

THESIS FOR THE DEGREE OF LICENTIATE OF ENGINEERING

The Workshop and Beyond:

Understanding Co-Design Practices
in Mobility Service Development

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Cover:

Illustration of a hand-drawn interpretation of the thesis's clearing concept, with a forest clearing as a metaphor for co-design: a space where people come together to make sense of complex mobility futures, exchange perspectives, and create new possibilities. The clearing itself represents a moment of shared understanding from which new directions can emerge. The image reflects co-design in mobility development. This illustration and the illustrations in this thesis, are made by Yuren Chen.

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Abstract

Reducing private car dependence requires different mobility strategies to work together within better-connected transport systems. Shared mobility is increasingly integrated with public transport as part of wider multimodal transport systems, including through approaches such as Mobility as a Service. Developing mobility services within such systems is complex, involving evolving user needs, diverse stakeholder interests and responsibilities distributed across actors and levels of governance. Against this background, co-design has been applied in mobility service development to involve users and other stakeholders in shaping mobility solutions. However, its application is not uniform and is largely documented through individual case studies that differ in scale, mobility problem, context, actors and intended outcomes. This limits comparison across cases and the accumulation of knowledge about co-design's contribution to mobility service development.

This licentiate thesis addresses this problem through two studies: a literature review using a systematic search and review approach covering shared mobility and related mobility service development, and an empirical three-stage co-design process conducted in Fredrikstad, Norway, within the development of a shared mobility service involving citizens and multiple public and private stakeholders. The review provides a comparative understanding of heterogeneous co-design practices by examining their intended functions, participation arrangements and outcomes, while the empirical study provides an in-depth account of how co-design unfolds within one real-world process.

Bringing the studies together shifts attention from co-design as a set of methods and immediate outputs towards how participation is organised and how contributions develop over time. The thesis contributes an analytical understanding of co-design as a situated and evolving part of mobility service development, shaped by changing participation and project conditions and by what happens as outputs move beyond the collaborative setting into wider project and institutional contexts. This perspective provides implications for how co-design can be organised, connected to subsequent development and evaluated.

Key words: Co-design, Mobility service development, Shared mobility, Co-creation, Multi-stakeholder, Participatory methods, Stakeholder participation, Co-design outcomes, Implementation

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Appended papers

This thesis is based on the following works:

PAPER 1

Y. Chen, H. Strömberg, P. Wallgren, M. Karlsson: *Making sense of Co-design in Shared Mobility: A Review of Practices, Outcomes and Challenges*. Manuscript submitted to scientific journal.

Contributions: Conceptualisation, review design, literature search and screening, data extraction, analysis and synthesis, visualisation, writing – original draft, writing – review and editing.

PAPER 2

Y. Chen, P. Wallgren, H. Strömberg, M. Karlsson: *Co-Designing Shared Mobility in Fredrikstad: A Clearing for Citizens and Multi-Stakeholders*. In *Proceedings of the 11th Transport Research Arena (TRA 2026)*. Budapest, Hungary, May 18–21, 2026, to be published.

Contributions: Conceptualisation, study design, data collection, analysis and interpretation, visualisation, writing – original draft, writing – review and editing.

PAPER 3

Y. Chen, H. Strömberg, P. Wallgren: *Participation in Shared Mobility Co-design: A Case Study of an Automated Ferry in Fredrikstad*. In *Proceedings of the 8th International Conference on Sustainable Mobility (CSuM 2026)*. Skyros, Greece July 1-3, 2026, in press.

Contributions: Conceptualisation, study design, data collection, analysis and interpretation, visualisation, writing – original draft, writing – review and editing.

Additional publications

A

Y. Chen, H. Strömberg, P. Wallgren: *Shared Modes Strategies (Deliverable D1.3). SUM—Seamless Shared Urban Mobility, 2024.*

B

Y. Chen, P. Wallgren, H. Strömberg: *Application of Co-Design in Shared Mobility Solution-finding [Poster presentation]. Persontrafik 2024. Gothenburg, Sweden, November 5-7, 2024.*

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1. Introduction

Car dependence is reinforced by interconnected elements within transport systems, creating carbon lock-ins that make the transition towards more sustainable mobility challenging [1]. Public transport has long provided an alternative to private-car travel, while shared mobility has received increasing attention as a complementary strategy [2] that potentially reduces car dependency [3]. Shared mobility enables travellers to access transport services on an ‘as-needed’ basis [4] and encompasses both sequentially shared modes, such as car- and bike-sharing, and simultaneously shared modes, such as pooled rides [5]. Its connection with public transport is both conceptual and practical. There are still debates as to whether public transport itself is a part of shared mobility [5, 6], while shared mobility services can fill gaps in public transport networks and support first- and last-mile travel [4, 7]. More broadly, reducing car dependence requires mobility strategies to work in combination [8], with emerging shared mobility services complementing rather than replacing public transport [9]. Mobility as a Service (MaaS) exemplifies this integration by bringing these mobility services together as bundled packages for users to plan, book and pay through a joint digital interface, enabling shared mobility to extend from isolated transport solutions to be part of a wider multimodal mobility system that potentially supports the sustainability transition [4, 10].

Developing mobility solutions across these interconnected services, actors and institutional contexts is complex. Shared mobility involves stakeholders with different interests, resources and responsibilities [11], while transport more broadly is characterised by multi-level governance across different institutional and spatial scales [12, 13]. MaaS further brings together public and private actors across transport services, infrastructure, information and payment [9, 14]. At the same time, mobility solutions need to accommodate diverse and evolving user needs within different urban and social contexts. Consequently, mobility development involves combining different forms of knowledge and experiences across professions, institutions and everyday lives. Participatory approaches offer opportunities for citizens and stakeholders to contribute their knowledge and experience to planning processes and have long been discussed and applied in transport planning [15–18]. European policy also advocates citizen and stakeholder involvement throughout the development and implementation of Sustainable Urban Mobility Plans (SUMP) [19]. However, the presence of participatory processes does not necessarily ensure that participants’ perspectives meaningfully inform planning [15, 18]. While citizen and stakeholder involvement is widely advocated in sustainable mobility planning, unresolved questions remain concerning the organisation of participation, the selection of engagement techniques, and the uncertain quality of resulting decisions [16].

Within this broader participatory landscape, co-design offers a particular approach by bringing participation into the design and development of solutions, combining notions of both collaboration and design [20], and has been applied across different forms of mobility development [21–24]. Co-design is commonly understood as the collective creativity of designers and people not trained in design working together in design development [25]. It positions users as active contributors and ‘experts of their experience’, enabling experiential, tacit and latent knowledge to inform design processes [25, 26], and can give a voice to people traditionally excluded from these processes [27]. Beyond user involvement, co-design has been applied to simultaneously engaging multiple stakeholders in not only industrial design but also a range of public-sector development [20, 28–32].

However, co-design has not been practised in mobility service development in a uniform way, which makes it difficult to compare practices and outcomes across cases and draw transferable lessons [23]. Pappas et al. [23] question the conceptual novelty of co-design and co-creation concepts in relation to established public participation [33] and observe that their application in transport has largely been documented through individual case studies. Case-based mobility applications add heterogeneity because individual initiatives differ in their scale, mobility problem, local context, targeted user groups, intended outcomes and so on. Consequently, it remains difficult for researchers and practitioners to distinguish insights that are transferable across mobility co-design practices from those that are specific to individual mobility initiatives.

Aim and Research Questions

The aim of this licentiate thesis is to explore how co-design is practised and how it contributes to shared mobility and related mobility service developments.

The aim is addressed through two research questions:

RQ1 - How is co-design conceptualised and practised across shared mobility and related mobility service developments?

RQ2 - What opportunities and challenges arise in co-design processes involving diverse stakeholders in shared mobility and related mobility service developments?

2. Frame of Reference

This chapter introduces the theoretical background of co-design as a participatory approach, its application in complex public-sector contexts, and considerations for evaluating its processes and outcomes. It concludes by positioning the present research in relation to these perspectives.

2.1 Co-design as a participatory design approach

Co-design does not have a single, consistently applied definition [27]. Co-design, co-creation and participatory design have overlapping intellectual and methodological histories. Co-design and co-creation, in particular, are variously treated as either interchangeable concepts or as having a hierarchical relationship, with co-design viewed as the broader approach and co-creation as a specific stage or activity, although the reverse interpretation also occurs [27]. This thesis adopts Sanders and Stappers' distinction [25], in which co-creation broadly refers to collective creativity, while co-design refers more specifically to collective creativity applied across a design development process.

This understanding reflects a broader shift in design from designing “for” users in user-centred design towards designing “with” them. Users move from being objects of study towards active participants, while researchers and designers (sometimes the same person) increasingly take facilitative roles in supporting knowledge and idea development. This shift was motivated partly by the recognition that traditional design and market research methods, such as observation, focus groups, interviews and questionnaires, provide limited access to experiential knowledge [34]. What people say or do provides access mainly to explicit and observable knowledge, potentially missing tacit knowledge that cannot readily be expressed in words and latent needs that are not yet recognised. Tools allowing non-verbal modes of expression have therefore been developed to help participants express thoughts, feelings and experiences through what they “make” [26, 34]. These include for example “make tools” that provide a “design language” through activities such as collages, diaries, maps, three-dimensional models and diagrams [26, 34].

Co-design is also closely related to the tradition of participatory design (PD), which emphasises the direct involvement of people in the co-design of the technologies they use [35]. Rooted in Scandinavian efforts to strengthen workplace democracy, PD emphasises workers' participation and influence in the design of technologies affecting their working lives [36]. Co-design and PD are often used synonymously in Nordic countries [27] and share many participatory tools and techniques [37].

Research on co-design and participatory design has devoted substantial attention to developing and reporting methods and techniques for involving participants [38,

39]. However, co-design involves more than the selection of methods and tools: planning, tool adaptation and facilitation need to be considered together in supporting collaboration [27]. Related work in participatory design identifies multiple variables to carefully consider when planning the organisation of design tools and techniques, including group size and composition, face-to-face or on-line, venue, and stakeholder relationships [37]. Together, these considerations highlight the importance of a process-oriented understanding of co-design, particularly when multiple actors participate across multiple occasions.

2.2 Co-design in complex public-sector contexts

Co-design has extended beyond collaboration between designers and users to involve multiple stakeholders, including professionals from other fields [31]. In public-sector contexts, it has been promoted as an effective, democratic and innovative alternative to conventional approaches to community engagement, public participation and policy development [20]. Blomkamp [20] characterises co-design for policy as a design-led process that uses participatory principles and creative tools to engage different people and forms of knowledge in public problem-solving. This positions co-design as an approach to collective problem-solving rather than simply a technique for gathering public views.

Related literature on co-creation provides a broader perspective on collaboration across multiple actors. Co-creation can bring together actors from public and private organisations and civil society in not only public service delivery, but also problem-solving and regulation, combining different forms of knowledge, resources and responsibilities [40]. Torfing [40] argues that this reflects a shift from traditional understandings of citizen participation [33] towards more systematic engagement among relevant public and private actors. In complex and multi-layered societies, no single actor possesses all the knowledge, expertise and resources required to address public problems independently, making governance dependent on exchanges of resources among actors.

However, bringing diverse actors together does not directly imply equal influence over the process or its outcomes. Citizen participation varies considerably in the degree of decision-making influence afforded to participants [33], while public-sector co-design also takes place within existing distributions of authority, resources and institutional ways of working [20, 31]. Co-design and co-creation have also been criticised for conceptual ambiguity and overly optimistic expectations about their benefits [41]. Research on co-creation further suggests that its operational meaning may differ across policy contexts and stages of development [42]. Broad and inconsistent uses of co-design can make it difficult to identify what constitutes co-design in practice and to evaluate its impacts [20]. Evidence for its claimed benefits also remains limited, leading to calls for greater attention to who participates, how participants communicate and make decisions, and how outcomes connect to public policy and action [20].

These considerations are particularly relevant to mobility development, where users, municipalities, public transport organisations, mobility providers and other actors may participate within the same initiative while retaining different interests and institutional responsibilities. Transport planning has a longer history of citizen and stakeholder participation, but evidence concerning its influence on planning decisions remains uneven, and studies often provide limited information about who participated, how, when and why [15]. Studies of co-design and co-creation in transport similarly remain largely case-based [23], making attention to how participation is organised and enacted important when interpreting each initiative with specific conditions.

2.3 Evaluating co-design: process, participation and outcomes

Evaluating co-design is difficult partly because there is no agreement about what constitutes its value or result. Wang et al. [32], in a review of co-design evaluation methods, distinguish three main aspects of evaluation: the approach, including tools and activities designed; the process, including participants' experience, engagement and collaboration; and outcomes, ranging from direct outputs to implementation and longer-term impacts. Evaluation methods are similarly diverse, including surveys, interviews, observations, designers' reflections and comparative experiments, while limited data, long time horizons and potential bias create challenges [32].

Process evaluation of co-design often assesses how the participants worked together qualitatively, while changes in group dynamics and individual perspectives can be difficult to capture [32, 43]. More detailed principles have been proposed for evaluating participatory processes, include factors such as facilitation, team diversity, a supportive environment, shared visions and the handling of conflicting interests [44].

The boundaries of co-design outcomes are equally difficult to define. Co-design may generate tangible outputs such as ideas, concepts and prototypes, but also learning, relationships, shared understanding, increased agency and changed perspectives. From the perspective of PD with its core aims (mutual learning, empowerment, democracy, workplace quality), evaluation may concern not only what is produced but also whether participation strengthens participants' voice, knowledge, ownership or capacity to act [45, 46]. Moreover, the effects of participation may extend beyond the immediate collaborative activity, raising questions about how outcomes are carried forward and what happens after a project ends [45]. Explicit and systematic evaluation of such longer-term and less tangible effects nevertheless remains limited [47].

These issues are also evident in mobility research, where studies of co-design and co-creation remain largely case-based and research has often focused on

participatory processes rather than longer-term outcomes and impacts [23]. Studies have variously assessed participatory processes, prototypes and other process outputs, or the methodological value of co-design for generating mobility proposals [48–52].

2.4 Point of Departure and Research Positioning

The literature presents co-design as a participatory approach that seeks to involve multiple actors in collective problem-solving and development processes. It has increasingly been applied in public-sector contexts characterised by multiple stakeholders with differing roles, responsibilities and interests. At the same time, co-design is understood as generating value through both participation and outcomes, while questions concerning its evaluation remain unresolved.

Despite growing interest in co-design, considerable uncertainty remains regarding how it is practised and understood in different contexts. Co-design is defined, organised and evaluated in diverse ways, making it difficult to compare cases and understand its contributions in practice, particularly in complex public-sector settings such as mobility development. These considerations provide the point of departure for the present research.

This research approaches co-design in mobility development as a hands-on, participatory and exploratory process in which methods and tools are carefully selected and adapted to support collective inquiry, knowledge sharing and idea development.

Given the diversity of co-design practices, contexts and evaluation approaches described above, the research is interested not only in the methods used, but also in how co-design is practised in real-world mobility development settings. Particular attention is therefore given to how co-design processes unfold, how they relate to implementation and uptake, and how they are shaped by broader project contexts. This interest in real-world practice is accompanied by a commitment to transparent reporting of processes and outcomes, including challenges, unexpected developments and adaptations.

Meanwhile, co-design is not assumed to be inherently democratic or beneficial. The research adopts a reflexive perspective, attending to tensions, negotiations and participation dynamics, and to how knowledge, power, responsibility and institutional conditions shape co-design processes and outcomes.

3. Methodology

3.1 Personal Background

My background is in architecture, with interests in urban design, sustainable planning, and community development. Through this background, mobility has often been understood as an inseparable part of urban life and public space, embedded within broader urban systems. Prior experiences with participatory projects introduced me to the value of engaging users and stakeholders in shaping design outcomes, and sparked an interest in designing “with” people rather than “for” them.

At the beginning of this PhD, I tended to approach mobility challenges from a relatively zoomed-out and solution-oriented perspective, focusing on how mobility solutions could be designed and implemented. As the research progressed, however, my perspective gradually shifted towards a stronger interest in processes and the conditions under which solutions emerge, as the solution development processes are never clean-cut. Engaging directly with users, stakeholders, planners, and industry partners highlighted the importance of understanding everyday practices, participation dynamics, and the tensions that arise when different interests meet.

This shift from architect to researcher-practitioner has shaped the overall orientation of the research. While maintaining a design perspective, the focus has increasingly moved from designing solutions towards understanding the processes through which solutions are developed within complex multi-stakeholder contexts.

3.2 Project Context

This research was conducted within the EU-funded Seamless Shared Urban Mobility (SUM) project. The SUM project investigates how shared mobility can contribute to more sustainable and accessible urban mobility, with participating cities developing and testing shared mobility solutions in different local contexts, achieved with a Living Lab approach. The project emphasises co-creation between municipalities, mobility providers, researchers, citizens, and other local stakeholders. Within this broader project setting, the PhD research focused specifically on the conceptualisation, the practice and contributions of co-design in shared mobility and related mobility service developments, respectively resulting in Study 1, a literature review study, and Study 2, an empirical study in Fredrikstad as one of SUM’s Living Labs.

Within SUM, co-creation was used as the broader project term for participatory activities across the Living Labs. In this thesis and the related academic publications, co-design is used for the Fredrikstad process to emphasise its use of design activities and the simultaneous involvement of diverse actors.

3.3 Research Process

The research consists of two parallel and interconnected studies that together address the practice and contributions of co-design in mobility service development (Figure 1). Study 1, a literature review, investigates how co-design is described and documented in the literature of shared mobility and related mobility service developments, providing a comparative and broad perspective across cases and contexts. Study 2, an empirical case study, investigates how co-design unfolds within a specific shared mobility initiative through direct engagement with stakeholders, providing a situated perspective from someone who practices a co-design process. Table 1 summarises the key characteristics of the two studies.

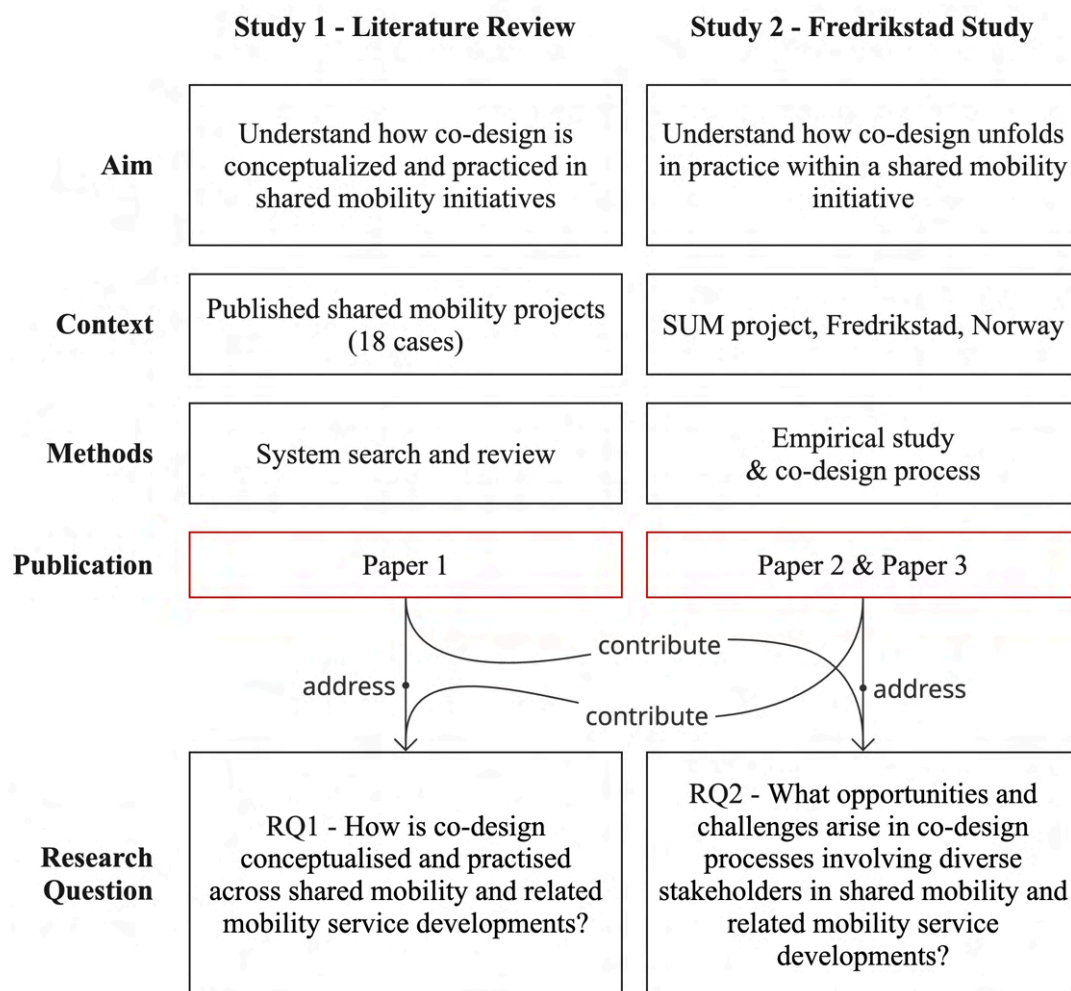


Table 1. Comparison of the two studies and their respective perspectives on co-design in mobility service developments.

Study 1 - Literature Review	Study 2 – Empirical Case
Documented practice	Situated practice
Researcher position	Researcher-practitioner position
What is reported	What unfolds
Breadth	Depth

3.4 Study 1: Literature Review

Study 1 provides a comparative perspective on co-design practices documented across mobility service developments. Its aim and methodological approach are outlined below.

3.4.1 Aim

The aim of Study 1 was to understand how co-design is conceptualised and practised in shared mobility and related mobility service developments as documented in existing literature.

3.4.2 Method

Study 1 adopted a systematic search and review approach [53]. Relevant literature was identified through systematic searches in Scopus, Web of Science, and Transport Research International Documentation (TRID), followed by screening and selection procedures informed by PRISMA guidelines. The final dataset consisted of empirical cases in which co-design or related participatory approaches were applied to shared mobility and related mobility development challenges.

Because co-design and related terms such as co-creation, co-production and participatory design are used inconsistently and often interchangeable or overlapping across disciplines without agreed definitions, an operational understanding was required to delimit the literature search and selection. Co-design was understood broadly as a design-oriented participatory multi-staged

collaborative process in which users and/or other stakeholders contributed beyond consultation to the exploration, generation, development or decision-making of mobility solutions. For analytical consistency, Study 1 uses co-design as an umbrella term for the included practices, without assuming that these terms are theoretically equivalent.

The review did not begin with the analytical focus ultimately presented in Paper 1. Initially, the review sought to examine the effectiveness of co-design in supporting mobility service developments. However, preliminary screening revealed substantial variation in project goals, actor constellations, methods, processes, reporting focus, and levels of documentation, making direct comparison difficult. Consequently, the focus shifted towards understanding how co-design was conceptualised and practised across service development processes.

Through an iterative process of reviewing, coding, and comparing studies, a broad set of analytical questions was gradually refined and consolidated into six aspects through which the findings are presented, answering RQ1. To address RQ2, reported opportunities and challenges were also examined across the reviewed cases. Opportunities were understood as reported positive contributions associated with co-design, while challenges referred to reported difficulties encountered during the process. Rather than evaluating individual projects against a predefined standard, the review sought to construct an overview of how co-design is currently understood and enacted within mobility research and practice.

Study 1 resulted in Paper 1. A more detailed account of the literature search, conceptual scope, study selection and review approach is provided in Paper 1.

3.5 Study 2: Fredrikstad Empirical Study

Complementing the comparative perspective of Study 1, Study 2 examines co-design through direct engagement in an empirical process in Fredrikstad. Its aim and methodological approach are outlined below.

3.5.1 Aim

The aim of Study 2 was to understand how co-design unfolds in practice within a shared mobility initiative involving diverse stakeholders.

3.5.2 Method

Situated within a research-through-design methodology [54], Study 2 used generative making activities to surface tacit knowledge from everyday people [55] and support the development of shared mobility solutions. This research perspective was combined with the SUM project's broader ambition to use co-creation in developing shared mobility and with a Living Lab approach.

The study was conducted in Fredrikstad, Norway, one of the participating SUM cities. Within SUM, the city explored the introduction of a new autonomous-to-be ferry service as part of its sustainable mobility transition (Figure 2), more specifically as an alternative to private car use.



Figure 2. The ferry service explored within the Fredrikstad mobility initiative.

The co-design process developed alongside this mobility initiative and involved citizens, municipal planners, ferry operators, local businesses, project partners, and researchers from Chalmers. The research team consisted primarily of the author and a senior researcher, with additional researchers participating in selected co-design activities.

Study 2 employed a three-stage co-design process (Figure 3). Across the three stages, stakeholders were involved in identifying mobility challenges, generating service ideas, and evaluating future directions for implementation. During the study, changing operational conditions and practical constraints influenced both the mobility intervention and the co-design process, and the planned pilot testing in Stage 3 did not take place. The final stage instead consisted of reflective interviews with municipal planners concerning the co-design process, outcomes and learnings. We treated these changes less as external disruptions, and more as a part of the situated conditions through which co-design unfolded.

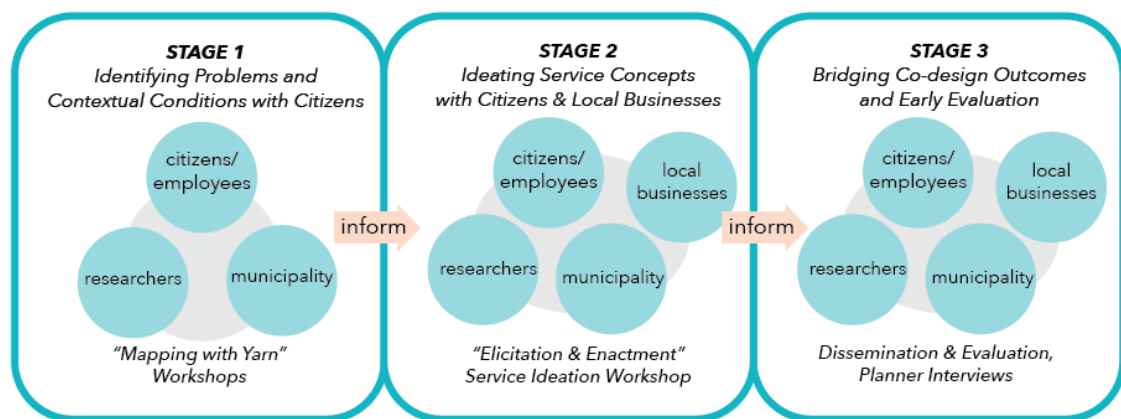


Figure 3. Three-stage co-design process in the Fredrikstad study.

We designed the co-design activities informed by design methods emphasising making, enacting and playing [37, 56], while prioritising formats through which participants' contributions could be captured and preserved in self-explanatory, visual forms. The workshops generated a range of empirical materials, including maps, written ideas, videos, field notes, and recordings. Together with researcher reflections from the author and other participating researchers, these materials documented the development of the co-design process.

We analysed the empirical material generated during the Fredrikstad study through two complementary analytical lenses. The first analysis focused on describing the co-design process, including its activities, outcomes, and identified challenges. It was conducted after the second stage, at a point when the co-design process was

expected to continue along its planned trajectory and forms the basis of Paper 2. However, the third stage did not proceed as initially planned and instead brought other aspects of the process into focus. We realised the difficulty of understanding the co-design process and its outcomes through the design activities alone, without considering participation and actor dynamics. We therefore revisited the empirical material as well as interviews with municipal planners through a reflexive lens, examining how participation, roles, power relations, and institutional conditions shaped the unfolding of the process. This analysis forms the basis of Paper 3.

The two papers offer different analytical perspectives with the same empirical material. Paper 2 focuses primarily on the co-design process and what it produced, whereas Paper 3 examines how participation and the surrounding conditions shaped that process and its outcomes. Together, they provide both a descriptive and a reflexive understanding of co-design in practice.

3.6 Cross-Study Synthesis through Contrapuntal Listening

While the two studies primarily address different research questions and can be read independently, their relationship developed iteratively throughout the research process. Early insights from the literature review informed the design and interpretation of the Fredrikstad case, including attention to process documentation, participation, activity outputs, and awareness of the coexistence of research, project, and local rationales. At the same time, conducting the Fredrikstad process sensitised the reading of the literature to aspects that were often difficult to identify from publications alone, particularly changing participation, translation between activities, institutional conditions, and the development of outcomes over time. As both studies progressed, insights from each continually shaped the interpretation of the other.

The cross-study synthesis made this relationship explicit by rereading the findings of the two studies through common dimensions: the intended function of co-design, how participation was organised and the process conducted, and what the process produced. Similarities, differences and tensions between the two perspectives were identified across these dimensions. Examining how insights from one study changed the interpretation of findings from the other resulted in three shifts in understanding: from named methods to organising participation; from immediate outputs to institutionally conditioned contributions; and from configurations to evolving trajectories.

To articulate this relationship, I draw on the musical notion of *counterpoint* as an analytical metaphor. The studies can be understood as two distinct analytical “voices”. Each develops its own analytical line and can be understood independently, while further understanding emerges by “listening” to them together and attending to points of convergence, divergence as well as tension. The three shifts resulting from this *contrapuntal listening* are presented in the Findings chapter.

4. Findings

This chapter presents findings from the literature review (Study 1) and the Fredrikstad empirical study (Study 2), organised in relation to the two research questions. The findings are then brought together in a cross-study synthesis to develop a broader understanding of co-design practices and their contributions to mobility service development.

4.1 Study 1 - Systematic Search and Review: Understanding Co-design Practices in Mobility Service Developments

This section presents findings from the literature review study. Study 1 revealed substantial diversity across the reviewed studies in what was described as co-design, why it was used, when it was used, who participated, how participation and activities were organised, what the processes produced and what challenges affected the processes.

4.1.1 Insights for RQ 1:

How is co-design conceptualised and practised in shared mobility and related mobility service developments?

To make the heterogeneous co-design practices comparable and examine how co-design is conceptualised and practised, a main contribution of Study 1 is an analytical map (Figure. 4). The map organises each case according to three dimensions: why co-design is used (intended function), how it is conducted (participation arrangements and stages), and what it produces (the principal outcome of the furthest documented stage).

Ref.	Why co-design was used		How co-design was conducted							What co-design produced
	Intended Function	Category & Focus	Actors	Actor Cont.	Stage Context	Stage Problem	Stage Ideation	Stage Prototype	Stage Implement	Furthest Stage Outcome
[60]	Access seniors' experiences for usability	Knowledge Experiences	U	Core					⇒	Refined mobility app prototype
[50]	Integrate seniors' everyday mobility practices into platform design	Knowledge Practices	U	Core						Intermodal mobility platform prototype
[58]	Access richer design insights from people with intellectual disabilities	Knowledge Experiences	U							Navigation app prototype preferences
[62]	Access older adults' journey experiences to identify needs	Knowledge Experiences	U							Autonomous shuttle needs and solutions
[64]	Enable mobility-impaired users to constructively shape service improvements	Participation Creative contributions	U	Core						Mobility app feature prototypes
[52]	Access public lived experience to explore future metro design	Knowledge Experiences	U	Both						Metro design proposals
[68]	Access passengers' experiential knowledge for service ideation	Knowledge Experiences	U							Digital bus service concepts
[24]	Understand collective user values for future mobility	Knowledge Values	U + other	Open						Social acceptability framework
[65]	Integrate mobility solutions into neighborhood everyday life	Knowledge Routines	UCB	Open					⇒	Festival; grocery shuttle; mobility concepts (Sites 1-3)
[69]	Develop shared spatial qualities among stakeholders	Coordination Shared vision	UGB	Both					⇒	Spatial design alternatives for river crossing
[61]	Develop local government policy capacity	Capacity Governance	UGM						⇒	Information exchange platform concept
[67]	Tailor rural mobility solutions to local contexts	Knowledge Local conditions	UGM	Open					⇒	Ride-sharing bench software concept
[57]	Coordinate mobility planning across municipalities.	Coordination Alignment	UGM	Core						Draft SUMP & seasonal bus service proposal
[59]	Empower people with disabilities “nothing about us without us”	Participation Empowerment	UGMC	Core					⇒	Accessibility intervention proposals
[23]	Support participatory planning for new ways of decision-making	Participation Planning	UGMC	Open					⇒	Traffic-calming intervention
[49]	Empower citizens to develop local mobility solutions	Participation Empowerment	UGMC	Open					⇒	Pilot mobility concepts
[48]	Empower vulnerable communities	Participation Empowerment	UGMC	Both						Pilot interventions; ongoing community working group
[66]	Address user needs to increase MaaS uptake	Knowledge Needs	UGMC B	Open						MaaS carpooling integration challenges

 Conducted
  Conducted, not reported here
  Planned / Ongoing

Figure 4. Analytical map of the 18 reviewed co-design cases [24, 48–50, 52, 57–69], organised by intended function, practice configuration and documented outcomes. Note: Numbers in square brackets refer to publications in the reference list. U = individual users, G = governance actors, M = mobility service actors, C = civil society actors, B = cross-sector business actors

Overall, the dimensions of the analytical map show that co-design practices are better understood as configurations than as collections of individual methods or stages. User-centred cases, i.e. those involving only users alongside researchers (U), more often combined knowledge-oriented functions, relatively stable participation, earlier development stages and knowledge, concept or prototype outcomes. Multi-actor cases, i.e. those involving users together with governance, mobility, civil society or business actors (e.g. UGB, UGM, UGMC and UGMCB), more often combined coordination, planning or governance-oriented functions with broader participation and planning or implementation-oriented outcomes. We argue that a co-design process can be better understood when its intended function, participation arrangement, position in the development process and outcomes are considered together.

To make the analytical map more accessible, here follows the explanations of each dimension with patterns most relevant to understanding the map. A more detailed account of co-design conceptualisations, actor categories, stages, activities and methods arrangements, and outcomes and implementations across the reviewed cases is provided in Paper 1.

Why using co-design: intended function

Study 1 found considerable conceptual inconsistency in how co-design is described across mobility service developments. Co-design and co-creation are both used as central terms, often alongside other co-x terminology, without clearly defined boundaries between them. Their relationship also varies between cases: co-creation may describe a broader participatory approach within which co-design refers to particular solution-generating stage, while in other cases co-design provides the overarching framing and co-creation refers to specific collaborative activities. Co-design is further combined with approaches such as user-centred design, participatory design, citizen participation and Living Labs. Few cases explicitly define the term, and where definitions are absent, co-design is often introduced through its anticipated benefits or the purpose it is expected to serve, such as accessing user knowledge, involving particular groups or supporting solution development, with "we use co-design to do ..." / "the project objectives is to do ... with co-design" structures.

This means that there is no consistent conceptualisation of co-design. In many cases, what co-design means is partly expressed through what it is expected to do. The review therefore created the term "intended function" to examine co-design: the primary reason for employing co-design in the process within the reported case, instead of summing up all the mentioned project rationales and objects-to-design. Intended function does not imply an assumed intention inferred of the authors' accounts, but was interpreted from how studies described the aims, rationales, design and anticipated contributions of their co-design processes, using the reported practice and its position within the wider mobility service developments.

Across the reviewed cases, four broad intended functions were identified: accessing knowledge, enabling participation, coordinating multiple actors, and developing governance capacity. Knowledge-oriented functions were the most common, followed by participation. These functions provide a more analytically useful basis for comparing cases than co-x terminology alone, because they make visible what similarly labelled processes were expected to perform.

How it is conducted: Participation arrangements and stages

Co-design practices were similarly diverse in terms of involved actors, participation arrangements, activities, process stages and duration. However, when relating these dimensions to one another, co-design practices became more understandable than when compared separately. In particular, differences in actor configurations were associated with how participation was organised across the process and with the functions that co-design served within the wider mobility service developments. Activities and methods were practised flexibly, with their meanings depending on who participated, for what purpose, and where they were positioned within the wider development process.

Regarding **actor configurations**, five actor types were identified across the reviewed cases, alongside researchers who were involved in every case: individual users, governance actors, mobility service actors, civil society actors and cross-sector business actors. Two broad configurations were particularly visible: user-centred cases (U), involving primarily researchers and users, and multi-actor cases (U+), additionally involving governance and/or mobility service and/or other actors. User-centred cases tended to involve groups with special needs and focus on experiential knowledge and developing services or interfaces, whereas in multi-actor cases tended to position co-design more broadly within participatory planning, stakeholder coordination and governance processes. Involved governance and mobility service actors mainly contributed to validation or implementation-oriented discussions.

Regarding process **stages**, the cases did not share a common structure, with stage descriptions ranging from design development to participation engagement and project delivery. To enable comparison, five stages were synthesised from the

reported processes: contextualisation, problem definition, ideation, prototyping and implementation. Co-design was identified to concentrate in earlier stages, while implementation appeared in fewer cases and was rarely completed by the time of publication.

Participation continuity also varied across cases: some cases maintained a relatively stable core group across multiple activities (“Core”), while others involved broader (“Open”, broad participation through open calls or drop-in events) or changing participants. The former was more common among U cases, while open participation occurred more often in U+ cases. Where participation changed, continuity between stages depended more strongly on researchers or other actors translating and carrying outputs forward.

Regarding **activities and methods**, the reviewed cases showed that they were used flexibly rather than corresponding consistently to particular stages or purposes. Larger formats, such as workshops, meetings and hybrid public events, and more detailed formats, such as mapping, storytelling or prototyping, supported different forms of participation depending on the actors involved, project stage and intended function of the event.

Workshops were a common activity format, appearing across different stages, but their content varied considerably. Meetings, public events and self-paced tasks were sometimes combined with workshops to involve different stakeholder groups or support continuity. Methods ranged from more open techniques to more structured prompts and prototypes, depending partly on how far the problem or solution had been defined. Organizing participation also involved considerations of group composition, sequencing of stakeholder involvement and digital tools.

A limited set of participatory formats were adapted and combined with ongoing decisions. Cases were characterised less by specific methods used, than by how participation was configured and carried through the wider development process. A detailed analysis of activities and methods is provided in Paper 1.

What co-design produces: Outcomes

The reviewed cases reported diverse outcomes, including experiential knowledge and problem definitions, concepts and prototypes, planning proposals, and implemented or planned interventions. These outcomes occupied different positions within broader mobility development processes and did not consistently progress towards implementation. Completed implementation was reported in very few cases. Elsewhere implementation was planned and beyond the scope of the publication or not reported as it was out of the scope of study while co-design outputs instead informed subsequent design and planning activities.

This suggests that implementation is only one indicator of co-design's contribution. Knowledge, shared understanding, concepts and planning outcomes may perform

meaningful roles within longer development processes even when they do not become implemented interventions within the reported project. Evaluation of these contributions, however, was inconsistent and limited across the reviewed literature. The gap between diverse outcomes, uncommon implementation and absence of evaluation process, hints the importance of attention to broader challenges surrounding co-design.

4.1.2 Insights for RQ2:

What opportunities and challenges arise in co-design processes involving diverse stakeholders in shared mobility and related mobility service developments?

The types of opportunities reported differed according to actor configuration. **In user-centred projects**, opportunities most commonly related to knowledge generation and design, including making experiential knowledge available for design, revealing overlooked needs and constraints, exposing differences in perspectives, and developing more contextually appropriate mobility solutions. In several user-centred cases, participation and knowledge generation were closely intertwined: participants helped translate abstract concepts into everyday contexts, negotiate competing preferences, articulate otherwise inaccessible needs, and contribute directly to the development of design solutions rather than merely informing them.

In multi-actor projects, opportunities more frequently related to participation and relationships. These opportunities extended beyond access to knowledge and included mutual learning between actors, greater understanding of different perspectives and responsibilities, the development of trust and shared agendas, and increased ownership of mobility service developments. Multi-actor projects were also more likely to report implementation- and institution-related opportunities, including service adaptation, identification of feasibility and operational constraints, governance learning, implementation readiness, uptake, and continuity beyond the project period. While such opportunities were less frequently reported overall, their concentration within multi-actor projects suggests that implementation-related value was associated with the involvement of actors holding responsibilities or resources to act on co-designed outcomes.

Meanwhile, broader participation also brought a range of **challenges in conducting co-design**. Recruitment was often reported as difficult, both in attracting participants and in sustaining their involvement over time, which was closely influenced by decisions regarding activity formats and duration. In a few cases, participants' engagement was limited either by a lack of design training, which constrained their capacity to contribute to mobility problems, or by lower willingness to use shared mobility in particular physical and social contexts.

Handling of co-design outputs was also reported as challenging, as participatory processes generated rich and diverse materials that could be challenging to

document and synthesise. Scaling up participation raised questions about how to represent diverse perspectives without oversimplification. Interestingly, this reflects a broader tension in mobility development: while participatory processes are often expected to account for diverse needs, attempts to identify consensus and common issues may leave behind the individual needs and differences that shape travel choices.

Other challenges arose beyond the immediate co-design activities. Fixed project timelines and limited resources filtered which proposals could be taken forward, putting pressure on the cooperative process which has a time-consuming nature; coordination became difficult when organisations had competing interests and responsibilities; and in some studies actors participating in co-design did not hold sufficient decision-making authority within their organisations to carry proposals into subsequent planning and implementation processes. Consequently, co-design outcomes did not connect easily with existing planning and implementation processes. Study 1 therefore shows that the opportunities of diverse participation depend not only on who is brought into co-design, but also on how participation is organised and how the process connects with the project and institutional conditions surrounding it.

Summary

Overall, Study 1 conceptualises co-design practice beyond a set of specific methods or stages. Instead, it understands co-design practice as a configuration of intended functions, participation arrangements, practices and reported outcomes situated within broader project and institutional conditions. This perspective provides the analytical basis for examining in Study 2 how these relationships unfold within a single co-design process over time.

In the following section, the findings from Study 2 are presented using the three dimensions: intended function, conducting and outcomes of co-design. These dimensions are used as the framework to describe the empirical case and enable the Cross-Study Synthesis.

4.2 Study 2 -Fredrikstad Case: Understanding One Co-design Practice in Depth

This section presents findings from the Fredrikstad co-design process, first examining the three dimensions in relation to RQ1, followed by the opportunities and challenges of involving diverse stakeholders in relation to RQ2.

4.2.1 Insights for RQ1:

How is co-design conceptualised and practised in shared mobility and related mobility service developments?

Why using co-design: intended function

In the Fredrikstad case, co-design served multiple, overlapping intended functions. At the project level, it was intended to support the SUM project's ambition to develop shared mobility solutions through citizen and multi-stakeholder involvement, combined with a Living Lab approach. For the municipality, a more specific function was to learn from local perspectives that were not otherwise accessible through conventional planning processes to tackle the city's private car dependency, and to explore ideas that could potentially inform the ferry trial during the Living Lab 12-month test period. For the researchers at Chalmers, co-design was intended to function both as an advanced user study method and a design method, surfacing tacit knowledge and supporting collective solution development. Combined with the municipality's objectives, this led to the simultaneous involvement of local citizens and other local stakeholders. However, as project conditions changed, the scope of participation and the type of service being explored also changed. Across the process, the intended functions developed from understanding local mobility experiences and generating ideas towards bringing diverse actors together and exploring possible service configurations.

How it is conducted: Participation arrangements and process development

Regarding **participation arrangements and continuity**, the Fredrikstad co-design process involved citizens, researchers, municipal planners, mobility service actors, local businesses and project partners, with the actor configuration changing across the three stages. The development of participation, activities and key project events across the three stages is illustrated in Figure 5. Participation expanded from primarily citizens and the local project team in Stage 1 to a broader multi-actor configuration in later stages, as additional service providers, municipal planners, project partners and decisionmaker became involved. This reflected both changing purposes and practical recruitment conditions. While citizens contributed knowledge of everyday mobility and local needs, the involvement of professional

stakeholders increasingly brought perspectives related to service development, feasibility and potential implementation.

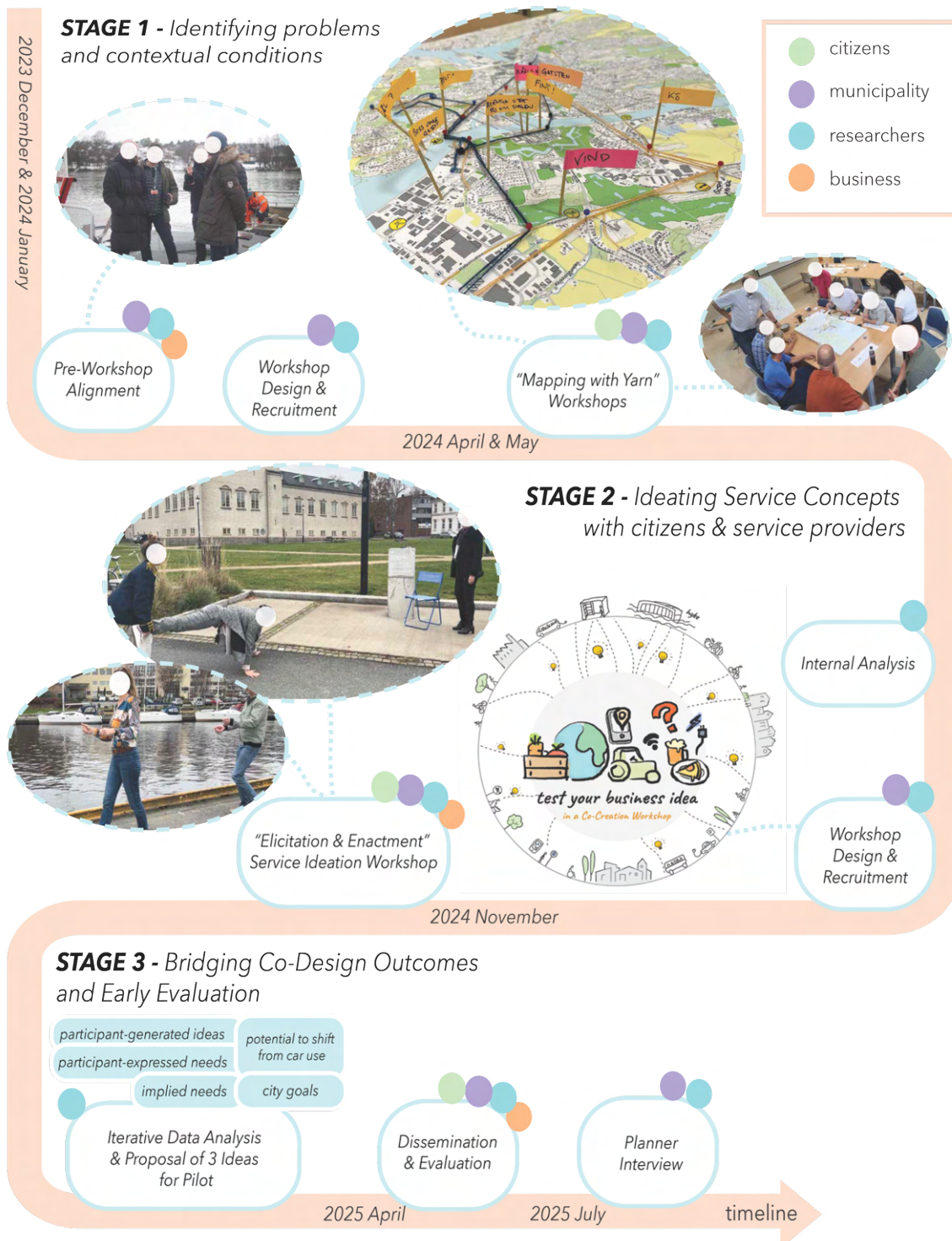


Figure 5. Timeline of the Fredrikstad co-design process, showing the three stages, participating actors, major activities and key project developments affecting the process.

Citizens and other external participants were recruited through a combination of open calls and targeted invitations, and participation varied between activities. Consequently, continuity depended substantially on the researchers, primarily me, carrying knowledge and outputs between stages. Participant contributions were synthesised and translated by me, supported with discussions with participating researchers and city planners, into materials that informed subsequent activities, allowing the process to remain connected despite changes in participation.

In terms of **process development** between the **stages**, the process was organised around three interconnected stages intended to move from understanding local mobility contexts and needs, through generating and developing service ideas, towards evaluating selected proposals through pilot testing. However, this trajectory changed as the project unfolded. Delays and changes to the ferry trial broadened the focus from the planned route to the wider city ferry system, while long recruitment period, time and budget constraints and institutional ownership affected what could be pursued. After the proposal development and dissemination, the intended pilot testing in Stage 3 did not take place. Instead, the stage concluded with reflective interviews with planners.

In practice, the three-stage project trajectory contained recurring cycles of preparation, participation and translation. Researchers and local partners discussed objectives, participants and activity formats; recruitment and workshop preparation developed in parallel; co-design activities generated participant contributions and artefacts; and these were subsequently analysed and translated into materials for discussion and subsequent activities. These cycles were simultaneously embedded within a more linear project trajectory shaped by deliverable deadlines, the 12-month ferry trial, dissemination events, changing ferry routes and recruitment possibilities. Consequently, co-design practice developed through the interaction between the iterative cycles and the more linear timeline and organisational conditions of the wider project, instead of through a fixed co-design procedure.

Activities and methods included workshops, meetings and dissemination activities supported by generative methods emphasising making, visualisation and enactment. Methods were adapted to the purpose, participants and conditions of each stage. In Stage 1, tactile mapping with yarn and pins supported exploration of travel routines, mobility challenges and alternative routes (Figure 6). In Stage 2, findings from the earlier stage were translated into a “Service Idea Buffet” that supported multi-actor concept generation, while enactment and filmmaking enabled groups to develop and communicate service ideas. In the later dissemination activities, visual presentations showcasing the outputs and translation work from each stage supported discussion of the proposals and their feasibility.



Figure 6. Yarn-and-pin mapping activity used during Stage 1. The method enabled participants to visualise and discuss everyday travel routes, mobility challenges and alternative travel possibilities. Yarn and pins were selected because of their familiarity within Norwegian knitting culture and that they are easy and fun to play with, allowing for adjustments and reflections in the making process.

Activity design also involved adapting facilitation and group composition to participation conditions. Visual and tangible materials supported communication across different backgrounds, while group compositions were arranged to combine different forms of knowledge and expertise. As attendance remained uncertain until shortly before activities, group configurations, timing and facilitation were repeatedly adjusted. Therefore, conducting the co-design process involved continually configuring participation and adapting methods in response to the actors and conditions involved.

More detailed accounts of the co-design activities and process are provided in Paper 2 and Paper 3, while Paper 3 also provides a more detailed analysis of actor participation and the conditions shaping the process.

What co-design produces: Outcomes

The Fredrikstad process produced different types of outcomes, ranging from knowledge about local mobility practices to participant-generated service ideas and researcher-translated pilot proposals. The first stage generated potential commuting routes with the new ferry, contextual knowledge about commuting practices, barriers to using the ferry and opportunities for integrating ferry travel with other everyday activities (Figure 7). In the second stage, this knowledge was carried forward into a broader range of service concepts addressing commuting, cultural experiences and practical services, which participants developed and communicated through written concepts and filmed enactments (Figure 8 and 9).

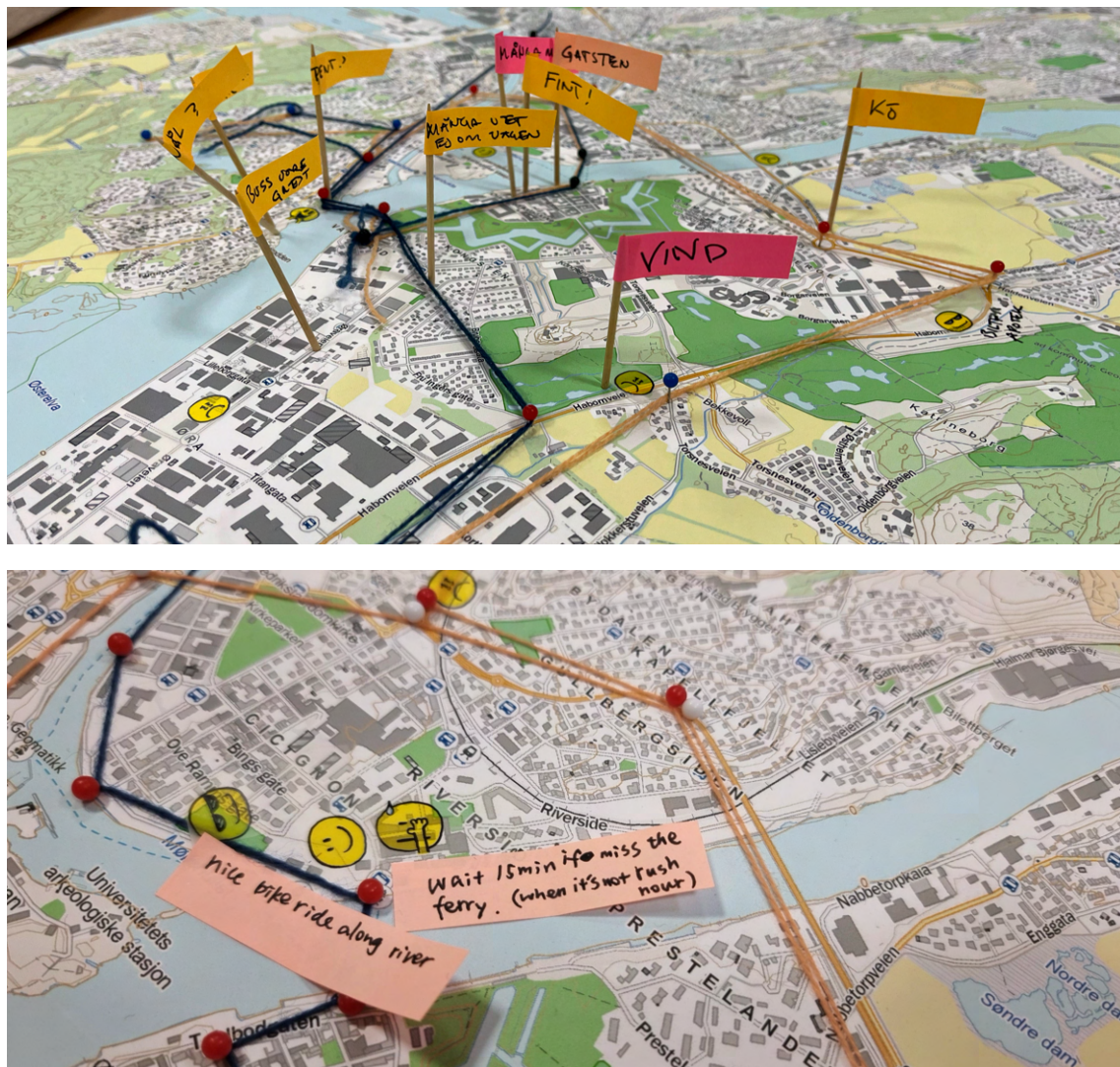
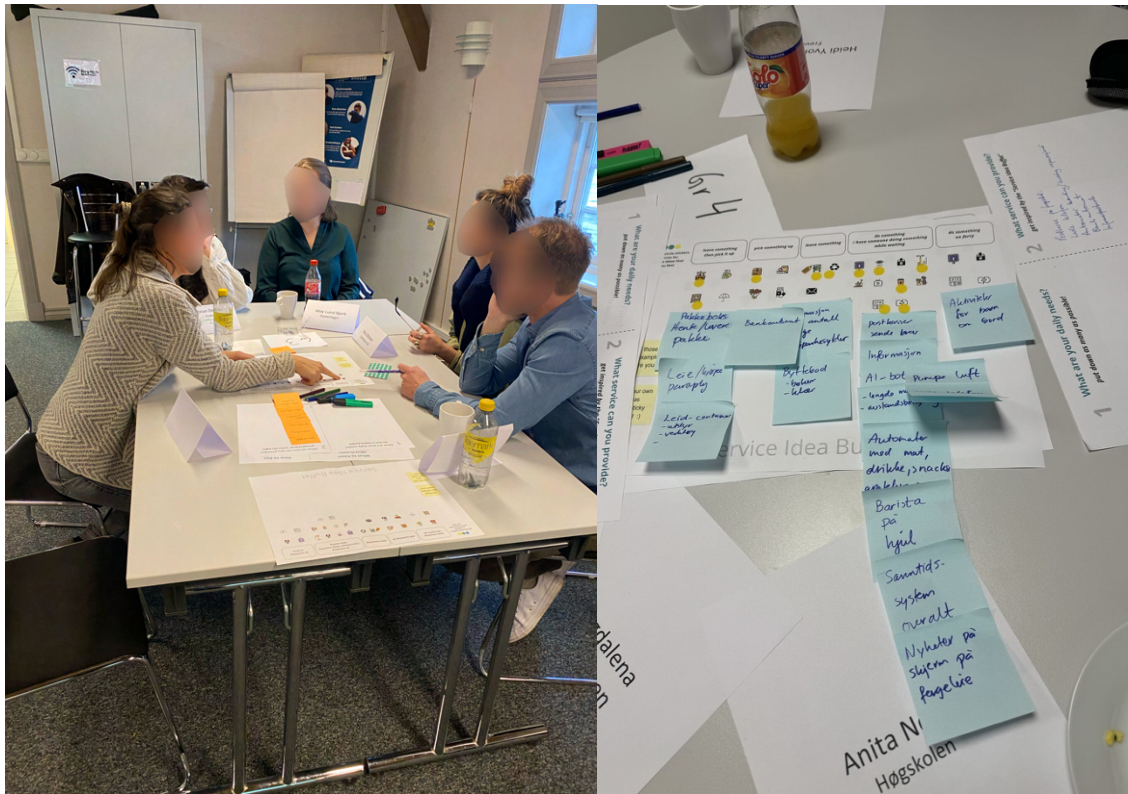
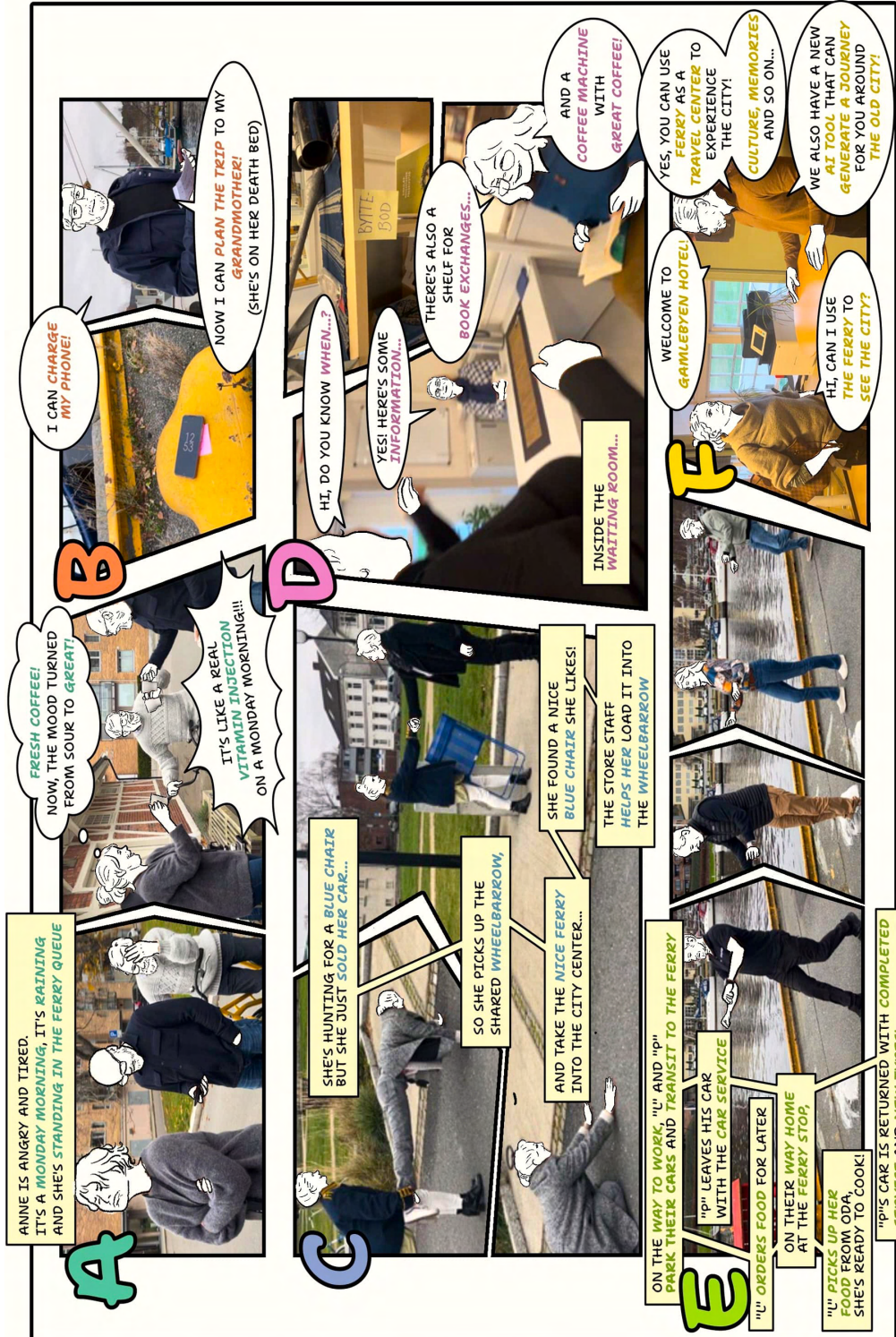


Figure 7. Examples of participant-generated route maps and mobility insights from Stage 1. The materials documented travel practices, moods, perceived barriers and opportunities related to ferry use.



These participant-generated outputs were not treated as final solutions and went through successive translation, analysis and synthesis. Following the workshops, the researchers analysed and translated the accumulated material, including expressed and interpreted user needs, more than 100 noted ideas, six films and participant votes, and synthesised them into three more developed proposals: an on-demand ferry service, additional services at ferry stops, and an improved waiting experience. In doing so, participant contributions were considered alongside feasibility considerations and the municipality's objective of reducing private car use, with priority given to ideas that may attract car users beyond existing shared mobility users.



The three proposals generated interest and further discussion among municipal planners, the ferry manufacturer and other project actors, including possibilities for connecting them with existing city initiatives. However, none was implemented within the project period. Retrospectively, the ferry failed route testing during the 12-month field trial, leading the municipality to change the routes on which it was deployed. At the same time, weather-related delays in its deployment and a prolonged participant recruitment period reduced opportunities to test the co-designed proposals during the trial period.

With no remaining project budget for piloting and the ferry testing period ending, the later outcomes instead included reflections and learning about both the co-design process and the conditions for implementation. Municipal reflections highlighted the value of collectively identifying problems and possible solutions, while also showing that implementation required alignment with existing planning structures, responsibilities and longer-term priorities. Therefore, the outcomes of the Fredrikstad process were not limited to the implementation of the proposed services but also included knowledge, concepts, translated proposals and learnings.

A more detailed account of the outcomes generated and developed through the Fredrikstad process is provided in Paper 2 (immediate outcomes) and Paper 3 (outcome development under changing participation dynamics between stages).

4.2.2 Insights for RQ2:

What opportunities and challenges arise in co-design processes involving diverse stakeholders in shared mobility and related mobility service development?

The Fredrikstad case shows that involving diverse stakeholders created opportunities for **interaction between different forms of knowledge and perspectives** within the same collaborative setting. Citizens contributed experiences of everyday mobility, while planners, operators and other stakeholders brought both personal experiences and professional knowledge. Through mapping, discussion, making and enactment, participants could articulate experiences that might otherwise remain tacit, respond to each other's perspectives, and negotiate possibilities and constraints. Individual concerns could develop into more collectively framed understandings and ideas. Thus, the value of diverse participation came from both representing different perspectives and enabling these perspectives to interact and develop together.

Paper 2 conceptualises this temporary collaborative space as a “clearing” (*Lichtung*), drawing on Heidegger's concept [70], in which different forms of knowledge could become visible and negotiable. From this perspective co-design is not merely a method but a means of creating conditions through which actors' everyday experiences and operational realities become visible and understood in relation to one another, amidst the complexity of mobility challenges. The observed movement from individually expressed concerns towards more

collectively framed understandings suggests not only shared ownership of ideas, but also a movement towards one another in participants' understanding of the problem itself.

The clearing, however, remained temporary. It created conditions for collaborative exploration without removing the different institutional positions and responsibilities participants occupied outside it.

However, **organising and sustaining diverse participation** presented several challenges. Recruiting a relevant mix of participants was challenging, particularly among car-dependent users, while differences in expertise, authority, familiarity and motivation required continuous adaptation of group composition, facilitation and activities. Participants did not always take the roles anticipated by researchers, and their roles and levels of participation changed across stages. Role fluidity was observed: participants from diverse organisational backgrounds engaged openly beyond their professional roles and sometimes adopted a more general citizen perspective, even when this was not explicitly asked of them.

Changing participation also created challenges for continuity. As the same individuals did not participate throughout the process, researchers had to carry forward and synthesise contributions between stages, while intangible learning and other gains were difficult to transfer. The role fluidity supported exploration, but while as the process moved towards synthesising and evaluating ideas, municipal participants increasingly drew on their formal responsibilities, making their roles narrower and more explicit. Researchers took on translation and synthesis of ideas, while governance actors' voices were much more active than citizens' during the evaluation of ideas. These challenges suggest that diverse participation needs to be actively organised and cannot be assumed simply by bringing different actors together.

Further challenges arose in **connecting collaborative exploration with institutional action**. The opportunities created within the collaborative setting did not automatically continue as outcomes travelled towards implementation. Role fluidity and a sense of ownership were most visible during collaborative exploration, whereas institutional responsibilities and decision-making authority became more prominent during later evaluation and implementation-oriented discussions. When interviewed, one municipal planner used “we” to refer to those who had participated in the workshops, and “they” to refer to those responsible for city planning, even though some workshop participants were themselves municipal actors with planning responsibilities. Actors with decision-making authority for implementation were not involved throughout the earlier stages, limiting their ownership of proposals developed through the process.

The case also revealed differences between local and experiential understandings of mobility and the broader “bird's-eye” perspective required in municipal

planning. Locally valued ideas had to be reconsidered in relation to city-wide priorities, existing responsibilities and longer-term planning processes. Study 2 hence suggests that a central challenge of multi-stakeholder co-design lies not only in creating productive interaction, but in maintaining connections between that temporary collaborative space and the institutional structures through which outcomes must subsequently travel.

Four interconnected tensions related to co-design's potential in mobility service development were identified: local problem framing versus institutional planning, collective "we" versus institutional "they", exploration versus implementation as the goal, and role fluidity versus role reassertion. A more detailed argument for the challenges and tensions is in Paper 3.

Summary

Overall, Study 2 shows that the opportunities and challenges of involving diverse stakeholders were closely connected to how co-design was practised and how participation, activities and outcomes developed within the wider project conditions. The collaborative setting enabled different perspectives to interact, but creating and sustaining this setting required continuous work, while connecting its outcomes to institutional action introduced further challenges.

4.3 Cross-study Synthesis

This section brings together the findings of the two studies. It first summarises their combined answers to the research questions, then presents three shifts in understanding developed through contrapuntal listening.

4.3.1 Summary of Answers to Research Questions

Taken together, the two studies answer RQ1 by showing that co-design in mobility service developments is conceptualised and practised through interrelated configurations of intended functions, participation arrangements, and process evolution. Co-design can be only vaguely defined by particular methods or rationales of related terminology, while it becomes more understandable through combining what it is intended to achieve, how participation is organised, how the process develops, and what its outcomes contribute within the wider mobility service development. Study 1 establishes these relationships across documented practices, while Study 2 shows how they evolve and are continually adapted within a situated process.

In relation to RQ2, the studies show that involving diverse stakeholders creates opportunities for making different forms of experiential knowledge and operational realities visible and negotiable, allowing different perspectives to interact. This supports shared understanding, mutual learning between actors, and the collective exploration and development of context-sensitive mobility proposals. At the same time, these opportunities are accompanied by challenges of recruitment, participation, facilitation, translation of the process and outcomes, ownership and implementation. These challenges arise not only within participatory activities but also through the relationship between co-design and the project and institutional conditions in which it is embedded.

4.3.2 Contrapuntal Listening and Shifts

Inspired by the musical notion of counterpoint introduced in the method chapter, the following sections read the two studies together, asking how each study changed the interpretation of the other. As summarised in Table 2, three shifts in understanding exist in this contrapuntal listening, cutting across the findings and develop the understanding of co-design practice and its contribution over time

Dimension	Study 1	Study 2	Cross-study Synthesis
Intended function	Co-design becomes more interpretable through the function it performs than through inconsistent conceptualization and rationales of co-design-related terminology.	What co-design meant developed through interaction between methodological intentions, project and local objectives and what became possible in practice. →	What co-design means is progressively shaped through practice
Conducting	Practice is characterized through actor configuration, participation continuity and stage position in the development process; methods are flexibly adapted within these arrangements.	Practice evolved through repeated preparation, participation and translation as participation and project conditions changed. Shift 1 →	From named methods to organizing participation
Outcomes	interventions and do not necessarily progress towards implementation.	Outcomes were progressively translated, filtered and disregarded as the process moved from collaborative exploration towards institutional planning. Shift 2 →	From immediate outputs to institutionally conditioned contributions
	All three dimensions together	Shift 3 →	From configurations to evolving trajectories

Shift 1: From named methods to organising participation

The literature review (Study 1) suggested that methods and activities alone provide a weak basis for comparing co-design practice. Similar methods appeared across projects, yet they served different purposes depending on participation arrangements, actor configurations and project stages. At the time, this was primarily perceived as an analytical challenge of combining the right dimensions.

The Fredrikstad study (Study 2) changed this perception by showing why methods appeared so heterogeneous. Throughout the project, methods were repeatedly adapted as participation changed. Project developments altered who should be recruited, changing actor configurations required different forms of facilitation, reshaping activities and expected outcomes.

A good example is the transition between the first and second stages of the co-design process. When the planned ferry route changed, recruitment shifted from local employees and residents towards general city ferry users. This is a change of what became meaningful to design. In the first stage, conversations centred on existing local conditions and place-specific commuting practices. Participants mapped their own routes, discussed concrete mobility problems, and planners and ferry operators responded at the level of operational feasibility, for example explaining that a feeder bus addressing winter comfort and connections to the ferry stop was already planned. In the second stage, the workshop shifted from improving one local setting towards imagining the broader experience of travelling by ferry in the city, as that was what the ferry was used for. To support this, participants were involved from much more diverse backgrounds, and municipal involvement expanded beyond planning and mobility to include culture, cycling, library and public health. Consequently, the ideas generated became less place-specific and more experience-oriented, focusing on improving the ferry journey rather than particular local interventions. This shift in abstraction may also have influenced what could later be carried forward, as these ideas were less directly connected to existing municipal responsibilities than the earlier place-specific proposals.

The shift in participation also changed the demands placed on facilitation. Greater diversity among participants introduced larger differences in authority, expertise and familiarity with participatory formats, requiring more deliberate decisions about group composition and stronger support for creativity and equal participation. This contributed to the decision to use enactment and short filmmaking. Methodologically, enactment may offer a more grounded experience in a mobility context than drawing and collaging [71], while also enabling groups of users to co-experience vehicle systems [56, 72]. As a facilitation strategy, its rapid, novel and playful format was also intended to help counter potential hierarchies in expertise and authority arising from participants' diverse backgrounds.

Returning to the literature review, the diversity of reported methods therefore appeared differently. What had originally been interpreted as methodological variation could now be understood as different ways of organising participation. Activities, methods and tools were no longer interpreted as transferable techniques, but as temporary responses to changing participation and project conditions. Thus, transferring co-design practices is difficult in two folds: first, practices must be adapted to different urban transport contexts and project conditions; second, methods and activities alone can capture only a limited part of how participation is organised.

Shift 2: From immediate outputs to institutionally conditioned contributions

The Fredrikstad study shifted the understanding of co-design outcomes beyond the immediate outputs of workshops. Although the co-design process generated ideas, shared learning and was warmly received by participants, what continued afterwards depended on ownership, institutional responsibilities and project conditions rather than on the quality of the co-design activities and outputs.

Within the Fredrikstad process, co-design was understood as a clearing for developing shared mobility solutions together with citizens and stakeholders. As discussed in Section 4.2.2, the process where individual realities were visible, assumptions were negotiated and understandings were collectively formed, generated proposals that were both grounded in everyday experiences and negotiated across diverse perspectives. However, when the proposals moved towards implementation, their continuation depended on actors holding institutional responsibility and decision-making authority. As these actors had not been involved throughout the earlier stages of the process, ownership of the proposals remained limited, and many of the co-designed outcomes were instead reframed as learning for future planning. This revealed a previously less visible interrelationship between the collaborative space created through co-design, where researchers and local stakeholders worked towards a shared project goal, and the institutional reality beyond the project, where actors simultaneously managed other responsibilities in projects and planning processes. The tensions identified in Study 2 emerged from this interrelationship, as co-designed outcomes became subject to different expectations and conditions as they travelled.

Returning to the literature review, these insights fundamentally changed the interpretation of the reported implementation patterns. The diverse outcomes and limited implementation documented across cases no longer appear to be characteristics of the co-design processes, but trajectories also shaped by conditions beyond the conducting of co-design. This led to the development of a *three-sphere perspective* (Figure 10) that distinguishes the conducting of co-design, the project and the broader institutional context, and helps situate where different challenges and tensions emerge.

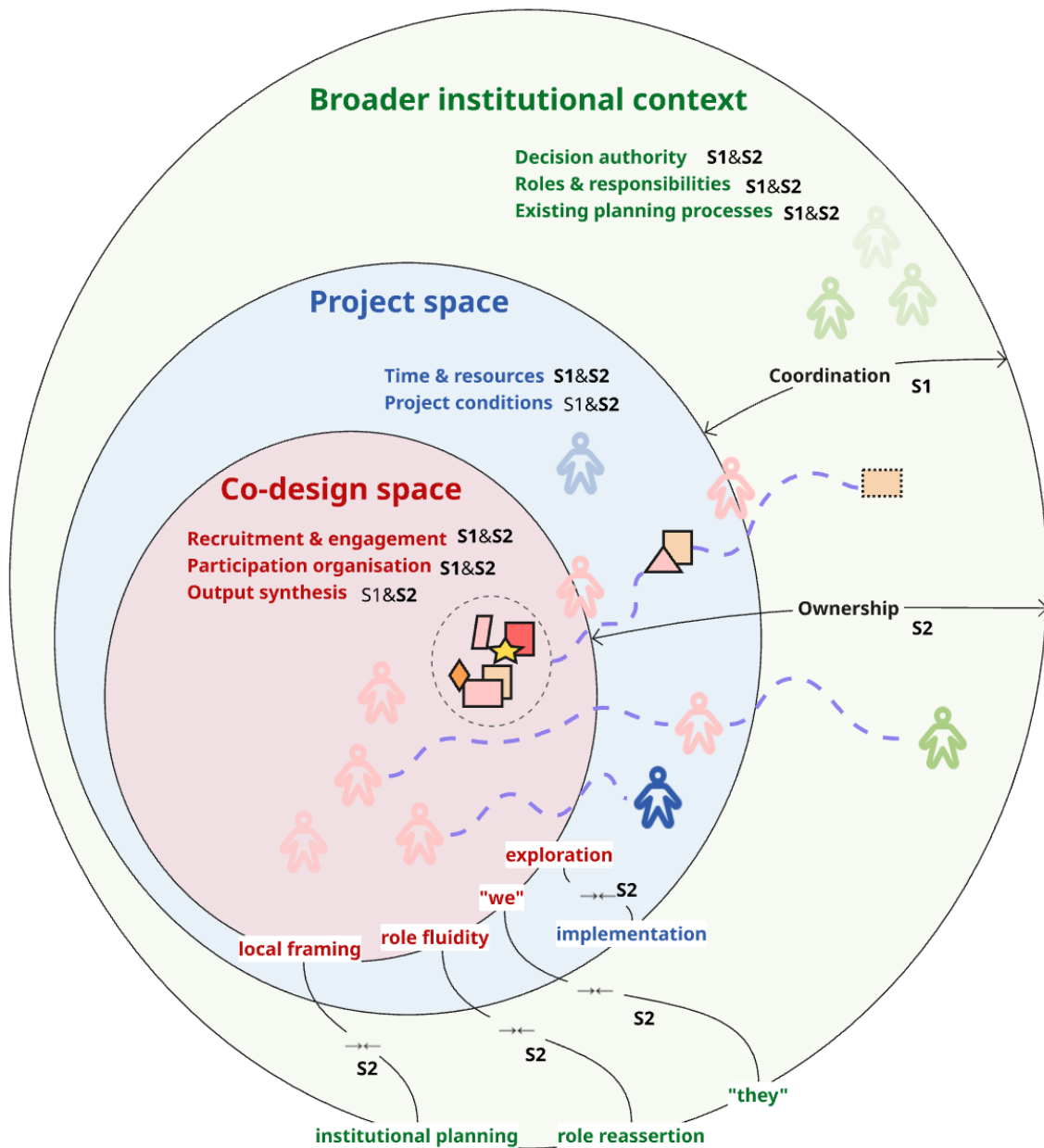


Figure 10. Three-sphere perspective developed through the cross-study synthesis. The framework situates challenges and tensions identified in Study 1 (S1) and Study 2 (S2) across the co-design process, the wider project setting and the broader institutional context.

The co-design sphere represents the temporary collaborative setting in which participation is organised, and co-design activities are conducted. It is situated within a wider project sphere shaped by project aims, timelines and resources, while the broader institutional context encompasses organisational responsibilities, decision-making authority and established planning processes.

Challenges identified in Study 1 can be located across these spheres: recruitment difficulties limited engagement and handling of co-design outputs arise largely within the conduct of co-design; fixed project timelines and limited resources are associated with the wider project; and decision-making authority becomes particularly important as outcomes connect with institutional processes. Coordination challenges emerged through the interrelationship between the project and institutional spheres, where their respective conditions and constraints interacted.

Challenges experienced in Study 2 resembled those identified in Study 1. However, the tensions identified in Study 2 make these interrelationships more explicit. Exploration versus implementation primarily reflected the relationship between the co-design and project spheres, while local problem framing versus institutional planning, collective “we” versus institutional “they”, and role fluidity versus role reassertion reflected the relationship between co-design and the broader institutional context. Maintaining ownership became particularly visible as responsibility for carrying ideas forward extended beyond the co-design process itself. Study 2 further shows that the three-sphere perspective is not static: actors and outcomes move between spheres, while their roles and possibilities for continuation change as different conditions come into play over time.

Shift 3: From configurations to evolving trajectories

The analytical map developed in Study 1 presents co-design practices as configurations that relate intended functions, practices and outcomes across reviewed cases. However, a retrospective reading of these configurations after Study 2 had fully unfolded changed this understanding. Rather than representing fixed characteristics of projects, they came to be understood as snapshots taken from evolving trajectories.

This shift became particularly visible when revisiting the quest of the intended function of co-design. During the literature review, identifying the intended function was unexpectedly difficult. It could rarely be determined from how co-design was introduced but only became interpretable after examining how the process was conducted and what kinds of outcomes it produced. At the time, this appeared mainly as a challenge of interpreting incomplete documentation.

The Fredrikstad study adds a temporal dimension, showing how multiple, initially folded and less visible reasons and motivations gradually unfolded over the three-year course of the project. The meaning of co-design was continuously shaped by

many layers: the objectives of the SUM project, which framed the work in terms of “co-creation”; changing local project conditions that initially supported pilots; the interests of the research team evolving from best solutions towards understanding the participatory process; activity decisions based on local team’s arrangements for venue and timing; and my own experience as a researcher-practitioner designing and facilitating the process. Instead of being determined solely by academic definitions before the project began, the intended function of co-design was progressively enacted as the project unfolded.

Returning to the literature review, the reviewed cases therefore appeared more compressed than before. The way they were described in the publications compressed this time dimension, leaving many motivations, negotiations and different anchor points within longer processes invisible. Therefore, the configurations identified in Study 1 could be reinterpreted as analytical snapshots of evolving processes, much as Paper 2 and Paper 3 present two different snapshots of the same study.

5. Discussion and Implications

This licentiate thesis aims to explore how co-design is practised, and how it contributes to the development process of shared mobility and related mobility services. This aim is addressed through two research questions. The previous chapter presented findings from two studies examining why and how co-design is practised, and what emerges from these practices, both across documented cases and through the experience of conducting co-design. The studies addressed the research questions in breadth through Study 1 and in depth through Study 2. Considering their findings together further suggests that the answers to RQ1 and RQ2 are closely interrelated: how co-design was practised shaped the opportunities and challenges that emerged, while changing participation and project conditions, which are part of the challenges, in turn reshaped how the process could be conducted, with whom, and what it could contribute.

Across the three shifts identified through the contrapuntal reading of the studies, a shared insight is the importance of restoring the dimension of time to the understanding of co-design. Configurations become trajectories when followed over time; methods become understandable through the changing organisation of participation; and immediate outputs become contributions whose meanings and possibilities change as they move through project and institutional contexts. This temporal understanding provides a more nuanced answer to the research aim: how co-design is conceptualised and practised is enacted and changes over time, while its contribution to mobility development may extend beyond the timeframe captured by individual projects or publications. The contributions therefore cannot be inferred from immediate outputs alone, but depend partly on how these are carried forward, transformed or discontinued within wider project and institutional processes. This may also help explain why the impact of participatory processes in transport can be difficult to capture, and why evidence of these impacts remains sparse [15, 23].

5.1 Positioning Co-design within Mobility Development

Concerns have been raised about the sustainability of co-design outcomes for mobility solutions after project completion [22, 49]. In this context, the present research suggests that, in mobility development, co-design can be understood as one situated component of a broader development process rather than as a self-contained process. The findings are consistent with established understandings of co-design as valuable for accessing experiential knowledge and enabling different forms of knowledge and perspectives to interact [25, 73]. At the same time, the findings show that these contributions do not, in themselves, resolve the wider

development activities required to bring mobility solutions into practice, which may involve analysing feasibility, developing technical specifications, pilot testing, performance evaluation, and the integration of services into routine practice and institutional structures.

I therefore argue that co-design can be more useful when its intended function is made explicit and considered in relation to other activities and approaches within the wider mobility-development process, rather than as a separate complete process. Previous research on service co-design has similarly argued that co-design must be integrated with broader development processes rather than remain disconnected from core organisational activities [31]. The present research extends this argument to mobility development, where co-design operates within longer and institutionally distributed processes involving other forms of analysis, planning and implementation.

This situated view also provides a more realistic basis for evaluating co-design's contribution. Its contribution should be considered in relation to what it was primarily intended to enable, instead of applying several evaluative orientations at the same time. The three shifts discussed below develop these arguments in greater detail.

5.2 Implications of the Three Shifts

The three shifts developed through the cross-study synthesis suggest implications for how co-design can be organised, connected to subsequent development and evaluated. These implications concern organising participation, supporting translation and continuity, and documenting and evaluating contributions over time.

5.2.1 Organising Participation in Relation to Intended Contribution

Study 2 shows that the co-design process did not unfold under stable conditions: project changes shaped choices of activities and methods and recruitment scope, while unforeseeable participation, in turn, required adjustments to methods and facilitation. These uncertainties surrounding both the project and participation suggest that methods and participation arrangements should not be treated as separable characteristics of co-design practice.

Existing research has recognised the diversity of participatory methods and emphasised their flexible and adaptive use in response to real-world conditions [17, 26, 31, 37, 74, 75], including the combination of multiple methods to engage diverse interests in transport planning [17]. At the same time, there is no clear way of evaluating particular methods in relation to their outcomes [16, 32, 47, 76]. In transport, Pappas et al. [23] suggest that applying similar approaches or methods in similar contexts could facilitate comparison across cases. The present findings

support the need for comparison, but suggest that methodological and contextual similarity alone may be insufficient. This aligns with broader critiques in participatory design research of method-centred understandings of practice [38, 39]. Light and Akama [38] call for greater attention to how participation is practised, questioning an emphasis on methods and replicability that abstracts methods from the people who enact them. Botero et al. [39] similarly argue that methods are intertwined with mundane organizing work, strategic considerations and design outcomes, which continuously shape one another in practice.

The present findings specify how these interdependencies unfolded in mobility service development: what a method enables depends on how participation is organised, what the co-design process is intended to contribute, and how project conditions develop. The findings further show how the organisation of participation and the continuation of outcomes involve relationships across the co-design, project and broader institutional spheres. Transferability of co-design in such development may therefore depend not only on methodological and contextual similarity, but also on making these relationships visible and understandable.

This understanding has implications for how participation might be organised in practice. Different intended contributions may require different participation strategies. Where exploration and learning are the primary aims, it may be appropriate to prioritise openness, diversity of perspectives and room for creative exploration, while being transparent about decisions that remain outside participants' control. Where a participatory process is expected to contribute more directly towards implementation, the findings suggest a need to involve actors with relevant responsibilities, resources and decision-making authority earlier in the process, even if this may narrow the collaborative space at an earlier stage. In support of this, facilitation then may benefit from attention to both collaborative exploration and balancing the power differences associated with decision-making. Neither arrangement is inherently better; rather the choice has consequences for both participation and what can continue afterwards.

Previous mobility co-design research has pointed to the need for flexibility in organizing participation, for example, by adapting to participants' experiences and needs, the scale of participation [52], and stakeholders' expectations as projects evolve [69]. Study 2 adds to this debate by suggesting that the organisation of participation should be treated as an ongoing task rather than something that can be largely planned or decided in advance. Activities, methods and facilitation needed to be adjusted responsively as participation and project conditions changed. Whether particular participation strategies systematically lead to better continuity or other forms of contribution requires further investigation.

5.2.2 Designing for Translation and Continuity

Existing service co-design research has identified barriers and enablers related to collaboration, organisation, processes, implementation and methods, including difficulties in translating co-design outcomes into organisational language and the importance of committed internal “agents” [31]. Mobility participation research similarly highlights the role of local “agents” or “champions” [17, 48, 57], who may maintain participation, coordinate actors and connect community interests with decision-making authorities, often being well connected across multiple levels of government, enabling them to bridge different interests and processes [17].

While existing research has identified agents or champions as important for implementation, the present findings complement this by shifting attention from who matters to the challenges they help address. By locating these challenges within the co-design, project and institutional spheres, the framework reveals where different forms of support and coordination become necessary. For example, actors with responsibility for resource allocation or coordination across institutional boundaries may become important when outcomes move from the project sphere to institutional sphere. The perspective also helps explain why productive participatory activities may coexist with limited visible or sustained contributions, as co-design outcomes encounter different conditions and challenges across spheres.

The Fredrikstad case further suggests that responsibilities and authority may shift as outcomes move between spheres. An actor who is able to carry an idea forward in one sphere, even when well-connected across several spheres, may not retain the same influence or authority in another. This adds another dimension to existing observations in mobility research that participants’ motivations and stakeholder positions might change over time [22, 69].

If co-design outcomes are expected to continue beyond collaborative activities, attention therefore needs to be given to how outputs are translated and carried forward. Organisers of generative activities such as workshops may therefore need to consider how outcomes are documented, who takes responsibility for their continuation, and how they connect with subsequent project processes. More self-explanatory outputs may help reduce some of the translation work required.

In Study 2, a playful approach and accessible, self-explanatory forms of representation appeared to support translation and continued interest by catalysing shared creativity and joy. The short films, for example, made participant-generated ideas visible and communicable beyond the groups that created them. However, translation still required substantial work from researchers to synthesise diverse materials into proposals that could be discussed with project partners and participants. This resembles previous mobility co-design research showing the

effort involved in translating participant-generated material into forms that can be communicated and used in subsequent activities, for example by synthesizing rich participant experiences into accessible “headlines” [52]. The present findings further suggest that designing for continuity requires treating translation work as a core part of the co-design process rather than as additional efforts undertaken by researchers after participatory activities have concluded. This is consistent with Botero et al.’s broader conceptualisation of participatory design as ongoing translation between methods, practical work, strategic considerations and design outcomes [39].

As outcomes enter broader institutional contexts, further attention is needed to who carries and translates them, into which processes, with what authority and resources, and in what form. These questions, together with institutional constraints, may need to be considered early and collectively to support later ownership and continuity.

5.2.3 Documenting and Evaluating Trajectories

Existing research on co-design evaluation recognises that outcomes are often multidimensional and may take time to develop, making longer-term impact difficult to assess [32, 77, 78]. Identifying the direct impacts of participation can be difficult, since observed changes may result from the combined influence of participants, practitioners and contextual conditions [78]. Longer implementation lead times can further complicate evaluation [77]. Proposed approaches include follow-up interviews, longitudinal indicators, diaries, surveys and continued data collection [32].

The present findings also emphasise the need for longer-term evaluation but suggest that later evaluation can still provide another snapshot if transformations between evaluation points remain invisible. A trajectory perspective instead asks how outcomes change in meaning, form, ownership and institutional relevance as they move across stages and contexts. Follow-up interviews, diaries and continued data collection could support such an account, but their value for tracing trajectories depends on whether they capture how outcomes change between stages and contexts. This does not resolve the temporal challenge of evaluation but shifts attention from asking only whether outcomes persist to following what happens in between.

Study 1 further showed that publications often capture particular activities and outcomes while leaving the relationships between them difficult to reconstruct. Documenting intended functions, practices, outcomes and their connections may provide a more relational account of how co-design unfolds. This documentation strategy may also support the transferability discussed in Section 5.2.1 as it helps others judge how findings relate to their own conditions. Evaluation may similarly need to move beyond treating implementation as a single yes-or-no endpoint, as

outcomes can continue, transform or discontinue over time. Learning and other intangible contributions may therefore benefit from being documented during the process, as they are not always visible in immediate outputs and can be difficult to reconstruct retrospectively once actors have returned to their everyday roles.

Documenting trajectories may offer one way to respond to the uncertainties underlying heterogeneous co-design processes discussed in Section 5.2.1 and to account for contributions that are otherwise difficult to demonstrate. It may also provide a shared account that can be revisited and reduce the fragmented effort of repeatedly reconstructing co-design processes for different audiences, deliverables and evaluative frames. If co-design contributions are understood partly through their development over time, the pressure to justify co-design's value through isolated snapshots and immediate outcomes may therefore be reduced, while accounts of the process become more coherent. However, whether this reduces retrospective reconstruction work or instead adds to documentation demands remains an empirical question.

While trajectory documentation offers one possible way forward, further methodological development is needed to understand how it can be carried out in practice and accommodated within project and publication boundaries.

5.3 Potential Relevance Beyond Mobility

Although these findings are grounded in mobility development, several conditions identified in the studies are not specific to mobility contexts. Some findings here may be relevant to other public-sector multi-actor projects where co-design is used to address complex problems. Such projects are often time-bounded initiatives to address issues that cut across organisational responsibilities, while resources and implementation remain embedded in established institutions. This creates conditions for similar tensions between temporary collaboration and longer-term change, and uncertainty over how participation connects to decision-making and implementation. Public policy co-design research similarly notes that implementation and scaling remain difficult within bureaucratic systems and existing resource-allocation arrangements [20].

Research on design projects in public-sector organisations has reflected on similar challenges of turning design ideas into action. Tensions have been identified across initiative, organisational and system levels, including between temporary initiatives and enduring organisational structures, and between situated engagement and systemic change [79]. These levels resemble the distinction between the co-design, project and broader institutional spheres, while the tensions also resonate with findings from Fredrikstad: the temporary collaborative “we” and fluid roles created through co-design encountered more enduring institutional

positions and responsibilities, while locally grounded problem framings did not always align with broader planning perspectives.

These parallels suggest that some of the challenges and tensions discussed here may provide a useful lens for understanding why the contributions of co-design and related design work can be difficult to sustain in other multi-actor settings. Their relevance beyond mobility, however, requires further investigation.

5.4 Reflection on the Journey

The previous sections have discussed the findings and contributions of the thesis primarily at an analytical level. Yet, the journey so far has been shaped by how I moved between different positions during the research: between comparative distance and situated involvement, between researcher and practitioner roles, and through different layers of otherness that I have. The following sections would turn from what the research shows to how these layered ways of knowing shaped what I was able to see.

5.4.1 Comparative distance and situated involvement

The iterative movement between the breadth of Study 1 and the depth of Study 2 changed my attitude towards co-design practice. I became less concerned with identifying the “best” way of conducting co-design and more interested in understanding why practices take particular forms under particular conditions. Moving between breadth and depth also made me more cautious about drawing general conclusions from either perspective alone.

The literature review provided breadth in understanding co-design practice. The systematic search and screening process enabled a diverse range of practices to be compared, while the variety of mobility issues helped me separate, analytically, co-design practice from the particular mobility problem around which it was organised. The literature review also allowed me to “hover over” the studies from roughly the same distance, which encouraged me to leave more space before judgement. Differences, inconsistencies and diversity gradually stopped appearing as weaknesses in research or documentation and began to suggest something about the nature of co-design practice itself, shaping the stages and dimensions used in Study 1.

The Fredrikstad case, in contrast, made visible small dynamics, changes and tacit knowledge that are difficult to access through a literature review. By participating in the process, I experienced how seemingly straightforward arrangements could change as participants and project conditions evolved, how roles and atmosphere in similar collaborations varied from one occasion to another, and how substantial effort sometimes went into things with little research interest or that remained

difficult to interpret or report. I also experienced how carefully planned activities did not lead to the expected results, and how different considerations had to be balanced in real time.

These experiences subsequently changed how I read the literature. When descriptions of co-design practices were incomplete or uneven, I became more aware that considerable work and reasoning might lie behind what could be presented in a publication. This encouraged more interpretive work in Study 1. Moving repeatedly between the two studies helped connect what I experienced but could not always document in Study 2 with what had felt confusing or unanswered in Study 1. The Fredrikstad experience helped me imagine the complexity behind compressed accounts in publications, while the literature review helped me recognise that many difficulties encountered in practice were not necessarily failures of the Fredrikstad process, but tensions visible across other projects.

5.4.2 Researcher-practitioner position as a way of knowing

I have been involved in the EU SUM project for three years. Working within a large multi-actor consortium exposed me to collaborations between municipalities, public transport operators, researchers, companies and other organisations across Europe. It also made visible how different institutional, professional and cultural perspectives shape communication, priorities and ways of working. I learned that mobility developments are embedded in different local contexts and associated with varying ambitions, meaning that seemingly shared objectives or solutions may carry quite different meanings and implications across places and organisations.

My own position in this environment has been multiple: researcher, designer, facilitator and project partner. In the beginning, when the Fredrikstad local team asked whether we at Chalmers had enough competence for the co-creation work we were going to do, I experienced strong imposter syndrome. I was the only person employed full-time and responsible for this work, while having only recently entered the field. I was still trying to understand the breadth of shared mobility while simultaneously proposing activities, discussing recruitment requirements, and deciding what we should try to understand, in their city, with their people and their ferry routes.

My knowledge of Fredrikstad grew after the first site visit. I composed the information I had gathered about ongoing developments, places of interest and challenges around a city map and shared it with the local team. I believe this helped build trust through my openness and devotion to doing things together, even though this work was not directly related to a project deliverable or my research. More broadly, I often found myself doing work that did not directly feed into any identifiable output.

I needed to think as a designer, about what should be designed and how relevant design knowledge could be gathered through activities; as a researcher, about how this knowledge could be recorded and understood, and how I could observe while participating without steering the process too strongly; and as a facilitator, about making participation dynamics more equal and warm, exploring ways to improve collective creativity. Part of my approach to facilitation draws on a playful design mindset, based on the view that creativity can be supported when participation is engaging and enjoyable. This is informed by Gaver et al.'s [80] view on how the notion of *homo ludens*, the playful humanity, and an emphasis on designers' visible effort, aesthetic care and personal investment could invite more personal engagement and response.

I was also drawn to ideas around psychological safety [81] and collective intelligence [82]. At the time, I often thought about how a room full of people with different experiences could become "smarter" together, and how tools and facilitation might create more equal opportunities for people to share and negotiate their perspectives. This influenced how I designed activities, composed groups and facilitated discussions. I tried to create conditions where participants felt comfortable expressing ideas while also feeling responsible for contributing to the collective exploration. Still, sometimes I needed to help certain participants speak more easily, while questioning whether I understood the situation better than they did, particularly as I am not Norwegian and sometimes needed translation myself.

As a project partner, I also needed to complete deliverables, participate in project dissemination and prepare materials. These timelines were not always aligned with the research timeline. I therefore needed to shift between project and research priorities, and between different levels of detail and ways of communicating. Within SUM, Chalmers was responsible for co-creating solutions with users and supporting the adoption of co-created solutions in the Living Labs. Whether proposed pilots were implemented was therefore highly valued. As a project partner, I felt pressure to design workshops that could generate ideas possible to implement, and this expectation also influenced how I interpreted outcomes and contributions. It gave me the initial mindset that implementation should be the goal of successful co-design practice; otherwise, the process somehow felt less successful for both the project and my research.

It took me some time to become more comfortable with deviations from this expectation. Through the project, I gradually became more aware that implementation was shaped not only by the quality of co-design activities, but also by a wider set of project and institutional conditions. The absence of implementation in the Fredrikstad case ultimately contributed to my interest in what happens to co-design outcomes as they move beyond the collaborative setting, which later became an important focus of this research.

5.4.3 Reflexivity and boundaries of interpretation

My position as an outsider and my disciplinary background influenced both what I noticed in the co-design process and what could have remained inaccessible to me. With an educational background in architecture and urban planning, now working in mobility research, and entering the Fredrikstad sessions as the only non-Scandinavian and non-European participant, I was often very aware of my difference from others. I sometimes felt the need to explain why I was there, why I was doing what I was doing, and what I should say to fit my role. This made me sensitive to how I was perceived, but also to how other participants positioned themselves within the collaborative setting.

This sensitivity sometimes helped me notice participation dynamics that might otherwise have been overlooked, such as certain participants receiving more agreement because they expressed themselves more confidently, while other opinions were interrupted or left unfinished. These observations influenced my facilitation strategies, such as deliberately inviting quieter participants into discussions or returning to interrupted opinions. At the same time, being an outsider sometimes placed me in what I experienced as a relatively neutral position. I was not involved in local interests around particular solutions and could more easily zoom out from detailed discussions about mobility problems to pay attention to participation itself. Some participants also seemed particularly engaged with my presence as an outsider. After one workshop, a participant asked whether I had collected everything I needed and whether I was happy with what I had learned from them, knowing that we had travelled from Sweden specifically for their lunchtime workshop.

More broadly, living and working in a culture distant from my own, while also crossing languages and disciplines, may have made me particularly sensitive to boundaries and the effort required to cross them. This contributed to my attention to participants' different backgrounds and readiness of engagement, and the work involved in understanding, translating and negotiating meaning.

The same outsider position also created boundaries around my interpretation. I did not share the assumptions of people living in the local context, including experiences of the city, culture, weather and mobility system that shaped their mobility choices. Sometimes things that appeared immediately obvious to Swedish colleagues were not obvious to me, and I needed discussions afterwards to develop a better understanding. When facilitating in English, I also prioritised creating space for participation, sometimes at the expense of following up on potentially important mobility-related discussions.

My architecture and urban design background similarly functioned as both a resource and a boundary. It supported the design of the first-stage workshops, since mapping and layering information spatially are familiar practices in architectural

design. At the same time, I had less experience analysing the large number of service ideas generated during the second stage. Architecture had also accustomed me to designs going through many iterations before being presented. In comparison, co-design ideas sometimes moved relatively quickly towards proposals for testing. I tended to leave more space for further development, being comfortable with things “hovering in the air” without making a decision, and struggled more with the researcher’s task of drawing conclusions from them.

My disciplinary background may also have influenced what I recognised as valuable. I may have been more sensitive to physical and spatial design ideas than to digital experiences, and carried stronger inherent values towards community and collective experiences than individual ones. These tendencies may have influenced what I paid attention to, how activities were designed, and how outcomes were interpreted.

Finally, I was not only observing the co-design process, but also participating in producing it. The activities I designed, the ways I facilitated groups, and the decisions made between stages all influenced the process that I later studied. This involvement provided access to otherwise less visible decisions and forms of work, but it also means that my interpretation cannot be separated from my participation. Consequently, the contribution of this research lies less in producing universally generalisable claims and more in providing a situated understanding of co-design practice that may inform and sensitise future research and practice in similar contexts.

5.5 Future direction

Building on this research, future work could further investigate how co-design can be documented and understood beyond project deliverables and immediate outputs. This includes examining how contributions evolve over time, who carries them across organisational contexts, how continuity is maintained, and how co-design processes might better support developments beyond the collaborative setting.

To further develop the findings of this licentiate, future research could proceed in the following directions:

- Longitudinal trajectories. Future research could continue investigating what happens to co-design outcomes over time in real-world multi-stakeholder settings: how they move towards implementation, transform along the way, remain inactive, or discontinue. This also raises the question of how longitudinal trajectories can be followed beyond the timelines and funding models of individual projects. Such studies could also further refine the proposed framework by examining whether the findings in this thesis remain useful across different mobility settings and implementation conditions.
- Actor perspectives and timescapes. While this licentiate identifies changing participation, tensions and trajectories across co-design processes, the findings raise questions about how actors in different organisational roles experience co-design over time. Future research could examine how researchers, practitioners and public-sector actors navigate changing responsibilities and different timescapes throughout co-design processes.
- Beyond mobility. Future research could extend this research to other complex public-sector contexts to examine how different institutional settings shape co-design practices and the trajectories of their contributions.

6. Conclusion

This licentiate thesis examines how co-design is practised and how it contributes to shared mobility and related mobility service development. The insights are drawn from two studies conducted in parallel: a literature review using a systematic search and review approach, and an empirical three-stage co-design process conducted in Fredrikstad, Norway, within the development of a shared mobility service. Together, the studies provide both a broad comparative understanding of co-design practices across mobility service developments and an in-depth situated account of how co-design unfolds within one real-world process.

The literature review makes heterogeneous co-design practices visible and comparable through analytical categories progressively developed from the terminology and descriptions found across the reviewed studies. It reveals considerable variation in how co-design is conceptualised and practised, including differences in intended functions, actor configurations, participation arrangements, positions within development processes and reported outcomes. Examining these dimensions together makes recurring relationships across heterogeneous practices more visible. User-centred cases tended to focus on accessing experiential knowledge and developing concepts or prototypes, while multi-actor cases more often involved broader participation, stakeholder coordination and planning- or implementation-oriented outcomes. Across cases, outcomes ranged from knowledge to interventions and did not necessarily progress towards implementation.

The Fredrikstad empirical study shows how co-design develops under changing participation and project conditions. The three-stage process recurring cycles of preparation, participation and translation continuously interacted with the timelines and organisational conditions of the wider project. Diverse participation enabled different forms of knowledge and perspectives to interact and develop into shared understandings and ideas, but creating and sustaining this collaborative process required continuous organisation and adaptation. Challenges related to participation continuity, translation, ownership and implementation emerged both within the co-design process and as its outcomes moved beyond the collaborative setting into wider project and institutional contexts.

Bringing the two studies together through contrapuntal listening, in which each study informs the interpretation of the other, shifts attention from co-design as a set of rationales, methods, activities and immediate outcomes towards how participation is organised and how contributions develop over time. Three shifts in understanding emerged: from named methods to organising participation, from immediate outputs to institutionally conditioned contributions, and from configurations to evolving trajectories. Together, these shifts suggest a temporal understanding of co-design, in which its intended functions, practices and

contributions are not fixed but progressively enacted through interactions with changing participation, as well as project and institutional conditions. How co-design is practised shapes the opportunities and challenges that emerge, while these changing conditions and challenges in turn reshape how the process can be conducted, with whom, and what it can contribute.

In summary, the thesis contributes an analytical understanding of co-design as a situated and evolving part of mobility service development, in which practices respond to changing conditions and outcomes may follow different trajectories through subsequent development processes. This positions co-design as one component of broader mobility development rather than a self-contained process leading to implementation. The findings suggest the importance of organising participation in relation to its intended contribution, designing for translation and continuity, and documenting and evaluating the trajectories of co-design contributions beyond isolated snapshots.

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