

- What are the visual tools solely designed to tackle WPs?
- What are the strategies recommended to handle WPs?

Sub-study III

Sub-study III applies the Mess Map™ tool and a collaborative strategy (found in sub-study II) in a case study on cross-border mobility in the Barents region. It aims to investigate how the tool can be applied in service design-oriented projects; thus, the research questions are:

- How did the Mess Map™ help the project participants and entities to identify common challenges in mobility as a service (MaaS) development? How did the Mess Map™ help to identify stakeholders for creating a common strategy?
- What are the advantages and disadvantages of using the Mess Map™ in service design projects?

The first two questions are related to each other, so they are presented together. The last question focuses more on the advantages and disadvantages of using the tool in the service design field.

The three sub-studies can be condensed into three main questions.

1) What is the relationship to and role of service design in WPs? (I)
2) What are the tools and strategies created specifically to handle WPs that service design can benefit from? (II)
3) Can the Mess Map™ tool be validated by investigating its advantages and disadvantages in an empirical service design context? (III)

1.4 Sub-Studies and their Objectives and Aims

All three sub-studies are linked, shown in detail in Table 1. It is important to understand the relationship between service design and WPs. Through this knowledge, it is possible to understand how service design should position itself within WPs and the kinds of roles service designers should play when handling WPs. This is what sub-study I aimed to examine. After understanding this perspective, I asked how service designers can start dealing with WPs and not simplify them, as mentioned in the literature (Hillgren et al. 2011; Norman and Stappers 2015). What are the tools and strategies created specifically to handle

WPs that service design can benefit from? This research question is covered by sub-study II. These can be tools that are applied elsewhere, but which the service design field has not taken advantage of yet. It would also be beneficial to investigate the existing tools before starting to create new tools or act in an ad hoc style, which can have disadvantages.

I believe that spending time on planning, creating strategy and understanding a problem and the deeper roots of its consequences can bring the "seriousness" desired to tackle WPs. We must bear in mind that people handling WPs cannot be wrong as there are consequences (Rittel and Webber 1973). The last research question relates to one of tools encountered in sub-study II. The selected Mess Map™ aimed to understand how it can be applied in service design on a practical level. The tool is designed to understand the overall image of a WP. Sub-study III thus continued to investigate one of the tools, Mess Map™, that was found in sub-study II. These three sub-studies can further the academic dialogue by giving direction on how to increase the capabilities of future service designers and design students for dealing with WPs (Augsten and Gekeler 2017; Dixon and Murphy 2017).

Table 1. Sub-studies included in this thesis with their research questions, deliverables, objectives and their overall aim

Sub-study/ Methodology	Articles	Research Questions	Deliverables and Objectives	Overall Aim
I–systematic literature review	Suoheimo, Mari, Rosana Vasques and Piia Rytilahti. 2020. "Deep Diving into Service Design Problems: Visualizing the Iceberg Model of Design Problems through a Literature Review on the Relation and Role of Service Design with Wicked Problems." *The Design Journal*, submitted for review.	What is the relationship to and role of service design in WPs?	Expose a current research gap and explain in greater detail the connection and role of service design as a facilitator in the WP process and change-making with a user-centred approach; to better understand the problem typologies for which the "Iceberg Model of Design Problems" is proposed; point out the need for further research on how to tackle WPs with appropriate tools and strategies	The aim is to analyse what has been learned in the entire thesis by analysing three sub-studies together. The thesis concentrates on describing WPs as a challenge of service design and its relationships and roles. Another goal is to increase capacities in the service design field with theory, tools and strategies designed for WPs.
II–desktop literature review	Suoheimo, Mari, 2019. "Strategies and Visual Tools to Resolve Wicked Problems." *The International Journal of Design Management and Professional Practice* 13 (2): 25–41. https://doi.org/10.18848/2325-162X/CGP/v13i02/25-41, ISSN: 2325-162X	What are the tools and strategies created specifically to handle WPs that service design can benefit from?	Find visual tools made solely to deal with WPs (also mentioned in sub-study I) and analyse the strategies that apply in these situations, specifically authoritarian, competitive and collaborative strategies	
III–participatory action research case study	Suoheimo, Mari, and Toni Lusikka. 2020. "Process of Mapping Challenges of Cross-Border Mobility in the Barents Region." Paper presented at the Sixth International Conference on Design Creativity (ICDC2020), Oulu, August 26-28, 170-177.	Validation of the Mess Map™ tool by investigating its advantages and disadvantages in an empirical service design context	Study how the Mess Map™ applies to the service design projects found in sub-study II	

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2 Literature Review

2.1 Service Design and Wicked Problems

A Short Overview of Service Design

Service design is still quite a new field, only around ten years old, and it has taken time to become recognised as a separate design field (Kimbell 2011; Sun 2020). Sun's (2020) systematic literature review shows how service design began to be treated as a separate discipline in academic publications around 2010 and how it uses mainly constructivist epistemology. Some early authors who discussed service design as a separate topic within the design field were Hollins and Hollins (1991) and Voss (1992). Before this time (since the 1970s), service (design) was found in other disciplines such as marketing or operations management (Secomandi and Snelders 2011; Sun 2020). Service blueprints, a common tool still used today, have long been applied in designing services, and they are one way to ensure a positive customer experience (Shostack 1982, 1984). Additionally, services have been under investigation in various other disciplines such as service engineering (Løkkegaard, Mortensen, and McAloone 2016) and service architecture (Voss and Hsuan 2009). Kimbell (2011) delineated the various approaches to service design and types of service design; this thesis deals with what Kimbell called "designing for service," which has its roots in schools of design and art rather than in engineering.

Service design from an art and design background arises from cognitive psychology and interaction design as an extension within the design field (Kimbell 2011; Koskinen et al. 2011; Rytilahti, Miettinen, and Vuontisjärvi 2015). Rytilahti et al. (2015, 88) described how "the connection with the interaction design discipline was left in the background when programmatic research on empathic design, co-design, and action research in Scandinavia; service design and design for sustainability in Milan; and research on user experience at Carnegie Mellon began to catch the attention of design researchers." In "designing for service," the focus is more on customers' and users' experience than on what the other approaches do (Kimbell 2011). Mager (2010) pointed out how the aim of service design is to create optimal service experiences, and

here, the user's experience of the service is essential. Sun (2020, 51) described how "'designing services' considers that 'services' are the object of design activities, just like products are the object of product design." According to Meroni and Sangiorgi (2011), services can also obtain a transformative approach.

There are several activities that constitute the service design practice. Stickdorn and Schneider (2011) used five principles to define service design: 1) user-centeredness, which means designing things from the user's perspective, where "user" can also be understood as a community; 2) co-creation, which is to have users, stakeholders and/or communities participate in the process; 3) sequencing can be visualised, for example, through maps to show how things or systems are organised; 4) evidencing can be used to visually illustrate the problems faced; and 5) holism is handling the service from a holistic point of view. Holism as a term in service design will be explained in the next chapter when introducing the paradigms.

A Short Overview of Wicked Problems

Rittel, professor of the science of design, the other writer of the landmark article "Dilemmas in a General Theory of Planning," published in a policy journal in 1973. Rittel was a teacher of architecture and design for over 30 years (Rith and Dubberly 2007). I thus believe that wicked problems (WPs) have always been connected to design since their "birth." WP terminology is common in social sciences (Hackmann, Moser, and St Clair 2014), policy planning (Rittel and Webber 1973), management (ibid.) and design (Buchanan 1992), among other fields. Service design is also a topic in design (Stickdorn and Schneider 2011), marketing (Andreassen et al. 2016), engineering (Pezzotta et al. 2015) and tourism (Stickdorn and Schwarzenberger 2016), as a few examples. Both WPs and service design share a common interest in holistic perspectives (e.g., Rittel and Webber 1973; Stickdorn and Schneider 2011) and collaborative approaches (e.g., Grint 2010; Roberts 2000; Stickdorn and Schneider 2011).

Rittel and Webber (1973) defined ten points that a problem should have to be considered a WP (Table 2).

Table 2. Summary of the ten WP points (adapted from Rittel and Webber 1973)

1. There is no precise formulation of a WP.
2. WPs do not have a stopping rule. WPs do not have a "final solution" because the resolution can always be improved.
3. Solutions to WPs are not "true" or "false," but "good" or "bad."
4. There is neither a final test nor an immediate solution to a WP.
5. Each attempt at a solution to a WP is a "one-time operation," and each attempt counts significantly.
6. WPs do not have enumerable sets of potential (or exhaustively descriptive) solutions.
7. Each WP is unique.
8. Each WP can be considered a symptom of another problem.
9. The existence of discrepancies in the representation of a WP can be explained in several ways. Choosing an explanation determines the nature of the problem's resolution.
10. The planner cannot be wrong because WPs have consequences.

The first problem is that it is difficult to define what a WP is. WPs are constantly evolving, as shown by the 8th point, which explains how each WP is a symptom of another WP. It is challenging to find a solution to a WP since there are no solutions. It is common to use terms such as "taming" or "tackling" WPs. Additionally, the "solutions" are not true or false, but good or bad. It is not possible to provide a final test or an immediate "solution" as one can always improve the "resolution." Each WP is unique, which can also be connected to geographical or historical spaces. In Finland, education is not a WP as it is many developing countries. The contexts of colonialism have left profound effects that can be seen even in the current education systems of those countries (Stafford and Nystrom 1971). The way we choose to explain the WP will influence the way it can have a "solution." This is why it is crucial that the right

stakeholders be involved in a service design project—so that there can be a better definition of the problem, thus avoiding a resolution that will create another spin-off WP as a consequence.

WPs have been applied in a wide range of disciplines, which reflects the characterization of WPs as being multifaceted and interconnected. There have been many attempts to reduce the number of characteristics of WPs. Weber and Khademian (2008) reduced WP characteristics to three: 1) cross-cutting, where independent stakeholders have different perspectives and solutions; 2) unstructured, where the links between the causes and effects are difficult to identify; and 3) relentless, because the resolution is a moving target. Xiang (2013) reduced the ten characteristics to five as 1) indeterminacy in problem formulation; 2) non-definitiveness in problem solution; 3) non-solubility; 4) irreversible consequentiality and 5) individual uniqueness. Head and Alford (2008), on the other hand, created two axes of WPs regarding their diversity and complexity, which are discussed later in sub-study II.

Termeer et al. (2019, 170) stated, "The 10 claims made by Rittel and Webber can therefore be read as a set of arguments against purely rational approaches to policy." The same authors continue to question how policies have been made:

> During the past 50 years, many insights have been developed to tackle societal problems, without referring to wickedness of these problems. Has wickedness become a new frame to advocate already existing governance approaches or does it offer new governance ideas for tackling a specific type of problems? (Termeer et al. 2019, 170)

Before Rittel and Webber, the term "wickedness" for a problem was first used by Churchman (1967, 141) to define "the mischievous and even evil quality of these problems, where proposed 'solutions' often turn out to be worse than the symptom;" the author continues to describe how "a class of social system problems which are ill- formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing." Simon (1960) is also attributed as an early theorist of complexities and their close relationship to WPs.

Rittel's work was ground-breaking in many senses. He, along with Webber, brought forth the theory of WPs (Rittel and Webber 1973). His work did not finish with this theory as he also studied the issue-based information system approach (IBIS), also called issue mapping (Rith and Dubberly 2007). He also pointed out how design is political, and argumentation may be one way to find a "solution" to a WP. His work on mapping has been the foundation for many other tools developed later, such as Dialogue Mapping (Conklin 2006). He also instigated the debate on design and science and how the two are different (Rith and Dubberly 2007), which is still discussed long after (e.g., Farrell and Hooker 2013; Galle and Kroes 2014).

Service design in the field of WPs

WPs have long been applied in the design field (in greater depth since Buchanan's 1992 article). In the *Harvard Business Review*, Camillus (2008) pointed out how creating strategies is a WP. In the same journal, Brown (2008) introduced design thinking, which later was also applied in the context of WPs in the design field (Brown and Wyatt 2010), popularizing its use in design and in other fields. Many countries have written publications linking WPs to public policy in relation to public services (see Australian Public Services Commission 2007).

Buchanan's (1992) landmark article, "Wicked Problems in Design Thinking" is extremely well cited and has created shifts within the design discipline. In that article, Buchanan (1992, 9–10) described four areas of design problems: 1) "design of symbolic and visual communications;" 2) "design of material objects;" 3) "design of activities and organised services;" and 4) "design of complex systems or environments for living, working, playing, and learning." The first we can understand more as graphic design (designing visuals), the second as product design (making physical objects), the third as service design (intangible products) and the fourth as the design of systems and environments or as political designs or interactions (Johansson-Sköldberg, Woodilla, and Çetinkaya 2013). It can sometimes be challenging to separate one area from another as they can be intertwined, and several design skills are needed for a certain project or problem. It seems that that the third and fourth areas or orders of design problems mostly deal with complex issues, or WPs. As Westerlund and Wetter-Edman (2017, 17) aptly pointed out, "Designers whose mind-set and approach works well considering the impact in Buchanan's first

and second orders, may not have the tools, mind-set or approach to create understandings of the impacts in the third and fourth orders of design."

In the design field, there has been a great deal of liberty in how to interpret these four orders and their application. Duman and Timur's (2020) article gathered 12 different ways of approaching the four orders. The four orders can be seen as design fields, as introduced above, or as areas of design problem fields. When visualising the areas as fields, I have noticed that service design's place is often ambiguous. For example, in Duman and Timur's (2020) article on the four orders of design education, they situated service design in the second order, probably considering it a product service system, which is one very narrow field of service design. At the same time, when they refer to the fourth order, the authors discuss designing carbon-free transportation solutions or healthcare processes, which I see as fields or problems of designing services (see Alhonsuo [2016] for healthcare processes in service design). In many ways, their article was inspiring, and I very much agree that design education needs a transdisciplinary direction and often new strategies to give new students the capabilities needed to face all four orders of design. Perhaps the framing of meso- and macro-levels comes in handy when defining the differences of the third (meso) and fourth (macro) orders. I believe that their boundaries are not clear and that both work in close interaction.

Service design also often deals with social issues that can be wicked (Miettinen and Kuure 2013; Sangiorgi 2009), but this is not mainstream literature in service design. Much of service design is related to commercial activities that aim to bring economic value to an enterprise, and the Service Logic Business Model Canvas is one tool used in this context (Ojasalo 2017). Some practical examples of this could be how to design a service experience for ordering food online or for a customer visiting a museum. On the other hand, there is service design that is more related to social or societal problems, such as designing services for unemployment, public transportation or healthcare.

In service design and design literature, there is not yet clarity about which tools and strategies should be applied in the WP context. Hillgren et al. (2011, 172) wrote, "Some actors working with social innovation have recently expressed concerns about the role of design in this field, pointing out the weaknesses of designers and the limits of design methods." Service design and social design very much go hand in hand, and they both have users or citizens at the centre, for example, by engaging citizens in co-designing public services (Hillgren et al. 2011). The process of design thinking commonly used by service

designers is used to deal with increasingly more WPs (Wrigley, Mosely, and Tomitsch 2018), but there has also been examination of how design thinking is inadequate for larger social problems (Hillgren et al. 2011). Larger social problems can be understood as WPs since they have a social angle to them (Horn and Weber 2007; Rittel and Webber 1973) or a societal angle (Termeer et al. 2019).

Sangiorgi (2009) called for more research on complexities in the service design field. In her article, she points out that there are actually three areas for future research: interactions, complexity and transformation. In this article, she also obliquely mentions WPs. These three research areas are interconnected. To deal with the complexities of WPs, there are interactions among the stakeholders, and the aim is to create change, or in other words, transformation. Manzini (2011) also believes that service design can deal with issues that are complex or "un-designable" and has written about how there should be more attention drawn to developing culture and practice. Woodham and Thomson (2017, 237), on the other hand, raised another issue.

> Service design strategies are seen to be successfully shaping new approaches and providing possible solutions to often intractable or "wicked" problems. In pursuing a user-centered ideology, it can be seen that the boundaries of nations are, at least in this context, increasingly permeable and reflect new approaches to policy-making that would have been unimaginable even ten years ago.

There has been criticism in the design field about how it tends to deal with complexities and WPs too simplistically; Norman and Stappers (2015) even wrote about how many of the "existing design methods were developed for relatively simple situations" (91). Furthermore, it is not very clear what the service designer's or designer's role should be in WPs (Schanz and De Lille 2017) or state directly that the role is unclear (Westerlund and Wetter-Edman 2017). It is difficult to find literature that directly deals with this matter and how service designers should orientate themselves or approach handling WPs. In fact, there has been a clear need identified by the design and service design fields for better training students to deal with WPs (Augsten and Gekeler 2017; Dixon and Murphy 2017). This was expressed nicely by Augsten and Gekeler (2017, 1058).

"To create solutions for these complex, even "wicked problems" (Rittel & Webber, 1973), completely new ways of designing are needed. These require designers to take on different roles and ultimately design education is in charge of reacting to this massive change."

"These new participatory approaches expand the work of designers and thus, should be reflected in the way we teach design. If designers nowadays are demanded as facilitators and moderators of innovation processes, what role should educators take, to prepare students appropriately?"

It seems that there are issues to be dealt with within the service design discipline to rethink our practice in relation to WPs. This is required as Sanders and Stappers (2008, 14) highlighted: "Designers will be in demand as the usefulness of design thinking is acknowledged in mankind's drive to address the challenges of global, systemic issues" and at the same time, along with other authors, they saw the need for new tools and methods to address these complexities. Vink (2019, 34, 38), on the other hand, pointed out that "design theory has a lot to offer regarding making and materiality, but often ignores macro-level dynamics and invisible influences on actors" and continued "much of the conversation has stayed at the micro-theoretical-level and been focused on the micro-level of aggregation of individual actors and groups."

2.2 Complexity Theories

The foundation for the typology of WPs in service design is based on the current debates in the field. The debates originated from general systems theory (e.g., Bertalanffy 1951; Bertalanffy 1968) and have subsequently arisen from industrial technology and management (Simon 1960), urban planning (Rittel and Webber 1973) and systems design and engineering (e.g., Checkland 1981). The interdisciplinary field of design has adopted this "problems" terminology as a basis for easily understood design discussions. The pre-discipline of service design, however, has only recently emerged; social design and sustainable design are areas where the problem-solving orientation of design is challenged by the complex and wicked nature of social issues and practices.

Table 3 shows the WP theorists and is adapted from Culmsee and Awati (2013), with additional information. I added the last column of landmark articles, showing the number of citations on the main search engines (Google Scholar and Scopus). Rittel and Webber's (1973) article mentioning the term "wicked problem" has more citations than the others collected in the table. This is one reason why I chose to work with WPs as they also have a social side (Horn and Weber 2007; Rittel and Weber 1973). In addition, Culmsee and Awati (2013) agreed that "wicked" is the most popular term. Still, there are nomenclatures and fields that come near to this, for example, sociotechnical systems, soft systems or messes. The number of citations was also added from Scopus in case the same article or book was found there. Unfortunately, many of the books were not found through this engine.

Table 3. Different complexity theories adapted from Culmsee and Awati (2013)

Author(s)	Low level of complexity	High level of complexity	Cited landmark article/Google citations (G) September 2018/ Scopus (S) April 2020/
Rittel, Horst & Melvin M. Webber	Tame problem	Wicked problem	Rittel, Horst and Melvin Webber. 1973. "Dilemmas in a General Theory of Planning." *Policy Sciences* 4 (2), 155–69. (G) 12,651/(S) 6,386
Peter Checkland	Hard systems	Soft systems	Checkland, Peter B. 1981. *Systems Thinking, Systems Practice*. Chichester: John Wiley & Sons. (G) 11,344/(S) n/a
Herbert A. Simon	Programmed decision	Non-programmed decision	Simon, Herbert A. 1960. *The New Science of Management Decision*. New York: Harper. (G) 7,655/(S) n/a
Ronald Heifetz	Technical challenge	Adaptive challenge	Heifetz, Ronald A. 1994. *Leadership without Easy Answers.* Vol. 465. Boston: Harvard University Press. (G) 4,608/(S) n/a

Russell L. Ackoff	Puzzle/ Problem	Mess	Ackoff, Russell L. 1974. *Redesigning the Future.* New York: Wiley. (G) 2,485/(S) n/a
Jerome Ravetz	Technical problem	Practical problem	Ravetz, Jerome R. 1973. *Scientific Knowledge and Its Social Problems*. London: Transaction Publishers. (G) 2,018/(S) n/a
Ludwig von Bertalanffy	Well-defined problems	Ill-defined problems	Bertalanffy, Ludwig von. 1951. "General System Theory: A New Approach to Unity of Science. 1. Problems of General System Theory." *Human Biology* 23 (4): 302–12. (G) 870/(S) 8
Barry Johnson	Problems to solve	Polarities to manage	Johnson, Barry. 1992. *Polarity Management: Identifying and Managing Unsolvable Problems*. *Human Resource Development*. Amherst: HRD Press. (G) 462/(S) n/a
Donald Schön	The high ground	The swamp	Schön, D. A. 1984. The Architectural Studio as an Exemplar of Education for Reflection-in-Action. *Journal of Architectural Education* 38 (1): 2–9. (G) 217/(S) 99

In Table 3, there are authors from various fields (e.g., science of design, city planning, biology, politics and management) who have been trying to envision more complex problems. After looking at Table 3, we can question whether scientists from different fields are trying to explain the same phenomena. A term raised in Checkland's (1981) research is on "soft systems" although his theory relies on the WP concept.

An additional point that Table 3 illustrates is the narrow categorisation of problems as either simple or wicked. This begs the question of what the problems are between these two extremes. Like Roberts (2000), I would prefer

to put problems into roughly three categories: tame (i.e., simple), complex and wicked. Of course, there are other methodologies, but these three categories can aid designers in searching for the best methods and tools when designing for a certain type of problem.

2.3 Mess Map™: A Tool for Service Design

Simon (1969) pointed out how design is used to shape the current situation into a desirable one, and Vizard (2016) illustrated how maps play a role in this. Maps show how to go from one place to another. In this way, they play a role in creating a strategy for reaching a desired state. Designers are known for using visualisation processes and even strategies (Degnegaard 2019; Stickdorn and Schneider 2011). Vizard believes that mapping processes come in handy in Buchanan's (1992) third order, which handles services. I believe that they come in handy in both the third and fourth orders.

A Mess Map™ is like a giant map of a central WP and has many subareas in it (Horn and Weber 2007). There is a shared WP that designers try to understand holistically (Horn and Weber 2007). In the map, there are several interconnected problems that are related to this "main WP." Some can be seen as several WPs intertwined together. The Mess Map™ is like a blood test to find what the problem is currently, and it is necessary to bear in mind that it is not a stable view, but one that is constantly evolving (Rittel and Webber 1973). As the citation below shows the, Mess Map™ essentially tries to bring stakeholders together to start creating a shared view of the WP in the initial phase of a project.

> I've emphasized that Mess Mapping is a way for task forces understand their issues. It is an initial stage process. It enables groups to get started, to form common mental models is the issues, to learn about each other, and to quickly achieve clarity about the interrelated set of problems they face. (Horn 2018, 42)

In his book, Horn (2018), the inventor of the tool, explained in more detail the processes of Mess Mapping™. In the map, there are chunks or boxes that present a problem field, and there can be links that show the interconnections

of the problems or causal links for the causes (Horn 2018). Besides these links, it can be shown where collaboration is required between different parties where better achievements can be established (Horn 2018). A tool designed to use together with the Mess Map™ is Resolution Mapping™, which attempts, through different steps (called events) found in the previous Mess Map™, to create a desired future called the "end state" (Horn and Weber 2007). It is also necessary to include events that are not desired and could hinder the end state so that they can be avoided.

In his book about social messes, Horn (2018) described Mess Map™ case studies made for Portland, Oregon's mental health services and the integration of long-term care for elderly people in Alameda County. He has taught at Harvard and Columbia Universities and is currently a research scholar and artist in the Human Sciences and Technology Advanced Research Institute at Stanford University. He is also the chief executive officer of MacroVu.com. Horn has created murals to aid in strategic development for organisations such as the World Business Council on Sustainable Development Task Force–Vision 2050, and he is currently working on the European Commission-sponsored project on resource efficiency by 2050 (Foresight Canada 2020).

The use of Mess Mapping™ and other WP tools became even more valid in my view when I learned about the new Megatrends 2020 report published by the Finnish Innovation Fund (SITRA). It shows how we live in a world of uncertainty (Dufva 2020). The world is a complex place, but still, according to the report, people try to seek simple answers to it. In this post-normal time, it is important to see a wider picture and what the connections are (Dufva 2020). According to the report, the ones that will succeed are those who are able to see the greatness of the changes and understand their relationships. Understanding the broader entirety is increasingly important (Dufva 2020). The Mess Map™ tool was designed to understand the connectedness of the WP so it could fit as a glove to these requirements of understanding complexities (WPs) that Dufva (2020) presents. One of the five published megatrends illustrate how power is also network-based and distributed (Dufva 2020). This is valid in the perspective of WPs and Mess Mapping™ as power is aimed to be shared through collaboration. It is also service design's or participatory development's aim to give voices to the participants (Kindon, Pain, and Kesby 2007; Stickdorn and Schneider 2011).

Dufva (2020) continued by explaining how it is important to enhance one's abilities to predict the future and imagine possible alternatives and what

they might bring. Here, the use of Resolution Mapping™ can be essential. The Resolution Map™ is used following the Mess Map™ in trying to think of positive "end states," and the Mess Map™ is used as a foundation for creating these states. Using these tools in the service design field will be novel and can aid our field in meeting the demand of not oversimplifying complexities and WPs, as has been discussed in the literature. However, using new tools is not enough; the need for a theory should also be considered as well as the theory's internalization so that the tool can be used effectively. We need to remember that WPs are unique and that there are no "right answers" to them, and we should consider whether the tools we have today will be sufficient to deal with complexities and WPs at the level they require.

2.4 Theoretical Framework of the Research
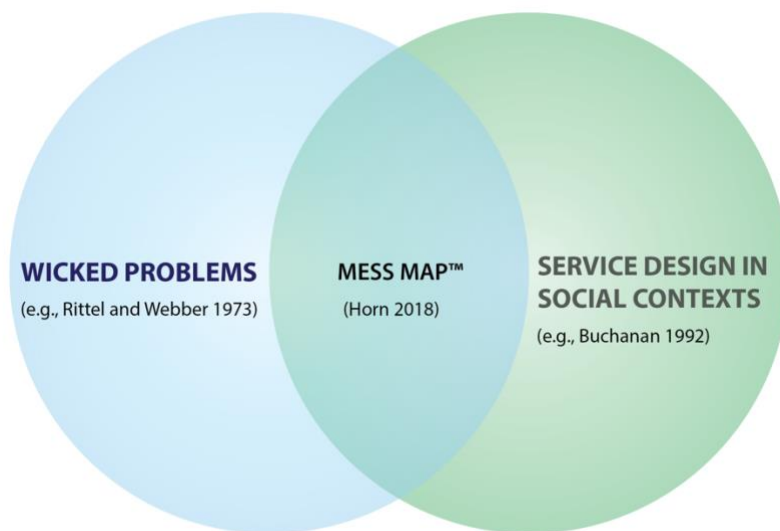
Figure 1. The key concepts of the thesis

The key concepts of this thesis are WPs and service design in the social context (Figure 1). The assumption is that service design and WPs relate to each other through services that have a social angle to them. I wish to investigate some further points that shed light on the relationship to and role of service design in WPs; sub-study I will concentrate on these questions. It is valid to know more specifically about the strategies and tools that have been developed to tackle

WPs and how service designers can benefit from them. Theory is also essential as it will shape how we carry out the practice.

This thesis will concentrate on WP theory, but the methodology of soft systems is a field that requires more research about its relationship to service design. It is a theory that is frequently cited with WPs, as illustrated in Table 3. WP theory was introduced in the literature review, and its basis is in Rittel's and Webber's (1973) ten characteristics, but many variations and new interpretations have been made. Buchanan's (1992) article can be cited in both WP and service design research since it handles a little bit of both by introducing the four orders of design and WPs in the design field. The deeper differences between the third and fourth orders will require future studies, but this thesis will not concentrate on them. The key concepts and theory(ies) of WPs will be used to interpret the data.

The idea of problem typologies and WP theory in service design is dealt with further in sub-studies I and II. Sub-study II will also deal with the strategies and tools to handle WPs that service design and other related design fields can benefit from. My aim with this research is to offer theory and practical tools, such as Mess Map™, that can be taken from policy science into service design. Sub-study III will give an example from the field and explain how it can be applied in service design. Although the Resolution Map™ is essential, I have limited my research to the initial phase, which is the Mess Map™. When I searched the words "service design" and "mess map" in Scopus in March 2020, I was not able to find any hits. I did a new search, "design" and "mess map," and again there were no hits. Hopefully, this thesis will aid universities in designing their curricula so that we can teach students more effectively about the relationship to and role of service design in WPs. The tools and methods in designing the course content are also important, as indicated by previous literature. This thesis will not concentrate on design thinking or other methods used to handle WPs, but it will be valid in reflecting the current practice of service design and how it can be adjusted or redirected for larger social issues, namely, WPs.

3 Methodology

3.1 The Worldview behind the Study

I place my personal worldview in this research *firstly* in the complexity paradigm as it embraces complexity (Gummesson 2017) and resonates with wicked problems (WPs) and *secondly* with interpretivism. Essentially, the complexity paradigm is holistic as no discipline alone can grant itself a place from which to derive an absolute and final knowledge (Serva, Dias, and Alperstedt 2010). I can still argue that there is some influence from the interpretive (social constructivist) paradigm (Jennings 2015) (*secondly*) in the sense that phenomena or truth are constructed socially together (Ponelis 2015). Constructivism is the most used epistemology within service design research (Sun 2020). Interestingly, Serva et al. (2010) even questioned whether it is necessary to include the interpretationist (constructivism) paradigm when developing complex thinking (Morin 1982).

The intersection of the two paradigms can be seen in what Schultz and Hatch (1996) called "paradigm incommensurability" as the two paradigms form a "joint venture" (Goles and Hirschheim 2000). Using multiple paradigms can have advantages such as bringing a larger view of a (organizational) phenomenon (Gioia and Pitre 1990). Often, paradigms have similar and non-similar linkages at the same point (Goles and Hirschheim 2000). The Mess Map™ as a tool in this research corresponds to the interpretationist paradigm as it aims to create a holistic view of a WP through social interaction. The tool also assimilates completely with the complexity paradigm as the topic is about WPs and social messes. It is not possible to create a vision of a WP alone. Different views of stakeholders and participants will be needed that a more holistic understanding could be obtained of a WP.

The WPs under study with the Mess Mapping™ tool are non-linear and non-hierarchical as in McMillan's (2002) description of complexities. In this case, reductionist thinking is not possible as complexity the paradigm's epistemology or the way to truth is a construct, via holism (McMillan 2002). The Mess Map™ as a tool aims to create this holistic dialogue, which can be very challenging to engage the right stakeholders in. To understand a phenomenon

here, the WP cannot be tackled just from one discipline; transdisciplinary collaboration is required (Serva et al. 2010). Gummesson (2017) highlighted that we live today in a highly complex and interconnected world. He also criticised how scientists try to make a complex phenomenon into something manageable, when complexity should be kept according to him complicated. I think this is the aim of Mess Mapping™ as it tries to embrace the entire picture and not simplify it, or at least it aims not to do so. Gummesson (2017) also stressed the importance of tacit knowledge when working with the complexity paradigm and the use of pragmatic wisdom.

Holism is a term that may require further definition; however, because it has been a much debated topic in philosophy (Pagin 2006) since its introduction by Hempel (1950) and Quine (1951) in the early 1950s, the term is not easy to explain. Pagin (2006, 213) described "one common view, meaning holism (MH) is the thesis that what a linguistic expression means depends on its relations to many or all other expressions within the same totality." The explanation of holism in the service design framework is similar: "Contextual and holistic understandings of user experiences can inform value propositions that better fit users' value-in-use" (Yu and Sangiorgi 2018, 51). In this sense, the user of a service can receive the experience from multiple touchpoints or channels that can be traced through service journeys (Yu and Sangiorgi 2018). Another broader way to express holism in service design is to embrace all of the stakeholders' needs, not only the users' (Stickdorn and Schneider 2011). Understanding this experience or attending to the needs of all stakeholders in a WP context might require different levels of holism in embracing different paradigms, methods and tools as these contexts are heavily related to stakeholders and their points of view, which requires cross-disciplinary approaches (Horn and Weber 2007; Yolles 2020). Embracing the experience from each stakeholder's point of view is a challenge. Yolles (2020) spoke of a general hybrid theory for WPs, where a mono-disciplinary inquiry is not suitable for creating possible "solutions" and thus defended using various instruments together.

One distinction that I wish to point out is with the positivistic paradigm and functionalism (Goles and Hirschheim 2000). This paradigm can bring valid insights to WPs such as global warming by explaining, for example, how the chemical elements in waste interact with chemical elements in nature. Nevertheless, it is humans that caused the problem of climate change, and thus I can see that the issues surrounding it are in the social realm, where

interpretivism can be placed, or what Burrell and Morgan (1979) referred to as subjectivity rather than objectivity. However, Deetz (1996) criticised this view because interpretivism can also be objective. On the other hand, I see some problems with Deetz's (1996) placement of interpretivism in line with consensus. Interpretivism or constructivism seeks the to hear the voices of different participants, which does not imply that there necessarily is going to be *consensus,* but rather *dissensus*. I do not wish to diminish the value and importance of research done in the positivist paradigm for WPs as this research is also important and can provide additional insights for research made in anti-positivistic paradigms. Nonetheless, WPs are social (Horn and Weber 2007; Rittel and Webber 1973), and thus, I believe there should be greater influence from the anti-positivistic paradigms when making strategies to deal with them.

The ontology of complexity can be explained in various ways depending on which authors one chooses to cite. In chapter two, Table 3 shows different authors from different disciplines who probably have attempted to explain similar complex phenomena. Some might disagree with me, but it would take a great deal of research to prove it one way or another. Often, the term "name complexity" is used as an umbrella term to describe all possible complexity terminology. Here, my selection is WP theory as it deals with social complexities more closely. The previous chapter explains in greater detail how Rittel and Webber (1973) defined the phenomenon. Whyte and Thompson (2012, 441– 42) very aptly described the formulation of problem ontology through WPs:

> The ontology of problem formulation has implications for the epistemology of problem response. Thus, to describe climate change as an economic problem means that one has already limited oneself to particular economic solutions to addressing it. Because proposed solutions are so closely tied to problem formulations, disagreements among stakeholders who foresee themselves as being impacted differently by the solutions can take the form of ontological debates. Unlike problems where there is little disagreement about its basic formulation, wicked problems are characterized by deep ambiguity in the ontological assumptions and metaphysical categories used in their articulation.

In design research, the complexity paradigm is still quite novel. From a Scopus search in December 2019, the search engine was able to find 11 hits for the words "complexity paradigm" AND "design research." Half of the results were articles, and the greatest number of these publications was from 2014 to 2019.

The three major areas were arts and humanities, computer science and engineering. In January 2020, for the words "complexity paradigm" AND "design," Scopus returned only one more hit, for a total of 12 publications (2006–2019). I believe this paradigm will see increasing use in the design field as more scientific research on complexities is being carried out. Using the complexity paradigm is one way to start dealing with complexities in the design discipline in a more novel and perhaps more precise way.

3.2 A Qualitative Multimethod Approach

This thesis is, in its essence, qualitative research. Qualitative research is in opposition to positivist and post-positivistic worldviews (Denzin and Lincoln 2011). It also aims to explore or understand the participants' perspectives in a natural setting (Creswell 2013), and it is often interactions between researchers and participants that create the data (Harrison et al. 2017). Creswell (2013, 66) also pointed out:

> Qualitative research begins with assumptions and the use of interpretive/theoretical frameworks that inform the study of research problems addressing the meaning **individuals or groups <u>ascribe to a social or human problem.</u>** To study this problem, qualitative researchers use an emerging qualitative approach to inquiry, the **collection of data in a natural setting** sensitive to the people and places under study, and data analysis that is both inductive and deductive and establishes patterns or themes. The **final written report or presentation includes the voices of participants**, the **reflexivity of the researcher**, a **complex description and interpretation of the problem**, and its **contribution to the literature** or <u>a call for change</u>. (Emphasis added)

The qualitative problem that this research aims to tackle is the simplified approaches used to deal with WPs in the design field (Norman and Stappers 2015); thus, the research calls for change in design and service design practices. This thesis uses a qualitative multi-method approach. Each of the sub-studies is qualitative research, but each has different methodologies and methods applied in its data collection. Dresch et al. (2015, 1117) pointed out that "rigorous methodology helps to ensure the validity of the research work and,

consequently, its recognition as a serious and well-conducted study." Creswell (2009), however, reminds us that validity is different in qualitative research in comparison to quantitative research.

Sub-study I aims to investigate through a systematic literature review how service design and WPs are connected and the role of service design in WPs. In addition to the literature review, sub-study I aims to create a theory of design problems to aid designers in a practical manner in identifying the kinds of problems they might deal with and how to approach these problems more in accordance with the tools and methods designed for them. Sub-study II aims to expand these tools and strategies designed for WPs. It uses a desktop literature review to obtain the data. Finally, sub-study III applies the Mess Map™ tool, which is one of the findings from the previous sub-study II. The study aims to look at how this tool works in the service design context, specifically via participatory action research (PAR). I selected action research as a method as it is used to deal with practice. "Action research aims at changing three things: practitioners' *practices*, their *understandings* of their practices, and the *conditions* in which they practice" (Kemmis 2009, 1, with added emphasis).

3.3 Data Collection Methods and Analysis

All the three studies are qualitative. The following sections will introduce each sub-study separately, along with their data collection methods and analysis.

3.3.1 Systematic Literature Review (Sub-Study I)

A systematic literature review, in comparison to other types of literature review, does the data collection more systematically, and it uses a protocol to ensure validity (Budgen and Brereton 2006; Peters et al. 2015). The data collected are often analysed by coding (Saldaña 2013). One needs to be aware that a code can sometimes "summarize, distil, or condense data, not simply reduce them" (Saldaña 2013, 4). Additionally, the researcher needs to understand that the way one researcher codes data could be different from another researcher as each one may interpret the data differently (Saldaña 2013). Various tools can be used in the coding process, including Excel tables or

programs created for this specific purpose such as ATLAS.ti (Lewis 2016; Saldaña 2013).

In the best cases, systematic literature reviews can also contribute to theory creation:

> Extending current theories or developing new theories will create directions for future research. However, extending or developing theories is a difficult task and is often the weakest part of a review. Nonetheless, it is the most important part of a review and generally needs the most elaboration. (Webster and Watson 2002, xix)

Theories often try to describe phenomena that can be dynamic in their nature, and for this reason, may require hybrid theories that include the best qualities of certain approaches (Webster and Watson 2002). There is not any exact recipe for developing a good theory, and one important factor that Webster and Watson (2002) mention is having colleagues comment on your research before submitting it for review as it is this process of revision that will ripen the paper and the theory. Papers that use a literature review should introduce issues that are new (Webster and Watson 2002).

A protocol (Appendix 1) was created to make the search "rigorous, replicable, and extensive" (Peters et al. 2015, 142). This protocol explains in more detail all of the issues considered during the search and analysis of the data. The search was conducted directly in design journals and not through search engines because I realised that many engines did not contain all of the journals; for example Scopus did not have *Design Philosophy Papers*. The search terms "wicked problem" AND "service design" and later "wicked problems" AND "service" were used. "Service design" was seen as too limited, thus "service" was chosen in the end. Peer review style meetings were held to discuss how to conduct the searches.

The timeline of the articles was from 2013 to 2018, and the search was performed at the end of 2018. The aim was to find the most recent research in the field. Additionally, there were not many publications before 2013, probably because service design literature has grown more expansive since 2010, shown by a search with the term "service design" conducted in Scopus in 2018. Sun's (2020) systematic literature review confirms this as she discovered that service design began to be treated as a separate discipline in the academic literature

around 2010. Our aim was to find how service design as a discipline dealt with or was connected to WPs.

Table 4. Results of the Systematic Literature Review (Suoheimo et al. 2020, submitted for review)

Journal October 2018	Scimago ranking (Arts and Humanities) 2018–2019	JUFO ranking 2018–2019	Number of articles	Number of excluded articles	Number of articles in total
THE DESIGN JOURNAL	Q2	2	27	12	15
DESIGN AND CULTURE	Q1/Q2	1	7	3	4
SHE JI	-	1	6	3	3
INTERNATIONAL JOURNAL OF DESIGN	Q2	2	4	4	0
DESIGN STUDIES	Q1	2	3	2	1
DESIGN PHILOSOPHY PAPERS	-	1	3	0	3
DESIGN MANAGEMENT JOURNAL	-	0	3	0	3
DESIGN MANAGEMENT REVIEW	-	1	2	2	0
STRATEGIC DESIGN RESEARCH JOURNAL	-	1	0	0	0

DESIGN ISSUES	Q2	3	0	0	0
TOTAL 10			55	25	29

Note: Scimago ranks the highest-quality journals as Q1 and the lowest as Q3. JUFO uses rank 3 for the highest-quality journals and 0 for the lowest.

Table 4 shows the journals' ranking, the number of articles found and the number of articles selected for reading. Many of the articles were abandoned simply because the results were in the references and not in the text; for example, Buchanan's (1992) article "Wicked Problems in Design Thinking" was the only one that had a reference to WPs. None of the articles had both terms in their keywords, but the terms were encountered within the text.

The selected articles for the systematic literature review were critically read to ensure they had service design or WPs discussed in them. This analysis was conducted in an Excel table (Cycle I). It was often difficult to make a clear distinction between design and service design since service design appears together with many other design fields such as social design and Transition Design. In the second phase (Cycle II), two columns were created in the table, in which direct text quotations of the sections that handled WPs and service design were pasted. These sections were coded as a way of analysing the qualitative data (Saldaña 2013).

The coding was done by the first author, but there were peer review-style meetings to discuss any doubts that arose in the process. In the end (Cycle III), the codes were grouped with issues that they had in common; for example, urban planning and transportation planning were grouped under the urban planning term. The aim was to analyse the codes about WP and service design separately and then both together.

3.3.2 Desktop Literature Review (Sub-Study II)

Sub-study II investigated the strategies recommended for WPs and the tools that have been designed solely to tackle WPs. A desktop literature review was

seen suitable since it gathers data from different sources. A good literature review is not restricted to one research methodology, one type of journal or one geographical region (Webster and Watson 2002). When searching the literature, it is advised not to quickly criticise it but rather to build on top of it by respecting how the researchers have laboured to create a foundation of knowledge (Webster and Watson 2002). It is also recommended to use the past tense when writing about others' statements or discoveries since their opinions may have changed over time (Webster and Watson 2002). One purpose of desktop literature reviews is to find the state of knowledge on a research topic or to point out research gaps (Morawska et al. 2003; Webster and Watson 2002).

The desktop literature review was conducted with the terms "wicked problems and visual presentation," "tools" and "visual tools," and with different aggregations of these words. The first search was conducted in 2016 and the second in 2018 when I was translating and refocusing the previous article. Some new tools were encountered, and the results for visual tools and non-visual tools were the same in the end. It was easier to first collect all types of tools aimed to deal with WPs and then removing the ones that had not yet been designed solely for WPs. This means that tools that could be used both for simple problems and WPs were taken out of the list. Below is a list of the tools that were not considered (Suoheimo 2019, 34):

> Team Alignment Map, Canvas, Blueprint, Complexity Based Diagnostic Tool (because it is a blueprint and it is a tool not originally developed for wicked problems), Visual Displays, Uncertainty and Robustness, Visual Interactive Optimization, Release Planning, RAAIS and H+10 model (because they are toolkits with many other existing tools like 5 Whys or Complexity mapping), Gap Mapping, Concept Map, Digital Storytelling, Affinity Diagram, Scenario Planning, Release Planning, Foresight, GIGA Mapping, Forecasting, Collective Competence or Transdisciplinary Imagination (because these last two are not tools, but mindsets).

The tools that remained for further analysis were Mess Map™, Resolution Map™, Dialogue Mapping (and other similar tools) and General Morphological Analysis.

3.3.3 PAR Case Study (Sub-Study III)

Action research aims to change practice (Kemmis 2009, 1): "Transforming our practices means transforming what we *do*; transforming our understandings means transforming what we *think* and *say*; and transforming the conditions of practice means transforming the ways we *relate* to others and to things and circumstances around us (with added emphasis)." This is one of the reasons I saw action research as a suitable method for collecting data from the field in the case study on cross-border mobility in the Barents region. On the other hand, the case study is a research methodology that aims to study the complexity of the "real" world (Gummesson 2017), which is too complex for surveys or experimental methods (Yin 2017).

PAR is a method of action research that is conducted in a participatory manner (Arellano, Balcazar, and Alvarado 2015). Participatory or co-design research aims to make the different stakeholders participate in or co-design the process (e.g., Parente and Sedini 2017; Tsekleves and Cooper 2017). Service design uses collaborative approaches when co-designing with different stakeholders (Stickdorn and Schneider 2011). Souleles (2017, 929) continued to explain how participatory design is also important because it distributes power in the design process:

> Characteristic of participatory design is that it questions the notion that only experts can become co-designers. It stands in opposition to practices that built on hierarchy and control. In fact, participatory design requires that top-down control be relinquished and end-users become active and equal partners. In this respect, it adopts an egalitarian idea of sharing in the decision-making process.

As PAR aims to distribute power, the Mess Map™ seems to fit within this scope as it aims to gather relevant stakeholders to discuss a WP together. Service design itself is also interested in the voices of the participants who are going to benefit from the service designed. In the design process, the Mess Map™ is a tool that is recommended for use in the empathy-building phase, when discovering what the WP is (Suoheimo and Miettinen 2018). From this shared view, it is possible to generate a common view or a strategy for how to begin to deal with a WP. According to Creswell (2013), in a qualitative case study, the

interpretation is subjective as the researchers' perceptions and interpretations become part of the research results. The researcher takes a reflective stance and can adopt methods such as memoing and journaling to support this stance (Denzin and Lincoln 2011; Harrison et al. 2017; Yin 2014).
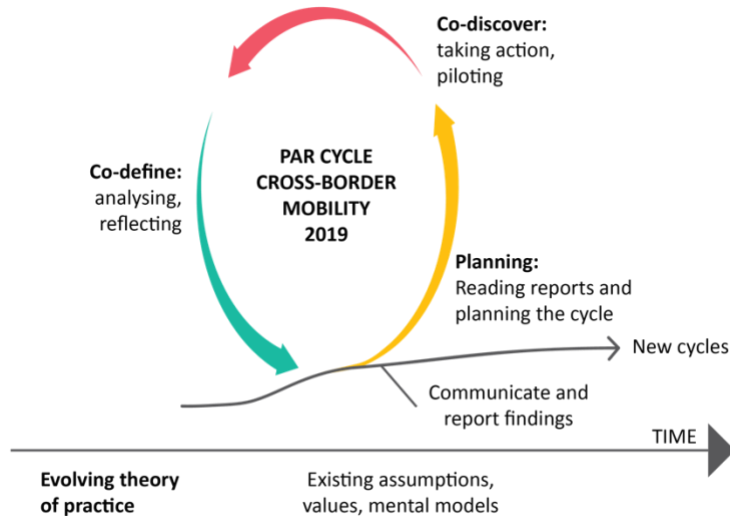
Figure 2. The PAR cycle conducted in the cross-border mobility in the Barents region case study

Figure 2 shows the PAR cycle of the cross-border mobility case study. I used models from Stringer (2007) and Castillo-Burguete, Viga de Alva, and Dickinson (2008) to create it. The PAR was conducted in three stages: plan, co-discover and co-define. First, I immersed myself as a researcher in the field of mobility by reading reports and articles regarding the topic and discussing it with some of the stakeholders beforehand. In the second stage, the process of Mess Mapping™ was carried out with the relevant stakeholders through co-discovering the problems related to cross-border mobility in the Barents region. In the last co-defining phase, the map was collaboratively analysed in a focus group.

Table 5. Mess Map™ focus groups

	MEETINGS 2019	Place	Date	Recording ~min. meeting	Participants
1	Kick-off	Online	12-Jun-19	110 min	4
2	Legislation & Local Authorities & Commitment	Online	27-Jun-19	40 min	3
3	Legislation Russia	Online	05-Jul-19	30 min	1
4	Legislation Norway	Online	25-Jul-19	47 min	1
5	Legislation Finland	Online	06-Aug-19	65 min	1
6	Technology, Users & Marketing	Online-Rovaniemi	09-Sep-19	240 min	9
7	Climate Action 1	Online	08-Oct-19	41 min	2
8	User-Finland to Russia	Online	14-Oct-19	77 min	1
9	Climate Action 2	Online	18-Oct-19	63 min	4
10	User-Finland to Norway	Online	07-Nov-19	56 min	1
11	Rescue Plan	Online	11-Nov-19	101 min	8
12	User-Russia to Finland	Online	21-Nov-19	27 min	1
13	Rovaniemi Final	Online-	18-Dec-19	240 min	9

	meeting Rovaniemi			
TOTAL	Online 11 /In person 2	13 focus groups	Ap. 19 hours	45 participants, 20 different people

A case study protocol (Appendix 2) was created to keep track of the study and make it replicable and rigorous (Brereton et al. 2008). I kept a personal journal, which helped me to note down my reflections between writing and the focus groups. The journal also contains field notes written after the focus groups met. I was not able to make field notes in locus as I was both facilitating the focus groups and writing in the maps most of the time. Table 5 shows the focus group meetings conducted during the case study, and Table 6 shows the included projects. In total, there were 13 focus group meetings, 11 of which took place online and two of which took place in person. All of the focus groups were audio recorded via iPhone. In one of the in-person focus groups, participants were separated into two groups, and one of these group's audio recording failed. This was the only time this happened. All of the other times, the audio was successfully recorded.

The participants in the focus groups came mainly from five different mobility as a service (MaaS) projects, as Table 6 shows. People from different areas were invited to certain focus groups to present their views. All five different MaaS projects were always invited to all of the focus groups, except the meetings with final users in order to protect their identity. The use of the mapping tool and WPs was introduced three times—in the beginning, in the middle and in the final focus group. In the final focus group, the participants evaluated the tool and the process via a survey (Appendix 3), which included 11 open-ended questions and 11 statements in which the answers were evaluated on a scale of 1–5. The survey was designed to answer the two research questions. The average age of the seven survey respondents was 41 years old with an average of 12 years of experience in their field. The backgrounds were diverse (a majority were public sector representatives) and none of them had the same background. Most of the participants were Finnish, and one participant was from Russia. There were Norwegians in previous focus group meetings, but they were unable to come to the final focus group and hence did

not respond to the survey. Only those who had participated the last meeting could answer the survey since it contained questions related to the last focus group. The research data were triangulated (Bailey and Bailey 2017) through the mapping in the focus groups, the evaluation forms and the research diary with field notes. Two researchers were involved in the writing process, and for the analysis of the data, peer review-style meetings were held between the authors to discuss the analysis.

Table 6. MaaS projects involved in the mapping (adapted from Suoheimo and Lusikka 2020, 173)

Project	1) Barents on Time	2–3) Open Arctic MaaS	4) Visit Arctic Europe II	5) Sea Lapland Tourism MaaS
Website	https://kolarctic.info/	https://www.arcticmaas.fi/	https://www.lme.fi/hankkeet/visit-arctic-europe-ii.html	http://www.meri-lappi.fi/fi/ajankohtaista/meri-lapin-matkailu-maas/
Description	Barents on Time is a project that is initiating collaboration between Finland, Russia and Norway and concentrates mainly on cross-border bus services. It aims to make a website and	The Open Arctic MaaS project portfolio consists of two projects for the development of mobility services in Northern Finland. The project has worked to promote internal accessibility and the digitalisation of transport in sparsely populated areas. The vision is to significantly promote and integrate local and tourist	The Visit Arctic Europe II project concentrates on developing year-round, sustainable and high-quality tourism in Finnish and Swedish Lapland and Northern Norway. Mobility planning is essential in getting the tourists to their	In Tourism MaaS, the tourism product itself is at the forefront of the service package, and the transfer is an additional service. Currently it is challenging to link tourism and mobility services. The

	app to sell tickets to cross-border travellers.	mobility services by making them simple and reliable, thus enabling sustainable travel.	destinations.	main goal of the project is to link the Maas services as part of the tourism business.
Project Partners	Finnmark County Administra-tion–Centre for Economic Development in Norway; Centre for Economic Develop-ment, Transport and the Environment (ELY Centre) in Finland; Murmansk Avtovakzal in Russia	Lapland University, VTT Technical Research Centre of Finland; SITRA; Kideve Kittilä Development; Regional Council of Lapland; ELY-Centres of Lapland & North Ostrobothnia; Ylläksen Matkailuyhdistys Ry; Pyhä-Luosto Matkailuyhdistys ry; Municipalities of Sodankylä, Kemijärvi, Muonio, Enontekiö, Salla and Pudasjärvi; Inari Municipal Business & Development Nordica; Naturpolis Ltd.; Apinf Oy	Finnish Lapland Tourist Board, Swedish Lapland Visitors' Board, Northern Norway Tourist Board	Sea Lapland municipalities: Kemi, Keminmaa, Tervola, Tornio and Simo; tourism companies and mobility operators in the area

3.5 Evaluation of the Quality of the Research

In qualitative research, reliability it is important, and the researcher's approach must be consistent across the researchers and research projects (Creswell 2009). This section will discuss the reliability, validity, replicability and limitations of each of the methods used in the sub-studies. Sub-studies I and II are presented together since they are both literature reviews and thus have

many similarities even though one is a systematic literature review and the other is a desktop literature review.

3.5.1 Sub-Studies I and II

Sub-studies I and II used literature reviews for collecting data. The first sub-study used a systematic literature review, and the second used a desktop literature review. In literature reviews, the assumption is that the representation of the given data depends on how the data were selected. One important issue in literature review data collection is how it is limited in terms of time and when the data are collected (Webster and Watson 2002). The results can be different if the data are collected one month or even one day earlier or later. Both studies give a timeline of when the data were collected. Furthermore, the sources of information create limitations for the results. For the desktop review in these cases, scientific rigor is looser in comparison to the systematic literature review.

The reliability of a desktop literature review can be questioned in the sense of how the researchers' own abilities to find information can influence the results as well as the selection of search engines to find the literature. The systematic literature review's validity is higher as a research protocol was created to make the study more rigorous and replicable (Webster and Watson 2002). Boundaries were also set to limit the results that are searched (Webster and Watson 2002) as well as specific inclusion and exclusion criteria (Budgen and Brereton 2006), which are all presented in the protocol (Appendix 1).

The interpretation of the data has been done solely by me in the desktop literature review. In the systematic literature review, the data were also analysed by me, but peer review-style meetings were held with other authors to discuss the coding. As Saldaña (2013) wrote, coding is a qualitative and interpretive act where the coder distils data. It is possible that someone else would do the coding differently in some ways. The background knowledge or the prejudices that a person may have can also influence the results (Long and Godfrey 2004). I consider both literature reviews to be reliable in the sense that generalizations and conclusions are possible, keeping in mind that the desktop review as a method is more limited.

Sub-study I's aim was theory creation, and it used several theories to create the "Iceberg Model of Design Problems." This can be viewed as one method of theory triangulation (Denzin 2009). Many of the theories had similarities and thus could be applied together. The literature review pointed to issues that would require a model more specifically directed at the design field.

3.5.2. Sub-Study III

Sub-study III was a single case study, so the conclusions are limited to one experiment. More case studies should be performed in the service design context to increase the validity of the results and the reliability of the tool. This PAR case study is qualitative, and the method's reliability can be questioned particularly in the sense that it was conducted by one person. As a researcher, I can have biases or prejudices that can influence the results (Long and Godfrey 2004). I believe that my background as a service designer had some influence since I suggested conducting user interviews, thus bringing the service design perspective into the use of the tool. Making the map as a facilitator requires skill in giving the actual decision-making power to the participants. As a facilitator, I was able to lead the conversation towards certain issues, such as getting the end-users' perspectives during the focus groups, but the aim was still to give stakeholders the power to draw the map. In fact, when I was preparing for the last meeting, I made the connections myself beforehand, but my map and the connections that the participants made were different.

If a person from another background conducted the same mapping, the results could be different. It is difficult to know without performing a similar mapping process in similar conditions with experts from mobility planning inside the Barents region. Future studies can be done as comparative case studies on how one person to another from the same field would do the mapping. This person having or not having a service design perspective could also influence the process and the results. I assume that another service designer would be equally concerned about how the users' voices are considered in the mapping process. The aim was to investigate how Mess Map™ works in the service design context, and thus this was one issue influencing the use and the adaptability of the tool, given my perspective in the context of service design. The cross-border mobility case study of Mess Mapping™ was my third experiment using the tool as a researcher. The sub-study III reporting was

done with another author. The study's internal, external and construct validity were considered when creating the research protocol (Appendix 2).

The selection of the group, i.e., the main mobility projects involved, was made based on the suggestions of the initial participants. This was a kind of snowball sampling as one project invited another and so on (Etikan, Alkassim, and Abubakar 2016). The same thing happened when asking the specialists to discuss the emergency-related issues. The "users" were found through a Facebook announcement or via emails. These samples are selective and the results could be slightly different if, for example, other MaaS projects were involved. For example, Sweden was not covered in this study, considering the geographical setting (Long and Godfrey 2004).

We can assume that the number of participants is sufficient for the generalization of results although more people could have been involved. However, it would have been difficult to manage a much larger group as there were already 20 different participants. The results of the mapping as well as the survey results can also be different if participants respond on a different day. In addition, a different set of participants can bring different results (Long and Godfrey 2004). Sometimes, participants may also want to or not want to please the researcher with their responses. The aim was to provide a neutral atmosphere. I also assume that there might have been some power relation- or hierarchy-related issues between the participants as some were in managerial positions, which can also compromise the honesty of some responses. The participants' cultural backgrounds can also influence these hierarchies.

Participants' consistent attendance in the focus groups most clearly had an influence on the survey. The published report of the case illustrates how the survey responses from the group with poorer attendance was not as consistent with the results from the others. It is possible that this group did not have enough of an opportunity to grasp what the tool was since they had missed all of the occasions on which it was presented. Power relations between participants can also influence the mapping process in the focus groups or the survey responses even though anonymity in the use of the data was promised to the participants. Considering all of these issues, I recognise that the generalisability and conclusions of this case study are possible, keeping in mind that they are limited to this one case study context within the framework presented.

In qualitative research, when working with people, it is challenging to obtain the same measurements twice (Eskola and Suoranta 2005;

Hirsjärvi and Hurme 2004). It is also important to consider that the interpretations of a situation are unique, and it is possible that the researcher would not make the same interpretations again. This makes qualitative research difficult to replicate. Nevertheless, Buchanan (2001, 18) pointed out that case studies might "give insight into problem that reach beyond the individual case."

Transferability of the sub-studies

Considering the transferability or external validity in terms of how the research in each sub-study can be generalised in other settings, I believe that each sub-study could be applicable for service designers, transition designers, social designers, design for sustainability, interaction design, systemic design, community design, design for policy, design for change or any other field, such as organizational studies, that handles WPs. Many of these cited fields deal with services, but it is worth noting how the areas between the fields can be quite blurry as they work often in parallel to achieve similar aims.

3.6 Ethical Considerations

Ethics must be considered in various parts of the research. I also believe that selecting the research topic should be ethically done so that it can benefit society. It is through tax money coming from the Finnish nation that we are able to have universities and keep the research going. In this sense, the research should somehow contribute back to society and be of high quality so that scientific trust is maintained with society (Kiikeri and Ylikoski 2004).

Ethics should be considered in all stages of collecting and analysing the data. All of the participants in the case study were asked to sign a consent form. They were informed that I would be participating as a researcher in a study of making the map, and I was collecting material for my thesis. I was an independent researcher with a one-year grant from the Lapland Regional Fund of the Finnish Cultural Foundation, which was also explained to the participants of the cross-border mobility case study. When I applied for this funding, I received a recommendation from a participant in a leadership position at one of the projects in the case study. My status was that of an observer participant in the PAR case study. The participants' names in all of the case studies have been

anonymised, and the recordings have been saved to a password-protected external hard drive. I took into consideration the ethical guidelines of the European Union's Horizon 2020 framework programme when I started creating the mobility case study. As a researcher in a Finnish university, I am also obligated to follow the norms of the Finnish National Board on Research Integrity (TENK).

The research has sometimes involved speaking to "gatekeepers" to access the participants needed. There have been also power issues in the researcher's relationship with the participants as some participants have a high-level professional status and needed invitations from parties that are from the same level as they are. This is highly related to cultural issues that are not relevant when working in a Scandinavian context, where generally power relations are low. Considering the ethics of scientific publication, the project managers had an opportunity to read the material before publication.

In terms of ethical considerations relating to the systematic and desktop literature reviews, I believe that the data need to be reliable. In the systematic literature review, the data were submitted for peer review that was transparent, but it was not published together with the article. Peer review-style meetings were held among the authors to discuss any issues about the data collection and analysis. A systematic literature review protocol was also created to ensure that the study was "rigorous, replicable, and extensive" (Peters et al. 2015, 142).

The Researcher's Role

Researchers bring their values to the research, and their aim is to impact the phenomenon or problem under study (Jacobs 2016; Ozanne and Saatcioglu 2008). Qualitative research is interpretive, and the researcher is involved with the participants in different situations (Creswell 2009). Here, ethical, personal and strategic issues can arise (Locke, Spirduso, and Silverman 2013). Creswell (2009) discussed in more detail about how the inquirer's own analysis or interpretations of the study can be biased by values, personal background such as gender, history and culture, and also by socioeconomic status. According to Creswell (2009), a solid qualitative study contains comments from the researcher about the interpretation of the findings in relation to their personal background.

I facilitated the process of making the Mess Maps™ in the focus groups as a service designer. I am a Finn born in Finland, but I have spent more than a decade in Brazil and obtained double citizenship as a Brazilian in 2017. It is possible that my background as a Finnish person who has lived abroad for a long time could influence the way I perceive the mapping and the issues raised. I have a great deal of experience travelling to the north of Norway and Russia, but I do not have this perspective as a native person of Russia or Norway. These issues also speak to interpretivism and the need to have different parties involved in the process.

Before the mapping, I did not have broad experience in mobility planning. My practical knowledge was limited to some service design workshops and courses in the field. I had also attended conferences, read many reports, academic articles and newspaper articles and browsed a lot of online material related to the topic. I did not have a similar background to any of the participants that attended the Mess Map™ focus groups. Moreover, the participants did not share any similar backgrounds. As a facilitator, my aim was not to overly influence the participants' conversations, but in my role as the only service designer, I was sometimes the only one looking at the issues from the user's perspective, and I asked questions in that direction. I agree with Guba and Lincoln (2004, 26) that in qualitative research, the values of the researcher "will inevitably influence the inquiry."

3.7 Summary of the Methods Used in Each Sub-Study

This part aims to show the summary of the three sub-studies. Table 7 was created to show the data and methods used in each sub-study to create new knowledge for the questions asked. Each study is linked to the others. Sub-study I uses the systematic literature review as a method to collect data to understand the connection to and role of service design in WPs. Sub-study II continues to investigate the tools and strategies indicated in sub-study I through a desktop literature review. From these tools, sub-study III investigates the Mess Map™ and how it can be applied in a service design context through an action research case study that uses focus groups, audio recordings, the created map, the research diary with field notes and the evaluation forms as a type of data triangulation.

Table 7. Three sub-studies of this thesis (research questions, data and analysis)

Main research questions and sub-questions	Sub-study	Article	Data collection method	Analysis
What is the relationship to and role of service design in WPs? (RQ1: What is the connection between service design and WPs? RQ2: What is the role of service design in tackling WPs?)	I	Suoheimo, Mari, Rosana Vasques and Piia Rytilahti. 2020. "Deep Diving into Service Design Problems: Visualizing the Iceberg Model of Design Problems through a Literature Review on the Relation and Role of Service Design with Wicked Problems." *The Design Journa,l* submitted for review.	Systematic literature review, 55 articles analysed from 10 different design journals	The collected material was qualitatively coded (Saldaña 2013). Theory triangulation was applied in creating the "Iceberg Model of Design Problems" (Denzin 1978).
What are the tools and strategies created specifically to handle WPs that service design can benefit from? (RQ1: What are the visual tools designed specifically to handle WPs? RQ2: What are the strategies	II	Suoheimo, Mari, 2019. "Strategies and Visual Tools to Resolve Wicked Problems." *The International Journal of Design Management and Professional Practice* 13 (2): 25–41.	Desktop literature review (various research articles about tools and strategies)	The tools encountered were qualitatively analysed and separated: Mess Map™, Resolution Map™, Dialogue Mapping (and other similar tools) and General Morphological Analysis. Three strategies of

				authoritarian, competitive and collaborative approaches in relation to tools were also analysed.
Validation of the Mess Map™ tool by investigating its advantages and disadvantages in an empirical service design context (RQ1: (A) How did the Mess Map™ help the projects and entities to identify common challenges in MaaS development? (B) How did the Mess Map™ help to identify stakeholders for creating a common strategy? RQ2: What are the advantages and disadvantages of using the Mess Map™ in service design projects?)	III	Suoheimo, Mari, and Toni Lusikka. 2020. "Process of Mapping Challenges of Cross-Border Mobility in the Barents Region." Paper presented at the Sixth International Conference on Design Creativity (ICDC2020), Oulu, August 26-28., 170-177.	• Focus groups (13 in total, with 20 different participants) • Audio recordings (approx. 19 hours) • Actual map • Research diary with field notes • Evaluation forms	PAR case study (Kemmis 2009); The empirical material collected was analysed through data triangulation (Bailey and Bailey 2017).

4 Results

This section aims to present the results and findings of each sub-study separately as they correspond to different research questions.

4.1 Approaching Wicked Problems in Service Design (Sub-Study I)

4.1.1 The Relationship to and Role of Service Design in Wicked Problems

Sub-study I investigated the relationship between service design and wicked problems (WPs) and the types of roles service design plays in handling them. The results from the third cycle of coding show the WP themes that were most frequently cited in the articles selected for the systematic literature review (Figure 3). Social change was first, followed by change, sustainability, politics, systems, the environment, public services, climate change and urban planning in descending order of frequency. The themes with the fewest mentions were organizational change, uncertainty and cultural issues. If sustainability, the environment and climate change were all grouped under sustainability, it would be the largest group. Additionally, if different areas of change such as social change and organizational change were brought together under the "change" term, it would create a new and interesting result. However, I preferred to leave them separate since this way we can see different nuances of change and sustainability.
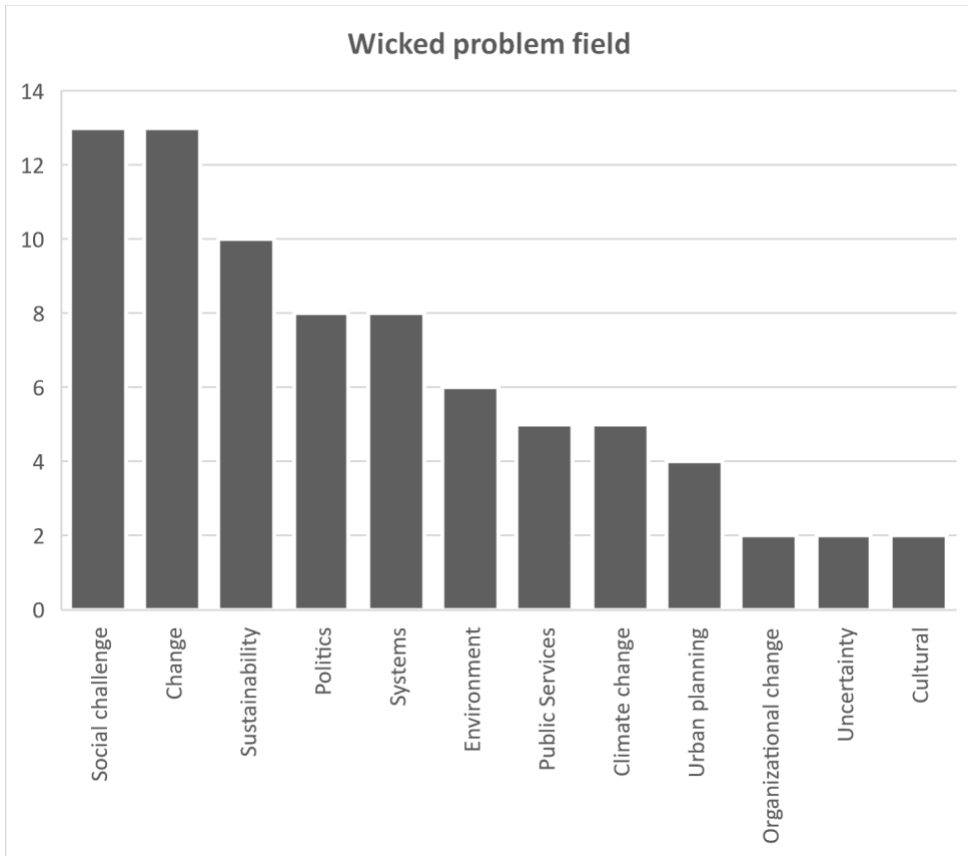
Figure 3. WP fields mentioned in the articles (Suoheimo et al. 2020, submitted for review)

Below is a list of some of the examples of WPs identified from the systematic literature review:

- organisational change (Schanz and De Lille 2017)
- climate change and global warming (White and van Koten 2016)
- public services (Deserti and Rizzo 2014; Prendiville 2018)
- transportation (Evans 2013; Jones and Bowes 2017)
- unemployment (Deserti and Rizzo 2014)
- healthcare (Deserti and Rizzo 2014; Tsekleves and Cooper 2017)
- uncertainty (Augsten and Gekeler 2017)
- social change (Souleles 2017)

- alcoholism (Champ 2018)
- urban planning (Westerlund and Wetter-Edman 2017)
- citywide infectious disease management (Jones and Bowes 2017)
- urban–rural wild ecosystem management (Jones and Bowes 2017)
- childhood obesity (Jones and Bowes 2017)
- "real world problems" (Zahedi, Tessier, and Hawey 2017)

The same literature also dealt with service design in one way or another.
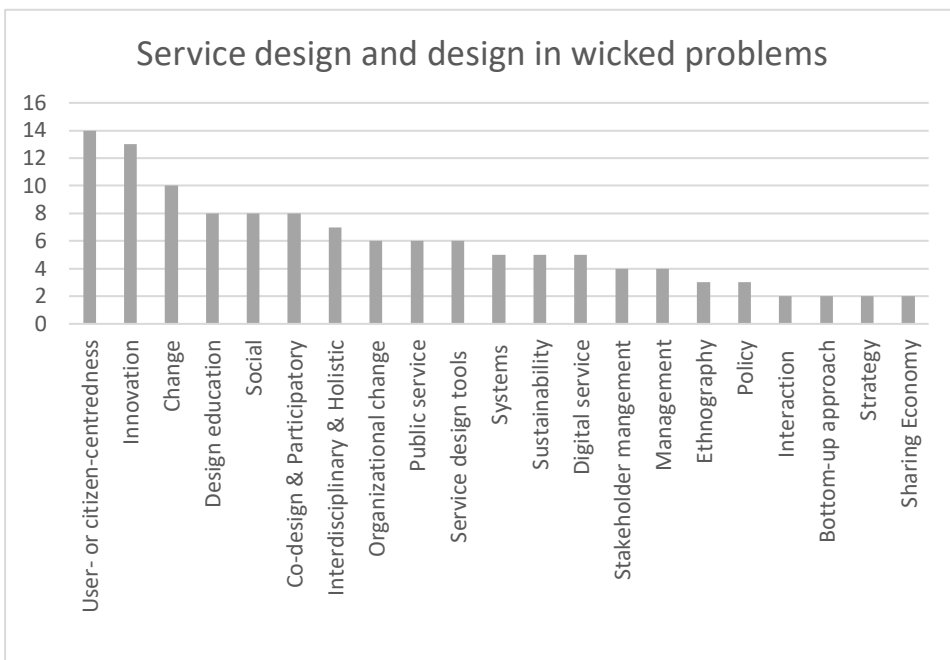
Figure 4. Words coded from the WPs in the service design and design fields (Suoheimo et al. 2020, submitted for review)

The themes most frequently raised in relation to service design (or design) in the articles in relation to WPs were user- or citizen-centeredness, innovation and change (Figure 4). These were followed by design education, social, co-design and participatory approaches, interdisciplinary and holism, organizational change, public service, and service design tools. The themes with

the fewest mentions were interaction, bottom-up approach, strategy and sharing economy. Many articles expressed the need to take a deeper look at service design and design education in terms of how it needs updating to better prepare new service designers.

An analysis of Figures 3 and 4 together shows that many of the words overlap. Figure 5 shows the themes that service design and WPs had in common. The themes were change, social, sustainability, politics, systems, public services and organizational change. We can see that service design connects to WPs through the themes of sustainability, politics, organizational change and public services with the aim of bringing change to the current status quo.
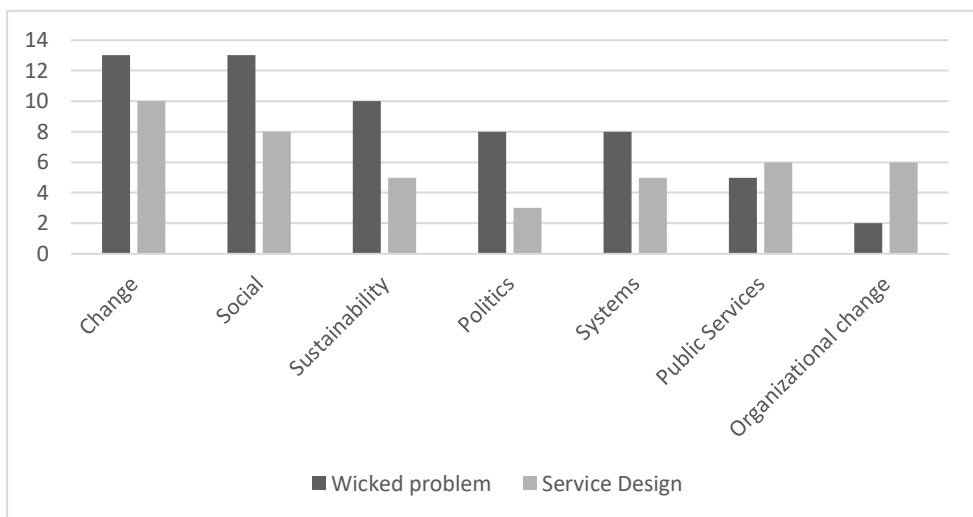
Figure 5. Themes and their frequency compared between WPs and service design (Suoheimo et al. 2020, submitted for review)

It is difficult to approach service design very separately from other design fields since it was often handled together with Transition Design, social design, design for sustainability and other design fields related to WPs. I agree with Dixon and Murphy (2017, 59), among other authors, that the role of design lies in change, and "strict delineation of sharp professional boundaries is no longer possible." Schanz and De Lille (2017) even ended their article by asking what the exact role of design is. I attempted to code separately how the role of service design was explained in the selected articles, but I ended up coding the

same parts as in the previous cycle. In this way, it is possible to inductively conclude that service design's role in WPs is, through collaborative (interdisciplinary and holistic) approaches, to bring about change and innovation by including users, citizens or communities in the process of creating the services. Through this, the service designer or designer in the process is an agent of change and can be in the role of facilitating or mediating the process. Table 8 summarises these results.

Table 8. Summary of the findings of sub-study I (adapted from Suoheimo et al. 2020, submitted for review)

Findings	References
Service designers **aid in creating innovations** to tackle WPs	Irwin, Kossoff, and Tonkinwise 2015; Schanz and De Lille 2017
The service designer's or designer's role is to be a **facilitator or mediator** of the process of **collaboration, participatory design and co-design**	Augsten and Gekeler 2017; Bofylatos and Spyrou 2016; Junginger 2017; Prendiville 2018; Sepers 2017; Souleles 2017; Westerlund and Wetter-Edman 2017; White and van Koten 2016
Service design or designers are **agents of change** or facilitators in **transdisciplinary, interdisciplinary or holistic** group work.	Augsten and Gekeler 2017; Engeler 2017; Schanz and De Lille 2017; Parente and Sedini 2017; Penin, Staszowski, and Brown 2016; Sepers 2017; Tonkinwise 2015
Service design **is present in many other fields**, e.g., it has importance in **social design, political design, management, organisational design and sustainability**.	**Social:** e.g., Irwin et al. 2015; Penin et al. 2016; White and van Koten 2016
	Political: e.g., Bofylatos and Spyrou 2016; Penin et al. 2016
	Management: e.g., Tonkinwise 2015
	Organisational: e.g. Schanz and De Lille 2017
	Sustainability: e.g., White and van Koten 2016
Service design and WPs can deal with political-level problems	Bofylatos and Spyrou 2016; Parente and Sedini 2017

Designers use **visualisation skills** to create shared understanding.	Jones and Bowes 2017; Parente and Sedini 2017
There is a **need to better train service designers** in the scope of WPs.	Augsten and Gekeler 2017
There is a need to focus the design of the **environment (sustainability) and not only for the user.**	Evans 2013

4.1.2 The Iceberg Model of Design Problems

According to Webster and Watson (2002), a well-made literature review creates or enhances theory. The aim of this is to mirror the data with WP-related frameworks and explore how to combine them. This can be seen as one way of theory creation, where different theories are brought together. Sub-study I looked at WP theory as well as the theories of Head and Alford (2008) and how they explained WPs in the management field. Table 9 shows how problems can be categorised by Head and Alford (2008) by basing their initial views on Heifetz (1994).

Table 9 has two axes—diversity and complexity. On the diversity axis, when a problem is simple or tame, there is no diversity of opinions among the participants since they all share the same opinion or goal. When a problem is a bit more complicated, there are multiple parties, where each one has some relevant knowledge of the problem. In the final stage, there are multiple parties, all of whom have conflicting interests and values. On the complexity axis, when a problem is simple, the problem and its solution are known. When the level of complexity arises, there is some knowledge of it, but in the case of WPs, neither the solution nor the problem is known. Head and Alford (2008) categorised problems from 1–9, but Suoheimo (2016) found that it would be more practical if there were only three categories: tame (simple) problems, complex problems and WPs. Other authors, such as Grint (2010) and Roberts (2000), have also supported the categorization of problems into three categories.

Table 9. Typology of Problems

Diversity → / Complexity ↓	1. Single party, as all share the same opinion or goal (Head and Alford 2008)	2. Multiple parties, each having only some of the relevant knowledge (Head and Alford 2008)	3. Multiple parties, conflicts in values/interests (Head and Alford 2008)
A. Both the problem and solution are known (Heifetz 1994)	1 Very tame problem (Head and Alford 2008; Roberts 2000)	2 Tame problem (Head and Alford 2008; Roberts 2000)	3 Complex problem (Head and Alford 2008; Roberts 2000)
B. The problem is known, but the solution is not, or the other way around (Heifetz 1994)	2 Tame problem (Head and Alford 2008; Roberts 2000)	3 Complex problem (Head and Alford 2008; Roberts 2000)	4 Wicked problem (Head and Alford 2008; Roberts 2000)
C. Neither the problem nor solution are known (Heifetz 1994)	3 Complex problem (Head and Alford 2008; Roberts 2000)	4 Wicked problem (Head and Alford 2008; Roberts 2000)	5 Very wicked problem (Head and Alford 2008; Roberts 2000)

Note: Adapted from Head and Alford (2008, 7) and Suoheimo (2016, 100).

Table 10 illustrates on a more practical level what the different problem typologies can be. A very simple problem is tying a shoelace, and a simple problem is designing a remote control. Complex problems can be issues such as how to create a library service for children. WPs can be described as services to tame unemployment or enhance education in slums. Very WPs are issues on another level of complexity, such as how to tame global warming. As a practical example of the problem typologies, making an envelope is a simple problem

and can be solved, but what about designing a physical envelope that has almost no environmental impact in its production and delivery? This illustrates how a simple problem can become a wicked one just by shifting the perspective.

Table 10. Examples of the typology of problems with cases

Very simple problem	Simple problem	Complex problem	Wicked problem	Very (super) wicked problem
How to tie a shoelace?	How to design a remote control?	How to create a library service for children?	How to create a service for unemployment?	How to tame global warming?

Buchanan (1992) has already discussed design problems and WPs. In his article "Wicked Problems in Design Thinking," Buchanan (1992, 9–10) introduced four orders (or areas) of design problems: 1) "symbolic and visual communications" (graphic design), 2) "material objects" (industrial or product design), 3) "the design of activities and organised services" (service design) and 4) "the design of complex systems or environments for living, working, playing, and learning" (systems, interactions). Service design is more related to the third order of design problems (problems of action), but it also plays a role in the fourth order. I believe that the third and fourth orders are more related to WPs, but this can depend on the perspective that one brings to them.

Borrowing the micro-, meso- and macro-frameworks from the social sciences (DeCarlo 2018), it seems that WPs are more related to macro-level issues since they deal with societal challenges (Horn and Weber 2007; Rittel and Webber 1973) although they also have an impact on meso- and micro-level issues. For a social worker, the micro-level issues are interactions between one person and another, and meso-level issues are when a group of people is involved (DeCarlo 2018). Macro-level refers to institutions and policies coming

onto the scene, which can affect communities or even issues on a national level (DeCarlo 2018).

Figure 6. The Iceberg Model of Design Problems (Suoheimo et al. 2020, submitted for review)

In sub-study I, WP theory, Buchanan's four orders of design and the framework of micro-, meso- and macro-levels and the results from the systematic literature review were brought together to form the "Iceberg Model of Design Problems" (Figure 6). The idea emerged from the challenge indicated by several authors who saw how the design field treats complexities and WPs too simplistically and how design tools or methods are designed for relatively simple problems or situations (Hillgren et al. 2011; Norman and Stappers 2015; Sanders and Stappers 2008). "Some actors working with social innovation have recently expressed concerns about the role of design in this field, pointing out

the weaknesses of designers and the limits of design methods" (Hillgren et al. 2011, 172). Understanding the theory in-depth influences how the field will handle the practice. Using tools that have been designed for simple problems on WPs can be painful (Conklin 2006). The time and resources required to use the tools designed for simple problems and for WPs is different. Additionally, the amount of collaboration will increase the more wicked the problem becomes. In their article "DesignX: Complex Sociotechnical Systems," Norman and Stappers (2015) point out that designers tend to seek simplistic solutions for complexities and thus may end up hitting an iceberg. The problem that seems to be simple has deep roots in WPs.

There are already iceberg models that have been put forth about the issues of complexities. One commonly used model is in organizational studies, where the problem is the organisation. Here, we wish to examine a phenomenon, which could be an organisation, but we do not want to be limited only to organisations. The iceberg model in systems thinking presented by Boylston (2019) resonates more and influenced this "Iceberg Model of Design Problems" as he writes how the mental models or paradigms are at the deepest level of the iceberg. This reverberates with the idea presented by Head and Alford (2008) about how stakeholders have different values and interests. It is the deepest level that influence the layers above, which Boylston (2019) describes as underlying structures, patterns and events. The events or simple problems are at the peak of the iceberg and appear at sea level.

As the systematic literature review shows, some examples of the issues that service designers or designers in other related design fields deal with as WPs are organizational change, political issues or urban planning, which have macro-level policies. Giving designers and service designers a basis that is familiar to them, such as Buchanan's (1992) four orders of design, and reflecting this in other theories can help the discipline to move forward in dealing with complexities and WPs in the ways they require, thus not simplifying the problems. This requires further investigation into the methods created to deal with WPs. Many authors demand new tools, but could it be that we are unfamiliar with tools that might already exist and can be applied in the design field?

4.2 Strategies and Visual Tools to Handle WPs (Sub-Study II)

4.2.1 Strategies to Handle WPs

Sub-study II investigated the tools that have been created specifically to deal with WPs. Tools that can be used for both simple problems and WPs were excluded, leaving only the tools that were made specifically for the WP context. At the same time, sub-study II aimed to investigate the strategies that have been used or recommended for the WP context, namely, authoritarian, competitive and collaborative approaches (Grint 2010; Roberts 2000). Authoritarian strategies are common, and they concentrate power on a small number of people (Roberts 2000). Roberts (2000) saw this strategy as one way of simplifying a WP. Competitive strategies also have a long history and have been used especially in the field of commerce (Roberts 2000). There are advantages to this strategy as in the commercial sector as companies will need to look for new ideas and eventually grow their businesses (Roberts 2000). Here, the power is decentralised, and it can circulate among the parties involved (Pfeffer 1992). Some disadvantages of using a competitive strategy are that it can also incite violence or even wars (Roberts 2000). The collaborative strategy is different as the initial idea is to create a win-win and not a win-lose type of situation (Roberts 2000). Doz and Hamel (1998) explained that if different parties work together, they can find better products or services. On the other hand, using the collaborative strategy requires more meetings, more people and more time, and for this reason, more resources are needed for it to be effective (Roberts 2000). Roberts (2000) also pointed out how collaboration is like an acquired gift that needs practice.

4.2.2 Results of Tools Encountered in Light of Strategies

The tools encountered through the desktop search were Mess Map™, Resolution Map™, Dialogue Mapping (and other similar tools) and General Morphological Analysis. These are analysed in Table 11, where each of the tools is presented in the first column. The second column aims to analyse whether the tools supported authoritarian, competitive or collaborative strategies. It was also investigated whether the tool can be hand-drawn or created through

computerised visualization, or both. Next, it aims to specify a degree of a need for a designer doing the visualization, using a scale from 1–5. Then, the kind of role the designer would play in using the tool is considered. The last column presents types of purposes the tool was made for, in other words, if it was designed to understand a WP or to tame it.

Table 11. Analysis of visual and graphic tools used only for WPs (adapted from Suoheimo 2016, 110; 2019, 40)

TOOL	Strategy: Authoritarian, Competitive, Collaborative	Hand-drawn/ Computerised	Need for a Visual Designer (1–5)	Designer's Role	Goal
MESS MAP™	Collaborative	Hand-drawn /Computerised	5	Facilitate the collaborative work and visualise the conversation as well as the mapping	Understand the problem
RESOLU-TION MAP™	Collaborative	Hand-drawn /Computerised	5	Facilitate the collaborative work and visualise the mapping	"Resolve" the problem
DIA-LOGUE MAP (and similar tools)	Collaborative	Hand-drawn /Computerised	4	Facilitate the collaborative work and visualise the conversation	Understand the problem or "resolve" the problem
GENERAL MORPHO-LOGICAL ANALYSIS	Collaborative	Computerised	3	Facilitate and visualise	Understand and "resolve" the problem

All of the tools are designed to use collaborative strategies, and some have a greater need for a designer. Additionally, the need for visualization varies as the Mess Map™ and Resolution Map™ seem to require more visualization in comparison to the other two tools. The General Morphological Analysis is made using computer, but the other tools can use a computer or be visualised by hand-drawing. All four tools are designed to involve stakeholders in defining the problem or to handle it by creating joint strategies. Stakeholders need to collaborate with each other although they might not agree with each other's opinions (Rittel and Webber 1973). This enforces Roberts's (2010) idea that the competitive strategy could be more unproductive in comparison to the collaborative strategy. These results show how there have been tools created for the WP context, mainly in the management or political studies fields, but it seems that they are not very well known in the design and service design fields.

4.3 Applying the Mess Map™ in Cross-Border Mobility in the Barents Region (Sub-Study III)

4.3.1 WPs in the Context of Mobility as a Service

Sub-study III investigated how the Mess Map™ tool was applied in a service design project by looking more deeply at the tool's advantages and disadvantages in the service design context. It was selected from sub-study II since it is more visual and is used in the phase of understanding a WP. Sub-study III also seeks to understand how the tool can help entities to identify common challenges in WPs and to find stakeholders for creating a common strategy. The specific WP case was cross-border mobility in the Barents region. Using WPs as a theory in for the mobility as a service (MaaS) or transportation perspective is quite novel as the search on Scopus in November 2019 was able to find only 27 documents with the words "wicked problem* AND transportation OR mobility OR maas."

MaaS or transportation planning fulfils the ten characteristics defined by Rittel and Webber (1973). For example, it is difficult to define what the problem exactly is since there are many layers in MaaS development. The problems are also constantly evolving as society changes and new needs arise. Laws change, and with today as an example, the mobility planners in many

countries are required to attend to people with special needs (e.g., blind, physically disabled and speakers of minority languages). It is difficult to define MaaS solutions as "true or false," so "better or worse" is preferred. Making decisions, pilot programmes or experiments in mobility planning may change the scenario positively or negatively. For example, building a new road in an indigenous land can bring unforeseen consequences for the local people. MaaS planning is vital as peoples' subsistence depends on it. Givoni (2014) used WPs in the context of sustainable mobility, and Noto and Bianchi (2015) adopted WP theory in transportation analysis. Lyons (2016), on the other hand, saw WP theory as useful for meeting the need of good stakeholder engagement when building better transportation futures. The field of mobility has many barriers, and breaking them down is a challenge (Eckhardt et al. 2018). How the problem is defined will also influence the way it is treated and the possible "solutions" created for it (Rittel and Webber 1973). We need to bear in mind that WPs do not have solutions, but I use this word for lack of a better one.

4.3.2 Results from Mess Mapping™

After 13 focus groups and half a year of collaborative work, a final map was generated (Figure 7). I conducted the focus groups and took notes on all of the online conversations and the topics that were raised in the map. In the in-person meetings, the participants were able to make the sticky notes themselves (Figure 8). The participants evaluated the map in the final meeting and raised the issues that they saw as most relevant. These were indicated with stars on an A1-sized printed map. The areas that gained stars were emergency planning; users, travellers or marketing perspectives; climate actions; creating a service encompassing existing services; legislation in terms of forms of ticketing or differences in laws between countries; and technological issues. Overall, the stars across the map showed the importance of collaboration and commitment. It is common in service design facilitation to use stickers to highlight issues that are found to be the most important. This helps to allocate resources more adequately. In the final meeting, the participants also used different coloured pens to draw connections between the problems, called causal links (black). Other connections were established with collaboration (green) in mind as well as how the fields interconnected with each other (red).
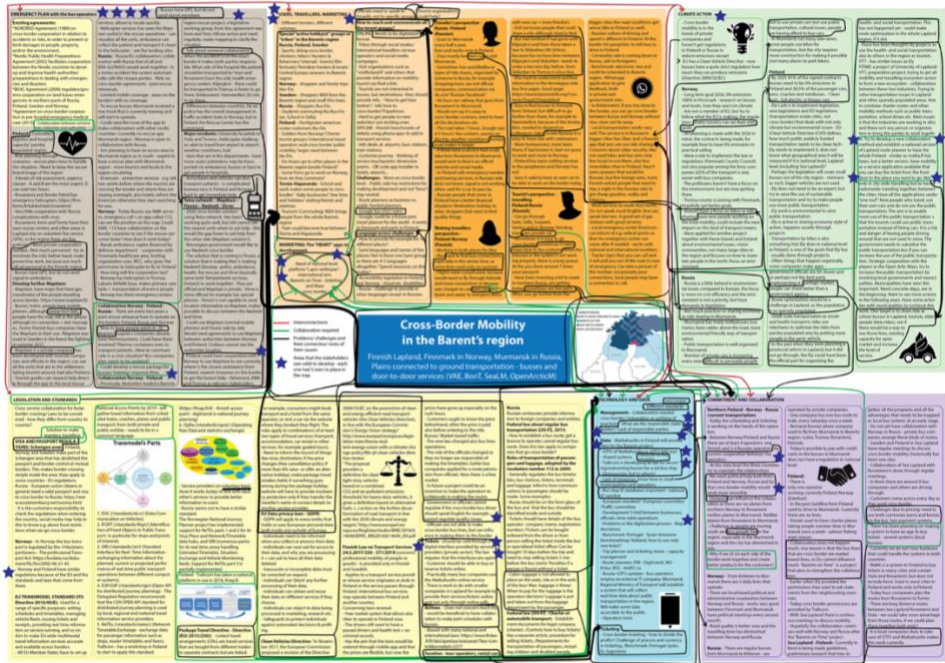
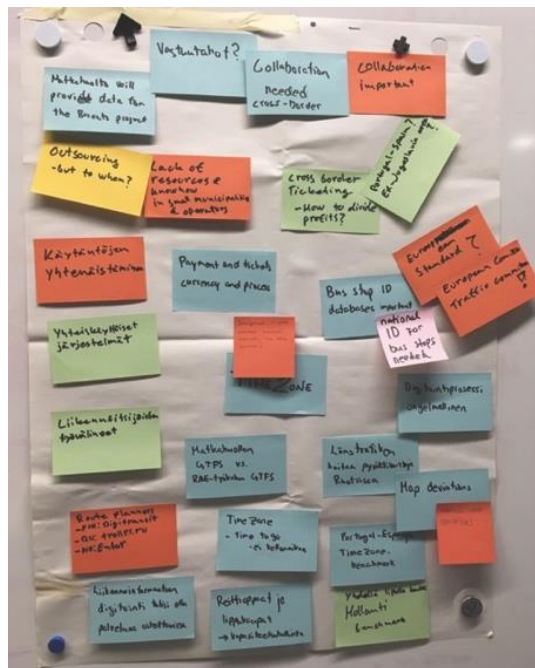**Figure 7**. The final Mess Map™ (see Appendix 3 for a larger version)

Figure 8. Sticky notes made in an in-person meeting

An analysis of the survey responses showed the participants reported that they had met new stakeholders. As one participant reported (FG05), they knew that some stakeholders were important to collaborate with, but they had not yet met them. Two participants (FG01, FG04) described how both national and international government officials were important in building a common strategy. One (FG02) saw that EU-level experts on transport legislation should be involved to co-create better mobility services. This was also indicated in the meetings. Additionally, participants such as bus companies, tourism entrepreneurs, airlines and train companies should be involved. We had many of these parties involved already, but an even larger group would be needed. All of the survey respondents saw a need to continue to collaborate further upon the common goals identified.

When examining the advantages and disadvantages of the tool, one participant (FG01) reported that the tool was appropriate because it pointed out the relevant stakeholders. Some said it gave them a lot to think about (FG04) or that it took too much time (FG02). One wished it could be more condensed (FG05). Most thought that the map covered the issues well and did not have anything else to add to the map. When considering improvements, the participants were more concerned about technical issues such as wanting the A1-sized map in the final meeting to be larger (FG04) or concerns that the online participants were not as present as the in-person participants and could miss out on information (FG05, FG02). It is worth noting that the online participants did not report these issues themselves, so it is possible that those at the in-person meetings were better able to see what the online participants were missing out on.

While analysing the questions on a scale from 1–5, the participants were quite uniform in their responses that the tool was able to map the cross-border mobility problems in the Barents region (4,6). They also thought that they had learned something new (3,9), had "aha moments" (4) and felt that they were heard (4,6). This is important in service design projects where different stakeholders' voices are visible, especially the end-users. Many felt that their participation was relevant (3,9). They thought that they work with WPs (4,4), but not many thought they would use the Mess Map™ tool in the future (3). Nevertheless, many thought that the tool had been suitable for their project or entity (4,1).

When reviewing the personal notes, one participant made a comment that the day's focus group had helped them to process their thoughts about the

project. Another note was about the end-users' participation in the mapping process. As a facilitator in one of the focus groups, I asked if the mappers saw it as relevant to interview some users from different countries in the process, and the response to this was a long silence. I re-phrased the question to ask if they thought it was important to have end-users participate, and only one expressed that it was always important to hear from the end-users. It was also understood that most of us, when meeting in person at the focus group meetings, would choose to travel with our private vehicles and not use public or private mass transportation service, which is understandable in the sparsely populated region. On the other hand, it shows the importance of the work being done. In the end, I created a table (Appendix 5) that gathered the main areas raised in the final focus group, as instructed by Horn (2018). The discussion section will debate more in-depth the implications of this participatory action research (PAR) case study.

4.4 A Summary of the Key Findings

Sub-study I

The coding of the systematic literature review of articles related to WPs and service design showed how the themes of the most frequently cited WPs were social change, change, sustainability, politics, systems, environment, public services, climate change and urban planning. The most frequent terms under service design were user- or citizen-centeredness, innovation, change, design education, social, co-design and participatory approaches, interdisciplinary and holism, organizational change, public service and service design tools. Many of the themes were the same as the ones coded for WPs, such as change, social, sustainability, politics, systems, public services and organizational change.

Table 8 shows that according to the key findings, the service designer's role according to the articles is to aid in making innovations for WPs by facilitating the processes of interdisciplinary or holistic group work that aims to make change. Service design was also present in many fields. Many articles pointed out the need for repositioning design and service design education and how the boundaries between disciplines were becoming blurred. WPs were present in many fields, and service design was often handled in a political

context. Moreover, many of the articles mentioned in the paper indicated a need for the future development of tools or strategies.

The study also showed how there are some issues showing that there is a lack of profound knowledge of WPs are due to some claims made in design-related publications as that all design problems wicked (Ameli 2017), which is not the case. The "Iceberg Model of Design Problems" was created to help service designers and those in other related fields to understand the type of approach that would be suitable for each type of problem.

Sub-study II

Sub-study II investigated through a desktop literature review the tools that have been developed solely for WPs, thus excluding the tools designed both for simple problems and WPs. Only four tools or their adaptations were discovered, namely, Mess Mapping™, Resolution Mapping™, Dialogue Mapping (and similar tools) and General Morphological Analysis. The analysis of the tools indicates a preference for the collaborative strategy, which also seemed to be the most favoured strategy in the literature review among the competitive and authoritarian strategies. The tools can also benefit from having designers facilitate their visual form and collaboration. They all are visual to some degree although some are more visual than others. The Mess Map™ was the most visual in comparison to the other tools in the initial stage of understanding a WP, as shown in Table 5.

Sub-study III

Sub-study III tested one of the tools found, the Mess Map™, which is used to create a shared understanding of a WP. The PAR case study showed many benefits and some disadvantages. A summary of the key findings is shown in Table 12 based on the survey results and the research diary with field notes. Difficulties included the power relations between the participants or the facilitator. There was a challenge in getting important people involved or having them commit to the process from the start until the end. Making the map also took a lot of time. On the other hand, there were many benefits, such as enabling the dialogue between participants and making their voices heard. The map enables stakeholders to see the larger picture of a WP, but it also can be used to zoom in to the details. It also helped to visualise the problem dynamics and indicated areas for the future development of a WP. The Mess Map™ was

used as a tool in the context of complex stakeholder management, and it allowed the participants to identify stakeholders needed for future development of the WP.

Table 12. The advantages and disadvantages of using the Mess Map™ tool

Disadvantages	Advantages
Difficult to involve all necessary stakeholders in the process	Enables dialogue between participants, stakeholders and others important to the WP matter–gives each participant a voice in the mapping
Power relations among the participants	Enables holistic understanding
Challenging to get participant commitment from the beginning to the end	Sees the big view, but also shows details by zooming in and out
Generalization of the problem—hides nuances	Aids in visualizing and understanding the dynamics of the relations between the problems
Takes a lot of time and joint effort—having enough time can be a challenge	Includes stakeholder mapping
	Shows possibilities and pain points for future development
	Can help stakeholders commit by seeing their importance in the problem
	A foundation to create a shared strategy

5 Discussion and Conclusions

The main objective of the research was to describe wicked problems (WPs) as challenges in service design. This thesis examined the topic through three main research questions:

1) What is the relationship to and role of service design in WPs (sub-study I)?
2) What are the tools and strategies created specifically to tackle WPs that service design could benefit from (sub-study II)?
3) Validation of the Mess Map™ tool by investigating its advantages and disadvantages in an empirical service design context (sub-study III)?

5.1 Summary

Understanding the Complexities Involved when Approaching WPs

(Sub-Study I)

The systematic literature review seems to have exposed a research gap in the service design and WP fields. None of the articles had the term "service design" and "wicked problem" together in the key words. All of the selected articles were read through to ensure that they dealt with both issues. The most cited term in the systematic literature coding was "user- or citizen-centeredness" regarding services in the WP context, which could mean that the aim of service design is to bring user- or citizen-centeredness to the WP process in order to create change, which requires innovation. The role of the service designer was inductively reasoned similarly to be someone that brings change (innovation), places the users at the centre and facilitates or mediates the process. The tools of service design seem to be used in WPs to bring users, citizens or communities to the development process, along with the other relevant stakeholders. Innovation is also required so that change can occur. In the coding, many words were equal in service design and for the WPs that the articles discussed. One in particular was public services. Policies play a role here as public services are often regulated by a country's laws. The relationship of

service design to WPs is that some services that service design deals with include WPs.

In a more detailed, holistic approach, collaboration among disciplines, professionals and "end-users" was an issue that emerged in the systematic literature review about the relationship to and role of service design in WPs. On the other hand, this also emphasises how it is difficult to place service design as a separate discipline since transdisciplinary and holistic approaches are required. As already noted, many of the articles were intertwined with many other design fields, such as Transition Design or social design, and it was often not easy to discern whether the authors were clearly discussing service design. This can, on one hand, show how service design does not act alone and that the process is holistic even within the design field. The same would probably apply to the other mentioned design fields as well. I welcome more studies and insight regarding this matter of holism or the transdisciplinary approach as well as the relationship to and role of service design in WPs. I hope these subjects can be discussed more in the design field.

Sub-study I identified childhood obesity, poverty and citywide infectious disease management as some example WPs, and I believe that service design would be needed to tackle all of these. Interestingly, most of them can be associated with public services such as transportation, addiction treatment or infectious disease management. Their value can be measured in ways other than economic. One key finding that these results seem to show in terms of the strong connection these WPs have with service design is that they have a social and/or societal side to them, which WPs also have (Horn and Weber 2007; Rittel and Webber 1973). Another important discovery is that WPs may also be connected to politics, which, in a way, very much goes in hand with social and societal issues; Vink (2019) also recognised this in her recently published thesis. Interestingly, Rittel and Webber's (1973) seminal article that brought forth WP theory was first published in the journal *Policy Sciences*. These findings strengthens the academic conversation in design field of how to prepare designers and service designers to tackle WPs when our current school curricula seldomly handle political issues.

The "Iceberg Model of Design Problems" (Figure 6), presented in the previous chapter, aims to help designers to comprehend the different problem levels that may exist in the fields of service design, Transition Design, social design, design for sustainability and other design fields related to WPs. This theoretical framework can aid in setting up an approach or mindset required for

WPs in particular. According to Westerlund and Wetter-Edman (2017, 17), "Designers whose mind-set and approach works well considering the impact in Buchanan's first and second orders, may not have the tools, mind-set or approach to create understandings of the impacts in the third and fourth orders of design." I argue that finding this "correct" mindset or approach could help our field handle WPs more efficiently and not oversimplify them.

Oversimplifying WPs includes using tools that were designed for simple problems. Some authors point out that tools (Conklin 2006) that were not designed for WPs can make the process of taming WPs painful. A simplistic approach can lead to "Band-Aid" solutions that can aggravate the problem in the long term (Boylston 2019). The current study leads to sub-study II, about understanding the tools and strategies that already exist and which can be used in the service design field. This can prevent those in the field from creating new tools in cases where tools from other fields can be adapted to the service design practice.

Collaborative Strategy and Visual Tools to Handle WPs (Sub-Study II)

Through a desk top literature review, sub-study II was able to find four tools designed to tackle WPs: Mess Mapping™, Resolution Mapping™, Dialogue Mapping (and other similar tools) and General Morphological Analysis. These tools were not designed to handle simple problems. As the literature indicated, the most recommended strategy among the authoritarian, competitive and collaborative strategies seems to be the collaborative strategy. Moreover, the tools all support the collaborative strategy as they all were designed to be used in collaboration with different stakeholders. It is important to have the right stakeholders since how the problem is defined leads to finding how it can be tamed (Rittel and Webber 1973).

All of the tools are visual in one form or another and can benefit a designer in making the visualization as well as facilitating the process. Further studies are required to test each of the tools in a service design context. All of these tools were created to make changes, and I share the same concerns as Sangiorgi (2011, 29), who pointed out that "service design is entering the fields of organisational studies and social change with little background knowledge of their respective theories and principles." Recently, Vink (2019) published a thesis that uses an iceberg model applied from organizational studies

(Sackmann 1991), which seems to show the tendency of service design moving more in that direction of organizational field.

By analysing the four tools found sub-study II, designers can take them to other levels in their visualization process by using computerised tools or even artificial intelligence. Using certain colours or visual language can have an influence on how people perceive the issues that arise. In this way, designers can emphasise one are area over another, which can be both beneficial and harmful for development. Harmful in the sense that the designer may leave an important issue for development unnoticed.

The more wicked or complex the situation, the more collaboration it seems to require. Service designers have the training to work in collaborative environments, but they also have the empathy-building tools to understand the problem from the user's or community's perspective. Facilitating or mediating the process is a type of managerial position, but it parts ways from the horizontal principle, where the participants are at an equal level, and bottom-up approaches are fostered (Souleles 2017). The study did not deal with the design thinking, double-diamond or soft systems methods as it aimed to find more tools and not larger methods. More research would be required to understand how these three or other similar methods can be applied in service design and WP-related contexts. Sub-study II concludes that, through the use of these tools, designers can be seen as tamers, mediators and visualisers of contemporary problems that might be wicked.

Long-Term Collaborative Development in Cross-Broder Mobility (Sub-Study III)

The participatory action research (PAR) case study using a Mess Map™ about cross-border mobility in the Barents region aimed to answer the third question about the advantages and disadvantages of the Mess Map™ tool. The findings are shown in Table 12. In total, five disadvantages were found regarding the power relations between the participants that could have influenced the mapping and the fact that the mapping took too much time and resources. On the other hand, there were many advantages, eight in total. These included the participants feeling that they were heard and that their views were gathered in the mapping. This enables a holistic understanding. Issues that could have been controversial may have become understandable to the stakeholders since they were there to listen to each other. The map also allowed the participants to start to create a shared strategy. Another important issue was that the mapping

helped in identifying relevant stakeholders. The next paragraphs will explore in greater detail some of the issues that arose.

The Mess Map™, as an advantage, was able to gather together a large number of stakeholders to discuss their shared problems, thus helping with stakeholder management. Getting the right people together right from the start to collaborate is a very novel perspective in research development. Often, researchers conduct interviews to understand problems, but they seldom have the stakeholders meet, discuss and interact, thus allowing stakeholders define what the problems are. Unless a researcher applies dynamic group interviewing, it will be difficult to give the decision-making power to the stakeholders. Stakeholder involvement can also aid in creating commitment.

One focus group showed me how getting the participants involved can reveal to them that they play a role in the bigger picture even though they themselves had not perceived it at first. There was a case where one participant was reluctant to come to one of the focus groups. It took several emails and phone calls and other participants inviting this person to come to the meeting. In the focus group, it was interesting to witness how this person eventually began to interact with the participants easily by bringing insights from a cross-border perspective and issues relevant for collaboration. This example taught me how mapping can make it visible to stakeholders that they actually have a role although they might not perceive it right away. On the other hand, the participants sometimes did not have sufficient time resources, required for this kind of development, in addition to their normal work, which is a disadvantage. Many of the advantages and disadvantages can be paradoxical, such as commitment. It is difficult to get people involved at the outset and during the process due to a lack of time. On the other hand, experience showed that participating a meeting helped people to see their importance and thus created commitment as they participated in the process.

It is important to have people meet as the mobility sector is shown to have barriers (Eckhardt et al. 2018); the question is how to break these barriers. Having the participants meet and discuss the issues can make them perceive the roles each one has in the broader context and recognise the gaps that exist. In one of the meetings, the participants were able to recognise that there were issues that no one was really responsible for, which is a great advantage of the tool. In service design, these are called "pain points," which require future investigation.

It is essential to note that this kind of development works in a participatory environment where hierarchies are relatively flat or non-existent. As researchers, we were able to see that not all of the participants' cultural backgrounds made them familiar with such development, which is a disadvantage. This finding arises in the conversations designers have about the difficulties of working in hierarchical organizational surroundings (Johansson and Woodilla 2008). Here, I would suggest future studies on how designers can work with collaborative and participatory practices when the hierarchies related to cultural contexts do not allow it.

In the last focus group, participants were able to see their common challenges, and many placed stars on the same points for further development. Later on, I made an Excel table that gathered the most important issues participants had defined together and sent it to them with a camera-ready conference paper (Appendix 5). This is a good basis for making a common strategy, and future work can be done with Resolution Mapping™ or with a roadmap. The tool also seems to be quite malleable as one can adapt it to the field that it is currently being applied in. This kind of interaction can foster holistic understanding as many different professionals come together to discuss the WP. The map can give a broader picture, but one can also zoom in to see more details, which is very beneficial in development.

This case study revalidates the "Iceberg Model of Design Problems" (Figure 6) in the sense that targeting the WPs requires tools that are designed for them so that the problems are not oversimplified. I doubt that one person alone would be able to create a picture or see how the issues interconnect with each other like we did together during the mapping. One problem can be connected to several areas, and in many cases, the collaboration was about the issues between the problems, shown by causal links in black and collaboration in green. This kind of work requires more time, collaboration and resources as the "Iceberg Model of Design Problems" also shows (Figure 6).

Some participants did not fully participate in the way that the mapping required. Similarly, as the tool can foster engagement, getting people engaged at the outset is a challenge. In the end, time will show how the different entities commit after the mapping process. Initially, as Horn (2018) pointed out, participants have an initial image of what the problem is, but they will start seeing the interconnectedness during the mapping process. Other issues that I noticed during the facilitation process were some power relations due to cultural differences. In addition, it is not easy to engage everyone that should

be involved. Still, the map shows some areas that were not covered by the participants involved but should have future collaboration, such as involving tourism companies. In this case, the main participants were from public entities.

Tools such as stakeholder mapping and ecosystem mapping that are generally used in service design rarely involve a large number of people, and they take much less time to develop. They give a good initial picture, but since they do not involve many stakeholders, the collaboration element is lacking. In fact, these tools can serve as a foundation to start making a Mess Map™. The Mess Map™ itself shows the stakeholders and other entities involved in the WP, but it is larger than a stakeholder map or an ecosystem map. As this case study illustrated, some stakeholders knew of the existence of others and knew that they were relevant to the collaboration, but they had not met previously. I think it will be much easier to collaborate in the future and across borders when people have met at least once or twice to discuss matters in common rather than reading reports that identify the problems. This is what the Mess Map™ fostered as many participants were exchanging business cards during the development process. Future studies should be done on creating a Mess Map™ by using a stakeholder or ecosystem map as a base.

From the service design perspective, the tool was successful in the sense that it is holistic and fosters collaboration, but the involvement of users and their viewpoints could have been better elaborated. It was seen in one of the meetings that user-centred development was not familiar to all of the participants. This can make the mapping process more centred on the organizations' needs if the users are not part of the process. Both sides are important, but this is a gap from the service design perspective. I was able to make some participants heard by interviewing them, but analysing this afterwards, it would be more effective to use tools to create empathy during the process. Professional developers could be taken into the field through service journeys or by shadowing customers travelling across borders. An example situation can be a person making daily commutes across borders to work or study. These kinds of exercises could be done during the mapping or even afterwards to complement the data collected. Including these kinds of empathy-building activities, on the other hand, requires more time and investment, which is also noted in the "Iceberg Model of Design Problems." I believe that there is a need for building toolboxes in a future study to better prepare service designers and designers in other fields such as Transition Design, social design, design for policy or design for change.

Transferability of the Findings of the Three Sub-Studies

WPs can encompass many kinds of issues, ranging from health and urban planning to immigration and peace-planning issues. The proposed framework, the "Iceberg Model of the Design Problems" and the tools and collaborative strategies in this thesis can even apply to global pandemics such as the COVID-19 situation that we are currently experiencing. Governments provide services to tackle WPs, and often the laws of a country as well as the politicians who administer funds are actors that regulate the activities that take place. Other issues such as climate change and global warming (or COVID-19) are super WPs because they are larger systems than what a country's public services can address alone. They require international collaboration, regulation and development.

The "Iceberg Model of Design Problems" (sub-study I) can aid in understanding the complexities involved in various kinds of WPs by looking at them from the macro-level perspective. For a problem to become a WP, it should contain the ten characteristics that Rittel and Webber (1973) defined. WPs can be various and from a wide range of fields, but what they all seem all to have in common is that they are social in some way or another (Horn and Weber 2007; Rittel and Weber 1973). A connection to politics is also evident (Rittel and Weber 1973). The "Iceberg Model of Design Problems" will aid, for example, in preparing a team as it starts to deal with a WP and plan the resources required for executing a plan. The deeper the level of the "iceberg," the greater the need for time and resources. A collaborative strategy is essential in approaching a WP (sub-study II). It is somewhat naïve to think that one person alone can understand such a complexity and draw conclusions about what to do. Since WPs are handled collaboratively, it also leads to the question of what belongs in each field as (service) design is extending more towards organizational studies and politics. On the other hand, having a familiarity with tools or even terminology from other disciplines will enable better cross-disciplinary work. I suggest future studies about service design relating to organizational studies and politics as these were not discussed in this research but were issues that arose repeatedly.

Through understanding the big picture through Mess Mapping™ (sub-study III), the level of complexity (sub-study I) will aid a team in being more realistic about the resources they have at hand and to approach issues accordingly. When one understands the greater interconnectedness of a WP, it is easier to understand that work in one sector will influence other sectors (the

boxes or chunks in the map). It is also essential to be "down to earth" and not exaggerate the effects of the interactions in a project dealing with a certain WP. The Mess Map™ can only aid in understanding the structural changes required in each WP case. The PAR case study in sub-study III is unique and difficult to transfer to other applications (limitations are discussed in chapter three), but the use of the tool is transferable. It can be used for and adapted to other WPs, not only the one handled in this thesis. Tools designed for WPs take time as they are made to handle macro-level changes, as discussed in the literature review. A team should not begin to approach the complexity of a WP if it is not prepared for it in terms of time and resources.

The "Iceberg Model of Design Problems," on the other hand, can bring clarity to problems that should be called wicked and those that are not. It is quite interesting how our field discusses handling WPs, but not many of the tools designed for them, identified in sub-study II, have been applied more broadly in the field. I see a need for future studies on applying the four tools in the design field.

5.3 Final Conclusions

The research began by investigating WPs as service design challenges. Sub-study I dealt with them most clearly by pointing how service design handles them or has a role in collaborative approaches when designers act as a facilitators or mediators, which was inductively reasoned from the results of the systematic literature review. Bringing the user's point of view was also discussed. The relationship of service design to WPs is how service design can handle a range of WPs, which often seem to be related to public services.

As Kemmis (2009, 1) pointed out, "Action research aims at changing three things: practitioners' *practices*, their *understandings* of their practices, and the *conditions* in which they practice, (with added emphasis)" I think that this PAR case study and the two other sub-studies were able to allow reflection on the practice of our field. Sub-study I and the thesis literature review pointed out the problem of designers' tendency to oversimplify wicked or complex problems and that the field needs new tools, methods and strategies to approach them (e.g., Avdiji et al. 2018; Bofylatos and Spyrou 2016; Hillgren et al. 2011; Norman and Stappers 2015). This thesis fills this gap by introducing strategies and tools as well as theory to start dealing with WPs with the

required "seriousness." Sub-study II was able to find tools that are not yet common in the service design field, which could be tested and analysed if they were more widely implemented in service design. Sub-study III tested Mess Mapping™, one of the tools encountered in the literature. The thesis also responds to the insights in Dufva's (2020) megatrend report about how to handle complexities, see their connections and divide the power. I recommend using more mapping tools such as Mess Map™ in the design field so that we can see and better understand the interconnectedness of WPs.

Working with WPs requires a new mindset or approach that is different from what we have used previously and perhaps which are not taught in many design schools. Designers are good at handling chaos and zooming in and out of problems (Johansson and Woodilla 2008), which gives us a good foundation for handling WPs, but even so, WPs require more. We should bear in mind that not all design schools are the same, and many universities have begun to create courses related to WPs (e.g., Carnegie Mellon University; University of São Paulo, Federal University of Paraná), which is one example of the need for change in design education to handle complexities and WPs. In sub-study I, it was indicated very clearly that design education is in transition, and it needs to be redirected so that new students can be properly prepared to handle complexities and WPs (Augsten and Gekeler 2017; Dixon and Murphy 2017; Sepers 2017; Schanz and De Lille 2017; Westerlund and Wetter-Edman 2017). Education is the optimal place to start making the shifts of change within the practice of any field.

Teaching or working with WPs may be about changing our perspective, mindset or approach in how we deal with WPs in the first place by handling issues more on a macro-level. This thesis has unravelled how service design works or could work in close collaboration with politicians and people in power to make decisions so that a citizen-centric view can be implemented in decision-making processes. One discovery was how some service design fields have social, societal or even political contexts in their development. This means that we can have courses that focus on these topics so that the next generation of students can learn new skills and even the vocabulary to handle issues related to public policy, management studies, anthropology (Penin et al. 2015) psychology, sociology and philosophy (Willis 2015). I recommend future research on how to create inter/transdisciplinary courses so that the students can obtain these skills.

This thesis aimed to introduce a complexity paradigm (Gummesson 2017) to be used in parallel with the interpretive paradigm (Serva et al. 2010). This may represent an initial sift in mindset or worldview to begin to approach WPs and larger complexities. It could also be one step towards not simplifying problems. As Gummesson (2017) pointed out, complex problems should be kept complicated. Design as a field often cuts problems up into more manageable parts, but it may be wiser to do this only after the bigger picture has been viewed, and the interrelations that one needs to be aware of have been recognised to see how dealing with one WP area will influence the other. Making "Band-Aid" solutions is not an option as WPs have consequences (Rittel and Webber 1973). I also wish to invite scholars to debate the paradigmatic positioning that would be most beneficial for WPs. I believe there is more to study about this issue. Yolles (2020) introduced a new paradigm, called the relational paradigm, for dealing with WPs, which also requires future study about how it applies in the design and service design fields. Taking into consideration the findings, the participatory paradigm also requires future studies, and the critical theories paradigm may be suitable for WPs in marginalised communities or in post-colonial contexts.

Figure 9. The evolved model showing how service design and WPs relate

In light of the findings, a collaborative strategy is essential, and for this reason, I ended up rethinking Figure 1 (presented previously in the theoretical

framework) and added the collaborative strategy in between service design and WPs. Collaboration can occur on many levels, and different tools can aid in fostering it. Figure 9 shows only one tool, the Mess Map™, that applies quite well in a collaborative strategy. It is one tool that I recommend adapting as part of the service design discipline to better understand the bigger picture that service design aims to see and not to "hit an iceberg" when approaching complex issues with a simple problem mindset.

One discovery of the thesis is the common feature that socially oriented services seem to share with WPs, which is the political angle as public services or other services related to WPs are bound by a country's laws. These laws ideally represent the interests of the political parties that have been voted into power by the people in democratic countries. For this reason, I have updated the model and added into the green circle that the field of service design, which handles WPs, can have social and political contexts. This creates a distinction between more commercially oriented services such as refuelling a car in a gas station and socially and politically oriented issues such as how to design public services related to unemployment. Here, we must bear in mind that a simple problem can become a WP if the perspective changes. The example of a service at a gas station can become wicked if it is viewed from the perspective of creating a sustainable and environmentally friendly fuelling service. At this point, macro-level issues would need to be addressed. The assumption that service design and WPs relate through social issues was confirmed, and there was the addition of the political angle of these problems.

As this thesis ended up testing only one of the tools found in sub-study II, I recommend conducting further studies to test the other tools encountered and see how they might work in service design to deal with WPs that handle macro-level issues. A specific toolbox for WPs could be created, which can aid service designers in tackling WPs. The Mess Map™ is not the strongest tool for applying user-centeredness. For this reason, I suggest more studies on how to orientate or adapt it, or to explore whether a toolbox can be created so that empathy-building regarding the problem and "user" could be covered parallelly in the development process. Another aspect that this thesis did not cover is the context of WP theory within systems theory. I believe that there is a strong connection, and future studies analysing the two theories in service design would be an interesting path of study.

Service design in its essence is centred on user experience, but in larger service contexts, it can consider all stakeholder needs within that context.

Transition Design has been positioned towards the latter (Scupelli 2015). For this reason, it may be useful for service designers to work in collaboration with transition designers or create hybrids with Transition Design when handling the fourth type of macro-level WPs. When service design advances, so do the services that serve people in our countries and, depending on the case, across borders as well. Often, people's well-being depends on the services they are provided, especially those from the public sector. Services are important even in the sense of creating over 70% of the GDP in OECD countries (OECD 2000).

  I wish to mention Souleles (2017) again, where the author described how participatory design makes the participants into co-designers during the design process, which is one way of sharing decision-making power and is in opposition to hierarchy. After the three sub-studies, I realise that for a participatory strategy to occur, a democratic environment is needed. In a top-down, authoritarian culture it would be difficult to create a collaborative environment. Doing development in such context would require different methods and tools to break the initial "ice." Cultural issues of power relations are something to consider when working on WPs together. In Northern Europe, we may take participatory development for granted, but in cultures with stricter hierarchies, this type of development can be much more difficult to achieve. The user is no longer at the centre as the hierarchies were built to support a privileged group. The lowest layer of the "Iceberg Model of Design Problems" (Figure 6) is about the values and mental models that exist in a context. These are macro- and meso-level issues and can include how a certain culture creates and maintains their values. This is all reflected in the process of taming WPs.

  WPs are not "solvable" or "tamed" in a short amount of time. This mindset takes the current funding instruments into consideration as they are often designed as six-month-long to four-year-long projects. Making more effective change can take decades in wicked, macro-level problems. Another complex issue in working on WPs is how national or city governments change and set up new targets, which can end up hindering long-term development. This was an issue raised in the sub-study III case study. In past years in Finland, there has been news about WPs in the country such as youth marginalization (Islannin Mallista Helsingin Malliin [From the Icelandic Model to the Helsinki Model] 2020) and domestic violence (Asenteiden Muutosta Perheväkivaltaa Kohtaan Tarvitaan [Attitude Change to Domestic Violence Needed] 2020), which cannot be simply "projects" that start and end; there is a demand for more consistent policies and funding for these issues. Fostering long-term development requires strategic thinking and collaborative strategies. There are

many societal WP challenges to be tackled such as refugee policies, sustainability, social marginalization and urbanization, and it will be interesting to see future studies on how the service design field will handle and tackle them. I agree with Woodham and Thomson (2017, 237) that service design can "be successfully shaping new approaches and providing possible solutions to often intractable or 'wicked' problems" and "reflect new approaches to policy-making that would have been unimaginable even ten years ago."

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Appendices

APPENDIX 1/ Systematic Literature Review Protocol (Sub-Study I)

SYSTEMATIC LITERATURE REVIEW PROTOCOL

Aim	Description
Question	What is the relation and role of service design in wicked problems?
Objective	The objective is to find articles that show what is the relation and role of service design in wicked problems. We start with an assumption that there is a research gap in the area that the research also aims to show. Needs clarification as the word wicked problems is not often well explained. Find out what is the current literature of the topic.
Protocol	The whole process of making the literature review (as the aims, questions, selection of articles ...) was made in meetings among the authors and with peer-review way of seeking best practices.
	Author A reviewed articles from: THE DESIGN JOURNAL/ SHE JI/ INTERNATIONAL JOURNAL OF DESIGN/ DESIGN STUDIES/ DESIGN MANAGEMENT JOURNAL/ DESIGN MANAGEMENT REVIEW/ STRATEGIC DESIGN RESEARCH JOURNAL, total number of articles: 43
	Author B reviewed articles from: DESIGN PHILOSOPHY PAPERS/ DESIGN MANAGEMENT JOURNAL/ DESIGN AND CULTURE, total number of articles: 12
Search strategy	The research directly to design journals was more accurate. There was not latest articles researched at the Luc Finna university portal. It was decided that the journals should have a Finnish Publication Forum ranking. Conference proceedings were left out. List of the journals selected: THE DESIGN JOURNAL/ DESIGN AND CULTURE/ SHE JI/ INTERNATIONAL JOURNAL OF DESIGN/ DESIGN STUDIES/ DESIGN PHILOSOPHY PAPERS/ DESIGN MANAGEMENT JOURNAL/ DESIGN MANAGEMENT REVIEW/ STRATEGIC DESIGN RESEARCH JOURNAL.
Process of selecting articles	The research was conducted directly at the journals portal with the words 'service design' and wicked (problem). The words with relation to wicked problems such as sociotechnical systems or hard systems (systems thinking) were left out. The focus was given to wicked problems only. The terms 'service design' and 'wicked problem' (both entered with quotation marks) were very limited and were abandoned for this reason. It could be that some authors refer to wicked issues in other terms and not just as problems. The timeline of the articles was the last five years, from 2013 to 2018, and all the research was done in September and October of 2018. We used this timeline to see what is the state-of-the-art research in the field. Book reviews, opinions and editorials were excluded. We tried with a wider scope too before the year 2013, but there were even less articles that the research engines from the journals was able to find.
Inclusion and exclusion criteria	Needs to explain well what is service design and wicked problems that is not "accidentally" there. Many were left out for not being able to show it. The articles were also rated as high, medium and low. High: were able to explain the 10 points of Rittel and Webber or otherwise the wicked problem was very clear for example by showing that the cases treated were essentially wicked with social connotations. One important fact is that the problem in question should be social as wicked problems are social. Could be that the article did not explain thoroughly all the points, but otherwise the problem at had could be clearly be seen as wicked. It was not simple as some are case studies and others more philosophical texts. Medium: the 10 points were somehow explained or reader could have some certainty of the wicked problem. Low: the writer was unable to explain wicked problems and it was unclear for the reader if the text really was treating a wicked problem. It does not mean that the excluded articles would not necessarily treat wicked problems, but it does not come thoroughly clear for the reader. Some might really treat them and there were many very good papers, but it was necessary to set them aside. Also, articles that had the word wicked only in the references, were immediately excluded. This was the case often with the Buchanan's article about "Wicked problems in Design Thinking", as it appeared in the references only with the word wicked the research engine selected it.

Aim	Description
Process of extraction of relevant information	An excel table has been created with columns extracting basic knowledge of the publication first: Author/ YEAR 2018-2013/ Institution/Faculty, organization, etc./ Country/ Name of the Article/ Journal/ Keywords/ N. of Citations Google Scholar, Oct, Nov 2018/
	Each article was marked by the name of the reader
	CYCLE 1: At the pre-phase as pilot review the table had columns to extract important parts of the text with marks form the readers: Input: complex/ wicked problem service design relation and contribution/ Relevance WP - SD/ Field of wicked problem/ Role of Designer (Service designer). This was sufficient to know what articles to include and exclude.
	CYCLE 2: At the end phase more exact information was needed and the columns were formed as: Wicked problem fields; Descriptive code - field of wicked problem; How Service Design is raised?; Descriptive code (summarizes the primary topic of the excerpt). These columns helped to extract more detailed analysis made by coding.
	CYCLE 3: Counting the actual codes and regrouping them under synonyms.
	All coding was performed by author A in collaboration and peer-review meetings with author C.
Coding rules	Codes for wicked problem fields/ Codes with words related to service design: fields that they treat; what kind of service; how the service tackles the wicked problem/ Codes for roles of service design
	Also, there was applied grouping of the codes in the way they were synonyms or otherwise under the same topic. For example, the words change, transition or any other similar words were gathered under the term change. Other example could be words as transdisciplinary interdisciplinary, multi-level or holistic, so they were gathered together. Most grouping was performed with the wicked problem areas as there were so many of them. For example there were many public services mentioned as "library services" or "citizen centric services". All these were gathered under the public services, still the healthcare was kept separately although it could be a public service in some countries. There were also words coded from the same article as sustainability and environment, these although come close got own separate codes.
	"one vote (number) for each article" - If the article for example treats two or three things of a same category, only one gets a vote. Codes that were cited only ones were not included to the results as they did not get support form other articles.
	Example of two categories: Organizational change or service systems - separated to organization and change/ service and systems - still one for each article
Results and data synthesis	The results found are provided in a separate table.
Discussion	Discussion is realized in a form of an article.
References	Protocol made according to: Reeves S, Freeth D. 2006. Re-examining the evaluation of interprofessional education for community mental health teams with a different lens: Understanding presage, process and product factors. J Psychiatr MentHealth Nurs 13:65-770. / Hammick, Marilyn, Timothy Dornan, and Yvonne Steinert. "Conducting a best evidence systematic review. Part 1: From idea to data coding. BEME Guide No. 13." Medical teacher 32, no. 1 (2010): 3-15. / Saldaña, Johnny. The coding manual for qualitative researchers. Sage, 2015. / Webster, Jane, and Richard T. Watson. "Analyzing the past to prepare for the future: Writing a literature review." MIS quarterly (2002): xiii-xxiii.

APPENDIX 2/ Case Study Protocol (Sub-Study III)

Cross-Border Mobility in the Barents Region

CASE STUDY PROTOCOL

POINTS	PLAN
General	This specific case study aims to study the challenges of cross-border mobility in the Barents region. Five different MaaS projects are involved in the project of Mess Mapping™ the challenges.
Background	Making a search at Scopus in November 2019, the research engine found 27 documents in total with the words "wicked problem* AND transportation OR mobility OR maas". More literature on the topic was issued only in the recent years 2014-2018. The specific research questions for this case study are: 1) How did the Mess Map™ help the projects and entities to identify common challenges in MaaS development? How did the Mess Map™ help to identify stakeholders for creating a common strategy? 2) What are the advantages and disadvantages of using Mess Map™ in service design
Design	Conducting a single case study of applying wicked problem theory and Mess Map™ in a novel context, which is MaaS development. The aim is to test how the tool applies policy sciences in service design to a complex stakeholder management context through the research questions. The questions of the survey were planned according to the research questions and how they are responded to.
Data Collection	The data will be collected via focus groups, research diary with field notes and a survey. The audio recorded material from the focus groups will be stored in two external hard drives protected with a password.
Analysis	The data will be triangulated through the different ways of data collection. The focus of interpreting the data is designed to respond the research questions. An excel table will be made to analyse the responses of the surveys. The analysis criteria as well as the refocusing of the research questions will be discussed in peer-review style meetings between the two authors.
Plan Validity	**Construct validity:** This planned protocol is one way to construct the validity of this research; tables of the survey analysis will provide validity and replicability. **Internal validity:** will be made through data triangulation: research will be performed by two researchers; focus groups; field notes; research diary. **External validity:** The research techniques can be used in similar situations to replicate the research. It would be recommendable to conduct similar studies, for example, in other circumstances, regions or countries.
Reporting	Reporting the findings in an international conference to discuss them.
Schedule	Data collection around 6 moths in 2019. Writing the article in the late 2019 to the early 2020 and publishing it in 2020.
References	**Gibbert,** Michael, Winfried Ruigrok, and Barbara Wicki. "What passes as a rigorous case study?." Strategic management journal 29, no. 13 (2008): 1465-1474. **Pervan,** Graham, and M. Maimbo. "Designing a case study protocol for application in IS research." In Proceedings of the Ninth Pacific Asia Conference on Information Systems, pp. 1281-1292. PACIS, 2005. **Pathirage**, C. P., Dilanthi Amaratunga, and Richard Haigh. "Knowledge management research within the built environment: Research methodological perspectives." (2005). **Piekkari**, Rebecca, Emmanuella Plakoyiannaki, and Catherine Welch. "The case study approach in industrial marketing: insights from research practice." In IMP Conference. Manchester. 2007.

APPENDIX 3/ Survey (Sub-Study III)

How much do you agree with the following statements?

	Agree				Disagree
	5	4	3	2	1
7. I had new "aha" moments while doing the map	5	4	3	2	1
8. I learned to identify wicked problems	5	4	3	2	1
9. I learned that through Mess Mapping™ I can map wicked problems	5	4	3	2	1
10. I work with wicked problems	5	4	3	2	1
11. In the future, I'll use Mess MappingTM in my work?	5	4	3	2	1
12. I felt my participation relevant in the process of workshop today?	5	4	3	2	1
13. I felt I was heard?	5	4	3	2	1
14. I felt that the users of the cross-border mobility in the Barent's region were heard?	5	4	3	2	1
15. I learned something new about the needs of the users of the cross-border mobility	5	4	3	2	1
16. We were able to map problems concerning cross-border mobility in the Barent's region?	5	4	3	2	1
17. How appropriate you see this tool for your project, entity?	5	4	3	2	1

Why?_____

18. How well did the map capture the problems? Were some of the problems not said yet? What?
_____
_____

19. What was your own input on the Mess Map™ process? Could you have done something differently?
_____
_____

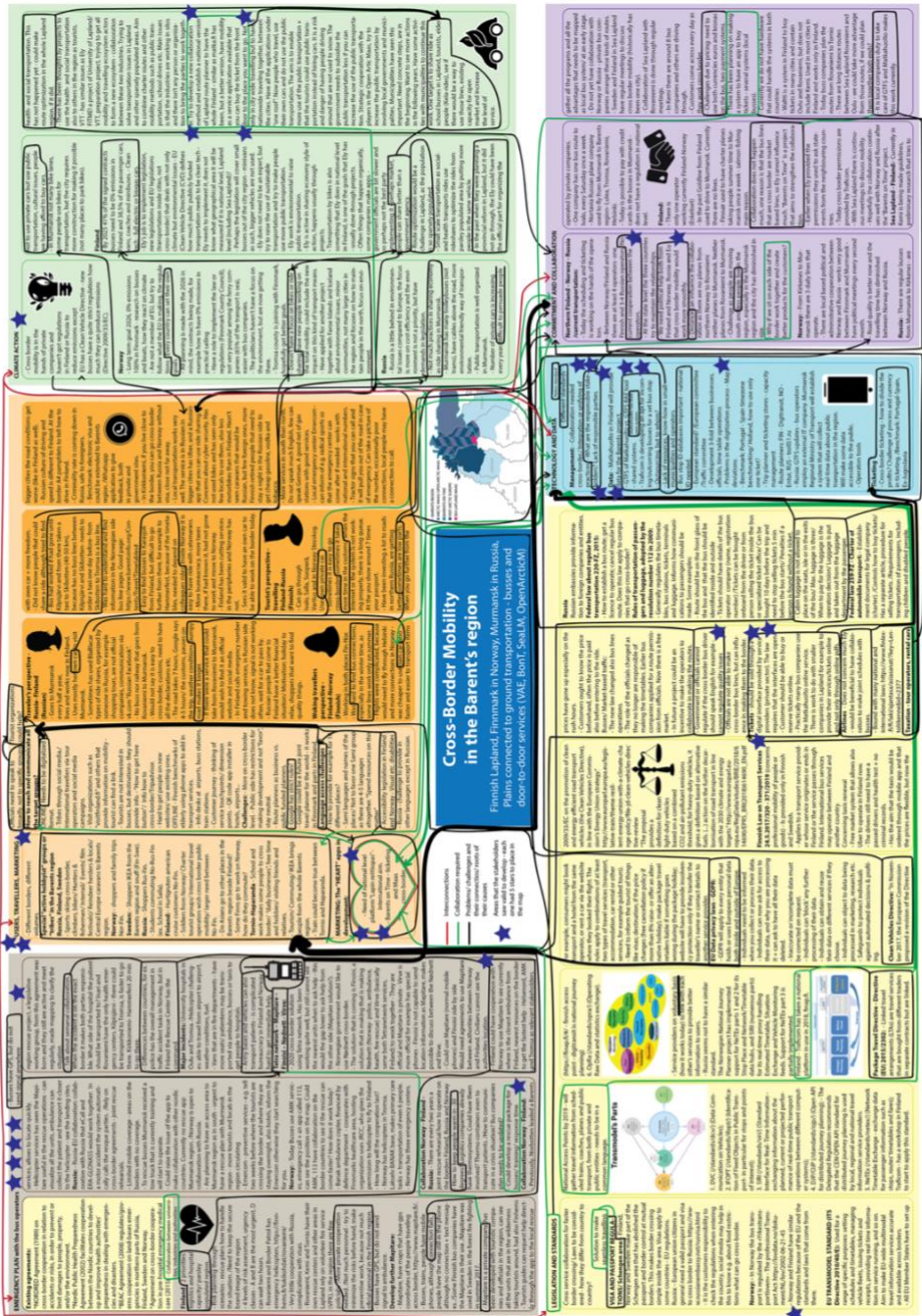20. What do you think about the workshops? Any improvements?
_____
_____

21. Any suggestions on the future use of this tool? What contexts?
_____
_____

Do I allow the use of the images, texts, pictures and videos for scientific purposes?
❑ Yes   ❑ No

Date: __/__/2019, City:_____ Signature:_____

Cross-Border Mobility
in the Barent's region

Finnish Lapland, Finnmark in Norway, Murmansk in Russia,
Plains connected to ground transportation - buses and
door-to-door services (VAE, BonT, SeaLM, OpenArcticM)

APPENDIX 5/ Reduced Issues from Cross-Border Mobility Mess Map™ (Sub-Study III)

CLIMATE ACTION	USERS, TRAVELLERS, MARKETING	EMERGENCY PLAN with bus operators
Every country can set their own goals	Special "active hobbyist" groups or "tribes" in the Barents region, Russia, Finland, Sweden Sports: Cross-border skiers, climbers, bikers/hunters & fishermen/interrail/events (film festivals)/reindeer herders & locals/Central European caravans to Barents region **Norway:** Shoppers and family trips Nor–Fin **Sweden:** Shoppers (IKEA/snuff) from the Barents region (Fin–Swe) **Russia:** Shoppers Rus–Fin, student commuters No–Rus–Fin (ex. school in Salla) **Finland:** Hurtigruten American cruise customers No–Fin/soldiers from Norway/charter tourist groups/international travel operators want cross-border public mobility/greater need between No–Fin Do Asians go to other places in the Barents region besides Finland?/some Finns go to work in Norway, how do they commute? Tornio-Haparanda–School and work makes some people cross borders/"daily business," free time and hobbies/visiting friends and relatives/tourism/commuting/IKEA brings people from the entire Barents region/train line could become true between Tornio and Haparanda.	Collaboration between universities, industries and authorities
Norway: Doesn't have a focus on bikes or ride sharing	MARKETING: The "HEART" apps in development; need for national-	2 priorities: logistics and hospital capacity/sparsely populated region

	level platform "Lapin reittiopas"/international aim Barents on Time–ticketing and Maas cross-border	
Russia: Not many participate in sharing economy such as ride sharing in Murmansk.	Officials need to speak broadly, not to specific groups. Tourist organizations could help?	More private cooperation needed/ not much personnel; try to minimise the risks beforehand, do preventive work because not much official personnel in the Finnish region
Difficult to persuade people not to use private cars and use public transportation, cultural issues, people can afford to buy cars	How to reach and communicate to all the target groups?	Connection failures
Finland: By 2025, 41% of the signed contract busses need to be 0% emissions in Finland and 38.5% of passenger cars, vans, coaches and minibuses; clean tech, full electric or biogas cars	Needs to be digitalised	Mapitare is a private company/ Finland could cooperate with Norway to use Mapitare to instantly find the closest ambulance from Finland, nearest resources on the border to get the fastest help; Helsenord, Lapland University of Applied Sciences (AMK) and Tromsa as relevant stakeholders
Norway: Long term goal 2026, 0% emissions 100% in Finnmark; research on busses and boats, how they react to climate	Google has strict rules!	How to keep people warm in −30 degrees C?
Often things happen organically; some companies make apps; government officials are bit slower and so perhaps not the best party for implementing these; perhaps market, people can share better than a government agency	Language access challenges	Could develop a rescue package for busses/training/response time
Route optimization would be a challenge in Lapland as the region is so sparsely populated	Accessibility legislation in Finland and Norway; visual impairments etc. disabilities	Busses have GPS, but do not send a signal anywhere
In the past they were planning provincial reform in Lapland, but these did not go through; the Ely could have been the official party for organizing health and social transportation; this has not	People travel with their own private car	Talk about seminal collaboration

happened yet; could have made route optimization across the entire Lapland region, if it had worked		
Try to develop a new collaboration method and establish a national version of a Lapland route planner to include all of Finland; similar to what matka.fi has been, but a better version; have mobility as a service application available where you can buy the ticket at the front gate to the place you want to go	Russia: bumpy roads makes trips longer/sometimes it takes more time in customs	Differences between countries, for ex., police have the overall management of traffic accident tasks in Norway, but in Finland the Rescue Centre is in command
One target is to share rides like school busses in Lapland or tourists, elderly people (Kela-rides); see if there is a way to use those lines, existing capacity for the open market and increase the level of service	Finland/Norway: Hard to find bus connections, especially in winter, as some lines work only in summer/easy to find busses to Karasjok from Finland but difficult to go further from there, for example to Hammerfest, because of the timetables, need to depend on rides from colleagues	Army bases and vehicles can also transport patients/complicated bureaucracy in Finland and Norway/hard to get immediate help
	Bus worked if it went to Kilpisjärvi and from there take a taxi to Skibotten (40–50 km) because there are no bus lines between Kilpisjärvi and Skibotten; need to order a taxi one day before; there is a bus line from Skibotten to Tromsa	Tetra network–Mapitare–Finoisi–Nødnett–Virve

LEGISLATION AND STANDARDS	TECHNOLOGY AND DATA	COMMITMENT AND COLLABORATION
VISA AND PASSPORT REGULATIONS/Schengen area-Solution to make seamless travel	Netex standard	No current cooperation between operators
National Access Points by 2019-will gather travel information from scheduled trains, coaches, planes and public transport, from both private and public entities; needs to be in a common language	Different standards	We need political help from Finland and Norway, Russia and EU for cross-border mobility to work more smoothly

Service providers on voluntary basis (how it works today) to link with each other's services to provide better information to users	Who are the responsible stakeholders? Lack of responsible parties	Distance can influence collaboration as there are no planes from northern Norway to Rovaniemi or planes to Murmansk; no planes from Rovaniemi to Murmansk
Finland: Traficom has taken a national platform into use in 2018, finap.fi	GTFS of Matkahuolto vs. GTFS RAE tool shared systems Traficom is developing an app for incoming/outcoming busses for a set bus stop Outsourcing, but to whom?	Challenge as people are moving south and fewer people live in the region, especially in the Murmansk region and the city has decreased in size
Package Travel Directive-Directive (EU) 2015/2302: Linked travel arrangements (LTAs) are travel services that are bought from different traders in separate contracts but are linked	Matkahuolto has their own system	Why, since we are sitting on each side of the border, don't we work together and create better products for customers?
EU Data privacy laws-GDPR: GDPR will apply to every entity that holds or uses European personal data both inside and outside of Europe	Lack of resources, know-how in small municipalities and operators	Collaboration does not happen much, one reason is that the bus lines that cross the border are market-based lines, so Ely cannot influence them much; "Barents on Time" is a project that aims to strengthen collaboration
Clean Vehicles Directive: "In November 2017, the European Commission proposed a revision of the directive"	Bus stop ID databases important-national ID needed.	Challenges due to pricing: need to use both currencies (euros and kronas) on the bus, two payment systems
Government or officials cannot regulate whether the cross-border bus drivers should speak English, for example; cannot regulate quality issues	Cross-border ticketing-how to divide the profits? Challenge of process and currency in ticketing/benchmark: Portugal–Spain, former Yugoslavia	There has been planning about making a system to have an app for buying tickets
Tickets: Should be sold through a digital interface provided by service providers (private sector); the law requires that the software interfaces should be open		several systems (local busses)

Customers should be able to buy or reserve tickets online

Practically all bus companies use the Matkahuolto online service

There is work to do with smaller companies in Lapland, for example, to provide their services/tickets online and not only through online pdfs

Airlines: Are not connected much to Ely; would be beneficial to collaborate to make joint schedules with busses

It is local companies' duty to take care of GTFS and Matkahuolto does this work currently

Taxation: Tour operators, rental cars

Russia: Cabin luggage is not allowed to be placed on the seats, aisle or in the exits of the bus/max. luggage is three pcs./when to pay for luggage is the operators' decision/luggage is put in and taken out of the luggage compartment by the passenger