Enhancing Metro Mapping

Towards an Intuitive, Collaborative and Data-enabled Tool

Master Thesis | Xinjie Li

Delft University of Technology

Faculty of Industrial Design Engineering

MSc Design for Interaction

Graduation committee

dr. J. Bourgeois

dr. R.S.K. Chandrasegaran

P.M.S. Melo Signerez

Company

Panton B.V.

Supervised by J.B.P. Brands, MSc

Design strategist and co-owner at Panton

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Finally, I also want to thank all participants who were involved in this project in interviews/co-creation sessions/evaluation sessions. Your sharing and contributions to the project have been a great help to me!

I will list the information of David J Parker and participants who have agreed to have their information published in this thesis to acknowledge their contributions below.

The Microsoft Visio technical support expert

David J Parker, B.Sc., Dip. Arch.

Owner of bVisual ltd; Independent Visio Consultant and Author; Microsoft MVP (21 years). (see Bio of David Parker - bVisual)

Participants

N. Smolenaars, a feminist healthcare designer in hospital practice. (see https://www.noasmolenaars.com/)

E.S. van Hoorn, researcher. (see https://www.eur.nl/people/shannon-van-hoorn)

A. Verschuure, adviseur waardegedreven zorgpaden. (see https://www.linkedin.com/in/anniek-verschuure-a0852883/?originalSubdomain=nl)

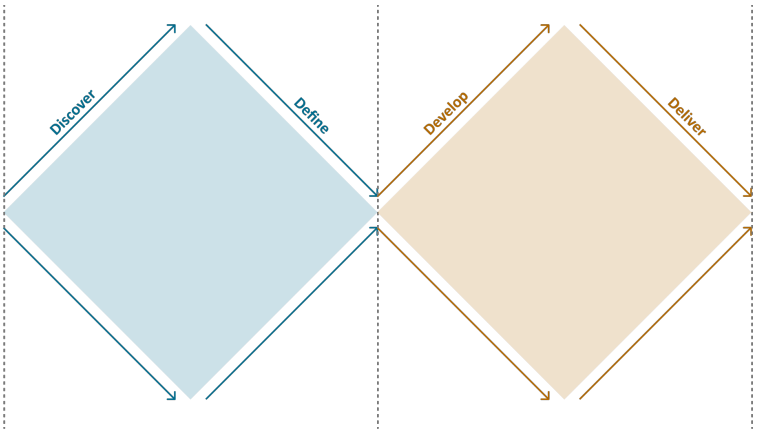
Executive summary

Healthcare teams increasingly need clear, shared overviews of complex care processes. Metro Mapping offers a layered way to design and improve these pathways, but its Microsoft Visio-based practice has made users struggling with manual editing, editor-driven collaboration, and data that lives outside the map. This project aimed to investigate how the usability of Metro Mapping in Visio can be improved to support the core Metro Mapping team members in creating and maintaining healthcare pathways more effectively, how the collaboration of them could be better supported, and how Metro Mapping can be data-enabled to extend its utility. The main research question was: How can the Metro Mapping tool better support collaborative and data-enabled design of healthcare pathways for core Metro Mapping team members within healthcare organizations?

Approach

To answer the question, guided by the Double Diamond, literature reviews and interviews of core Metro Mapping users (designers, researchers, clinicians) were conducted. Insights from the research were translated into the future vision of Metro Mapping in Visio: “Metro Mapping tool should be an intuitive and data-enabled tool that allow multidisciplinary teams to co-create, analyze, and communicate healthcare pathways in a clear and collaborative way.”

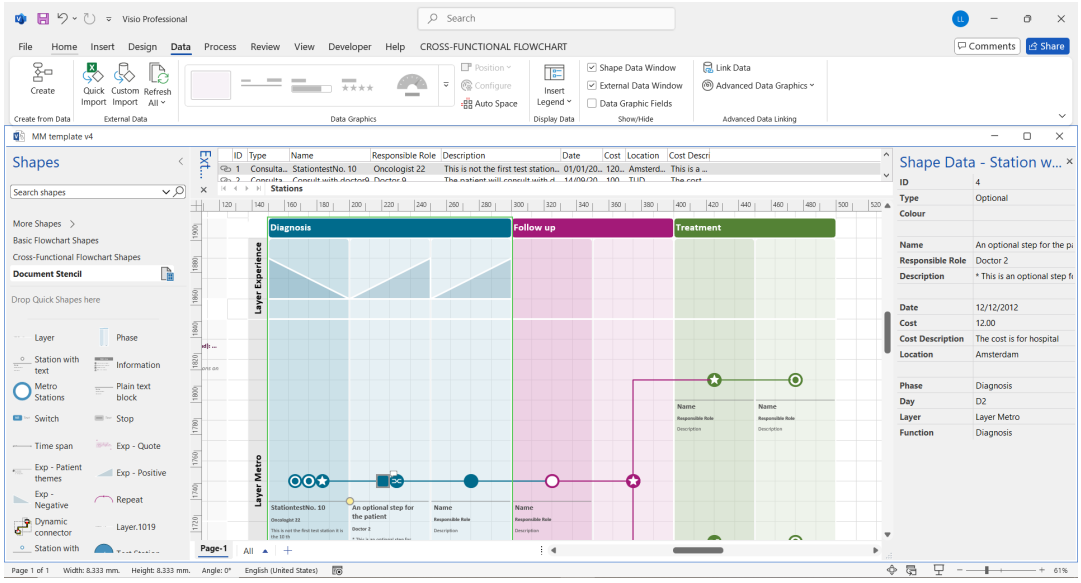
The vision was then translated into concepts through brainstorming and two co-creation sessions. The design converged into a final concept with an MVP prototype in Microsoft Visio, followed by usability and concept evaluations with four intended users.

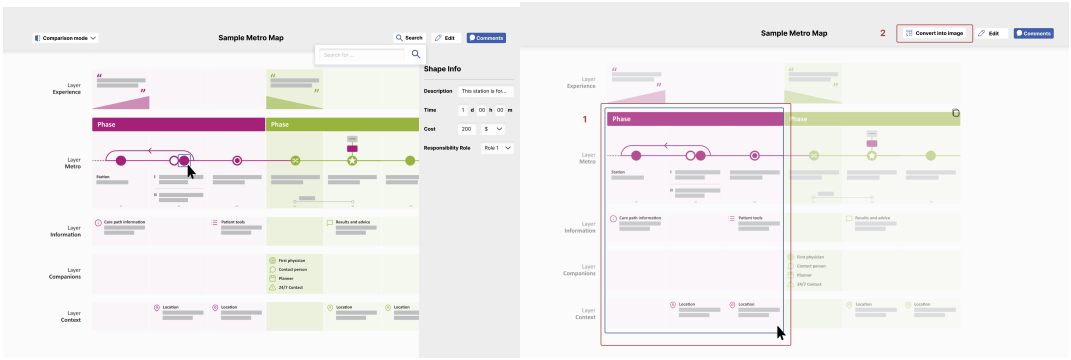


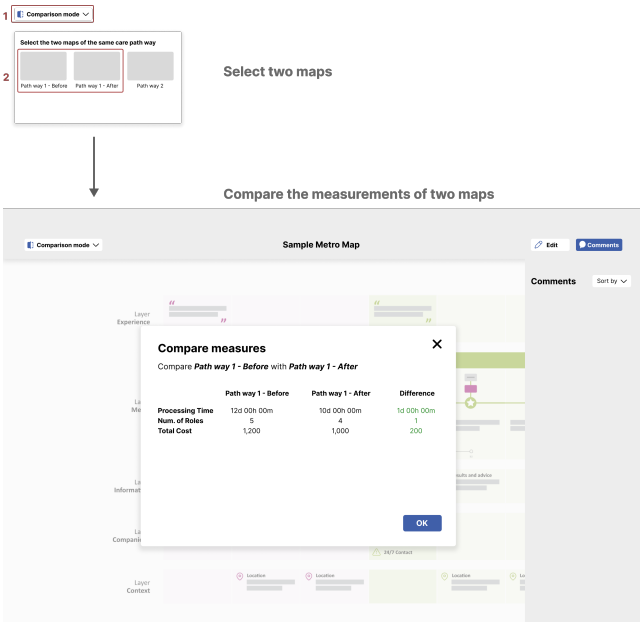
Results

The final concept includes three levels of functionality:

- **Basic features** that make the tool more intuitive: a pre-built template; drag-and-drop stations; adjustable phases/layers; automatic day columns; selectable station types/colors with auto-matching; and export.
- **Core features** that realize the vision: station-specific data linking to an external Excel template (refreshable in place) and online commenting for asynchronous, traceable input.
- **Extended features** (concept mockups): search across a large map, selective export to image, and before–after measurement comparison.







In task-based evaluations using the MVP, all participants achieved over 80% task success without intervention and completed the scripted scenario in under 30 minutes. Participants highlighted smooth structure editing, fluent

station placement, and practical data linking (“refresh once” updates) as top strengths. They thought commenting for collecting input across roles and selective export for communication beyond Visio would also be valuable.

The project delivers a coherent concept with a working MVP that demonstrates feasibility in real workflows. It directly addresses three priorities identified with users: improve usability with structured, intuitive interactions, broaden participation with asynchronous collaboration, and enable data integration by linking key metrics to stations for updates and comparison. These enhancements shift Metro Mapping from a static canvas to a living and shared workspace that supports further improvement.

The thesis concludes with recommendations for the next steps of the development of Metro Mapping in Visio including potential for the concept features and iteration of the prototype. This project provides a validated foundation and a clear direction for further development of Metro Mapping in Visio.

Table of content

1. Introduction

This chapter provides an overview of the necessity of this graduation project. It describes the pressures faced by the healthcare system and the challenges related to Metro Mapping. Additionally, I will introduce the aim, scope, research question, stakeholders, and the approach adopted for the project.

1.1 Project background

Context

Healthcare systems are increasingly understood as complex, adaptive systems involving many interdependent actors, dynamic interactions and rapidly evolving needs (Tan et al., 2005). This complexity makes it difficult to design and improve healthcare processes, as healthcare delivery is highly variable and involves stakeholders with differing interests and motivations (Antonacci et al., 2021). In this environment, healthcare professionals and patients frequently encounter breakdowns in coordination, communication, and shared understanding (Prior et al., 2023).

To address these challenges, structured healthcare pathways have been introduced to organize healthcare. Defined by Vanhaecht (2007) as "a complex intervention for the mutual decision making and organization of care processes for a well-defined group of patients during a well-defined period", healthcare pathways clarify stakeholders' roles, align treatment steps, and monitor healthcare delivery more consistently. The context will be further explained in Chapter 2.1.

Many visualization methodologies and tools have emerged to support the design and improvement of healthcare pathways. One of these is Metro Mapping, a service design method originally developed to support Shared Decision Making (SDM) in oncology care. SDM is commonly described as a process in which both the physician and the patient contribute to the medical decision-making process, sharing information and reaching agreement on the treatment to implement (Charles et al., 1997). Metro Mapping builds on this principle by offering a layered visual framework that supports collaborative healthcare planning, patient involvement, and care transparency.

Metro Mapping

Metro Mapping is a service design method developed to design and optimize healthcare pathways. It visualizes healthcare processes through a layered structure that combines patient experience, treatment flow, information exchange, involved roles and physical context (Metro Mapping, n.d.). The method promotes collaborative healthcare pathway designing by aligning different perspectives from stakeholders within a unified visual language, and its use has expanded across various medical domains and institutions in Europe (Stiggelbout et al., 2023).

Panton is the design studio that developed the Metro Mapping method in collaboration with healthcare professionals and patients, and now continues to support its implementation and technical development. To support these implementations, the Metro Net and Metro Map, which are created for visualizing a healthcare pathway, are most commonly built using a diagramming tool Microsoft Visio (which will be referred as Visio in the following text). Panton has developed editable templates and visual building blocks for the Metro Map in Visio (Metro Mapping, n.d.). However, some Metro Map developers have also created Metro Maps on other platforms such as Miro or EngageProcess, depending on familiarity and accessibility of their organizations. Metro Mapping and Visio will be further introduced in Chapter 2.2, and Figure 1 below is an example of Metro Map.

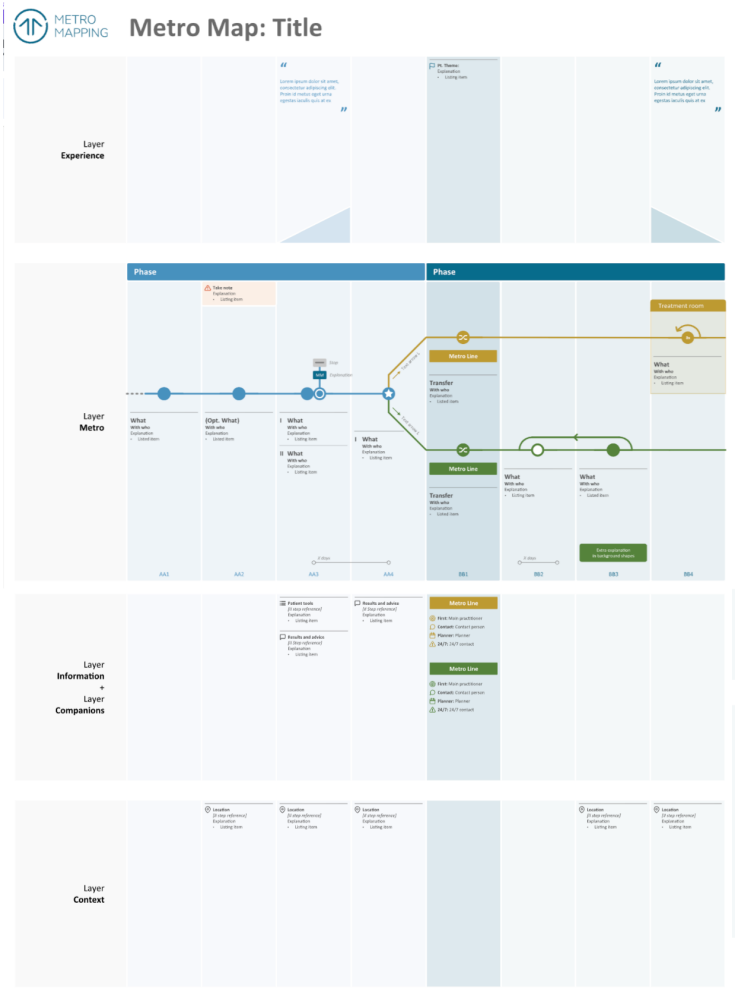


Figure 1. An example of Metro Map (Metro Mapping, n.d.).

Challenges

Despite its wide applicability, Metro Mapping also faces several practical limitations when implemented through the current Microsoft Visio-based tool. Users, especially non-designers, struggle with technical complexity of the Metro Mapping template in Visio, making it difficult to use for co-creating, adjusting and editing maps. This often results in one-way collaboration, where a map manager builds the map while others only contribute via workshops or email. Additionally, the tool lacks integration with data, forcing users to rely on static annotations that are hard to maintain and synchronize. These challenges limit the tool's usability, collaboration potential, and ability to support data-informed decision-making, highlighting the need for a more user-friendly, collaborative and data-enabled solution.

Project aim

This project aims to investigate how the usability of Metro Mapping in Visio can be improved to support the core Metro Mapping team members in creating and maintaining healthcare pathways more effectively, how the collaboration of them could be better supported, and how Metro Mapping can be data-enabled, which means being able to integrate and dynamically update relevant healthcare data, to extend its utility without compromising its visual clarity or structural logic.

“Collaboration” here refers to multiple stakeholders, such as designers, researchers, and healthcare professionals, jointly create, edit, and maintain the same Metro Map, and “collaborative” in the following thesis means the ability of collaboration.

Project scope

This project is scoped at the institutional level, focusing on hospitals, research organizations and clinical organizations where Metro Mapping is actively used to coordinate and redesign care pathways. However, rather than addressing organizational strategy, the project specifically targets the core Metro Mapping team members within these institutions, such as designers, researchers, and healthcare professionals, who are directly responsible for creating, managing, and editing Metro Maps. These users form the primary audience for the tool improvements proposed in this project.

Research questions

To guide this project, a main research question and five sub-questions were defined based on the challenges and project aim: How can the Metro Mapping tool better support **collaborative** and **data-enabled** design of healthcare pathways for **core Metro Mapping team members** within healthcare organizations?

To study this research question systematically, three related aspects have been established: the Core Metro Mapping Team Aspect, the Collaboration Aspect, and the Data-enabled Aspect.

Core Metro Mapping Team Aspect

1. What are the roles and responsibilities within a Metro Mapping team in a healthcare organization?
2. What challenges and expectations do the Metro Mapping team have when using the current Metro Mapping tool?

Collaboration Aspect

3. What are the existing modes of collaboration in healthcare pathway design, especially in Metro Mapping projects?

Data-enabled Aspect

4. What types of data are considered most relevant by the Metro Mapping team?
5. How can these types of data be integrated to support the development of Metro Maps?

Chapter 1.3 provides an outline of the approach of the whole project to address these research questions.

1.2 Stakeholders

This graduation project is supported by three stakeholders: **Panton** and **TU Delft**, each plays a different but complementary role in the development, supervision, and contextualization of this research.

Panton (Practice Stakeholder)

Panton is a Dutch design agency specialized in healthcare innovation, service design, and user-centered tool development. As the hosting organization of this graduation project, Panton provides direct access to the Metro Mapping method in practice, as well as the opportunity to engage with people who regularly use and improve the tool in real healthcare settings.

The project is closely cooperated by Panton team members with experience in service design and healthcare pathway visualization, such as J.B.P. Brands, who is the design strategist and managing director in Panton. Their inputs added to the research and design direction, and their professional networks enabled the recruitment of

interview participants who are actively using Metro Mapping within different healthcare organizations. The insights gained from Panton's internal context form a central part of this project's knowledge base.

TU Delft (Academic Stakeholder)

This project is part of a graduation project from the Design for Interaction master's program at TU Delft. The university provides the academic framework and methodological support to ensure that the project is grounded in design research principles. The project is supervised by Jacky Bourgeois and Paula Melo Signerez, who offered guidance through their expertise in academic research, refining the research questions, selecting appropriate methods, and aligning the project goals with academic standards.

1.3 Approach

This project adopts the Double Diamond Design Model to guide the research and design process through four phases: Discover, Define, Develop, and Deliver. This model was developed by the British Design Council, and has been widely used in design practice and emphasizes the alternation between divergent and convergent thinking to ensure both broad exploration and focused decision-making (Design Council, n.d.).

I chose the Double Diamond Design Model as the overall framework because it perfectly aligns with the logic of this project. In this project, I need to first conduct research on Metro Mapping and engage with multiple stakeholders for exploration, then converge on a clear problem definition and design goals; subsequently, I need to generate ideas based on the results of the research stage, evaluate them, and converge on the final design concept. The Double Diamond Design Model matches this process well and provides a clear exploring and decision-making path. Figure 2 shows how I implemented this framework, how each Chapter of this thesis corresponds to it and what methods I employed at each stage.

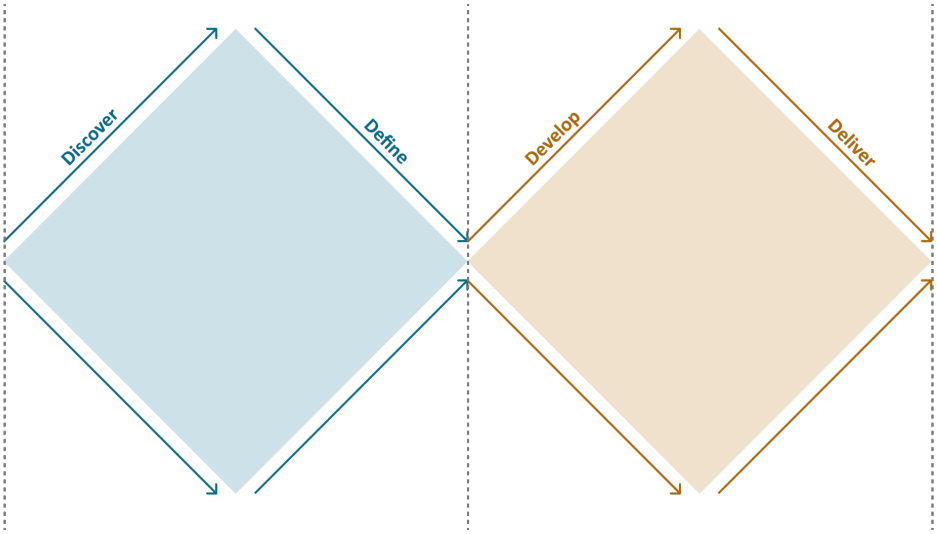


Figure 2. The Double Diamond approach for this project.

In the first diamond (research phase, Discover and Define), I focused on identifying key problems in the current Metro Mapping with the guidance of research questions through a combination of **literature review** (see Chapter 2) and **stakeholder interviews** (see Chapter 3). After the review of the literature and discussions with experienced

Metro Mapping staff at Panton, I realized the importance of first exploring the initial three sub-questions through literature research to build a solid background understanding of Metro Mapping. Therefore, I conducted literature research to gain knowledge of the Core Metro Mapping Team Aspect and the Collaboration Aspect of the research question. After identifying key limitations of Metro Mapping, I carried these insights into semi-structured interviews as described in the Delft Design Guide Interviews method by Van Boeijen et al. (2014) with stakeholders to see from users' perspectives on usability, collaboration, and potential directions for data integration of Metro Mapping.

Based on the key takeaways from the research phase, I then formulated a more detailed **problem statement** and identified **key user needs**, which shaped the **design goal** that guides the design phase of this project (see Chapter 4).

In the second diamond (design phase, Develop and Deliver), I focused on translating research insights into design solutions. **Ideas were generated** and iterated through brainstorming and initial concepting, particularly under the Microsoft Visio environment, then discussed with users in **co-creation sessions** (see Chapter 5). Through discussions and validation with users, the **initial features** were iterated and prioritized, forming the foundation for the final concept. In parallel, I have also been iteratively building and adjusting the Minimum Viable Product (MVP) prototype in Visio based on user feedback (see Chapter 6).

Finally, I combined all the outcomes in previous stage and delivered **a final design concept** as a first version of the new Metro Mapping in Visio, which includes **a functional MVP prototype** with basic features and core features of the concept, and **interface mockups** for extended features of the concept. The final concept was evaluated with Metro Mapping users by using Product Usability and Concept Evaluation methods described by Van Boeijen et al. (2014). I also raised out recommendations for features and iteration direction of Metro Mapping in Visio for the future.

2. Literature Review

This chapter begins with an overview of the healthcare system as a background for the project and introduces the theoretical and practical foundations of pathway design, visual mapping tools, co-design and SDM. This background provides context for understanding the needs and constraints in healthcare pathway improvement. Following this, the chapter explores research directly relevant to the first three research questions of the graduation project, focusing on (1) how the Metro Mapping tool is structured and used, and (2) how collaboration happens in healthcare pathway design and in Metro Mapping practice. By reviewing both the literature and existing implementations, I gained a deeper understanding of the actual operation mode of Metro Mapping and identified aspects that potential improvements could be made.

2.1 Complexity of healthcare pathways and design responses

The healthcare system is increasingly recognized as a complex system, involving numerous interdependent actors, dynamic interactions, and emergent behaviors that complicate the design and improvement of care processes (Tan et al., 2005). These complexities arise from factors such as high variability in care delivery, distributing decision-making across departments, and multidisciplinary involvement from clinicians, administrators, and support staff (Antonacci et al., 2021). In such fragmented and rapidly evolving care environments, healthcare professionals and patients often experience difficulties in maintaining continuity and coordination of care, leading to breakdowns in information transfer, coordination and decision-making (Prior et al., 2023).

One of the key approaches to address these challenges is the design of structured healthcare pathways. Healthcare pathways, also referred to as care pathways or clinical pathways, are defined by Vanhaecht et al. (2007) as “a complex intervention for the mutual decision-making and organization of care processes for a well-defined group of patients during a well-defined period.” These pathways aim to bring clarity and consistency into care delivery by sequencing clinical steps, defining responsibilities, facilitating communication, and monitoring outcomes. They form the operational and conceptual basis for many process design and visualization efforts (Vanhaecht et al., 2007). In this context, applying quality improvement (QI) methodology, such as Lean, Six Sigma, or the Model for Improvement, can also help make these pathways more efficient and responsive (Antonacci et al., 2021).

In addition to structured pathway design, visual mapping methods such as process mapping and journey mapping have been increasingly adopted in healthcare pathway design and quality improvement. Process mapping is used to develop a shared understanding of healthcare workflows and to identify inefficiencies within local contexts (Antonacci et al., 2021), while patient journey mapping is often applied to reveal gaps in healthcare and unmet patient needs (Bulto et al., 2024).

While visual tools help clarify care processes and improve service transparency, relying solely on them may overlook important aspects such as the personal experiences of patients, situational differences, and the values that influence how care is delivered and perceived. In response, growing attention has been paid to more participatory approaches, particularly co-design, which enable patients, professionals, and other stakeholders to jointly shape healthcare services through shared dialogue. Over the past two decades, attempts to improve healthcare quality have increasingly focused on co-design as a way to transform healthcare systems by involving patients and healthcare professionals in more participatory processes (Farrington, 2016). These approaches are further supported by frameworks such as the “Making Care Fit” manifesto, which calls for care that is maximally responsive to patient context, values, and lived experience, co-created through respectful and iterative dialogue (Kunneman et al., 2021b).

In parallel with the rise of co-design approaches, SDM has also gained widespread attention as a way to improve the quality and person-centeredness of healthcare. SDM is not defined by a single consensus but is instead described through multiple conceptual models that reflect the complexity of patient–clinician interactions. As Pieterse et al. (2018) point out, there were at least 22 definitions of SDM in the literature at the time of their

publication, showing emphases varying across models from descriptive approaches to normative approaches. One of the most frequently cited and foundational definitions is provided by Charles et al. (1997), who define SDM as "a process in which both the physician and the patient contribute to the medical decision-making process, sharing information and reaching agreement on the treatment to implement". While SDM is widely endorsed in clinical ethics and communication frameworks, its practical uptake remains inconsistent and strongly influenced by context. A systematic review from Pollard et al. (2015) found that although many healthcare professionals express positive attitudes toward SDM in principle, they often revert to more traditional, physician-led decision-making models in situations with time constraints or pressure to adhere to clinical guidelines.

Given these limitations in implementing SDM effectively, the Metro Mapping method was developed to facilitate shared understanding, decision-making, and healthcare pathway transparency. It is a visual service design framework to support shared decision making and improve care clarity. Originally designed in the context of oncology care, Metro Mapping now represents a broader class of healthcare service design tools that seek to bring together structure, collaboration, and real-life context.

2.2 Research on Metro Mapping

An introduction of Metro Mapping and Metro Map

Metro Mapping is a service design method by which healthcare pathways can be designed and optimized. It can be used to improve patient experience and help with clinical challenges, for example, around shared decision making, patient value creation and multidisciplinary collaboration (Metro Mapping, n.d.).

Metro Mapping tool is a clear and structured way used to visualize and present a healthcare pathway and space for improvement, and it is also used to design or redesign a new healthcare pathway (Metro Mapping, n.d.). The Metro Mapping tool consists of two parts: the Metro Net and the Metro Map.

Some key terms of Metro Mapping tool are explained as follows with reference to the official website of Metro Mapping and are shown in Figure 3:

- Phase: The Metro Map and Metro Net are representations of a care path that consists of several phases. A phase is a part of the care pathway with a specific goal, such as diagnosis or treatment (Metro Mapping, n.d.).
- Layer: The layers related to the healthcare pathway that can be dissected and present information in different aspects.
- Metro Line: A Metro Line is a combination of several steps (Stations) within a phase (Metro Mapping, n.d.).
- Station: A station is a step in a Metro Line. This can be a decision moment, consultation, treatment, examination, transfer or multi-disciplinary consultation (Metro Mapping, n.d.).

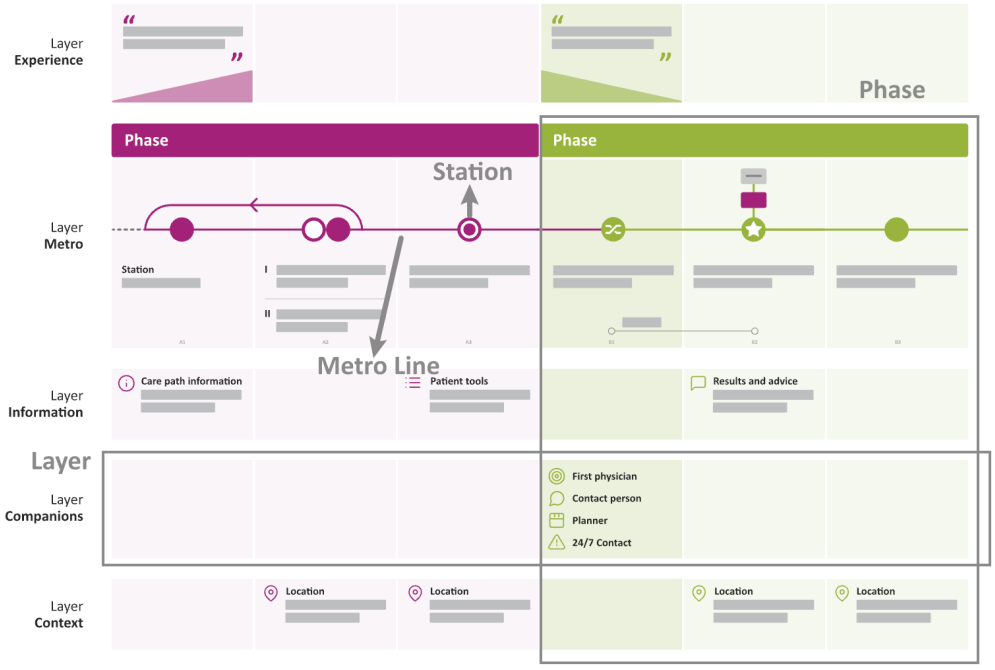


Figure 3. Key terms of Metro Mapping tool

The Metro Net is a visual overview that outlines all diagnostic and treatment options for a healthcare pathway, which uses the following elements: Phases, Diagnostic and treatment options, Transfer stations, Connecting lines. An example of the Metro Net is shown in Figure 4.

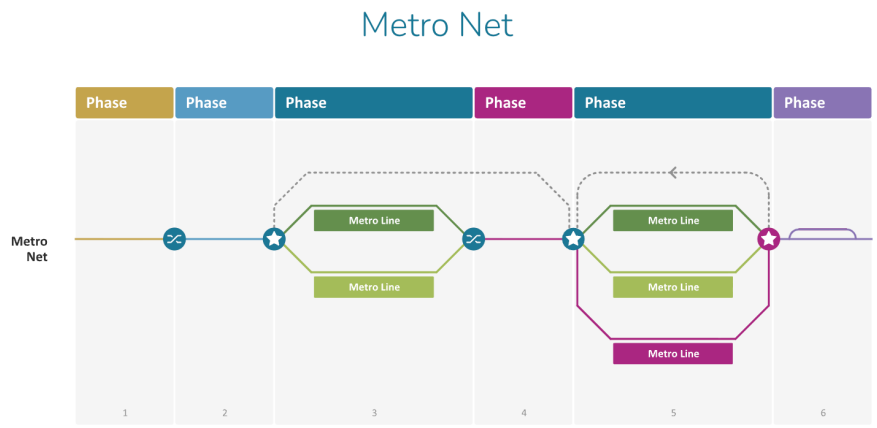


Figure 4: An example of the Metro Net (Metro Mapping, n.d.).

The Metro Map is a detailed visualization of a specific care path within the Metro Net. It consists of five Layers:

- Layer Experience: in which the experiences of patients and relatives with the healthcare pathway are described.
- Layer Metro: a visualization of the phases of the pathway, in which Metro Lines and Stations are visualized. Metro Lines represent the patient's journey, while a Metro Station represents a step in the pathway.

- Layer Information: in which what information is exchanged with the patient and relatives is noted.
- Layer Companions: in which the caregivers and their roles are described.
- Layer Context: in which where each step takes place and what medical devices are used are shown.

The Metro Map also has columns under Phases, which are the connection between the Layers to show that the information in the different layers within the same column belongs together. Each column has a unique code for identification.

An example of the Metro Map is shown in Figure 5.

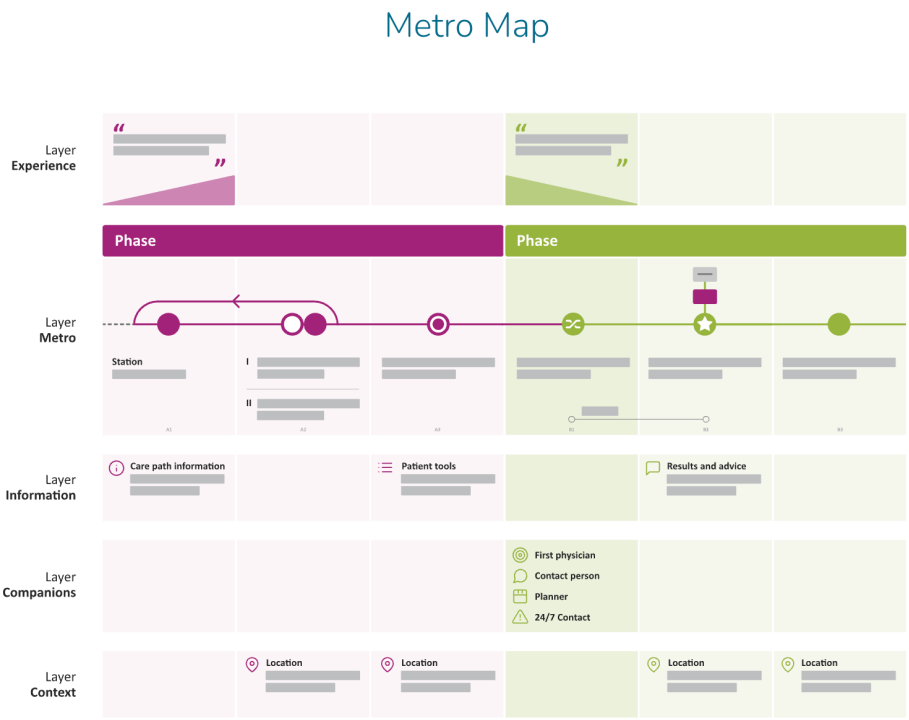


Figure 5: An example of the Metro Map(Metro Mapping, n.d.).

Currently, the Metro Mapping tool is developed and used in Microsoft Visio environment. Panton chose Visio as the software platform of the tool because the Microsoft system is widely applied in and familiar with different types of organizations, which means any stakeholder has basic access to the software. Users can download the templates of the Metro Net and Metro Map from Metro Mapping's official website, open the files in Visio with an account of Visio Plan 2 and start creating their Metro Maps.

Microsoft Visio is a diagramming and flowchart software, in which people can build many different types of flowcharts and diagrams, such as cross-functional flowcharts, network diagrams, org charts, floor plans and so on using modern shapes and templates (Microsoft 365, n.d.).

Visio Plan 2 is a subscription-based version of Microsoft Visio that provides the most comprehensive set of features for professional diagramming and data visualization. It includes all the capabilities of Plan 1 plus additional features such as Data Visualizer, Export to Power Automate, and support for advanced templates and diagrams. Until when this thesis is written, only Visio Plan 2 supports the full functionality of the Metro Mapping Template. Other plans, such as Visio Plan 1 or the Visio version included with Microsoft 365, do not provide access to the complete feature

set required to use the current version of the Metro Mapping Template effectively. In this project, Visio Plan 2 was used for developing the functional prototype.

The development and implementation of Metro Mapping

Metro Mapping was initially developed by a designer drawing from personal experiences of navigating a family member's pancreatic cancer journey, and was further refined through interviews with other patients and healthcare professionals. These early insights highlighted four themes: unpredictable decision-making moments, access to information, unclear responsibilities, and emotional burdens, all of which were addressed in Metro Mapping's layered design (Stiggelbout et al., 2023). According to Stiggelbout et al. (2023), this structured foundation and visual metaphor helps make complex processes understandable and collaborative.

Due to its adaptability and visual clarity, Metro Mapping has been applied across various scales of healthcare. It is used at three different levels: the national level, the institution level and the individual level. For the national level, it is used for policy communication and standardization discussions. It is applied in oncology (e.g., pancreatic, breast, and prostate cancer), but also being explored in areas like dementia and transgender care (Rietjens et al., 2024).

At the institutional level, Metro Mapping is used for redesigning healthcare pathways across healthcare organizations or specialties. It has been implemented in several healthcare organizations, such as Erasmus MC and Radboud UMC in the Netherlands. It is also being used in the European 4D PICTURE project for breast, prostate, and melanoma cancer pathways across eight countries (Rietjens et al., 2024).

At the individual level, Metro Mapping is used by a range of stakeholders. The Metro Team structure, as described on the official website, explicitly includes healthcare professionals, care management, and project coordinators alongside service designers, highlighting the method's intention to be multidisciplinary (MetroMapping.org, 2024). Patients and their families also play a role by either contributing to co-design activities or benefiting from the resulting clarity in care planning (Stiggelbout et al., 2023).

Methodological Strengths and Design Affordances of Metro Mapping

A central strength of Metro Mapping lies in its ability to structure complex healthcare paths without losing sight of the human experience. The method's five layers enable the alignment of logistical steps with emotional, informational, social, and environmental elements of care. This multi-dimensional structure helps "translate abstract care plans into concrete and discussable formats," especially when multiple stakeholders are involved in the trajectory (Stiggelbout et al., 2023).

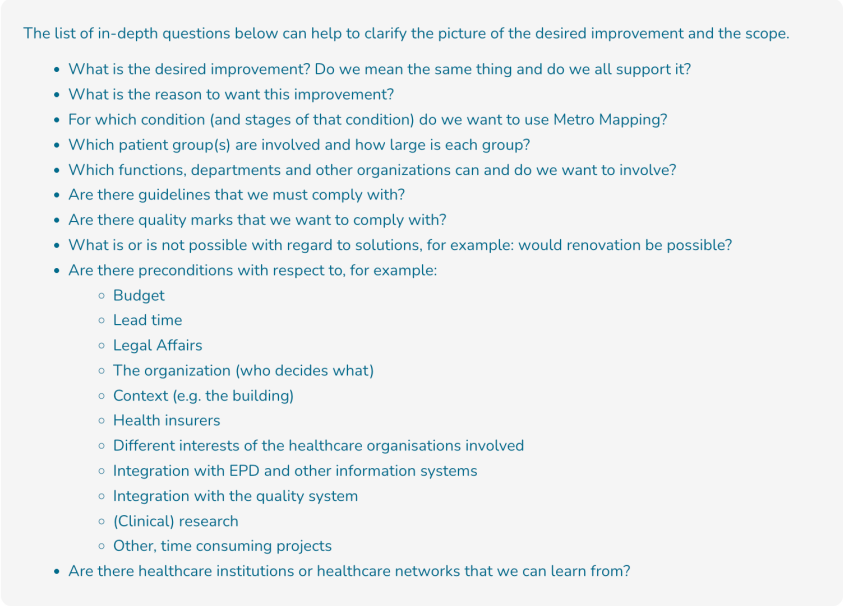
Another affordance is its visual grammar. The method's modular layout, standardized symbols, and metaphorical consistency (e.g. compare treatment path to a metro line) allow people with different backgrounds, such as healthcare professional, patients, researchers and designers, to collaborate through a shared representation. Its flexibility supports both institutional standardization and local adaptation. (Rietjens et al., 2024).

Furthermore, its iterative, co-design-based workflow enables adaptation to case-specific needs. In the "Build" phase of the methodology, team members collaboratively design each layer using guided tools such as editable Microsoft Visio templates. According to the official documentation, this modularity is designed to be "adjustable over time" and capable of integrating new types of input (Metro Mapping, n.d.).

Application Challenges and Boundaries of Metro Mapping tool

Although Metro Mapping has demonstrated strength in its layered structure and collaborative potential, existing publications and documentation reveal limitations in its implementation and methodological scope.

While the method is framed as adaptable to broader institutional and systemic contexts, including financial scope, integration with quality systems, and alignment with EPD (Electronic Patient Dossiers), such aspects are not clearly operationalized within the structure of the current layers. For instance, the “Plan of Action” section on the official MetroMapping.org manual (see Figure 6) outlines goals such as evaluating development budgets and exploring links to IT infrastructures and health insurers. However, in the layer-level documentation, especially the Layer Information, the content remains focused on patient-facing materials such as lab results, consultation prep tools, and care path explanations. No pre-defined information is made for visualizing cost metrics, resource allocation, or real-time operational indicators. This suggests a gap between the method’s strategic vision and its current technical affordances (Metro Mapping, n.d.).


The list of in-depth questions below can help to clarify the picture of the desired improvement and the scope.

- What is the desired improvement? Do we mean the same thing and do we all support it?
- What is the reason to want this improvement?
- For which condition (and stages of that condition) do we want to use Metro Mapping?
- Which patient group(s) are involved and how large is each group?
- Which functions, departments and other organizations can and do we want to involve?
- Are there guidelines that we must comply with?
- Are there quality marks that we want to comply with?
- What is or is not possible with regard to solutions, for example: would renovation be possible?
- Are there preconditions with respect to, for example:
    - Budget
    - Lead time
    - Legal Affairs
    - The organization (who decides what)
    - Context (e.g. the building)
    - Health insurers
    - Different interests of the healthcare organisations involved
    - Integration with EPD and other information systems
    - Integration with the quality system
    - (Clinical) research
    - Other, time consuming projects
- Are there healthcare institutions or healthcare networks that we can learn from?

Figure 6. Screenshot of part of “Plan of Action” session on Metro Mapping official website (Metro Mapping, n.d.).

Another observation is that while co-design is emphasized throughout the methodology, and the Metro Mapping documentation also provides a detailed step-by-step guidance on the official website, the technical threshold of using Metro Mapping template in Visio still costs lots of effort. For example, there are over forty types of shapes offered by the template (see Figure 7 below), users need to browse through a huge number of shapes and pick their target shapes, which might cause a burden for them when working on a Metro Map for a long time. This limits users, especially non-design stakeholders such as healthcare professionals or care managers, to effectively contribute to the creating or editing of Metro Maps.

Figure 7. Lots of types of shapes offered by the current Metro Mapping template.

In conclusion, the Metro Mapping method offers a structurally rich and visually grounded approach to healthcare pathway design. Its conceptual strengths lie in its layered framework, adaptable metaphor, and explicit commitment to co-design and Shared Decision Making. However, current applications reveal key limitations that constrain its broader adoption. These include limited support for systemic or data-driven content and a lack of clearly defined interaction and collaboration models for diverse user types. These challenges, highlighted both by the literature and by omissions in the method's official documentation, motivate this graduation project, which investigates how the usability of Metro Mapping can be improved for different types of stakeholders, and how data integration can extend its value while preserving its visual structure and co-design and collaboration strengths.

2.3 Collaboration in Healthcare Pathway Design

Designing and managing healthcare pathways requires input from diverse stakeholders including clinicians, designers, patients, and administrators. Effective collaboration is critical not only to align goals but also to maintain continuity understanding across complex, multidisciplinary processes. In the context of Metro Mapping, collaboration is fundamental to both the co-design and co-production stages. However, as past applications have shown, facilitating collaborative input, especially across time, to different roles, and within technical tools, remains challenging (Stiggelbout et al., 2023). This need for collaboration across professional boundaries is particularly relevant in healthcare, where the delivery of services is often distributed across multiple departments and providers (Donetto et al., 2015).

Collaboration in healthcare service design traditionally relies on synchronous formats such as workshops. However, as Mallakin et al. (2023) noted, time constraints, power dynamics, and technical barriers in clinical settings often block full stakeholder participation. In response, hybrid models combining synchronous and asynchronous tools, such as shared whiteboards, flexible online survey feedback, or mailed physical materials, have proven useful in maintaining engagement across time and space. These approaches enable stakeholders to contribute within their own constraints.

Currently, Metro Mapping is typically used in in-person workshops or asynchronously through emails and Visio files edited by a limited number of core Metro Mapping team members in the organization. Despite its foundation in co-design, this setup limits the participation of non-design stakeholders (e.g., patients or healthcare professionals unfamiliar with Visio). Discussions with Panton staff who are working on Metro Maps revealed that non-design stakeholders often rely on designers from their own organizations or from Panton to edit or finalize maps, which creates bottlenecks and undermines the method's original goal of shared ownership of Metro Maps. The tool's high technical threshold, such as Visio operation, asynchronous and manual information updating and file versioning, restricts real-time or distributed collaboration. There was a similar but broader challenge identified by Donetto et al. (2015): traditional improvement mechanisms tend to centralize agency and decision-making power, whereas participatory models aim to redistribute that power among patients, families, and staff.

Literature and practical cases suggest that enabling both synchronous and asynchronous collaboration, especially through accessible, low-barrier platforms, can significantly enhance tool engagement and real-world utility. This includes features such as version tracking, role-specific editing modes, or integrated feedback mechanisms. Supporting multi-role input asynchronously allows diverse users to reflect, contribute, and iterate outside constrained in-person workshop settings. Moreover, adopting practices from digital collaboration research, such as co-facilitation, scenario-based ideation, and distributed mapping tasks, can also increase inclusivity and creative output (Mallakin et al., 2023).

In summary, current collaboration in healthcare pathway design often relies on co-design workshops, participatory models, and increasing hybrid methods combining synchronous and asynchronous input. Literature highlights the importance of lowering technical barriers and enabling broader stakeholder engagement across time and roles. However, in Metro Mapping practice, collaboration tends to be limited to a group of core users due to tool complexity and workflow constraints. This created a gap between Metro Mapping method's co-design ideals and its real-world implementation, revealed needs in collaborative scenarios, particularly for distributed participation of contributors.

Key takeaways 2.3

1. Current collaboration in healthcare pathway design often relies on workshops, participatory models, and increasing hybrid methods combining synchronous and asynchronous input.
2. It is essential to lower technical barriers and support hybrid collaboration across time and roles, including both synchronous and asynchronous input.
3. Collaboration is essential to align goals and maintain continuity across complex, multi-role care processes. However, current Metro Mapping practice concentrates editing in a small core team due to tool complexity and workflow constraints. It would be nice if it could be improved for distributed contributors.

3. Interview with Core Metro Mapping Team Members

In this chapter, five participants from core Metro Mapping teams were involved to understand how the Metro Mapping tool is currently applied in real-world healthcare settings. Among them, three semi-structured interviews were conducted in depth, while a written response from two participants were collected for background reference. All participants came from different professional backgrounds, including design, research, clinical practice and data analysis. The interviews were coded and analyzed thematically, with findings structured across four key perspectives: roles & responsibilities, ways of applying Metro Mapping, challenges encountered, and expectations for future tool development.

3.1 Interview Methodology

Since existing Metro Mapping literature describe the Metro Mapping method, its visual structure and broad use-cases but do not articulate how multidisciplinary teams actually apply the Visio-based tool in practice, I conducted a set of semi-structured interviews (Van Boeijen et al.,2014) to gain relevant insights (see Figure 8).

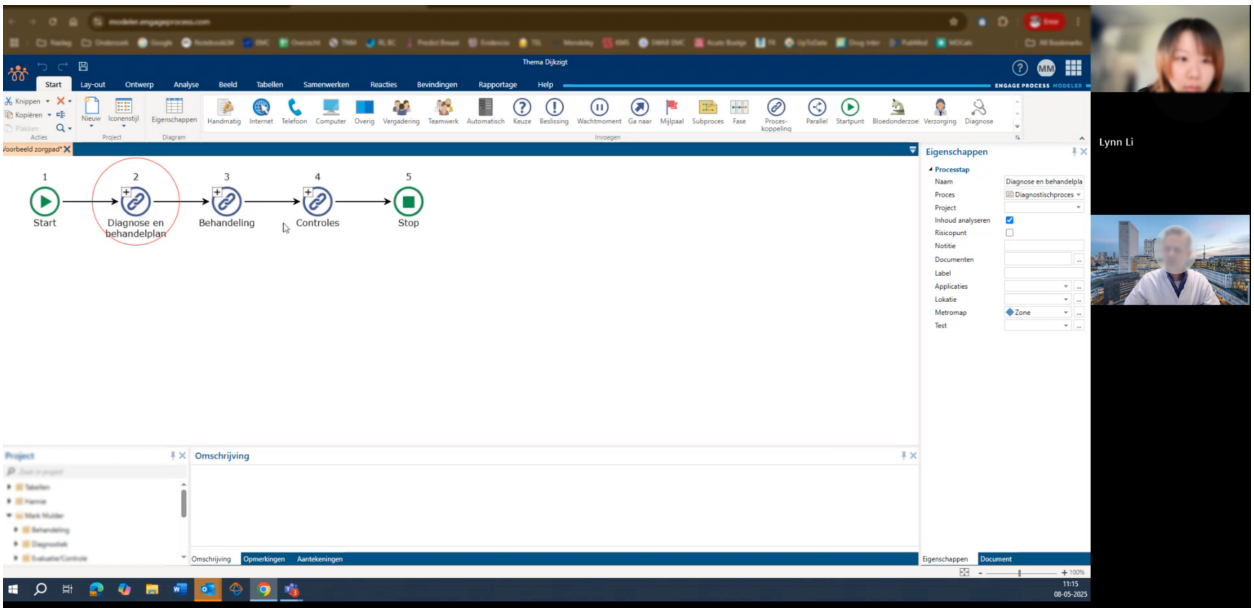


Figure 8. An online interview with a core Metro Mapping team member

The aim of these interviews was to understand how core Metro Mapping team members reflect on their experience with the tool, both individually and collaboratively, and their comments on the potential of integrating data into Metro Mapping. The interview questions were informed by the three research aspects defined in Chapter 1.1 (Core Metro Mapping Team, Collaboration, and Data Integration) and helped uncover the practical challenges and users' expectations from different roles involved in Metro Mapping.

A set of open-ended interview questions (see Appendix A) was designed and adjusted based on the interviewee's professional role and responses. The participants were recruited by Panton's professional networks (mainly through J.B.P. Brands, the Design Strategist of Panton). In total, three semi-structured interviews (Participants #1, #2, and #3) and one written email-based response (preferred by Participants #4 and #5) were conducted. Since Participants #4 and #5 did not participate in live interviews (online or offline) but responded in writing, their input is treated as background supplementary to support the understanding of **roles and responsibilities within a core Metro Mapping team,** and is not used as the basis for primary insights. All participants are considered core Metro Mapping team members and represent different organizational perspectives. Below are the list of participants and a short description of each.

(Two participants out of five agreed to remain non-anonymous in the context of this project to acknowledge their contributions. Their publicly available professional information will be listed at the end of this thesis; for clarity, participants are referred to here using participant numbers, e.g. Participant #1/P#1.)

- **Participant #1:** A healthcare pathway designer at Catharina Hospital, applying Metro Mapping in the redesign of hybrid care paths together with healthcare professionals.
- **Participant #2:** A postdoctoral researcher at Erasmus MC, using Metro Mapping to visualize and analyze pregnancy-related care processes for research purposes.
- **Participant #3**: A medical oncologist at Erasmus MC, previously involved in oncology pathway design with Metro Mapping, and currently applying Metro Mapping's principles through a custom-built digital platform named EngageProcess.
- **Participant #4**: A policy advisor on value-based healthcare at an oncology center, using Metro Mapping to identify opportunities for pathway improvement and support multidisciplinary collaboration.
- **Participant #5**: A data analyst with experience at the Netherlands Comprehensive Cancer Organisation (IKNL), applying Metro Mapping to compare "as-is" and "to-be" processes supported by real-world data such as event logs or process mining outputs.

The interview transcripts were reviewed to extract valuable content segments. Each segment was tagged with an initial code that described its key meaning or relevance. These initial codes were then grouped into mid-level categories based on thematic similarity. Finally, the mid-level categories were mapped to four main codes: **Job&Role, Experience, Challenges, Expectations**, which respond to the research questions and structure the insights presented in this section. The screenshots of the coding file could be found in Appendix B.

3.2 The roles and responsibilities within a Metro Mapping team

Based on both interview responses and official documentation, the core team responsible for Metro Mapping typically includes healthcare professionals, service designers, care managers and researchers (Metro Mapping, n.d.). Depending on the project structure, one of these members often also acts as the project coordinator, facilitating the design process and maintaining continuity. According to Panton and J.B.P. Brands, the role of project coordinator is not restricted to a particular discipline, and can be fulfilled by individuals from different professional backgrounds depending on the needs of the project.

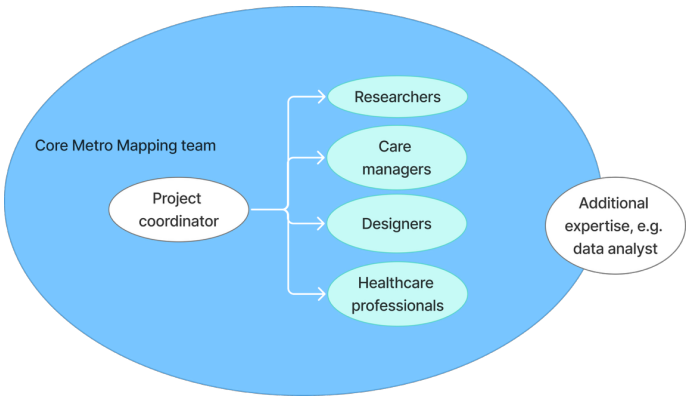


Figure 9. The roles and responsibilities within a Metro Mapping team

Participants in this graduation project reflect this multidisciplinary structure and show different responsibilities during their involvement in Metro Mapping projects:

- **The designer** (P#1) is mainly responsible for facilitation co-design and improve healthcare pathway in Metro Mapping projects. She prepares templates, guides co-creation workshops, collects stakeholder input, and ensures the visual and structural consistency of the map.

- **The researcher** (P#2) focuses on documenting and analyzing healthcare processes. She constructs Metro Maps to compare current and future healthcare pathways, links steps to indicators such as waiting times or costs per step, and evaluates the impact of interventions.
- **The healthcare professional** (P#3) contributes clinical knowledge and ensures that the map reflects accurate treatment logic. In some cases, he also adapts maps into modular, patient-friendly formats that can be embedded into the app of his healthcare organization.
- **The care manager, in this case also the project coordinator** (P#4), oversees the mapping process, coordinates team inputs and ensuring the pathway remains aligned with organizational and patient-centered goals.
- **The data analyst** (P#5) does not directly participate in the creating or structuring of Metro Maps. However, she supports the team by extracting insights from event logs and comparing current versus future care pathways.

"We tried to connect the specialists, and map how patients flow across different parts of the hospital." (P#1)

"We've developed structured care pathways in oncology, like breast cancer. Even though we don't use the Metro Mapping tool itself anymore, the structure is still the same." (P#3)

"(I use Metro Mapping) To engage in a dialogue with the multidisciplinary team and explore the care pathway in detail, with a particular focus on contributing substantive input to each step." (P#4)

Key takeaway 3.2

- A core Metro Mapping team in a healthcare organization is multidisciplinary, typically consisting of a project coordinator and key contributors from healthcare, design, research, and managerial backgrounds.
- The project coordinator role can be carried by one of these members and is responsible for keeping the team aligned and ensuring that contributions from different disciplines are integrated into a coherent mapping process.
- Additional expertise, such as data analysts or IT specialists, can be involved depending on project scope and complexity.

3.3 The application of Metro Mapping tool

Different ways of applying Metro Mapping method

Although the official Metro Mapping manual provides step-by-step instructions for creating Metro Maps using Microsoft Visio and its pre-designed templates (MetroMapping.org/manual, 2024), in practice, the workflow often varies depending on the context of application, the creator's role, and the knowledge backgrounds of other contributors involved. According to a conversation with J.B.P. Brands, the design strategist and managing director of Panton, such adaptation is acknowledged and even encouraged: the value of the Metro Mapping method lies in offering a way to visualize complex care paths, while the exact form of implementation remains flexible.

According to the interviews, Participant #1 and Participant #3 prefer to apply the Metro Mapping method using other tools such as Miro and EngageProcess. For Participant #1, Miro better supports online collaboration and offers a more intuitive editing experience. Participant #3, on the other hand, needs to export the maps and connect them to the digital app environment of his organization, which is the reason that he prefers using EngageProcess. Participant #2 stays to work with Visio when creating and applying Metro Maps.

"We developed a Miro template to use the Metro Mapping method online. So it's like we took the structure, but we adjusted the visuals a bit to make it work better in our workshop context." (P#1)

"So even though I use another tool, I use it because it's digital… and still use the ideas from the Metro Mapping principles like I use stations." (P#3)

"I wanted to use that in our hospital app… so patients can see this is the first station, and then this happens and this, and we thought it would be nice to have something like that. But of course, Visio doesn't support that kind of interaction. So, in the end we ended up using EngageProcess." (P#3)

Using context and summarized using flow

The actual application of Metro Mapping varies depending on the role and background of the user and the intended goal of use. Based on the interviews of participant #1, #2 and #3, three ways of applying the tool emerged, each rooted in different roles and contexts: design, research, and clinical care.

Designer's workflow: facilitation-centered iteration or redesign

From a designer's view, the method acts as a facilitation tool for healthcare pathway redesign or improvement. Participant #1 (healthcare pathway designer) described a workflow that begins with defining a project goal and developing base materials to support structured co-creation. This includes preparing Miro templates for online co-creation and printed visuals such as blank maps or annotation cards for guiding in-person collaborative workshops. Stakeholders contribute feedback in physical or digital forms. For the physical ones, the inputs could be comments, post-its or verbal notes during in-person workshops, which will be processed and integrated into the digital version by the designer. For the digital ones, the feedback is always given via Miro comment. As participant #1 explained, her responsibility in map management centers on maintaining visual logic, organizing input, and coordinating versions across teams. In some cases, the maps are printed again for comparison and further discussion.

The workflow emphasizes control over the process: the designer serves as the main editor, ensures visual consistency, and manages version updates. Other contributors involved in the project might hand in inputs, but main revisions remain the designer's responsibility. The final maps are used to compare current and proposed pathways, often supported by design goals and stakeholder alignment.

"We developed a Miro template to use the Metro Mapping method online. So it's like we took the structure, but we adjusted the visuals a bit to make it work better in our workshop context."

"They give input via post-its or verbally, or via Miro comment. And then we go back and integrate this in the map."

"We print the maps and put them on the table so we can mark them or compare before-after with notes or sticky dots."
(P#1)

Researcher's workflow: structured documenting and outcome tracking

From a researcher's view, Metro Mapping is used as a documentation and analysis tool. Participant #2 builds maps in Microsoft Visio to study and evaluate care processes, especially to compare "before" and "after" pathways in the context of interventions. Her work relies on predefined goals and institutional data, which she uses to calculate cost differentials and monitor design impact. She also highlighted the practice of printing out maps and manually annotating them with sticky notes and graphs to track changes to support analysis. Her maps remain primarily edited by herself, with input from other professionals gathered separately. The goal is to use the map to quantify the impact of interventions, often linking steps to metrics like waiting time, resource use, or consultation frequency.

"By creating the Metro Maps, I have a clear indication what changes after the implementation of the intervention and I am able to calculate the cost of care for the delta."

"I would like to be able to link costs to specific steps within the care pathway with an automatic way to

calculate the cost over the whole care process."

"We also map the outcomes on the Metro Map (that we printed out) using sticky notes and pictures of graphs. From this we draw conclusions and set redesign goals."

"So, the presence of data will only help if the Metro Maps are used in a context… if the aim is to improve care and to determine the impact of changes."
(P#2)

Healthcare professional's workflow: modularization and clinical embedding

From a healthcare professional's view, the goal is to provide patients with a clear and modular overview of their treatment pathway. Participant #3, an oncologist, has adopted the methodological structure of Metro Mapping on EngageProcess, which is a platform better suited for exporting content to XML format. His process is focused on modularizing care steps, such as creating reusable blocks for chemotherapy sessions or intake procedures.

After assembling the pathway using pre-defined components, he exports the content in a structured format that syncs directly with the hospital app. He ensures that each step includes the required information (e.g. what will happen in this step, when, and who in the organization will take the responsibility), while keeping the logic consistent with Metro Mapping principles (e.g. Metro stations, Metro lines). The map is not co-created, but maintained under his responsibility, with an emphasis on readability, modularity, and automation.

"I try to systematically build a library so I can reuse certain parts… for example chemotherapy… I just make one description of the cycle and then I can just put it in 12 times and I'm done."

"I export it, I update the file that describes how my care pathway looks and it automatically is updated in the app."

"So even though I use another tool, I use it because it's digital… and still use the ideas from the Metro Mapping principles like I use stations."

"The patient should get a clear overview of what's going to happen, when, and where."
(P#3)

Key takeaway 3.3

Based on interview insights, the **responsibilities within a Metro Mapping team** differ across roles:

- Designers are responsible for redesigning or improving the existing pathway, while facilitating co-creation and maintaining visual and structural consistency.
- Researchers focus on documenting and analyzing healthcare processes, linking steps to indicators such as waiting times or costs, and comparing healthcare pathways before and after interventions.
- Healthcare professionals provide clinical knowledge and ensure pathways are modular, accurate, and suitable for patient-facing communication.

While these responsibilities highlight the multidisciplinary nature of the team, interviews also showed the **current collaboration modes** in Metro Mapping projects:

- Collaboration tends to be asynchronous and editor-driven: One owner maintains the map, others contribute via workshops, emails, or comments, and the owner integrates input afterwards. Editing rights are often concentrated in a single role to better maintain the structure and consistency of the maps, which preserves coherence but reduces co-ownership and slows iteration.

3.4 Challenges in Using the Current Metro Mapping Tool

Tool usability and workflow friction

While the Metro Mapping method offers a structured visual framework, its actual implementation in Microsoft Visio is often hindered by usability issues, especially for those without prior design or software experience.

According to Participant #2, who works directly with Visio, the software demands significant effort to maintain alignment, space, and visual consistency. She noted that visually arranging steps, especially in complex care

scenarios, becomes time-consuming and technically frustrating. Even basic operations such as aligning shapes or reserving layout space require manual adjustment, leading to a steep learning curve and poor using experience.

"Visio is very manual… if I need to change the order or insert a new step, I have to move everything else around."

"Sometimes you need more room to explain something or to put a box… then everything gets out of line. It's a lot of work to re-align everything."

"There are no smart components or templates for common things like consultation steps or tests… so I have to recreate them each time."

(P#2)

This sentiment was also mentioned by Participant #1, who has turned to using Miro instead of Visio. She described Visio as rigid and difficult to experiment with during collaborative sessions, highlighting that its editing logic makes it harder for non-designers to engage or provide input. According to Participant #1, compared to Visio, Miro was seen as more intuitive, with flexible commenting and easier real-time interaction. These insights reflect the broader usability gap of the current Metro Mapping tool setup in Visio, where users spent a great deal of time on achieving visual accuracy of the map in Visio.

"With Miro, we can comment directly, move things quickly. Visio feels a bit rigid—it's harder to experiment during workshops."
"Visio is a bit more technical… and that makes it harder for people like healthcare professionals to jump in."
– Participant #1 (care pathway designer)

In summary, the usability of the current tool, particularly in the Visio environment, is a clear barrier to wider adoption among healthcare professionals and non-design map creators. There is a need for more intuitive interaction modes, better visual scaffolding, and support for fluid, collaborative editing workflows.

Collaborative support

While Metro Mapping was designed with co-design and collaboration in mind, its current tool implementation limits multi-person contributions and synchronized editing. All three participants noted that collaboration is typically handled through fragmented workflows: one main person creates or updates the map, while others provide feedback via email, comments, or verbal suggestions. This model introduces a separation between editing and input, reducing co-ownership and slowing iteration.

Participant #2 described how in her workflow, collaboration takes the form of interviews or discussions, after which she alone edits the Metro Map. She emphasized that the person building the map is not always the one responsible for maintaining it, resulting in sustainability issues. The lack of shared access for viewing and commenting on the map means that knowledge about the structure and logic of the map remains with a single person. Participant #1 shared a similar setup, where she manages editing in Miro while others comment, but only she can make visual changes. She pointed out that giving edit rights to everyone risks disrupting the logic of the map, especially when contributors lack design training. Participant #3, though using another platform, also works alone to assemble and export care pathways based on predefined logic, highlighting a similar reliance on single-user editing.

"I mostly have experience with one person editing the map. One person gathers the data to create the map, during an interview with involved healthcare professionals adjustments to the Map are discussed, and this one person edits the metro map after the interview."
"In the current software, you cannot work together on one Metro Map making it necessary to appoint an owner."
(P#2)

"They give input via post-its or verbally, or via Miro comment. And then we go back and integrate this in the map."
"We have 1 carepathway designer per project. So they are responsible for editing the map."
"If everyone started to edit the carepathway according to their experiences it might be different… so I would be

interested to see how individual editing does not reduce the other value of co-creation."
(P#1)

Another recurring challenge is the absence of change tracking or role-based editing. Participants expressed the need to know who made what changes, particularly in larger or evolving maps. Without a structured way to track modifications or assign editing responsibilities by layer or role, participants hesitate to open up the map to broader collaboration.

"Still it would be important to see who has edited what or what the newest updates are."
(P#1)

These collaborative frictions reflect an issue in the current tool structure: while Metro Mapping emphasizes co-design conceptually, its primary environment, the template in Microsoft Visio, was not built for distributed or role-based editing. As a result, the workflow remains editor driven, and other people involved often contribute peripherally rather than as active co-creators.

Data integration

According to the interviews, Metro Mapping tool's current technical setup lacks robust support for structured or dynamic data integration. All three participants highlighted challenges related to embedding, updating, and maintaining data within the Metro Maps, especially when the map is used for tracking outcomes, improving processes, or informing patients.

Participant #2, who creates Metro Maps in Visio for research evaluation purposes, described the difficulty of calculating pathway costs and comparing before-and-after states without integrated data capabilities. She currently relies on external datasets and manually annotates printed maps to reflect changes, which limits scalability and responsiveness. For her, the potential of linking cost, waiting times, and role assignments to specific Metro Stations remains theoretical due to the absence of technical mechanisms in the tool.

"The presence of data will only help if the Metro Maps are used in a context… if the aim is to improve care and to determine the impact of changes within the care path."
"I can see the added value of adding waiting times, locations, and responsible roles. However, the added value really depends on what you want to use the Metro Map for…"
(P#2)

Participant #1 noted that in her Metro Mapping team, data dashboards are maintained separately from the Metro Maps. While data such as hospitalization days or remote monitoring trends are routinely collected and visualized in another tool, there is no streamlined way to reflect this data within the maps themselves. As a result, printed Metro Maps are physically marked with sticky notes or annotated graphs to represent outcomes, revealing a gap between data insight and visual communication.

"Integrating the data would show us a positive/negative increase or decrease of certain touchpoints in the metromap."
"We have this data visualized prior to introducing remote monitoring and track this in our own data dashboard after introducing remote monitoring. Furthermore we also map than the outcomes on the metromap (that we printed out) using sticky notes and pictures of graphs."
(P#1)

Participant #3 mentioned the difficulty of keeping care pathways up to date when information needs to be gathered from across departments. Without a modular, distributed update mechanism, maintaining accuracy becomes burdensome. He emphasized that it would be nice to make the process of creating and maintaining Metro Maps more streamlined and role-based, which would be beneficial for wider adoption of Metro Mapping method. Currently, he manually collects information from planners, nurses, and other professionals and enters it into the EngageProcess in a Metro Map logic, which is both inefficient and prone to delay.

"Maybe it's better that the radiologist defines that station and tells me what kind of information we provide to the patient… So every time they update something, it automatically updates in my care pathways."
"If we don't make it easier and more streamlined… it is impossible to spend so much time developing these care pathways."
(P#3)

In all cases, the lack of dynamic linkages to data, no matter in clinical systems, data platforms, semi-structured metadata or other outside data source prevents the Metro Map from becoming a living, data-enabled resource. Without modular maintenance or real-time updating, the effort of embedding data becomes unsustainable beyond small teams or short-term projects.

Key takeaways 3.4

Interview shows that **challenges** exist around three areas in Metro Mapping projects: tool usability in Visio, collaboration, and data integration.

- **Tool usability in Visio**
    - Manual and fragile layout work in Visio slows iteration of the map. Users spend significant effort on layout work when inserting or reordering shapes and components; lack of reusable smart components increases editing time and error risk.
    - Technical threshold limits non-designer participation. The editing logic in Visio feels rigid in collaborative settings, resulting in non-designer contributors tending to provide input verbally or via emails rather than co-edit.
- **Collaboration**
    - Editor-driven, asynchronous collaboration workflow results in long feedback cycles. Current collaboration mode is one owner maintaining the digital map while others contributing mainly via in-person workshops, emails, or comments in Miro.
    - A clearly defined map management mechanism is missing. As a result, the core Metro Mapping team hesitate to open broad input permissions, thereby further reinforcing the editor-driven collaboration model.
- **Data integration**
    - Data remains external and manually back-ported. Currently, data and metrics such as waiting times and costs live in dashboards separate from the Metro Mapping tool. The teams manually annotate the data on the map instead of structuring the data links in the tool, which has restricted the timeliness and decision-making value of the information.

These insights show that while the Metro Mapping tool offers a valuable structure for pathway design, its current Visio-based tool limits efficiency, broad collaboration, and the use of data in practice.

3.5 Expectations in Using the Current Metro Mapping Tool

Collaborative support

Despite the current single-user editing model observed in most Metro Mapping practices, all three participants expressed interest in developing more collaborative, multi-role input within the tool. These expectations start from practical concerns about sustainability and clarity of the tool, and the ability to share ownership across different contributors.

Participant #1 emphasized the need for structured collaboration workflows that support division of labor without compromising the whole process. Specifically, she suggested combining role-based input and suggestions-only

modes, depending on whether the team is working on an “as-is” (descriptive) or “to-be” (design-oriented) pathway. She also highlighted the importance of change tracking and edit history, particularly when multiple contributors are expected to maintain or iterate the map.

“I would go for change tracking and a role-based input… For the as-is pathway I would suggest prioritizing role-based input, for the to-be pathway I would suggest suggestions only.” (P#1)

Participant #2 also expected for a clearer distinction between creators and maintainers. She noted that the person who initially builds the map is not always the one who maintains it. To support more distributed map ownership, she envisioned a system where individual roles could edit their own parts of the map while the primary owner retains visibility and control over the full structure of the map. She saw value in approaches that make collaboration easier to manage, such as approval workflows and visibility into others’ changes.

“In the current software, you cannot work together on one Metro Map making it necessary to appoint an owner… The person that creates the Metro Maps is however not always the one that should maintain the map.” (P#2)

Participant #3 expressed a related need from a healthcare professional’s perspective: in his current workflow, he manually consults different specialists to gather updated information and re-integrate it into the map. Instead, he would prefer a modular system where specialists define and maintain their own segments (such as radiology or pharmacy) of the pathway, so that changes could automatically update in his version. This expectation shows a desire for role-responsible editing that enables dynamic integration across departments within the organization.

“Maybe it’s better that the radiologist defines that station and tells me what kind of information we provide to the patient… So every time they update something, it automatically updates in my care pathways.”(P#3)

Taken together, these expectations suggest that future versions of the Metro Mapping tool should support:

- Role-based editing rights (e.g., nurses manage nursing steps; project leads review changes),
- Change tracking and history logs to identify who made what changes,
- Suggestions-only or approval-based workflows, especially for collaborative redesign,
- Modularized segment management to distribute editing responsibility across departments,
- and the ability to coordinate asynchronous input without losing structural coherence.

Data integration

All three participants expressed a clear desire to integrate structured data directly into the Metro Mapping environment. However, their expectations differed based on roles and goals.

Participant #2, who uses Metro Mapping for intervention analysis and outcome tracking, emphasized the need to link cost and process metrics directly to visual elements in the map. She imagined an ideal scenario where updating a Metro Map would automatically recalculate the overall cost of care, making changes immediately traceable and actionable. Similarly, she hoped to see pathways become dynamic, where cost implications or timeline shifts could be visualized in real time as edits were made.

“I would like to be able to link costs to specific steps within the care pathway with an automatic way to calculate the cost over the whole care process. If you then make any changes to the Metro Map, you can immediately see how the changes impact the cost.”(P#2)

Participant #1 also expressed interest in linking key indicators (such as waiting times, locations, or responsible roles) to specific Metro Stations. While she acknowledged that not all Metro Mapping projects require data, she believed data integration could enhance its role as a decision-making and communication tool, especially when the maps are used to justify changes or report outcomes to stakeholders such as health insurers. She suggested that

being able to visualize the impact of changes across a Metro Map by presenting data would significantly improve its usability in strategic contexts.

"Integrating the data would show us a positive/negative increase or decrease of certain touchpoints in the Metro Map… Also to take the care pathway to the health insurances. For me the difference would be if we could measure/visualize the impact of changes." (P#1)

From a clinical implementation angle, Participant #3 discussed the burden of maintaining care pathways when information updates must be collected from different departments manually. He expressed a strong interest in role-based data updates, expecting a system where different units within a clinical organization (e.g., radiology, nursing) could manage and maintain their respective stations. This expectation points toward a modular data maintenance model for the map, where real-time updates and pathway synchronization would make the maps more scalable and reliable.

"Maybe it's better that the radiologist defines that station and tells me what kind of information we provide to the patient… So every time they update something, it automatically updates in my care pathways." (P#3)

Key takeaways 3.5

Interview insights reflect that expectations exist around two themes: **improving collaboration** and **strengthening the role of data** in Metro Mapping projects.

- **Improving collaboration**
  - Participants want a stronger sense of **shared ownership** of the map, instead of one person being the sole editor.
  - They expect **clearer ways to divide responsibilities**, so that contributors can add input without disrupting the overall structure.
  - Participants value a sense of **trust and transparency** in the collaboration process, with visibility of who contributed what, and opportunities to align asynchronously as well as during in-person workshops.
- **Strengthening the role of data**
  - Participants expect Metro Maps to become a **living resource**, where data is not only attached externally but integrated into Metro Mapping tool to support the healthcare pathway design.
  - They want data to **support reflection and decision-making**, for example, by showing the impact of changes on costs, waiting times, or patient experience.
  - Data is also seen as a means to **communicate value** to external stakeholders, such as demonstrating outcomes to insurers or management.

In short, the participants hope that Metro Mapping tool can go beyond being a static drawing aid and instead become a shared space, in which the division of responsibilities will be more clear, and the data can effectively support the dialogue, reflection, and decision-making process.

3.6 Current application of data in Metro Mapping projects

Current application of Metro Mapping tool largely treats data as a reference for the map but placed out of the map, rather than an embedded component of the map itself. According to the interviews, participants apply data often through manually management to support evaluation, redesign, and communication, but not through direct integration into the tool environment.

In Participant #1's workflow, data collected from institutional dashboards (e.g., hospitalization days, consultation counts) are used to evaluate changes before and after a service intervention. However, these data are not embedded into the digital Metro Maps. Instead, outcomes are physically mapped onto printed Metro Maps using sticky notes, annotations, and graph images during reflection workshops. This practice shows that the Metro Map is treated more as a coordination or storytelling surface than a dynamic data visualization.

"Most goals are set beforehand. So for example remote monitoring will reduce hospitalization, less consultation for people who do not need it, shorter waiting lists etc… We have this data visualized prior to introducing remote monitoring and track this in our own data dashboard after introducing remote monitoring." (P#1)

Participant #2, working in a research context, applies Metro Mapping to compare the structure and cost of care pathways before and after specific interventions. Like Participant #1, she prints Metro Maps and manually adds outcome indicators and visual cues to assess the effect of the changes. While she sees the map as a tool for clarifying process shifts and supporting evidence-based redesign, she also emphasized that the usefulness of data depends on whether the map is being used for continuous improvement or as a one-time research artifact.

"By creating the Metro Maps, I have a clear indication what changes after the implementation of the intervention and I am able to calculate the cost of care for the delta as well as calculate the total cost of care for this specific care process."

"So, the presence of data will only help if the Metro Maps are used in a context… if the aim is to improve care and to determine the impact of changes within the care path."
(P#2)

In both cases, Metro Mapping currently functions more as a canvas for illustrating insights gathered elsewhere, rather than as a data-driven tool. Data is applied through annotations and workshop discussions, but not yet systematically represented or computed within the tool itself. This limits its potential for responsive feedback, cost modeling, or real-time process tracking, especially as projects grow in scale or complexity.

Based on input from Participant #1, #2, and #3, and further refined through follow-up discussions with J.B.P. Brands, the following table (Table 1), which is a list of data types has been proposed as the most relevant to Metro Mapping use in healthcare contexts.

"Types of data: amount of patients in remote monitoring (how many quit/are active etc. but also the amount over time), amount of alarms, % of measurements completed, patient feedback (txt) and patient satisfaction scores, amount of consults, consults per patient (physical-, phone- and video consultation), days of hospitalization. We have some others but most are related to these topics." (P#1)

"I would like to be able to link costs to specific steps within the care pathway with an automatic way to calculate the cost over the whole care process. If you then make any changes to the Metro Map, you can immediately see how the changes impact the cost." (P#2)

"Maybe it's better that the radiologist defines that station and tells me what kind of information we provide to the patient… So every time they update something, it automatically updates in my care pathways." (P#3)

Name of data	Data type	Description
Station_ID	Alphanumeric	Unique identifier for the station
Name / Title	Short text	Name of the station
Description	Multi-line text	Short description of the activity or step
Responsible Role / Department	Dropdown or text	Who is responsible for this step (e.g. surgeon, radiology)
Location	Text	Where the step takes place (e.g. Outpatient Clinic)
Timing	Duration fields (e.g., days and hours)	Includes estimated processing time and possible waiting time
Cost	Number	Estimated or average cost associated with this step
Documents / Brochures	File attachment or hyperlink	Files or printed materials provided to the patient

Tags / Categories	Multi-select tags	Functional category tags such as Diagnosis, Treatment, Check-up
Last Updated / Version	Date or timestamp	Metadata for version tracking and accountability
Patient feedback	Text or web hyperlink	(Optional) Any data inputs related to patient feedback
Measurement completion rate	Number (%)	The completion rate of measurements within the whole carepath
A blank field	/	Left for users' self-defining

Table 1. A list of data types proposed as the most relevant to Metro Mapping use in healthcare contexts.

Based on the interviews, although various types of healthcare data are recognized as valuable for Metro Mapping, they are not yet fully embedded into the Metro Maps in current practice.

For Participant #1, institutional data such as hospitalization days, number of consultations, or patient satisfaction scores are used before and after a care intervention to assess its impact. However, these data remain external to the Metro Map. During project reflection moments, printed versions of the Metro Map are used to physically annotate outcomes with sticky notes and visual cues. In this way, the Metro Map becomes a collaborative canvas for reviewing and interpreting data, but not a digital tool for live data interaction.

"We have this data visualized prior to introducing remote monitoring and track this in our own data dashboard after introducing remote monitoring. Furthermore we also map than the outcomes on the metromap (that we printed out) using sticky notes and pictures of graphs." (P#1)

Participant #2 adopts a similar approach in her research projects. She uses the Metro Map to represent structural changes across a care pathway, then maps outcomes manually by printing the map and attaching visual indicators such as graphs or notes. These are used to evaluate the impact of an intervention on cost, waiting time, or process complexity. Although the data are central to her goals, they are not technically linked to the map layers or stations themselves.

"We also map the outcomes on the Metro Map (that we printed out) using sticky notes and pictures of graphs. From this we draw conclusions and set redesign goals." (P#2)

In both examples, data informs the interpretation of the Metro Map, but remains detached from its structure. The current use cases demonstrate a hybrid approach, where Metro Mapping serves as a shared visual anchor while data insights are introduced through parallel formats. This separation limits the potential of Metro Mapping to serve as a data-enabled design tool. Without integrated fields, dashboards, or automated calculations, participants must manually translate data into visual form, which reduces efficiency and increases the risk of misalignment between insights and the visualized pathway.

Key takeaways 3.6

Interviews show that data is related to reflection, decisions, and communication within Metro Mapping projects, yet it mostly lives outside the tool. To make sense of how data is handled and what this implies, the insights can be read from broad, human-organizational patterns down to concrete needs for integration.

- Data supports review steps in Metro Maps and aligns stakeholders, but accuracy and updates of data depend on one map owner gathering inputs from other contributors, which turns the map into a canvas for information presentation rather than a shared workspace with data input.
- According to the goals and experiences for using the Metro Mapping tool (mentioned in both Chapter 3.1 and 3.6), participants considered the following data to be the most relevant: operational flow (e.g. consultation counts, hospitalization days), time-related metrics (e.g. step durations, patient waiting times), resources and responsibility (e.g. cost per step, responsible roles, locations), outcomes and

experience (e.g. patient feedback, satisfaction), and map management-related metadata (e.g. version of the map, tags, links).

- Currently, these metrics are maintained in separate dashboards, then manually brought onto maps. With no structural links between metrics and map elements, there is no automatic calculation or immediate view of the impact when steps change.
- According to participants, they expect to treat the map as a living data resource to support decisions and communication by linking prioritized metrics to the map, enable distributed, role-responsible updates, and surface before–after visibility and impact cues.

Taken together, participants know which data matters and already use it to evaluate change; the missing piece is bringing that data into the map, so that the Metro Mapping tool could serve as a data-supported tool rather than a static canvas.

Summary

In this chapter, five participants from core Metro Mapping teams were involved to understand how the Metro Mapping tool is currently applied in real-world healthcare settings. Sub-research questions on Collaboration Perspective and Data-enabled Perspective are researched in this chapter. The main insights related to research questions are summarized below.

1. Roles and Responsibilities (related to RQ 1)
   Metro Mapping is practiced by multidisciplinary teams that typically include mainly designers, researchers, and healthcare professionals. Project coordinators can come from any of these roles depending on the context. Designers emphasized facilitation and visual structure; researchers focused on analytical clarity and cost evaluation; healthcare professionals emphasized patient communication and content modularization.

2. Challenges Encountered (related to RQ 2)
   Across interviews, participants reported three main categories of challenges:

   - Usability: Especially in Visio, users experience difficulty aligning visual elements, editing layouts, and maintaining consistency. This hinders both workflow and co-creation.
   - Collaboration: Current tools lack features for real-time, role-based collaboration. Most editing is done by a single person, with others providing input via comments or interviews.
   - Data Integration: Data insights are mostly used externally (e.g., via dashboards or other data analyzing apps) and then manually annotated onto printed Metro Maps. No dynamic linking or in-tool calculation is currently supported.

3. Expectations for Future Development (related to RQ 2, 4 and 5)
   All participants expressed clear expectations for improvement:

   - Collaboration: Users want role-based editing rights, change tracking, and modular contributions to reduce workload and increase co-ownership.
   - Data Integration: Users expect to link quantitative data (e.g., cost, time, responsibility) directly to steps or layers in the map, with real-time feedback on how edits impact outcomes.

These insights form the foundation for the next phase of this project: exploring how the Microsoft Visio-based Metro Mapping tool can be optimized for multidisciplinary collaboration and data-enabled healthcare design.

4. Scoping on the Design Direction

The first phase of this graduation project, which is the research phase, aimed to gain an overview of and understand how the Metro Mapping tool is used for researching, (re)designing and presenting healthcare pathways. With the background of Metro Mapping method and tool learned from the literature review, and the current use of the Metro Mapping tool in real scenarios concluded from interviews, the challenges users are facing and their expectations became clear. I clarified the problem statement to show the challenges, and reframed users' insights to show their expectations.

4.1 Problem statement

Core Metro Mapping team members expect a tool that is intuitive, supports smooth collaboration across roles, and embeds data directly into it to realize Metro Mapping's value in healthcare pathway design. However, the current Visio-based tool falls short in usability, collaboration, and data integration. The problem can be stated from the human side and technical side.

On the **human side**, from observation and users' reporting in interviews, the current interaction of the tool in Visio is not intuitive for non-design users: the technical threshold for creating, adjusting and maintaining a Metro Map in Visio limits non-designer participation, resulting in them tending to provide input verbally or by texts rather than co-edit, which is also the reason that the collaboration of working on a map often remains one-way: a single coordinator creates and maintains the map, while others most of the time contribute only through workshops or emails. This limits more efficient co-creation during the creation and maintenance of Metro Maps.

On the **technical side**, from users' reporting, the tool is disconnected from data and relies on static, manual editing. Relevant metrics such as costs, waiting times, or responsibilities, which were mentioned by users as criteria for evaluating and improving healthcare pathways, remain external and are annotated manually on maps, which lacks modularity, change tracking and synchronization, and makes the updating of maps labor-intensive.

Without a more **interactive, collaborative, and data-enabled** tool, Metro Mapping risks becoming rigid, editor-driven, and detached from data, instead of a method that efficiently and user-friendly supports core Metro Mapping team members in collaboratively creating, updating, and improving healthcare pathways.

4.2 Key needs of users

With the problem statement, the insights and key takeaways from the research phase of this project were concluded and translated into users' key needs to show their expectations.

First, I summarized three main types of core Metro Mapping teams members, which are researchers, designers and healthcare professionals, and their goals for using the Metro Mapping tool. From the research in the first phase, I learned that the three different types of core members would have their own purposes, workflows, preferences and habits when using the Metro Mapping tool. My final design concept needs to be a universal enhanced Metro Mapping tool that can meet the majority of the needs of most types of users. Therefore, it is necessary to explain the goals from the perspectives of these three different types of main users and to consider their needs together. Detailed user stories for each perspective can be seen in the next chapter.

Goals of three different types of core Metro Mapping team members:

- Researchers: Collect information, document and analyze the existing healthcare pathways, and support academic communication.
- Designers: Collect feedback from other stakeholders involved in the healthcare pathways, and improve/redesign the existing healthcare pathways by using Metro Mapping as both a communication and tracking tool.
- Healthcare professionals (e.g. oncologists, care coordinators): Integrate Metro Mapping method to digitally structure and present care pathways to patients in an easy/friendly way (in their hospital apps).

Key needs of core Metro Mapping team members:

1. **An intuitive and structured tool:** Users need a tool that is easy to use, visually clear, and could handle both simple and complex care pathways.
2. **Support flexible and transparent co-creation and collaboration:** The tool should support real-time and asynchronous co-creation among multiple map contributors to ensure the collaborative of the map without losing structural integrity.
3. **Integrate data to support analyzing and improving healthcare pathways:** Users need the ability to link Metro Maps to key metrics such as costs, waiting times, roles, etc. to support the analysis, improvements or redesign of healthcare pathways.
4. **Efficiency and modularity in workflow:** The tool should provide reusable, structured and modular components to reduce editing burden and ensure editing accuracy.
5. **Clear communication and export options:** The tool should support adaptation to different review, communication and iteration contexts, such as printing maps, sharing files, inserting visuals into academic articles, and presentation to non-designers, etc.

These key needs could be translated into a desired future vision:

4.3 Future vision of Metro Mapping tool

"Metro Mapping tool should be an **intuitive and data-enabled** tool that allow multidisciplinary teams to co-create, analyze, and communicate healthcare pathways in a **clear and collaborative** way."

Bringing the problem statement, key needs of users and the future vision together, a design goal was developed to guide the second phase of this project, which is the design phase:

4.4 Design goal

"Enhance Metro Mapping tool to enable core Metro Mapping teams in healthcare organizations to create, update and improve healthcare pathways by using the tool in an **intuitive, data-enabled and collaborative** way."

Six design criteria were proposed to define what the enhanced Metro Mapping tool should achieve. After discussions with J.B.P. Brands, the design strategist at Panton, these design criteria were considered reasonable from the perspective of the people who manage, promote and use the tool.

4.5 Design criteria

A. **Enable participation of different stakeholders:** The design should support collaboration, allowing different types of stakeholders to contribute in the co-designing of Metro Maps appropriately while maintaining the clarity and ownership of the map.

B. **Accommodate different levels of complexity of healthcare processes:** The design should be capable of representing linear, branching, and looping care pathways, including both typical and exceptional scenarios.

C. **Allow integration of human insights and operational data:** The design should support the inclusion of both human-centered insights and structured data in a meaningful and coherent manner.

D. **Maintain visual clarity across varying levels of complexity:** The mapping interface should remain interpretable and visually coherent regardless of pathway size or detail density.

E. **Support both real-time and asynchronous collaboration:** The design should facilitate both synchronous co-creation sessions and asynchronous contributions or reviews across team members.

F. **Allow export and documentation for multiple collaboration contexts:** The design should provide flexible output formats to support review, communication, and iteration in both digital and non-digital environments.

4.6 Scope of this project

Since the Metro Mapping tool can be discussed across a wide range of dimensions, such as usage scenarios, user types, purposes of use, and possible areas of optimization, and this graduation project only focuses on some of these aspects, it is important to clearly define the scope for design before entering the design phase. When enhancing and designing the new version of the Metro Mapping tool, attention should be placed on the following points:

1. **User knowledge background:** The users targeted in this project are members of Metro Mapping teams, all of whom already have substantial experience with the Metro Mapping tool. Therefore, the design of the new version of the Metro Mapping tool can assume that users have a basic understanding of the Metro Mapping tool and method. This means that the needs of non-users of the tool, such as patients or their family members, may be mentioned but will not be the main focus of exploration.

2. **Functionalities of the new version of the tool:** "Functionalities" here refers to what the new version of the Metro Mapping tool should be able to do, which includes three aspects: interaction and usability, collaboration mechanisms, and data-enabled way of the tool.

3. **Technical environment of use:** In this project, taking the need for a gradually iterative Metro Mapping tool into account and based on expectations from the client Panton, the final design must be implementable within Microsoft Visio's technical environment. Therefore, during the mid-stage of the design phase, when screening initial ideations, the main focus will be on applications in the digital environment, with feasibility in Visio being a key consideration. Other out-of-Visio topics or ideas may be mentioned and discussed, but they will appear as recommendations or possible future work.

Other topics outside the scope, such as a next generation of the Metro Mapping tool, better methods for applying the tool in in-person workshops, or promotion of the tool, may be touched upon or discussed, but will not be studied in depth.

4.7 User story with the current Metro Mapping

To clearly and intuitively present the current situation of users' usage of Metro Mapping, I have drawn a simplified user story to show the possible process of users when using the current Metro Mapping, as shown in Figure 10.

In this story, a healthcare pathway designer, who is also a Metro Map manager, builds a Metro Map in Visio, then uses it in an in-person workshop and handles the follow up. The story highlights three main points that leads to room for improvement of the user experience and efficiency of the current Metro Mapping in Visio:

- The current Metro Mapping in Visio is not intuitive. Almost all layout work is manual and easy to break.
- Data is outside the map. There is no linking between the map and the information collection file, so updates are slow and manually.
- Collaboration support is limited. Non-Visio users have limited way to contribute to the map and the manager acts as the single editor.

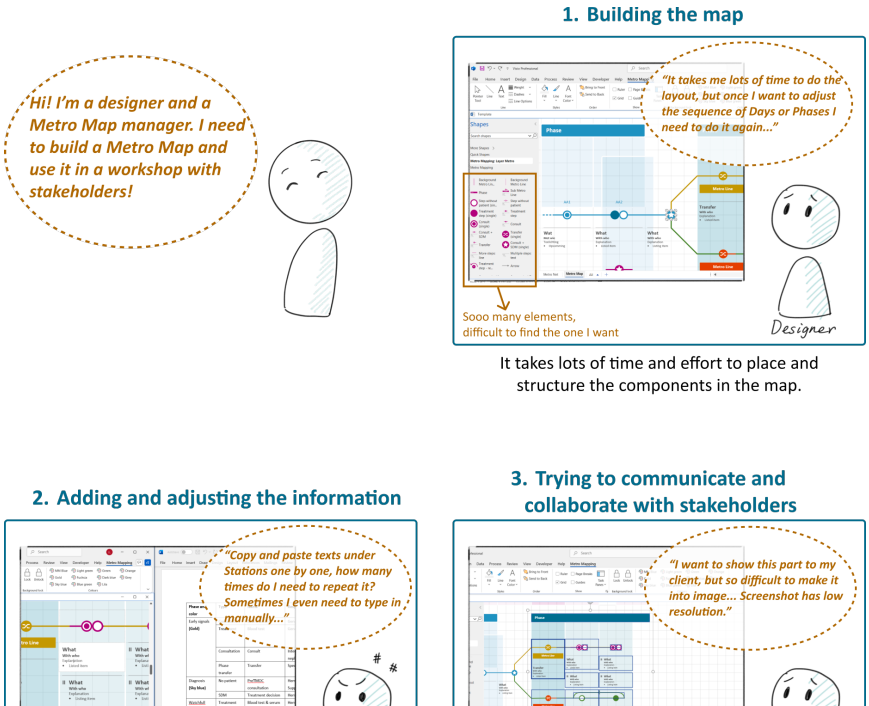


Figure 10. A simplified user story with the current Metro Mapping

5. Design Exploration

In this chapter, building on the previous research and synthesis, I summarized the goals and actions of three types of Metro Mapping users as contexts for idea generation and the co-creation sessions. I brainstormed ideas and discussed and iterated them with three participants during the co-creation sessions. Finally, I prioritized eight initial features and selected the ones to be considered in the final design concept.

5.1 General workflow of three types of users

During the interviews, it was found that different types of core Metro Mapping team members approach the tool from varying perspectives. They have different goals, workflows, and habits when using the tool. Since the final design needs to be universal and allow various types of users to engage with the tool in an intuitive, data-enabled, and collaborative way, it is reasonable to start design exploration by considering users' diverse viewpoints, then consolidated all generated ideas and filtered them based on the established design criteria.

As a result, general workflow of three types of users were translated from user needs and insights, representing the perspectives of designers, researchers, and healthcare professionals. Each workflow begins by describing the main goal this type of user has when working with Metro Mapping, followed by a timeline of potential actions they might take while using the tool. These goals and timelines were shared in the later co-creation sessions in Chapter 5.3 with participants as contexts for initial ideations.

Designers' workflow

Goal for using Metro Mapping:

Collect feedback from other stakeholders involved in the healthcare pathways, and improve/redesign the existing healthcare pathways by using Metro Mapping as both a communication and tracking tool.

Timeline of potential actions when using Metro Mapping:

- Starts with a **design challenge or improvement goal** (e.g., reduce waiting time, increase patient satisfaction).
- Selects or assembles a base template as starting point to **map out the current situation** ("as-is").
- Schedules and facilitates a series of **online or in-person co-creation workshops** with healthcare stakeholders (doctors, nurses, admin).
- In these workshops, the designer might use **printed or physical materials** (e.g., blank maps, sticky notes, annotation cards) to help participants contribute feedback and suggestions.
- After the session, **collects and organizes the input**; the input might be **online** (e.g. in a Miro board) or **on paper** (e.g. on stickers), some input may need clarification or structuring.
- Returns to the digital version to **revise the map** accordingly, while **keeping track of what changes** were made.
- Adds measurable improvement goals or outcomes if possible (e.g., fewer consultations needed).
- Prepares a clear **visual comparison** between current and proposed pathway for presentation and team feedback.
- Maintains control over the whole editing process and ensures visual consistency before submitting the final version.

Researchers' workflow

Goal for using Metro Mapping:

Collect information, document and analyze the existing healthcare pathways, and support academic communication.

Timeline of potential actions when using Metro Mapping:

- Starts by **gathering pathway-related information** through interviews, internal documents, and observational insights.
- Uses **a blank or stripped-down template** to ensure full control over how information is added.
- Builds the pathway **step-by-step** with careful attention to naming, timing, cost, and responsibility per action.
- Occasionally **receives input** from healthcare stakeholders, e.g. clinicians or administrative staff (usually via email or scheduled discussions?).
- Adds personal notes, uncertainties, or references (which might include **multi-types of resources**) directly onto the visual layout for transparency.
- Once the structure is finalized, **enriches the map with quantitative data** (e.g., average time per step, consultation cost) to support analysis.
- Uses the finished map in **internal presentations, research reports, or academic articles**, possibly accompanied by written interpretation.
- If needed, creates **a simplified or narrative version** for cross-disciplinary understanding.

Professionals' workflow

Goal for using Metro Mapping:

To clearly communicate the patient's care pathway (internally or to patients), and to collaboratively maintain the accuracy and modularity of that pathway over time.

Timeline of potential actions when using Metro Mapping:

- Starts with the need to **make a care pathway understandable and useful for either team coordination or patient education/presentation** (*present care pathways to patients on an easy/friendly way).
- Loads a pre-existing pathway or assembles one based on **departmental standards** or templates.
- Add **essential information** (mainly quantitative data) to each station as complete as possible
- **Adjusts or expands sections** based on different care scenarios.
- Focuses on ensuring that the pathway makes clear on what the patient will see, what actions are required, and in what sequence.
- **Collaborates with colleagues** by filling in different parts based on their own domain knowledge (e.g., nurse reviews monitoring section, physician reviews medication schedule).
- For complex treatments (e.g., with many loops, branches, etc.), uses reusable segments to reflect repeatable structures.
- Uses simple written annotations or update notes to clarify unclear or tentative steps.
- Exports as a version that is **readable by patients** and can be either shown digitally or printed for handouts.
- Occasionally **exports** the care pathway for **integration with other hospital documentation or applications**.

5.2 Brainstorming and initial features

Starting from the design goals and key user needs and combining user stories, I began the initial brainstorming process. Based on the identified user needs, I generated 21 initial ideas and organized them according to the design criteria (see Figure 11 below).

Figure 11. 21 initial ideas from brainstorming.

I then refined and consolidated these initial ideas based on the design criteria, while also referring to the three user stories. This resulted in nine initial features that address the key needs of different types of core Metro Mapping team members and align with the design goal of "using the tool in an intuitive, data-enabled, and collaborative way". These eight features would serve as the foundation for further iteration and convergence toward the final design concept. Some features are accompanied by sketches, which are used to visually demonstrate the using process or visual effects of that feature. These sketches (Figure 12-17) also served as the basis for my creation of visual effect illustrations in later steps.

1. A filter supporting role-guided modular editing: Allows different team roles to access and edit only designated sections of the map, while switching between simplified or full-feature modes based on their role.

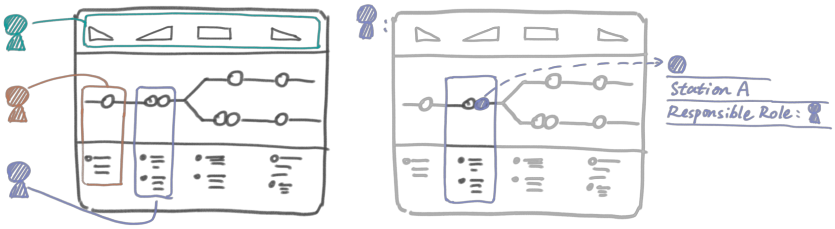


Figure 12. A filter supporting role-guided modular editing

2. Printable collaboration toolkit: Allows users to export the Metro Map into a print-ready version, accompanied by a toolkit of physical collaboration elements such as stickers, commenting cards, and color-coded layers that match the visual language of digital version.

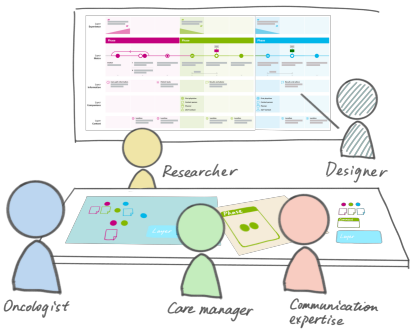


Figure 13. Printable collaboration toolkit

3. Commenting system for Metro Map contributors: Allows contributors (e.g., project leads, nurses, researchers) to leave comments, suggestions, or questions to specific parts of the Metro Map without editing the content directly.
4. Narrative documentation: Converts selected map segments into short stories or cards for team meetings, patient conversations, or documentation.

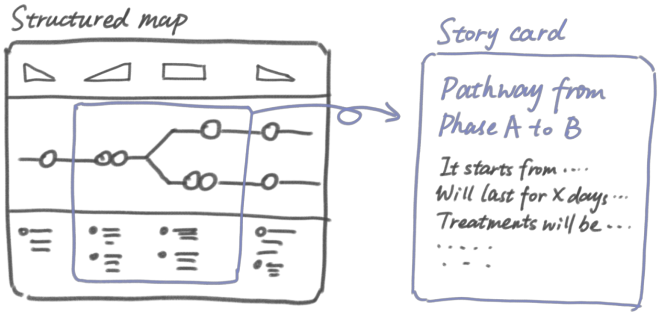


Figure 14. Narrative documentation

5. Automatic color matching: When a component is dropped onto the canvas, automatically match its color to the color of Day and Phase it is in to maintain visual consistency of the map and reduce manual effort.
6. Structured Station data view: Supports the display of structured data from data source such as waiting time, cost, and responsible party on each station via clicking.

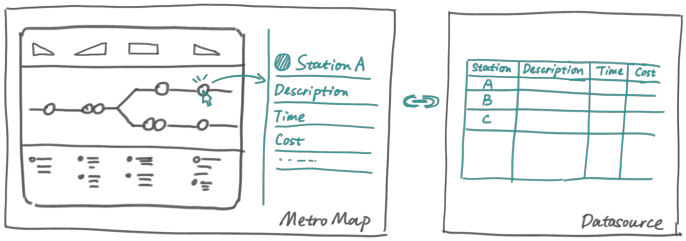


Figure 15. Structured Station data view

7. Before-After comparison: Enables toggling between two versions of a care pathway (before and after intervention), highlighting structural and data-based differences.

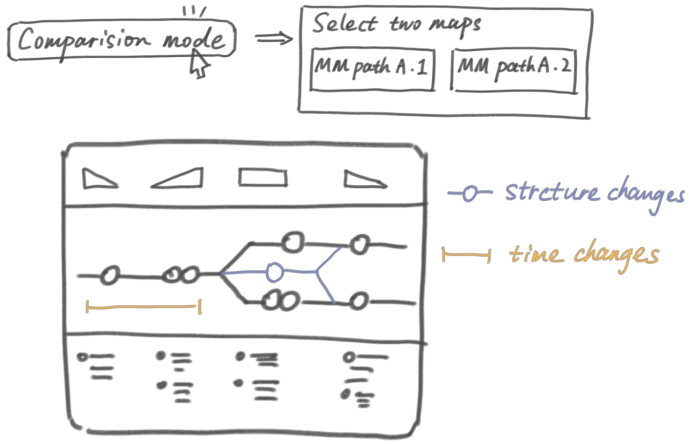


Figure 16. Before-After comparison

8. Expanding/collapsing map content: Allows the Metro Map to flexibly represent complex pathway patterns, including nested steps, conditional branches, and back-loops, with the ability to expand or collapse detail levels.

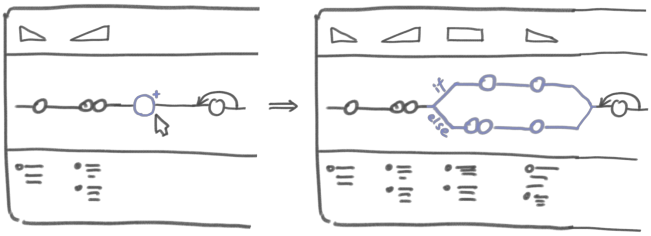


Figure 17. Expanding/collapsing map content

5.3 Co-creation sessions

To gather hands-on feedback and suggestions from core Metro Mapping team members on the initial features, I organized two co-creation sessions. The first one was an online session that lasted around 100 minutes, involving researcher Participant #2, who had previously taken part in the interview phase of the project. The second session was an in-person session lasting about two hours, with two designers from Panton (#Participant 6 and 7) as participants. They use Metro Mapping tool to visualize care pathways to support understanding of healthcare pathways for Panton's clients.

The co-creation session was divided into four sub-sessions: an introduction to the Metro Mapping tool, a guided exploration of initial features, a free co-creation phase, and finally a wrap-up and reflection. During the second sub-session, in order to help participants better understand the potential use and value of each feature within real-world contexts, I presented the initial features through the user stories. This approach allowed for a more intuitive and engaging explanation. Figure 18 shows the context and layout for the in-person session.

Figure 18. The context and layout for the in-person session.

The overall structure of the co-creation session is shown in Figure 19. A detailed version of the diagram, along with the full session plan, can be found in Appendix C and D.

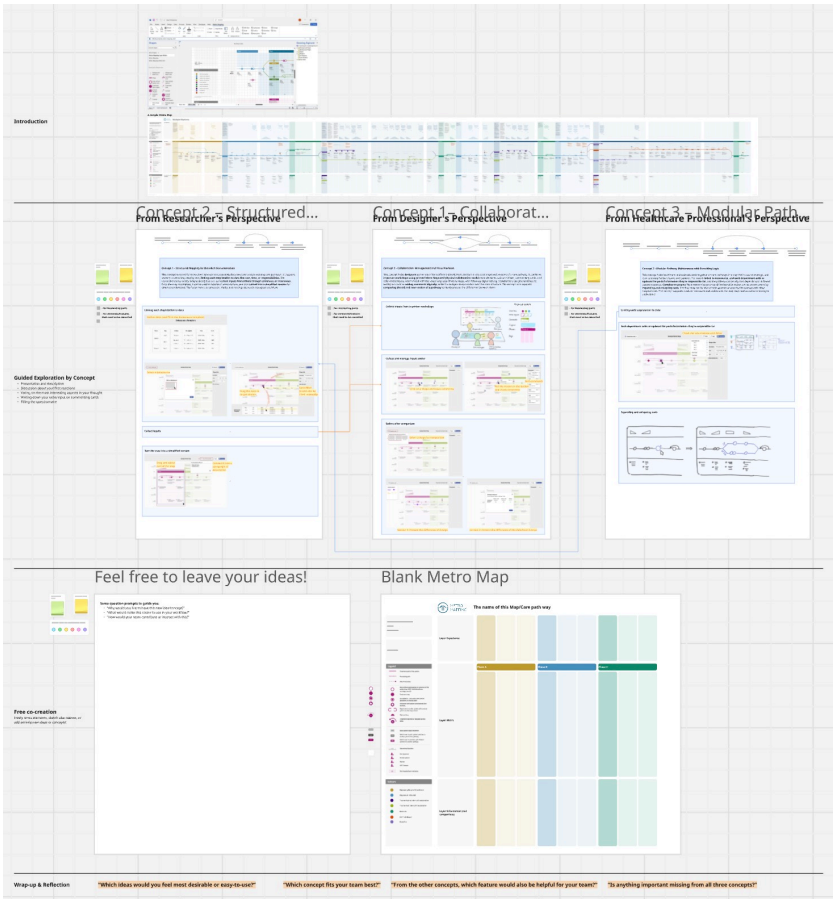


Figure 19. The overall structure of the co-creation session.

Both sessions provided valuable insights into whether the initial features could support their workflow, as well as how these initial features might be applied effectively in real-world contexts. In addition, the participants brought up new ideas that further contributed to the iteration and development of the final concept. The detailed outcomes from the co-creation sessions are summarized below.

Key feedback and comments from participants

This section summarizes the feedback and preferences expressed by the three co-creation session participants (P#2, P#6, P#7) on initial features.

1. Visual clarity and simplified views of the map (initial feature 1 and 9)

- Based on initial feature 9, P#2 emphasized the need for a simplified version of the Metro Map that supports presentation and high-level communication.
    - She mentioned that visual clarity and audience readability are more important than information density. According to her experience, a fully detailed Metro Map could be overwhelming when used for presentations, and a simplified version with only essential information but without losing the structure would be highly desirable.
- About initial feature 1, P#6 and P#7 shared concern that over-filtering of the map could lead to fragmented understanding, but agreed that focusing and exporting partial views based on expanding and collapsing the map (initial feature 9) is valuable for communication.
    - P#6 and P#7 expressed concern that filtering the Metro Map based on roles or responsibilities (initial feature 1) might cause people to overlook other important parts of the pathway. They emphasized the importance of giving everyone an impression of the complete pathway. As an alternative, they suggested that a “Search” function to help users locate specific parts while still seeing the map in full might be more appropriate.

2. Physical toolkit for workshops (initial feature 2)

- P#2 showed strong interest in this feature. She considered this to be one of the most easy-to-use and immediately applicable ideas for collaborative settings, and suggested that it would be even nicer if the toolkit could be provided as a Visio template file to make it customizable and printed by users themselves.
- However, P#6 and P#7 questioned its practicality, suggesting that post-workshop support tools would be more beneficial.
    - While P#6 and P#7 agreed it was a nice idea, they doubted its added value. In practice, they shared that workshops move quickly and involve continuous input, so “you might have no time to switch between these tools”, such as colored post-its.
    - Currently, they are "working well without any pre-defined toolkit". During the workshop, people continuously input in various aspects and at different levels of detail. The meeting host will try to record and note down the main points. If any important details are missed, they will contact the relevant people via email after the workshop.
    - During the discussion, P#6 and P#7 proposed an alternative direction: instead of focusing on tools during the workshop, the design could provide post-workshop support to help the Metro Map manager organize and process collected input (e.g., recordings or annotations). This might deliver more meaningful value.

3. Collaboration and communication (initial feature 3 and 4)

- P#6 and P#7 showed strong interest in online commenting for collecting feedbacks from map contributors. While P#2 said that it might not add many value to her work, she still agreed that it would be a core and necessary feature for other users.

- Instead of converting selected map segments into paragraphs, all participants preferred selective export of map sections to images, which would help a lot for other usage scenarios of Metro Maps (e.g. present maps in presentations, articles, slides or websites).

4. Interaction features (initial feature 5 and 8)

- All participants gave positive feedback on the automatic color-matching feature (initial feature 5) and strongly agreed that it would add to the efficiency of using the tool.
- All participants supported the idea of expanding/collapsing map content (initial feature 8), but with different expectations: P#6 and P#7 viewed it as a convenient feature for healthcare professionals to includ information as detailed as possible when keeping a clear over view of the structure of the map; P#1 focused more on its potential for presentation use since it could offer a simplified view of the map, which adds value for the clarity of information in map.

5. Data integration and contextualization (initial feature 6)

- All three participants showed strong interest in linking data source(s) to maps and expressed that this feature would be very useful. P#2 saw this feature as her most desirable feature, as it could directly support her current work flow and research; P#6 and P#7 emphasized that the meaning of data varies by stakeholder type and context, so it would be nice to leave a space for users to clarify the meaning of data.

6. Map comparison and measurement comparison (initial feature 7)

- Regarding comparing the structure of two maps, all participants preferred splitting the interface for side-by-side comparison over overlaying one map on another.
- About computing and comparing the differences between measurements (data) in two maps, P#2 particularly appreciated its potential to reduce the manual effort required in before-and-after comparison scenarios. However, P#6 and P#7 felt that this feature would not be very helpful for them. According to P#6, this might lead users to focus too much on numbers rather than on the structural or qualitative differences between pathways.

Possible iteration directions for initial features

According to participants' feedback and our discussions during the co-creation workshops, several possible iteration directions for the initial features were raised out. These possible directions can provide guidance during the iteration and selection of the initial features, enabling the features in the final concept to align more closely with the actual needs of the users.

1. **Iterate "Filter" feature to "Search" feature (initial feature 1):** The initial "Filter" feature focused on filtering the elements in the map according to the "responsible role". However, according to P#6 and P#7, over-filtering of the map could lead to fragmented understanding. After discussion, a "Search" feature to help users locate specific parts would be more appropriate since users could search and focus on part of the map while still seeing the map in full sight, which would help them keep an overview on the map.
2. **Provide the in-person workshop toolkit as a digital Visio template file, and make its color and shapes customizable and printable for users (initial feature 2):** According to P#2, this would leave more space for users to customize the toolkit according to their needs.
3. **Selective exporting as images (initial feature 4):** Instead of exporting parts of the map into a paragraph of description, exporting as images in PNG or JPG form would be more useful in other usage scenarios of Metro Maps (e.g. present maps in presentations, articles, slides or websites).
4. **Increase both information and visual clarity of Step/Station-specific data linking and view (initial feature 6)**: It is necessary to leave space for users to clarify data meanings; For the Shape Data side

window in Visio, sort and visually group data items by their properties or using frequency would be more user-friendly.

5. **Compare two maps by side-by-side view instead of overlaying view (initial feature 7):** When comparing the structure and layout of two maps, split the interface of Visio app for the maps for a side-by-side comparison instead of overlaying one map onto another since the latter way would add to the visual complexity.

Based on all the feedback from participants regarding each feature and considering the difficulty to implement each feature into Visio environment, I created a C-Box using "Desirability (of participants)" and "Difficulty to implement (the feature)" as the evaluation criteria. The results are shown in the Figure 20 below.

Among them, initial features 3 and 5 are highly desirable for participants and relatively easy to implement. Feature 6 is the most desirable for the participants, although there would be some difficulty in implementation. These three features may be considered as the core features in the final concept and implemented in the Minimum Viable Product (MVP) prototype of final design. Initial features 4, 7, and the iterative direction "Search feature" proposed in the discussion (see section Possible iteration directions for initial features for more details) have an appropriate level of expectation and difficulty in implementation, however, they are not the most closely related parts to the design goals. Therefore, they may be regarded as extended features in the final concept. Initial features 1, 2, and 8 may only be discussed briefly as recommendations or future works due to discouragement from the participants, difficulty in implementation, or not being within the design scope.

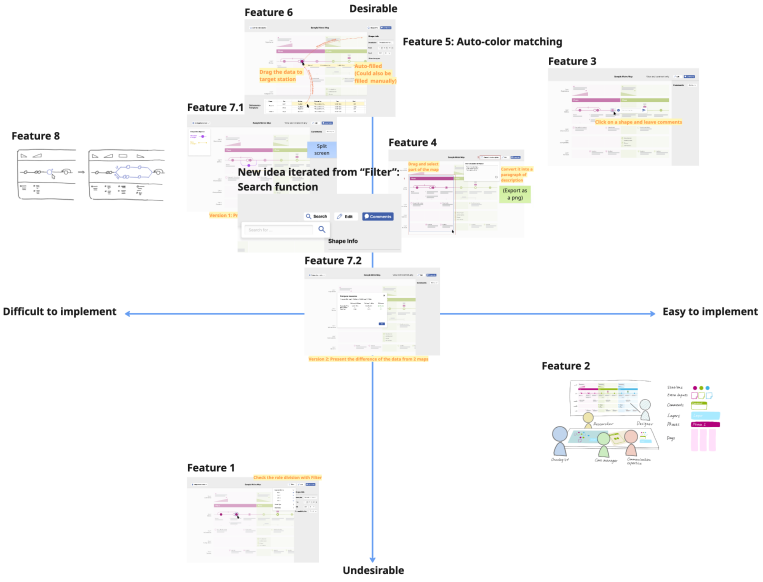


Figure 20. The result of the C-Box.

Based on all the analysis above, I aligned the iterated initial features (if there was an iteration direction) with the design criteria to further evaluate and confirm whether these features met the design criteria, and verified their feasibility in Visio and sought confirmation from a Visio expert, who is David Park in bVisual company, contacted with the help from Panton. Combining the feedback from the co-creation session participants, the alignment with design criteria, and the feasibility in Visio, I made a judgment on whether each feature could be included as a feature in the final design concept; if yes, whether it would be a core feature or an extended feature, and whether it would appear in the MVP prototype of the final concept. The results were summarized in the following Table 2.

Among the nine features (eight initial features and one new feature), features 3, 5, and 6 would be included as the core features of the final concept and implemented in the MVP prototype; features 4, 7, and the new feature "Search" would be included as the extended features of the final concept; features 2 and 8 would be discussed as recommendations, while initial feature 1 would be excluded from the final concept.

Features	User response	Iteration direction according to participants	Design criteria alignment	Feasibility in Visio	Final design potential	Priority for final design concept
1. Filter by Role/Responsibility	❌ Negative (seen as potentially harmful)	Change it to a "Search" function.	❌Conflicts with A due to fragmenting overview clarity	⚠ ! Technically possible but contextually problematic.	❌ Should be reconsidered; It is suggested to replace "filter" with "search" to avoid isolation of information.	Excluded
New idea iterated from "Filter": Search feature	✅ Positive	/	A, C, D	⚠ Medium – would require additional scripting and custom UI.	✅ Promising option	Included as extended feature
2. In-person workshop toolkit	⚠ Mixed	(If applied) Offer a Visio template to users for self-defining and printing.	E	✅ Feasible via pre-defined template set up	⚠ Since the final concept should focus on the digital part of Metro Mapping tool design, this feature could be a future work.	Included as future work
3. Online commenting & contribution	✅ Positive	/	A, E	✅ Feasible via the online version of Visio	✅ Strong candidate, build into MVP	Included as core feature
4. Selective exporting as narrative documentation	✅ Positive about the selective exporting	Export as PNG instead of a paragraph of description, which could be used in more types of contexts.	F	⚠ Medium - need to select and copy the target part, paste on another page and export as PNG or paste into PowerPoint as PNG.	✅ Promising option, could be an extended feature	Included as extended feature
5. Automatic color matching	✅ Positive (all participants interested)	/	D	✅ Feasible via Shape Data Sheet editing.	✅ Strong candidate, build into MVP	Included as basic feature
6. Step/Station-specific data linking and view	✅ Positive (all participants emphasized)	Leave space for users to clarify data meanings. For the Shape Data side window in Visio, sort and visually group data items by their using frequency.	C, D	✅ Feasible via Shape Data in Visio	✅ Strong candidate, build into MVP	Included as core feature
7. Before-After Measurement Comparison	⚠ Mixed (preferred by researcher/disliked by designers due to their using goal)	/	B, C	⚠ Medium – highly related to **Feature 3**, would require additional scripting/custom UI.	✅ Promising option, since it is preferred and liked by a specific type of user	Included as extended feature
8. Expand/Collapse View	✅ Positive (seen as useful for professionals)	/	B, D	⚠ ! Low - Feasible with containers, but very complex for both developer and user.	⚠ Nice but due to Visio feasibility, could be future work	Included as future work

Table 2. The result of whether each feature could be included as a feature in the final design concept.

5.4 Summary of design exploration

In the "design exploration" phase, I investigated from which aspects and in what ways I could optimize the user experience based on the existing Metro Mapping tool. I started by summarizing the user stories of three types of core Metro Mapping team members. Based on their purposes, processes, and preferences for using the tool, I brainstormed a series of ideas and categorized them as initial features. These features were discussed and iterated during co-creation sessions with the target users, and eventually were refined and used as the foundation for the next chapter.

6. Development of Final Concept

6.1 List of features for developing final concept

After iterating the initial features through co-creation sessions and confirming their feasibility, I compiled a list of features for developing the final concept (see Table 3). The list is divided and prioritized as four parts: basic features, core features, extended features and features for future. Among them, basic features, core features and extended features are included in the final concept, and basic features and core features are built into the functional MVP prototype of the new version of Metro Mapping in Visio. Features for the future have a lower priority and are not part of the final concept. Figure 21 shows the scope of final concept and the MVP prototype, as well as the corresponding features.

- **Basic features:** Compared to the current version of Metro Mapping in Visio, these features can enhance the usability of the new version of the tool at the basic interaction level, and reduce the obstacles encountered when creating, adjusting and maintaining maps. Any user who uses the tool will utilize these features, so they are classified as basic features. They are built into the MVP prototype.
- **Core features:** These features are not absolutely necessary for all users, but they meet the core expectations of both users and Panton for making Metro Mapping more data-enabled and collaborative. They help users process the information in Metro Maps in a more efficient and dynamic way and provide a new collaborative approach. These features are built into the MVP prototype.
- **Extended features:** These features are not required for initial usability, but users highlighted them as useful or expected in co-creation sessions. Bringing them into the scope of final concept can improve user experience by making Metro Mapping in Visio more user-friendly by enhancing efficiency, supporting communication out of Visio and facilitating comparison. These features remain outside the scope of the MVP prototype, but are illustrated in interface mock-ups.
- **Features for future:** Due to the low degree of correlation and compatibility with the design goals and scope of this project mentioned in Chapter 4, these features currently have a lower priority. They are not within the scope of the digital tool or very difficult to implement with the current technology and capabilities of Visio temporarily. However, they could be valuable in the long-term development of Metro Mapping and have the potential to be further explored in the future iteration. These features will be discussed here and in Chapter 8.

Categories	Features
Basic feature	A pre-built blank template
Basic feature	Drag and drop station placement
Basic feature	Pre-built and selectable Station type and color
Basic feature	Adjustable and arrangeable Phases and Layers
Basic feature	Automatic Day column generating
Basic feature	Detailed information editing of Stations
Basic feature	Map exporting
Core feature	Station-specific data linking
Core feature	Online commenting and contribution
Extended feature	Search function
Extended feature	Selective export to image
Extended feature	Before–After measurement comparison
Features for future	In-person workshop toolkit
Features for future	Expand/Collapse view

Table 3. A list of features for developing the final concept

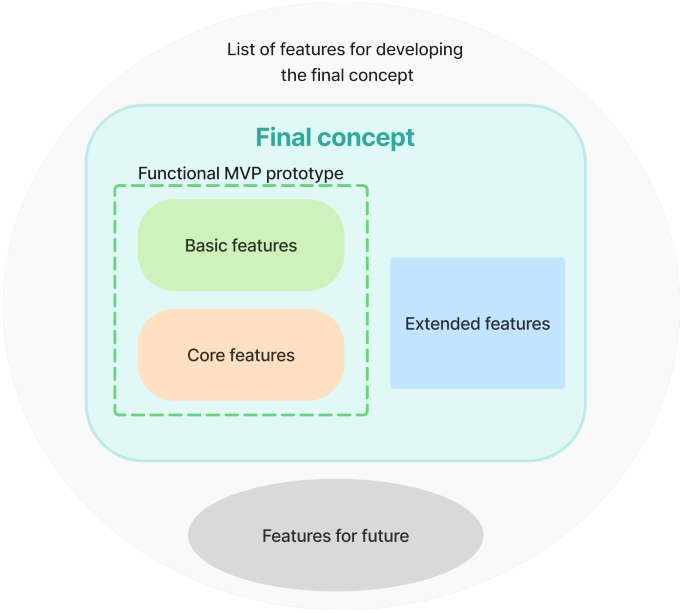


Figure 21. The scope of final concept and the MVP prototype as well as the corresponding features.

Basic features, core features and extended features will be described in detail in Chapter 7. The concepts of two features for future are briefly introduced below.

Expand/Collapse View for healthcare professionals

It supports expanding/collapsing branches or loops in a Metro Map. By choosing a part of the map and clicking on the “Fold” button, users can fold this part of the map into a nod and expand it later.

Why it remains in recommendation: Although it allows the map to be structured and navigated more flexibly, it requires advanced scripting in Visio and may change user workflows significantly, so it is not realistic for MVP and final concept but valuable for future iterations.

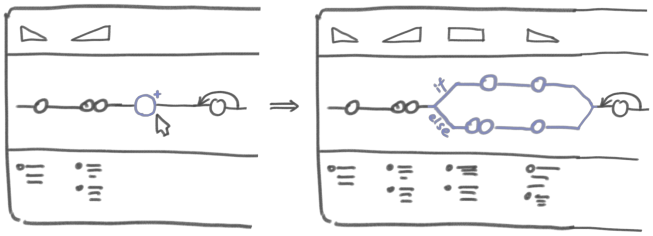


Figure 22. A sketch for feature: Expand/Collapse View for healthcare professionals.

Physical In-Person Workshop Toolkit

It is a digital Visio file including pre-defined shapes of sticky notes, commenting cards, Phase and Day rectangles and Metro stations, whose color is pre-defined in Metro Mapping official color and could be self-defined and printed out by users as physical toolkits for in-person workshops. Through color coding and shape matching, it can guide contributors to think in accordance with the structure of Metro Mapping, and also help the project coordinator or map manager synchronize the input collected in the in-person workshop onto the digital map more easily.

Why it remains in recommendation: This feature support in-person collaboration of the core Metro Mapping team. However, for the final concept, it is necessary to focus on the use experience of the digital part in Microsoft Visio. This feature is out of the scope of the project and may change user workflows significantly, so it is not for the final concept but valuable for future iterations.

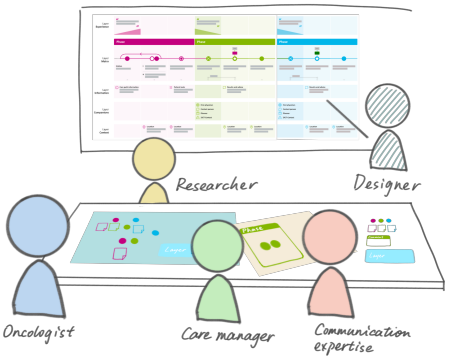


Figure 23. A sketch for feature: Physical In-Person Workshop Toolkit.

6.2 MVP prototype building

After defining the basic features and core features to be built in the MVP prototype for the new version of Metro Mapping, I began to develop the MVP prototype with full access to all the functions of Visio as permitted by Visio Plan2. The MVP prototype is the combination of **a Visio template for Metro Map** and **an Excel template for information collecting and managing for Station** in the map. In the Visio template, the healthcare pathway is visualized in Metro Map with the combination of Phases, Layers, Stations referring to steps in the pathway, addition information and so on. In the Excel template, the detailed information for all the Stations in one map is collected and arranged.

The Metro Net was not included within the scope of the MVP prototype and final concept since it has similar but simpler structure comparing to the Metro Map and can be developed in future works with the adjusted components from the Metro Map. With the guidance from Visio expert David Park, I gradually attempted and built the MVP prototype in the following steps (see Figure 24).

The development began with establishing basic visual and functional settings, including official color schemes and a customized Ribbon interface. The structure frame of a Metro Map was then built using Visio's "Container" and "Swimlane" functionalities to represent Phases and Layers. The key component "Station" was developed by integrating all station types into one component and enabling auto-coloring, data binding, and layout control. The Excel data template allowing for detailed data editing and visualization of station-specific information was also defined and tested. After that, external data linking was implemented to synchronize Excel-based data source with the map in Visio. Finally, online commenting and collaboration feature was tested to support shared inputting. These steps resulted in an MVP that supports both basic features (such as Station information editing and automatic color matching) and core functionalities (station-specific data linking and online contribution).

The specific technical details on how to carry out these steps in Visio are complex and interesting, but they are not the focus of the final design concept. Therefore, I will not describe the development-related technical operations and details in Visio here. The completed MVP prototype can be seen in Chapter 7.1.

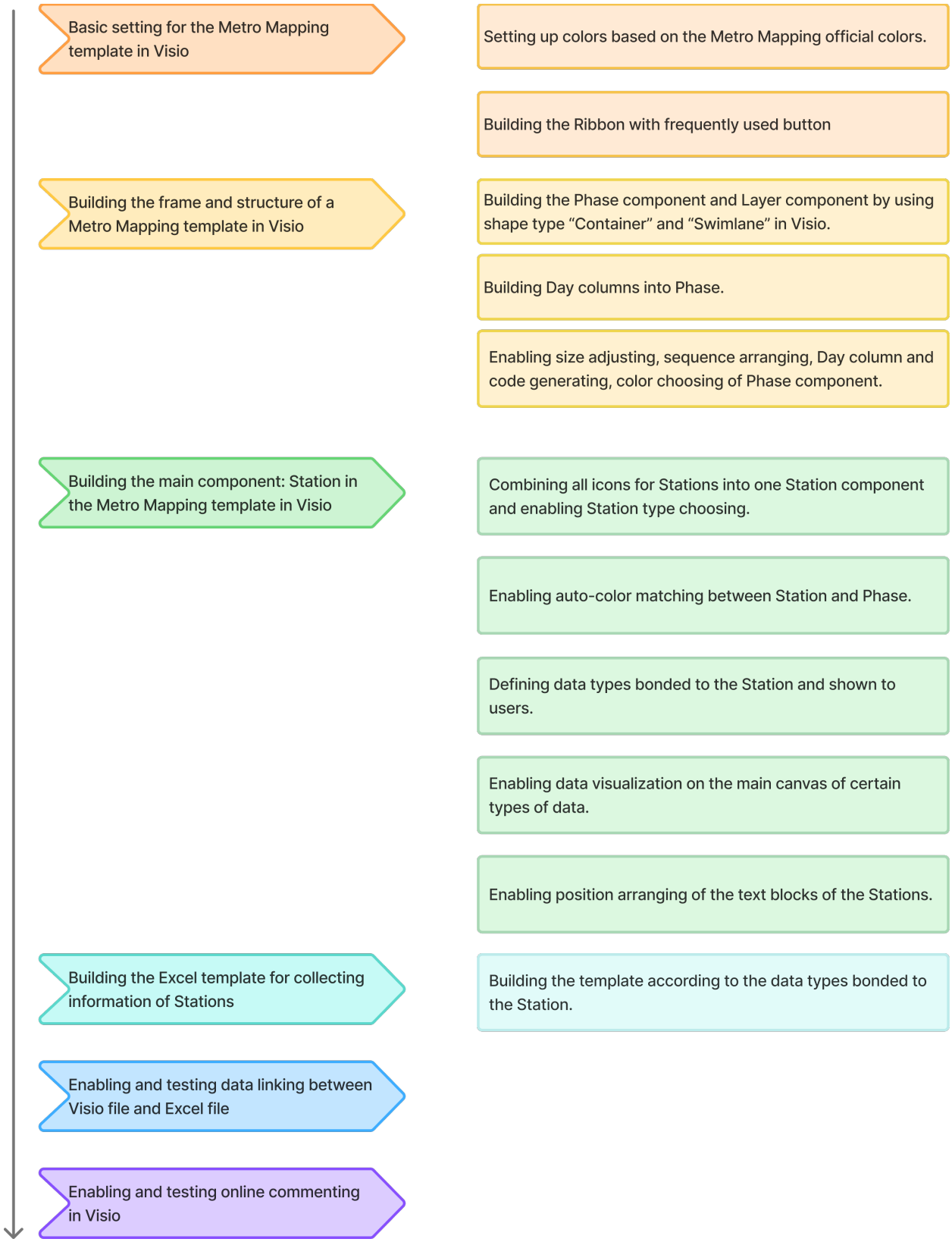


Figure 24. Steps for building the MVP template

6.3 Extended features building

I created interface mockups for each extended feature. The color scheme and layout of the interface referred to the online version of Visio (see Figure 25) and were simplified to highlight the interaction points and processes related to the features (see Figure 26 for an example). The focus of these mockups is to illustrate and indicate how the extended features can be used. Therefore, the color scheme, interface complexity, and design language of the interface will not be the primary considerations.

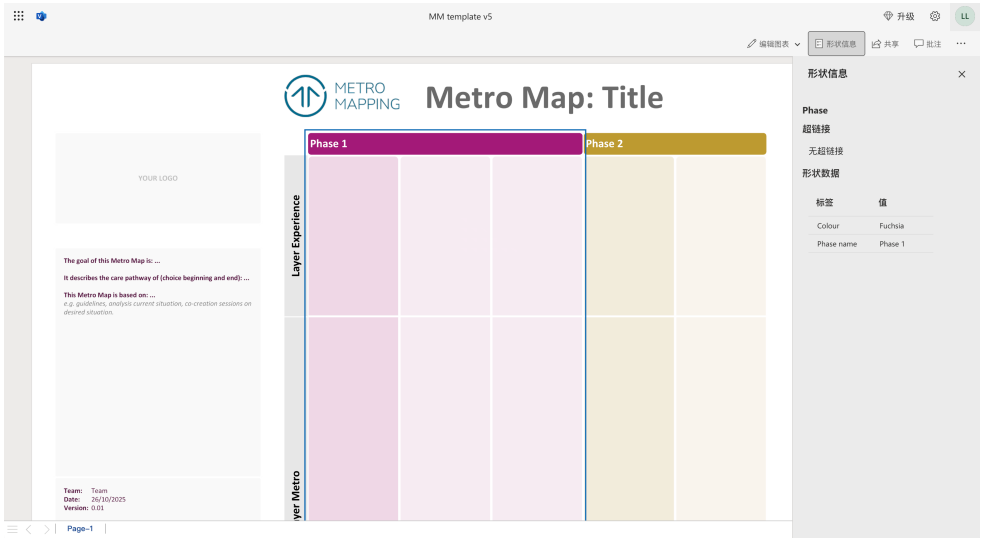


Figure 25. A screenshot for the interface of the online version of Visio.

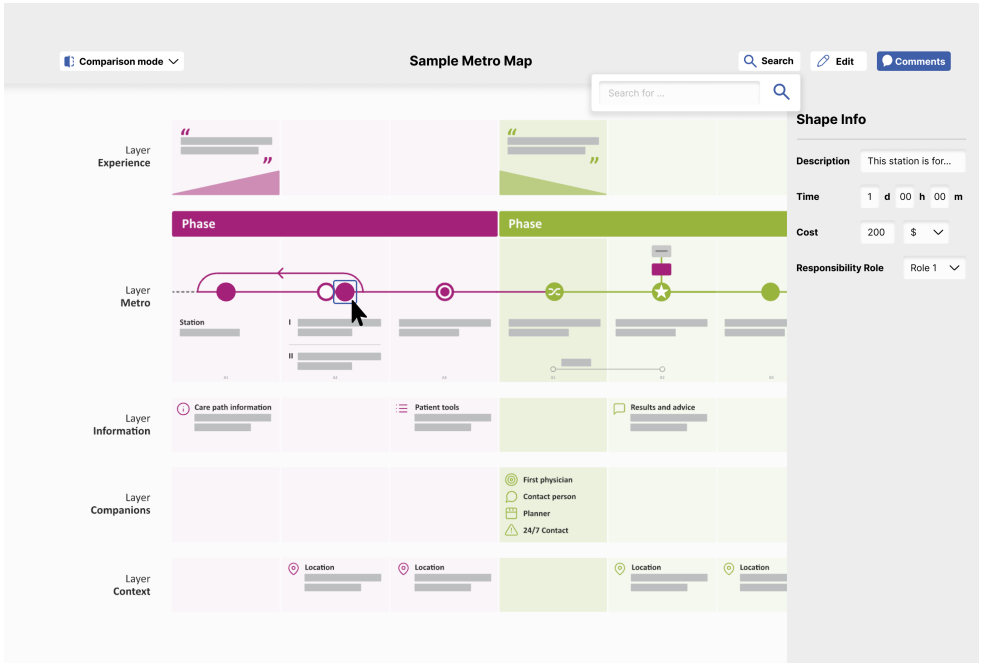


Figure 26. An example for the interface mockup draft for extended features.

7. Final Concept

7.1 Final concept

This chapter presents the final concept for Metro Mapping in Visio. It shows how the tool can become more intuitive, collaborative, and data enabled, and demonstrates its potential through a functional MVP prototype and interface mockups. The goal of this final concept is to establish the possible development and iteration directions for the next-generation Metro Mapping in Visio based on the needs and expectations of the core Metro Mapping team, and verify its feasibility.

The design aims to enable users to work within the Visio environment in an intuitive, collaborative, and data enabled way, and focuses on the features that are most relevant to that goal. All features are derived from earlier research and co-creation insights and refined based on user feedback. Basic features and core features are built into a functional MVP prototype in Visio, and extended features remain in concept shown by interface layout illustration. Features will be explained further in next sections.

An overview of the final concept and MVP prototype

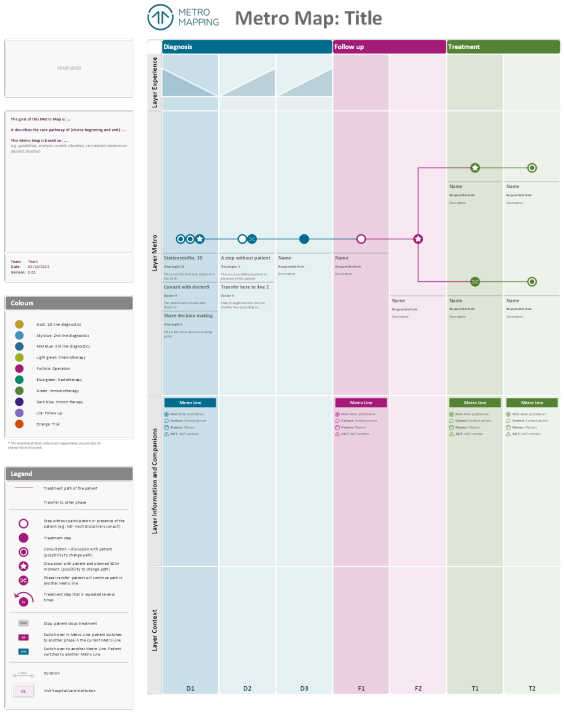


Figure 27. A sample Metro Map built with the MVP prototype in Visio

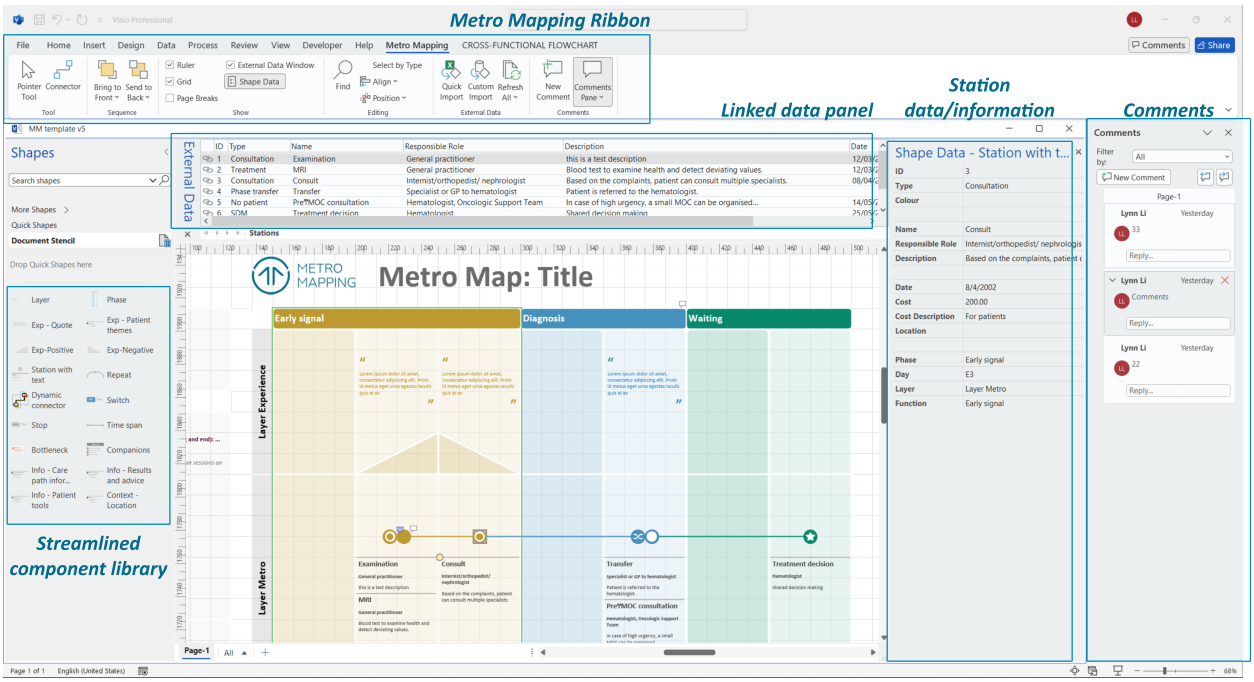


Figure 28. The full interface of the MVP prototype in Visio and a sample Metro Map in it.

A video recording of the functional showcase of the prototype can be found here:

https://drive.google.com/file/d/1r2JcVL0_b9GdCW6rRazCY3mIDxbs6sv2/view?usp=drive_link

Chosen features in final concept

As shown in Table 4 below, a list of chosen features for the final concept is created. Features are divided into three categories: basic features, core features and extended features.

- Basic features: These features are essential for building a Metro Map in Visio and ensure the usability of Metro Mapping tool and reduce current frictions in creating, adjusting and maintaining maps. They make the tool more usable and support the basic workflow of all Metro Mapping team roles. These features are built into the MVP prototype.
- Core features: These features are essential expectations about making Metro Mapping more data-enabled and collaborative from users, supporting working with data in Metro Maps in a dynamic way and collaborating in a more effective manner. These features are built into the MVP prototype.
- Extended features: These features are not strictly required for initial usability but were highlighted as useful by participants in co-creation sessions. They make Metro Mapping in Visio a more user-friendly tool by supporting communication, facilitating comparison and reflection, and enhancing efficiency. These features remain outside the scope of the MVP prototype, but are illustrated in interface mock-ups.

Categories	Features
Basic feature	A pre-built blank template
Basic feature	Drag and drop station placement
Basic feature	Pre-built and selectable Station type and color
Basic feature	Adjustable and arrangeable Phases and Layers
Basic feature	Automatic Day column generating

Basic feature	Detailed information editing of Stations
Basic feature	Map exporting
Core feature	Station-specific data linking
Core feature	Online commenting and contribution
Extended feature	Search function
Extended feature	Selective export to image
Extended feature	Before–After measurement comparison

Table 4. A list of chosen features for the final concept.

In this section, I will further explain features shown in the table and why they are important. Basic features and core features will be explained through how they work in MVP prototype, and extended features will be explained by interface layout illustration.

Basic features

A pre-built blank template

A Visio template is provided as the basic for users to build their Metro Maps. In the blank template, there will be places for the basic information of the map, such as the title of the map, users' logo, the goal of the map, further explanation and information, abbreviations and legends.

Why it is important: Metro Maps can be used in different contexts for different goals from analyzing an existing healthcare pathway to redesigning a pathway. Without clearly defining the goal and stating the basic explanation and information of the map, there might be misalignment among contributors of the map.

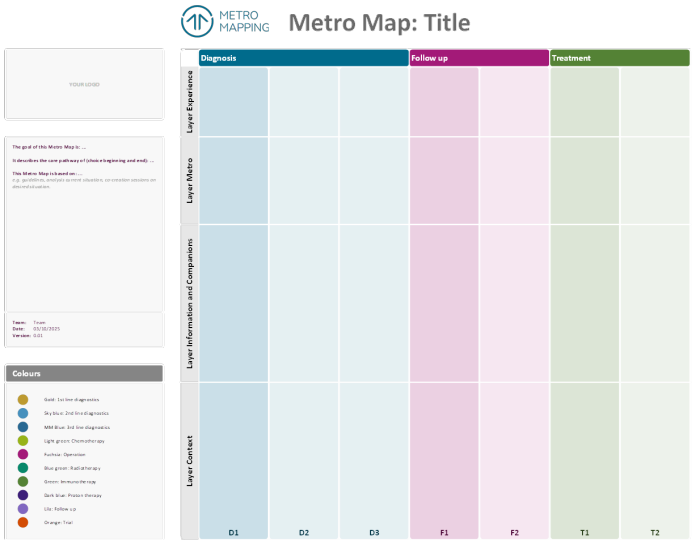


Figure 29. A pre-built blank template

Drag and drop station placement

Users can drag a shape (for example, a Station) from the "Shapes" panel on the left side and drop it into the main canvas. With the guide of "Grids" in grey, users can align and snap shapes to the grids or to each other easily. Shapes in the canvas can be moved and repositioned.

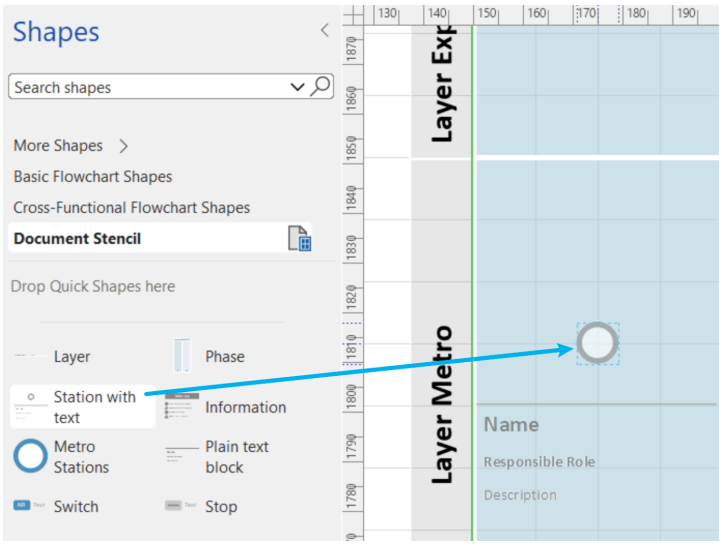


Figure 30. Drag and drop station placement

Pre-built and selectable Station type and color

All types of Stations are combined into one shape. The type and color of each Station can be defined in the pop-up window while dragging and dropping it into the canvas, and can be changed later in the "Shape Data" panel by using pre-built drop-down lists.

Moreover, the color of Stations **can be automatically matched** to the Phase and Day columns that they are placed in.

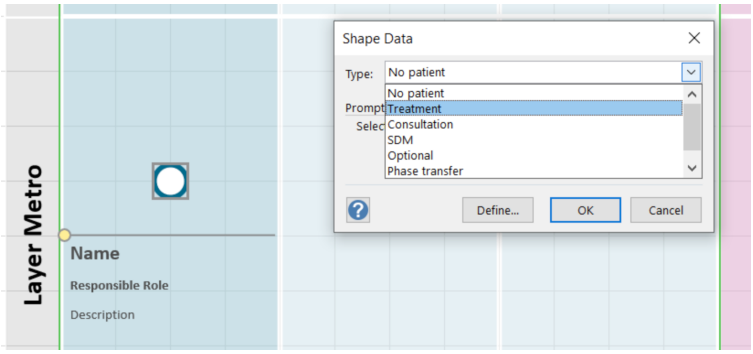


Figure 31. Selecting the Station type while dropping it into canvas.

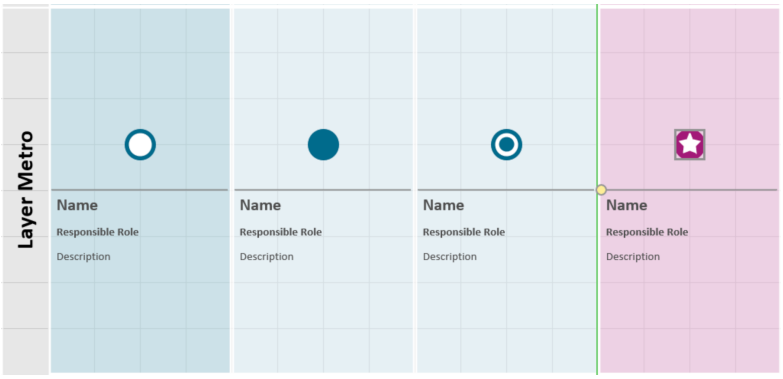


Figure 32. Automatic color matching of Stations according to Phases.

Why these two features are important: Users, especially non-designers, need to be able to build and adjust Metro Maps without experienced design skills. These two features reduce the obstacles for users to start building Metro Maps. They enable users to quickly place and adjust elements and maintain visual consistency in a simple way, making the tool more intuitive.

Adjustable and arrangeable Phases and Layers

By dragging and dropping Phases and Layers from the “Shapes” panel into canvas, users can add or remove phases and layers. The sequence of phases and layers can be easily arranged by dragging to different positions, and the elements contained in the same phase or layer can be adjusted together when keeping the position in the current phase or layer. Furthermore, the scale of them can be adjusted by dragging the boundary line.

Why it is important: Creating and adjusting a structured Metro Map requires the flexibility of repositioning elements in an easy way. Users reported that rearranging numbers of elements manually in Visio when inserting or removing a Phase in current Metro Mapping is very time consuming. Adjustable and arrangeable Phases and Layers offers a way of automatically grouping and adjusting the elements that belong to the same category, saving time and effort for users.

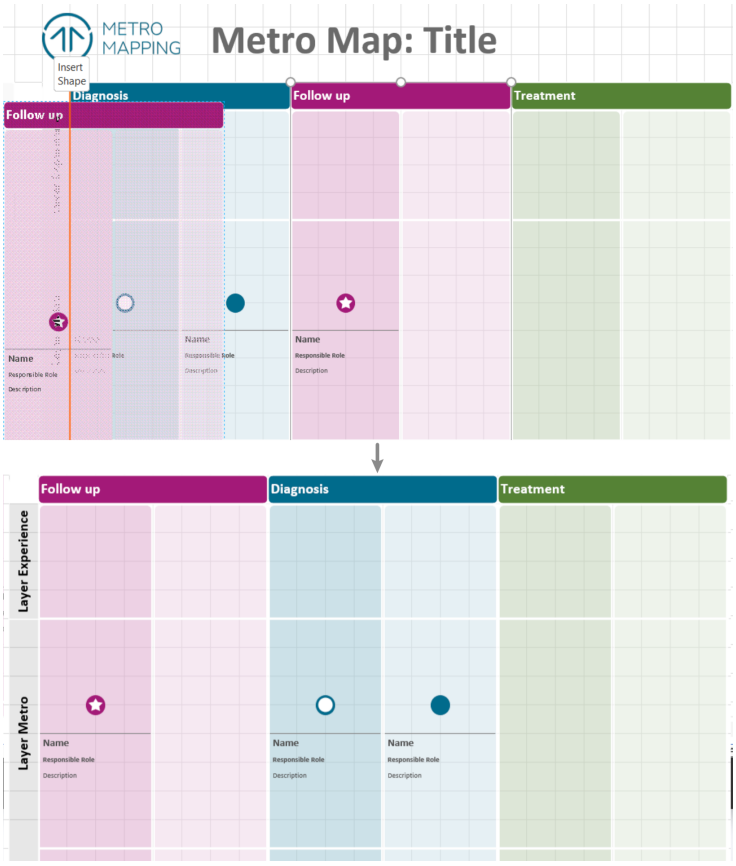


Figure 33. Arrange Phases.

Automatic Day column generating

By dragging the right boundary line of phases, Day columns within the current phase can be automatically generated. At the bottom of each column, there will be an automatically generated unique column code consisting

of the first letter of the current Phase's name and a sequential number, which helps users to number and distinguish them. When the color of the Phase is changed, the color of the columns will automatically synchronize to match the current Phase's color.

Why it is important: Users need to identify the position and sequence of Days with steps to have a clear control of the pathway. However, currently they have to spend lots of time on setting up and numbering Days manually. This feature helps them to finish this step in seconds, which increases working efficiency significantly.

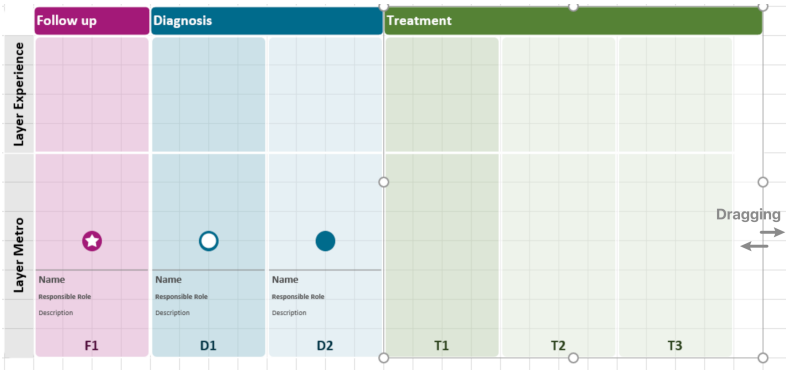


Figure 34. Automatic Day column and column code generating

Detailed information editing of Stations

Users can update the details of each Station by clicking on a Station, checking the information presented in “Shape Data” panel on the right side, and updating it if needed. The data types are the top seven in Table 1 in Chapter 3.6.

Why it is important: A Station, representing a step in a healthcare pathway, always includes details about what the step is for, who takes the responsibility, when it happens, how much it costs and so on. Users expressed the expectation of the ability to link, store and present corresponding information to each step to have control of the details, instead of working in a flat document.

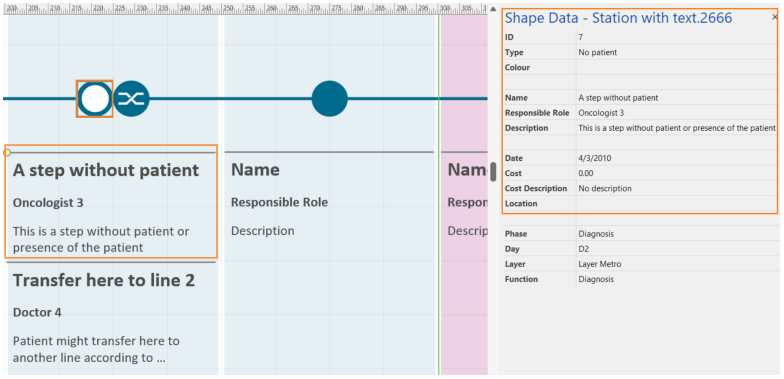


Figure 35. Detailed information linked to a Station

Core features

Station-specific data linking

Closely related to feature “**Detailed information editing of Stations**”, it allows assigning custom data fields to Stations and providing annotation fields for users to define what the data means in context.

It also allows the Metro Map to be connected with an external data source, which is a pre-built Excel template in the MVP prototype, and enables the map to automatically read and refresh data from the external data source. Users can link data from an Excel file to Stations in the map by simply dragging a line of data and dropping it onto the target Station.

Why it is important: Users reported that data relevant to pathways lives in separate dashboards and is only annotated manually on Metro Maps at the moment. This makes the map static and slows down attempts to use it for decision-making. With data linked in context, the map can further support reflection, help compare before–after states and improve communication with stakeholders such as insurers or managers with data as supporting evidence. Batch management, modification and calculation of data related to Stations can be done in Excel, which has greater potential compared to the current manual modification of data in plain text. With this feature, Metro Mapping can become a living resource for reflection and decision-making.

ID	Type	Name	Responsible Role	Description	Date	Cost	Location	Cost Description
1	Consultation	StationtestNo. 10	Oncologist 22	This is not the first test sta	01/01/2001	120000	Amsterdam	This is a cost for me
2	Consultation	Consult with doctor9	Doctor 9	The patient will consult wil	14/09/2033	100	TUD	The cost is for patients
3	SDM	Share decision making	Oncologist 2	This is the share decision	08/12/2009	400	TUD	The cost is for patients
4	Optional	An optional step for the p	Doctor 2	* This is an optional step for patient. * They can choose to take it or not. * Text for testing text for testing text for testing.	12/12/2012	12	Amsterdam	The cost is for hospital
5	Phase transfer	Transfer here to line 2	Doctor 4	Patient might transfer here	12/12/2010		Deventer	The cost is for organization A
6	Repeat	Repeat treatment 1 for 2	times	Patient need to repeat tre	14/12/2010	1400	TUD	The cost is for organization B
7	No patient	A step without patient	Oncologist 3	This is a step without patie	04/03/2010			No description

Figure 36. A sample data source in Excel

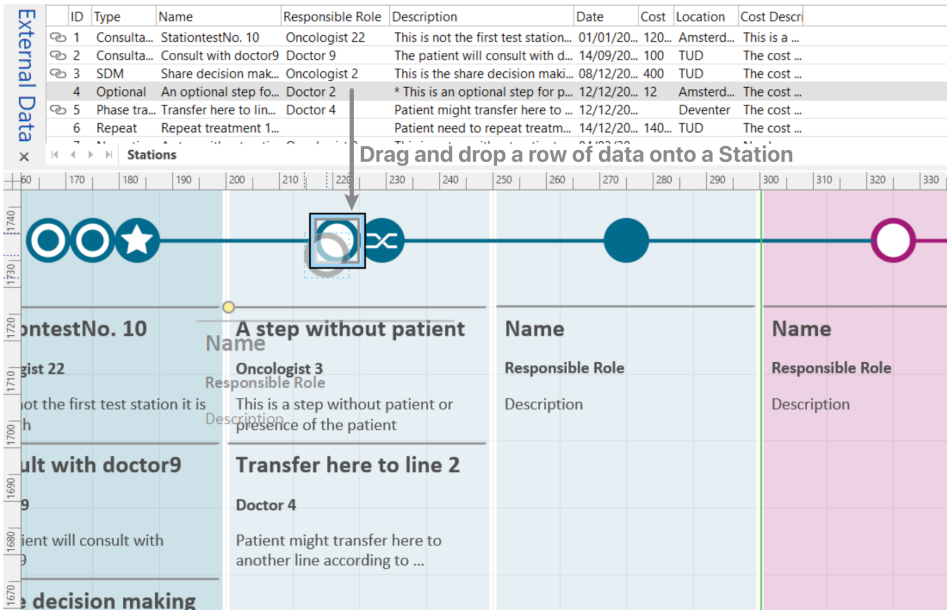


Figure 37. Connecting data from Excel onto a Station in Visio

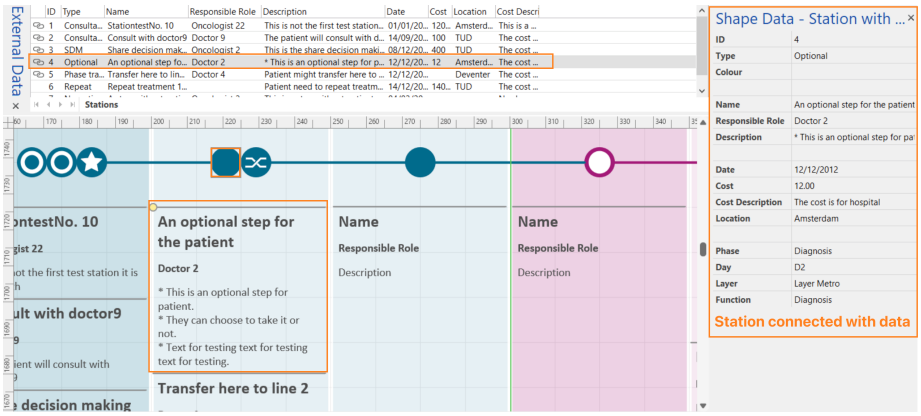


Figure 38. A view of Station connected with data

Online commenting and contribution

The map manager can share the “View and Comment” permission of the map online to other contributors, who can leave comments on specific shapes both synchronously and asynchronously. The map manager can then easily check, manage and sort these comments into the map.

Why it is important: Although Visio already provides an online commenting function, interviews showed that Metro Mapping teams rarely use it. Currently, they often rely on communication in in-person workshops or through emails. A structured commenting feature can enable asynchronous contributions without fragmenting the workflow, which also aligns with hybrid collaboration models. By making online commenting part of the Metro Mapping workflow itself, it becomes a clear channel for feedback: all inputs stay in one place, tied to the right stations or layers, and it is always visible who contributed what. This helps avoid version chaos, lowers the barrier for non-design users to join in, and turns commenting into one of the main ways to keep collaboration transparent and sustainable.

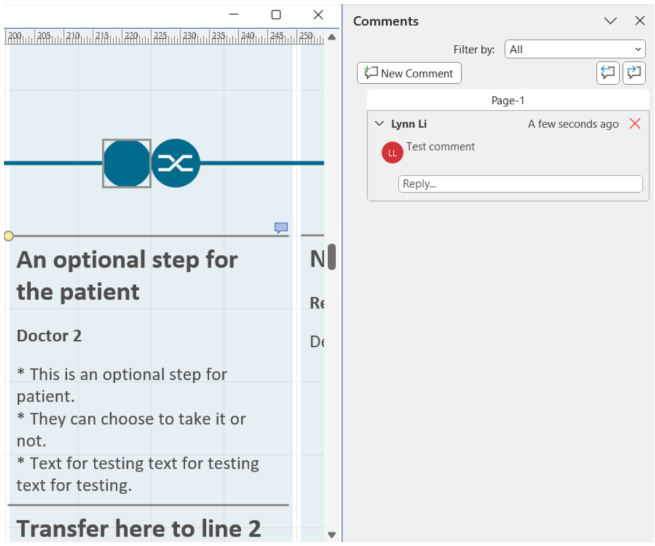


Figure 39. Add a comment on a Station

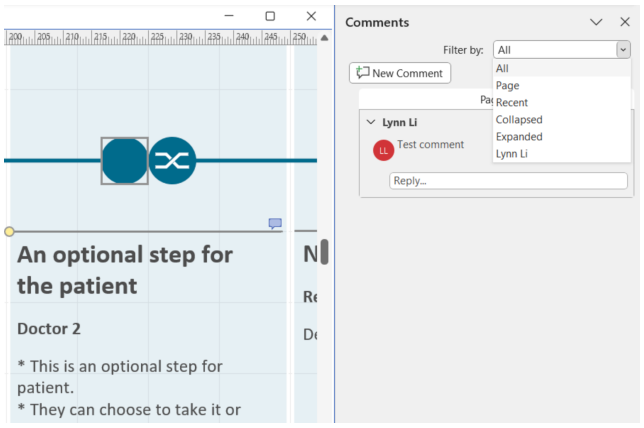


Figure 40. Filter and manage comments

Extended features

Search function

This feature allows users to search for description keywords, responsible role or station name within a map, while keeping the whole map visible.

Why it is important but extended: A Metro Map is usually huge and complex with different types of information, which adds to the complexity for users to find and target on a specific step. Search function improves efficiency and user experience, especially for large Metro Mapping projects, and addresses the challenge of navigating large maps. In collaborative settings, it also helps a new Metro Mapping team member to easily navigate and onboard the map. However, since it would need coding to customize a pop-up window and logic for searching in Visio, it is not included in the MVP prototype to reduce the complexity.

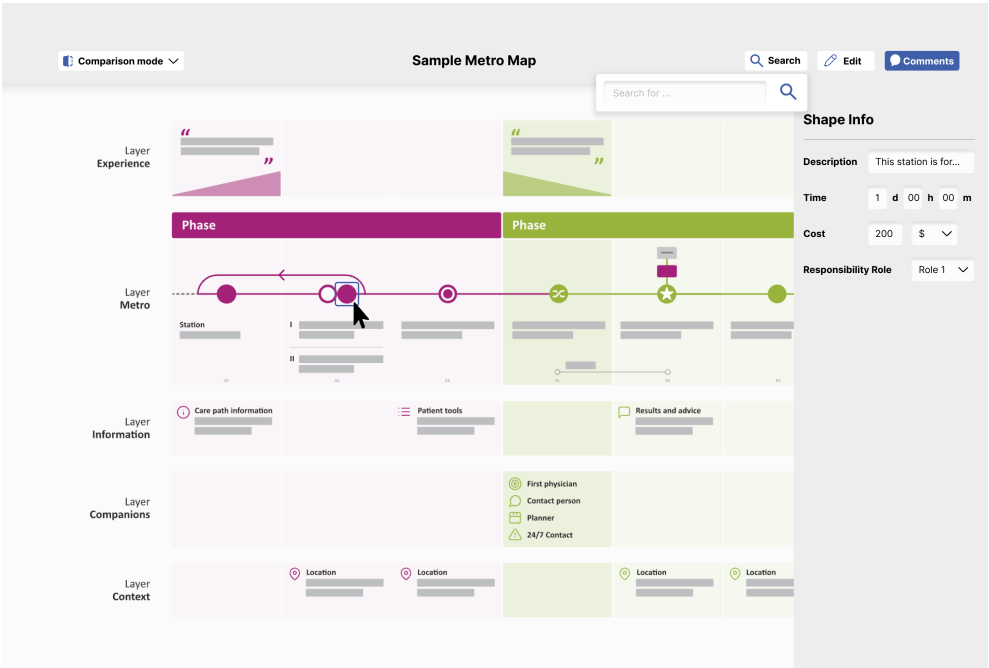


Figure 41. Search function

Selective export to image

Users can select a part of the map and export it in PNG format for use in presentations or stakeholder communication.

Why it is important but extended: Users expressed expectations to present the map to other stakeholders outside core Metro Mapping team, such as patients or insurers. While useful for collaboration and communication across stakeholders, this feature does not directly change how team members collaborate with each other or integrate data.

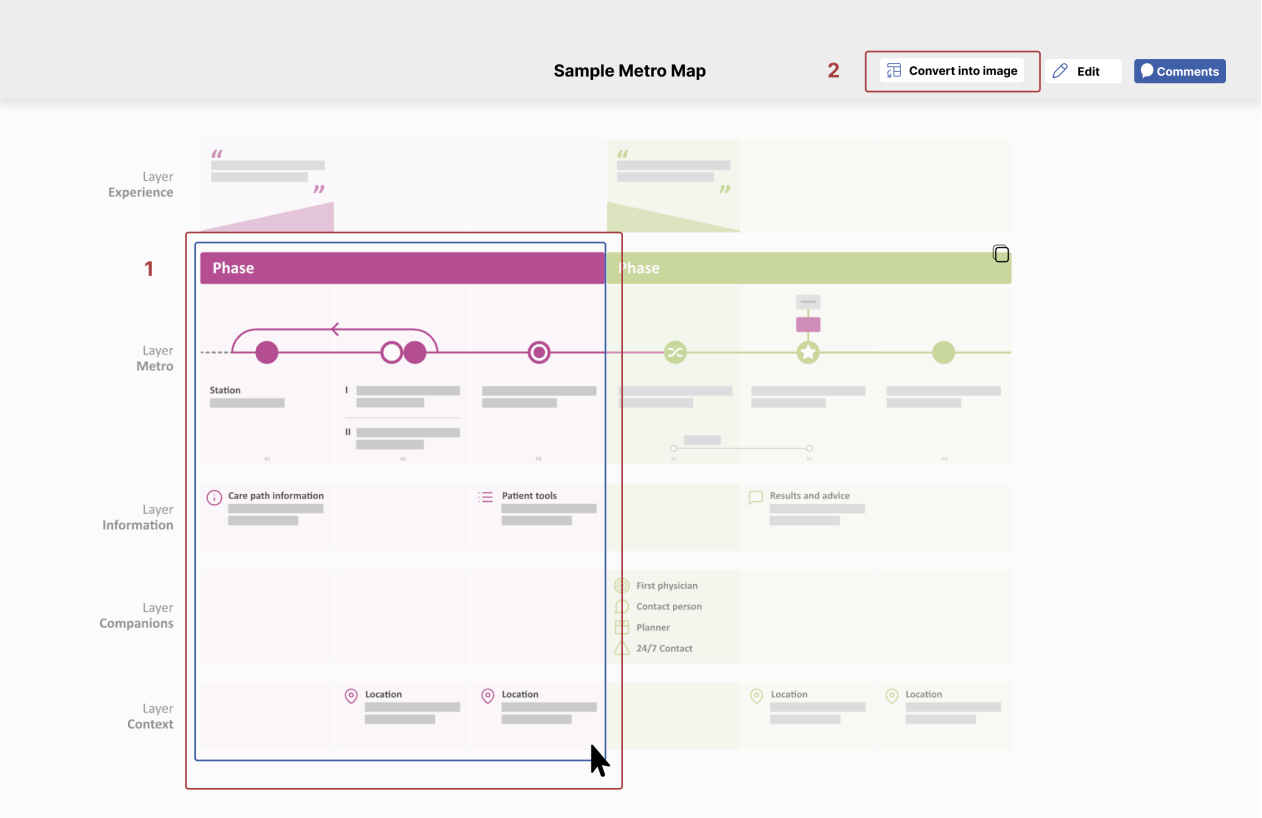


Figure 42. Selective export to image

Before–After map measurement comparison

It allows users to calculate key data differences (such as waiting time for patients, cost of the whole pathway and so on) across two selected maps about the same healthcare pathway, in which one map presents the current pathway, and another shows the pathway after improvement or redesign.

Why it is important but extended: Some users use Metro Map for improving or redesigning a healthcare pathway, during which they need to know the differences between the “as-is” and “to-be” pathway, and to what extent it is improved. Measurement comparison between two maps is very useful for data-driven comparison and reflection by supporting quantitative evaluation. It was not included in the core features because it was an expectation from part of users and an extension of the **Station-specific data linking** feature. However, it is necessary to treat it as an extended feature to ensure the universality of the final concept.

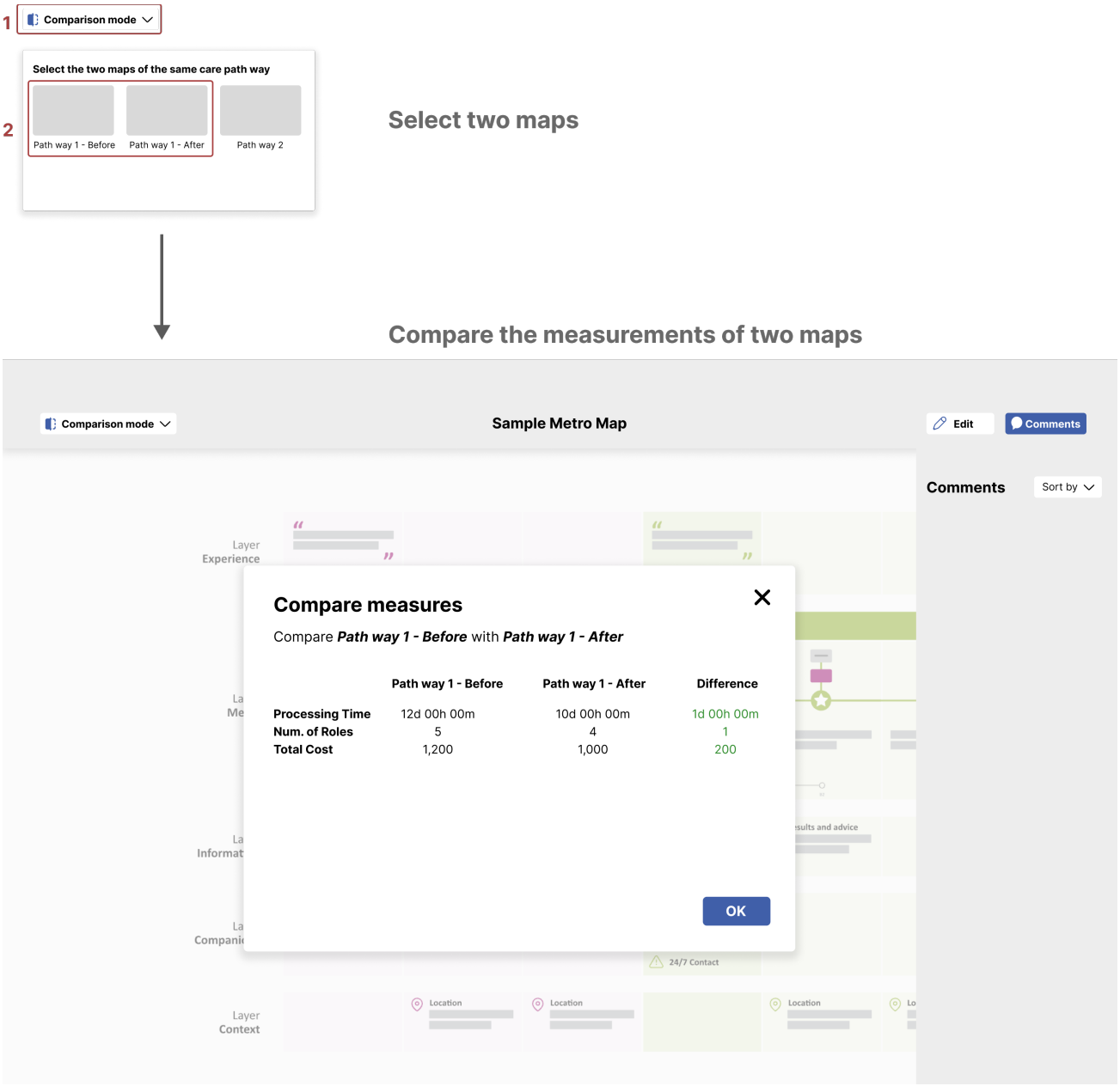


Figure 43. Before–After map measurement comparison

7.2 Before-After user stories

To mirror the user story in Chapter 4.7, I illustrated a before-after view of the map manager using the current Metro Mapping in Visio and the final concept (see Figure 44). The stories highlights where the user experience improves:

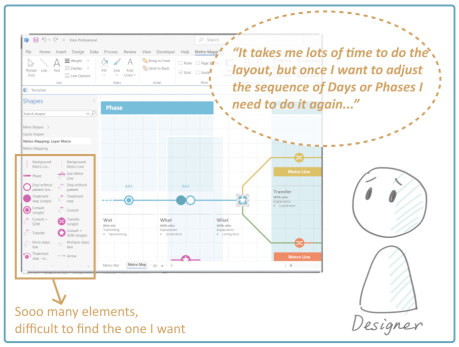
- **Building the map:** the structured template and clearer editing of phases, days, and stations reduce rework and make layout changes faster.
- **Adding and adjusting information:** station-level data linking to an external Excel file allows input and updates with a refresh, instead of copying text into stations one by one.

- **Communicating with stakeholders:** selective export makes it easy to share focused parts of the map with people who do not use Visio.
- **Collaborating during and after workshops:** online commenting enables both synchronous and asynchronous feedback in the map, so input can be reviewed without the manager collecting and updating everything by himself/herself.

These changes reflect the design goal: an intuitive tool that is data enabled and collaborative. The manager spends less time on mechanics and more time on decisions, while contributors can participate in ways that fit their schedules and roles.

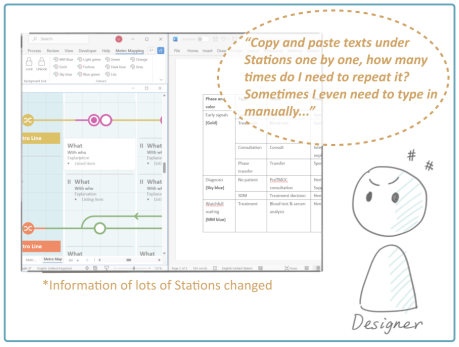
Before

1. Building the map



It takes lots of time and effort to place and structure the components in the map.

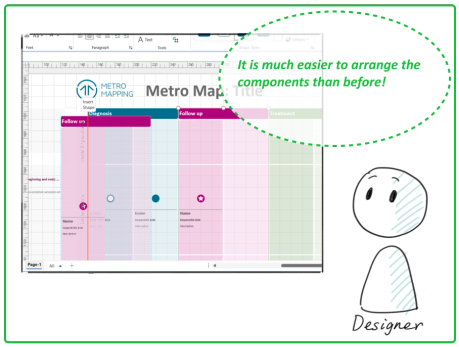
2. Adding and adjusting the information



Without linking to data, all the information and adjustments need to be input manually.

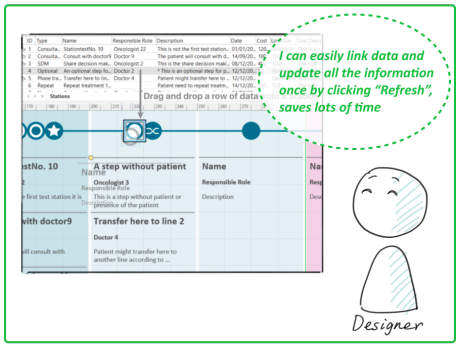
After

1. Building the map



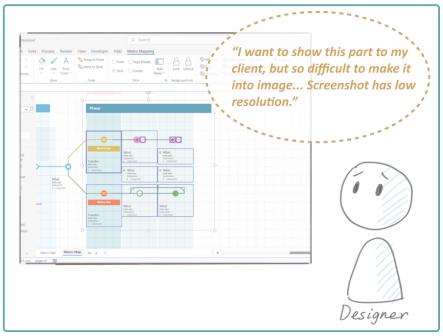
It saves time and effort on doing the layout in the map.

2. Adding and adjusting the information



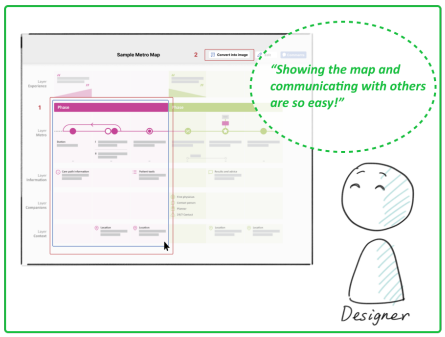
All the Station information can be input easily and updated with one clicking.

3. Trying to communicate and collaborate with stakeholders



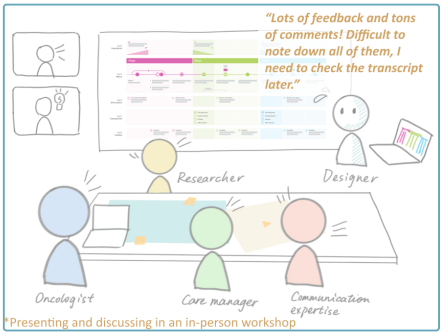
Difficult to present the map to stakeholders who are non-Visio users.

3. Trying to communicate and collaborate with stakeholders

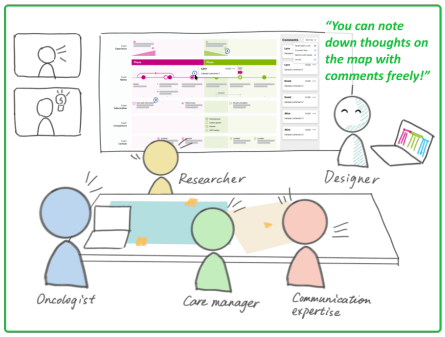


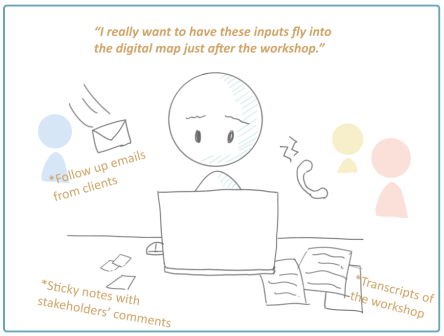
Easy and useful for collaboration and communication across stakeholders.

4. Collaborating during and after the workshop

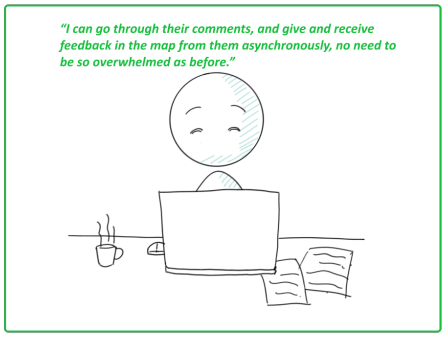


4. Collaborating during and after the workshop





All inputs in collaboration need to be collected and updated into the digital map manually by the map manager.



Collaboration with online commenting can be sync or async, providing an alternative for stakeholders.

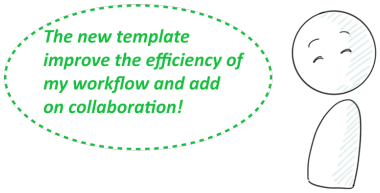


Figure 44. Before-After user stories

7.3 Evaluation

The final concept was evaluated through four online or offline one-to-one sessions with Metro Mapping team members from different organizations, in which P#2 also participated in the earlier interviews and co-creation sessions.

- **Participant #2:** A postdoctoral researcher at Erasmus MC, using Metro Mapping to visualize and analyze pregnancy-related care processes for research purposes.
- **Participant #8 and #9**: Designers at Panton, using Metro Mapping to visualize healthcare pathways for clients from healthcare organizations.
- **Participant #10**: An advisor for value-driven care pathways at Antoni van Leeuwenhoek (AvL).

The evaluation aimed to assess how the overall final concept, including basic and core features made into the MVP prototype and extended features remained in concept, is valued by intended users so that priorities for optimization in the future can be set. Figure 45 is the screenshot of one evaluation session. The evaluation applied two methods described by Van Boeijen et al. (2014): **Product Usability Evaluation**, used to validate the usability of basic features and core features built in the MVP prototype in realistic use, and **Product Concept Evaluation**, used to understand how users value the extended features. The detailed plan of evaluation session can be found in Appendix E.

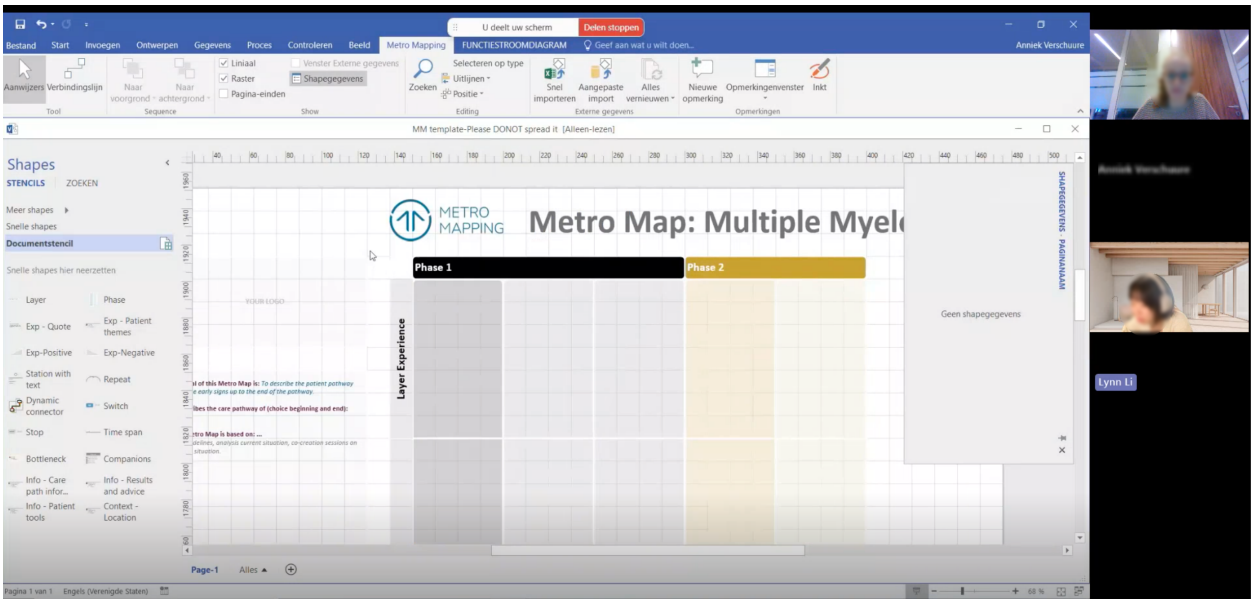


Figure 45. The screenshot of one evaluation session

How the two methods were applied

First, a task-based **Product Usability Evaluation** was run using a blank MVP template with all basic and core features built-in to see if participants can finish the tasks with high success and acceptable speed. Participants performed a scripted scenario that covered structure editing, components placement, data linking and basic online collaboration. The interactions between users and the prototype, the completion status of tasks, the time spent on each task, and the errors that occurred during the sub-session were observed, recorded and analyzed. Pass criteria were set against two hypotheses:

1. Participants achieve at least 80 percent of task success without intervention.

2. The median time to complete the full scenario is under 30 minutes.

Second, a **Product Concept Evaluation** was held to verify the value and clarity of the extended features not within the MVP scope. With explanations and interface mockups, participants reviewed "search", "selective export" and "before–after measurement comparison" features, then provided feedback on usefulness, clarity and priority.

The key outcomes of the evaluation sessions are summarized below with quotes from participants to show their experience and feedback on the final concept.

General feedback

Across sessions, participants expressed a positive attitude and enthusiasm toward the final concept. They thought it would be easier and faster to work with it than their current workflow, and all the participants emphasized that they would like to use the Metro Mapping template developed based on the MVP prototype in practice.

"I would definitely use it… I'm really excited." (P#9)

"I think it can be a big improvement." (P#8)

"Yeah, I will definitely use it because it's way easier." (P#10)

Participants highlighted value of the design concept in three areas:

- It increases work efficiency and ease of use, making it faster to build and adjust Metro Maps compared with current practice.
- It helps collaboration by helping to collect and keep track on the input from contributors of the map.
- It enables and integrates healthcare pathway data into the map in a consistent way.

"It would make it much easier and much quicker to make a Metro Map." (P#9)

"It's way easier, especially when building up the map." (P#10)

"I think that for me, it's of course good if people can comment on it." (P#2)

"I also like linking data with the Excel file. It makes it easy…" (P#10)

Usability evaluation of basic and core features through the MVP prototype

Since all basic and core features were built into the MVP prototype, their evaluation was conducted through testing of the MVP prototype. Based on the records of the number of tasks completed and the total time taken by the participants, all participants met the pass criteria, which were achieving at least 80% task success without intervention and completing the full scenario within 30 minutes. Table 5 shows the percentage of tasks completed and the total time taken by the four participants.

	The percentage of tasks completed by the participant out of 11 tasks	The total time taken by the participant (in minutes)
P#2	100%	26 mins
P#8	81.82%	22 mins
P#9	81.82%	16 mins
P#10	90.91%	25 mins

Table 5. The percentage of tasks completed and the total time taken by the four participants.

Top strengths: structure editing, elements building and data linking

In the evaluation, several strengths of the prototype that enabled participants progressing smoothly were observed:

- **Phase and Layer editing was understandable and workable:** Participants inserted and reordered Phases and Layers smoothly and described the structure as clear and easy to change, which indicates that the template's core frame supports quick layout operations.

  "I think it's very clear and easy to change them (Phase and Layers)." (P#9)

- **Station placement and general editing proceeded fluently:** Participants were able to place Stations, make selections, and edit detailed information without getting stuck, which indicates that the creating and management of key elements fits existing mental models of intended users.

- **Data linking is workable and convenient for information updating when an Excel template file for Station information is provided:** Participants reported that linking pathway data at the Station level is feasible in practice with an Excel template file for Stations, which would make it noticeably easier when lots of information need to be adjusted since they can be updated to the Metro Map by refreshing all the data at once. This lowers effort and helps users proceed with further data step such as calculate the sum of a certain type of data for the whole map.

  "I also like linking data with the Excel file. It makes it easy…" (P#10)

  "I mean more. You have this function (data linking) and some components like the cost and the …, and you can just generate a report and then it says the total duration and the total cost." (P#9)

Top frictions and proposed fixes: Visio Plan limitation and precise adjustment

At the same time, several frictions were found in practice during the evaluation. The most prominent frictions concerned the limitations of the Visio Plan and the difficulty in making precise adjustments on the canvas. Other suggestions and comments from participants for future iteration are discussed in Chapter 8.1.

- **Visio Plan limitations blocked key actions:** This friction was observed in two out of four sessions (P#8 and P#9). The differences in Visio Plan have prevented devices of users who are not using Visio Plan 2 from applying the self-defined data references and matching in the prototype, thereby affecting the color auto-matching feature.

  "I think it is because it doesn't support data-related functions to Visio Standard." (P#8)

  Based on the research conducted during the interview stage, I learned that healthcare organizations that are applying Metro Mapping in Visio often have at least one Visio Plan2 account for editing and updating Metro Maps. This account is usually used by the map managers in the core Metro Mapping team. In an ideal cooperative model, a few members in the core Metro Mapping team can directly edit Metro Maps, while other members and contributors can input information through online commenting features, email, workshops and so on, which do not require Visio Plan2. Therefore, the limitation of Visio Plan does not affect team collaboration, but providing alternatives still makes sense.

  Proposed fixes: Offer a manual color matching command in the template for non-Visio Plan2 users that applies the Phase color to selected stations without relying on self-defined data reference and matching.

- **Precise selection and alignment required extra effort:** This friction was mentioned in one session (P#8 and P#9) and concerned adjusting, centering and alignment of Station icons and text blocks. Participants reported difficulty in identifying the correct grab area and aligning elements precisely, which slowed down the progress.

  "Oh, now it's difficult to see which one I need to grab." (P#9)

  "A bit more spacing… would be better." (P#8).

Proposed fixes: Add a one-click “Center in column” action on stations to reduce error in selecting and grabbing and speed up alignment; Introduce **snap guides** that show “aligned” or “centered” feedback.

Concept evaluation of extended features

Following the tasks in usability evaluation, participants reviewed three extended features with short explanations and interface mockups, and provided thoughts and feedback on them.

Search function: The overall feedback for it was positive. Participants saw value in having an in-map search and expressed expectations that the scope should be broad enough to cover common fields such as text, Station types, colors and hidden information.

“It would be nice… if the search function could search… everything.” (P#2)

Selective export to image: It was widely liked by participants for preparing materials for communication out of the scope of Visio in daily work more efficiently. Some participants described the current workflow of creating image from Visio as troublesome, and P#2 indicated high personal need for this feature.

“That would be great because it’s such a hassle to do it right now.” (P#9)

“We definitely need that.” (P#2)

Before–after measurement comparison: No participants provided negative feedback regarding this feature. However, due to the different purposes for which they used Metro Mapping, their interest in this feature varied. P#2 who was involved in data collection and calculation during the use of Metro Mapping highly appreciated this feature, while P#8 who mainly used Metro Mapping for visualization of healthcare pathways expressed a low need for this feature.

“*It is exactly what I need and what we have talked about before.” (P#2)*

“I don’t think I really need this feature.” (P#8)

Critical feedback

Although participants were very enthusiastic about the final concept and full of expectation of the release of new Metro Mapping template, several points for discussion were also raised out. Some participants expressed varying degrees of need for certain functions. For instance, P#2 preferred to have face-to-face conversations with other map contributors rather than using online commenting for collaboration, while P#8 found this feature very useful. This project aims to provide a new version of Metro Mapping in Visio that can meet the basic and universal needs of most Metro Mapping users. Therefore, it is necessary to incorporate all the identified core requirements into the final concept. Some participants also found frictions regarding interaction and usability that would be uncovered during the use in practice of the MVP prototype (as mentioned in the previous “Top frictions"). This indicates that users have envisioned and experienced how the new version of Metro Mapping can be used in their practical work, and they are willing to actively participate in the future version iterations, which demonstrates the practicality and potential of the final concept.

Alignment with future vision and design goal

The evaluation outcomes are consistent with the **future vision** of making Metro Mapping intuitive and data enabled for multidisciplinary teams in a **clear and collaborative** way. Participants reported that this prototype is much more convenient and efficient to use, and the data linking provides a solid foundation for enhancing work efficiency and data-enabled healthcare pathway research. They also pointed out that collaboration both within and outside the core team has been supported by online commenting and image exporting.

The outcomes also align with the **design goal** of enhancing Metro Mapping so core teams can create, update, and improve pathways in an intuitive, data-enabled, and collaborative way. Quantitatively, all four participants met the pre-defined criteria for task success and time to complete the scenario, showing that the MVP prototype with basic

features and core features for final concept supports real workflow within acceptable effort. Qualitatively, participants' comments on clarity, data linking with an Excel template and basic commenting indicate that the concept translates the design goal into concrete and feasible workflow steps.

Key takeaways 7.3

- Users thought using the final concept would be easier and faster than current practice and expressed clear intention to adopt the new template.
- Strengths appear in structure editing, station creation and editing, and station level data linking that enable batch data updates and uncover the potential of subsequent data statistics in future version.
- Most urgent fixes are compatibility for users without Visio Plan 2 and more precise on station adjustments.
- Among extended features, search and selective export were appreciated by all participants. Interest in before-after measurement comparison depends on role and use case.
- Through the online comments and export features, collaboration can be achieved and feedback from core team members as well as other contributors can be obtained. However, preferences for the way of collaboration vary from person to person.
- Results support the future vision of an intuitive and data enabled tool for multidisciplinary teams and confirm the design goal that core teams can create, update, and improve pathways with acceptable effort in real workflows in an intuitive, data-enabled, and collaborative way.

8. Recommendations, Conclusion and Discussion

This project provides a clear concept and a functional MVP prototype for the new version of Metro Mapping in Visio, forming a solid basis for its further development. It also uncovers several areas for further exploration that may inspire future tool development. Based on user feedback from co-creation sessions and evaluation sessions, I will propose recommendations for future iteration of Metro Mapping in Visio, some of which go beyond the main scope of this project but are worth considering. In addition, I will answer the research questions and discuss the limitations of this project.

8.1 Recommendations for future iteration

Recommendations for two concept features for future

For the features for future introduced earlier in Chapter 6.1, I outline two directions that emerged as promising but remained outside the scope of the final concept.

Expand and Collapse View for Healthcare Professionals

This feature targets on tool usability, especially when users interacting with large and branching maps. The expand and collapse interaction can help users group elements in a more organized way, speed up navigation, and manage the map at a higher level. I see a similarity between this feature and the structure of Metro Net, since both operate from a higher level to manage and summarize the detailed Metro Map. Therefore, a possible future direction is to combine the visual language and logic of Metro Net with this feature, providing a cleaner view while preserving the full integrity of the map information.

From a Visio technical perspective, if future versions of Metro Mapping continue to use Visio as the software platform, implementing this feature will require substantial scripting. Even though development would be challenging, I remain positive about its potential because it could offer a new, more efficient and intuitive way to build Metro Maps, with a strong and positive impact on the workflows.

Physical In-Person Workshop Toolkit

This feature focuses on collaboration among stakeholders. It offers a printable Visio file with pre-defined station cards, comment cards, and phase and day rectangles that match with the Metro Mapping colors and shapes. In an in-person workshop, these materials can let designers, researchers, and healthcare professionals contribute without using Visio, while still thinking and speaking in the same visual language as the digital map. Color and shape matching can help participants place ideas in the right layer and reduce later transcription errors. After the session, the coordinator can transfer inputs into the digital map more quickly and keep a clear link between what was discussed in the room and what appears on the screen. This lowers the entry barrier for non-design stakeholders and strengthens shared ownership of the map.

For the current project, the final concept focuses on the digital experience in Microsoft Visio, so this toolkit sits outside scope and would require changes to workshop routines and facilitation. However, it has the potential to directly address the collaboration needs observed in evaluation since it can make in-person group sessions more productive.

Recommendations for the next steps of developing the MVP prototype

The following recommendations translate suggestions and discussions on the MVP prototype from the evaluation sessions into next steps for refining the prototype.

Interaction and usability: In the next iteration of the prototype, the interaction of the template could align better with the logic of real workflow of users while keeping room for user control. For example, allowing users to add the basic information of one Station when creating it, and giving users space for self-defining data fields when needed.

Compatibility for all types of accounts: Under the model that "a few people manage and edit the map, while the majority input through comments, emails and conversations", the limitations imposed by Visio on accounts with different subscriptions do not become apparent. However, it would still be necessary to increase template compatibility across Visio accounts with different subscriptions to lay the foundation for the further promotion of Metro Mapping.

Onboarding for new users: To lower the barrier for new users of the Metro Mapping template, an in-template walkthrough or a quick guide illustration can help users to learn the basic and core features of the template without prior Visio knowledge.

8.2 Conclusion

In this section, I conclude this project by answering the research question and sub-research questions and reflects on the design goal. This conclusion integrates insights from the literature review, interviews, co-creation sessions, and final concept evaluation (see Chapters 2, 3, 5 and 7).

Main RQ: How can the Metro Mapping tool better support collaborative and data-enabled design of healthcare pathways for core Metro Mapping team members within healthcare organizations?

Based on literature review and communication with core Metro Mapping team members and the final design concept, three main improvement priorities are raised out:

1. **Enhance usability** of Metro Mapping tool by applying structured templates, intuitive interaction modes and automatic visual matching in Visio, and reducing the manual effort currently required to update and maintain Metro Maps.
2. **Strengthen collaboration** by enabling participation beyond a single editor through online commenting for asynchronous, traceable input and selective export to share focused map fragments for review and discussion.
3. **Enable data integration** by embedding and linking key relevant healthcare pathway data directly into Metro Maps, ensuring real-time updates, easy maintenance, and providing visual cues of measurement comparison to support decision-making and communication.

RQ 1: What are the roles and responsibilities within a Metro Mapping team in a healthcare organization?

Interviews showed that a core Metro Mapping team is multidisciplinary, typically consisting of contributors from healthcare, design, research, and managerial backgrounds (key takeaway 3.2). In most Metro Mapping projects, there is a project coordinator role being responsible for integrating contributions from different stakeholders, building and managing the Metro Map, and ensuring that all stakeholders share a consistent understanding of the healthcare pathway visualized in the map, which may be taken up by a designer, researcher, or healthcare professional (key takeaway 3.2).

According to key takeaways 3.3, responsibilities of the project coordinator in a Metro Mapping project vary depending on the coordinator's expertise:

- Designers lead pathway improvement or redesign and maintain visual and structural consistency.
- Researchers document and analyze processes, link steps to indicators, and compare before–after maps.
- Healthcare professionals provide clinical knowledge, ensuring maps are modular, accurate, and suitable for communication with patients.

This structure enables the combination of different areas of expertise, but in current workflows, due to tool limitations, the permissions for contributing to, managing, and editing Metro Maps are often concentrated in a single role, limiting distributed contribution and ownership among stakeholders.

RQ 2: What challenges and expectations do the Metro Mapping team have when using the current Metro Mapping tool?

- **Challenges:** As summarized in Chapter 2.2 and corroborated by Key takeaways 3.3 and 3.4, the current tool offers limited support for systematic, data enabled content and lacks clearly defined interaction and collaboration models for diverse user types. Data remains external to the map, which weakens traceability from metrics to design decisions. In practice, editing in Visio is highly manual and fragile, slowing iteration of the maps. The technical threshold of using Visio prevents non-designers from co-editing, leading them to provide input verbally or via comments, and collaboration remains editor-driven and asynchronous with feedback integrated only after workshops or emails.

- **Expectations:** Knowing from key takeaways 3.5 and 3.6, participants expect the tool to support shared ownership and clearer responsibility division. They also want trust and transparency in collaboration, including visibility of "who contributed what in the map", and the possibility of both asynchronous and in-person alignment. Regarding data integration of Metro Mapping tool, they expect the tool to evolve into a living resource where key metrics are directly linked to map, updated dynamically, and can be used for reflection on current healthcare pathway, decisions related to metrics comparison, and communication with internal or external departments.

RQ 3: What are the existing modes of collaboration in healthcare pathway design, especially in Metro Mapping projects?

Collaboration in healthcare pathway design typically involves multiple stakeholders working together to align goals and maintain continuity across complex healthcare processes. Traditional approaches rely heavily on synchronous formats such as in-person workshops and multidisciplinary team meetings, which support real time discussion and decision making but can be constrained by time availability, hierarchical dynamics and logistical barriers. To address these limitations, the hybrid collaboration model emerged and combined synchronous workshops with asynchronous contributions. These approaches allow stakeholders to participate within their own schedules and from different locations, maintaining engagement over longer project timelines. As summarized in Key takeaway 2.3, lowering technical barriers and supporting both modes are essential to sustain engagement of stakeholders.

In Metro Mapping projects, the current mode of collaboration is primarily editor-driven: one person is responsible for maintaining the map, while other stakeholders contribute through workshops, emails or interviews (known from Chapter 2, 3 and 5). While this approach helps ensure visual consistency of the map, it reduces other stakeholders' familiarity with the map, thereby affecting co-ownership of stakeholders and slowing the iteration process of the map. Literatures on healthcare co-design in Chapter 2.3 suggests that role-based editing, real-time co-creation, and layered access could enhance stakeholder engagement without compromising the structure of the visualization of healthcare pathways.

RQ 4: What types of data are considered most relevant by the Metro Mapping team?

According to interviews, core Metro Mapping teams consistently considered several categories of data as most relevant: operational flow (consultation counts, hospitalization days, remote-monitoring volumes), time-related metrics (step durations, patient waiting times), resources and responsibility (cost per step, responsible roles, locations), outcomes and experience (patient feedback, satisfaction), and map management-related metadata (version, tags, links). These data types are essential for evaluating cost-effectiveness, process efficiency, and quality of healthcare (key takeaway 3.6).

RQ 5: How can these types of data be integrated to support the development of Metro Maps?

Currently, relevant data of healthcare pathway lives in separate dashboards and is manually annotated on maps, which prevents real-time reference and slows iteration. Interview insights suggest that effective integration requires linking prioritized metrics directly to map elements, enabling distributed, role-responsible updates across departments, and providing immediate before–after visibility and impact cues (key takeaway 3.6). In the final

concept, this is implemented through station-level data linking to an external Excel source with refresh, embedded data fields for key metrics, and clear in context annotations. It enables efficient updates and conducts the basis for the measurement comparison between maps. In this way, the Metro Mapping tool can shift from being static visuals to living resources that could help track changes, support evidence-based decisions, and improve communication in healthcare teams.

Reflection on design goal

The design goal was to enhance Metro Mapping tool to enable core Metro Mapping teams in healthcare organizations to create, update and improve healthcare pathways by using the tool in an **intuitive, data-enabled and collaborative** way.

The final concept translates this into concrete concept and functional MVP prototype in Visio. The intuitiveness of Metro Mapping in Visio is improved through a pre-built template, arrangeable phases and layers, automatic day columns and color matching; in evaluation, all four participants met the pass criteria and worked easily and fast (see Chapter 7.3). Collaboration is supported by online commenting for traceable asynchronous input and selective export to share focused fragments outside Visio, reducing the editor-driven bottleneck. Data is enabled through station-specific data linking to an external Excel data source, turning the map into a living resource and preparing for before-and-after comparison. Although there are still some remaining frictions, the final concept with the MVP prototype meets the design goal by making Metro Mapping more intuitive, data-enabled and collaborative in real workflows.

Overall conclusion

This project sets a clear direction and provides a working base for further development of the enhanced Metro Mapping tool in Visio, which is more intuitive, collaborative, and data-enabled comparing to the current version. Through literature, interviews, co-creation, and evaluation, the insights were translated into a coherent concept and a functional MVP prototype while preserving the Metro Mapping method's design logic.

Evaluation with intended users confirmed the feasibility and desirability of the final concept. All participants completed core tasks and thought the workflow of the concept was faster than current practice. Strengths of the concept centered on structure editing and station-level data linking, with online commenting and selective export supporting collaboration beyond a single editor.

To make the concept work well in real practice, the tool should address edition compatibility for non-Visio Plan 2 users and improve precise on components adjustments. More tests of the concept, followed by decisions on ownership, maintenance, and funding, will be needed to sustain the development and implementation of it.

8.3 Discussion of the limitation

Limited numbers and sampling of participants

It was difficult to recruit people who have both Metro Mapping experience and Microsoft Visio experience, and the number of participants was small. During the co-creation and evaluation sessions, the roles of the participants were mostly designers and researchers, while the participation of healthcare professionals was relatively low. This might lead to an overestimation of the ease of use of the tools without fully reflecting the needs of non-design-related stakeholders. Future work should include more diverse roles and settings to balance these views.

Lack of prototype evaluation with real and complex healthcare pathway

Usability of the MVP prototype was tested with simple and scripted tasks. This enhanced the control over the evaluation session, but the actions taken by the participants during the session were different from those performed in actual workflow on a Metro Map that contains a large amount of content, data and past designs. Future research could include tasks related to real maps in ongoing projects, as well as tests involving the import or cleaning of existing diagrams.

Collaboration model assumptions

Online commenting and selective export were validated as useful, but collaboration preferences differed across different types of users. The actual concurrent comments, permission settings or version history management have not been tested in a complete team environment. The next iteration could define a simple permission model, a comment resolution process, and a traceable change log, and then test them in the Metro Mapping team.

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Appendices

A. Interview Questions

Phase 1: Introduction (5-10 minutes)

- Briefly introduce the **research project** and the purpose of the interview.
- Explain **confidentiality and informed consent.** (or explain it through email before the interview)
    - Participants can choose to have their name published or remain anonymous.
    - Participation is voluntary, and they can withdraw at any time.
- Ask for **permission to record the conversation**.

Phase 2: Professional Background (5 minutes)

- Can you describe your **role and responsibilities** in healthcare/breast cancer care?
- How familiar (or not) are you with Metro Mapping?
    - If familiar → How often do you use Metro Mapping in your healthcare work?
    - If not familiar →
        - Have you heard about Metro Mapping?
        - What is your impression to it?
- Do you know if any of your colleagues or other departments are also using Metro Mapping?
- Are there **any existing tools or frameworks other than Metro Mapping** that your hospital/organization is already using for tracking patient journeys? How does Metro Mapping compare?
    - Do you use them?
        - If yes →
            - What are their strengths and limitations?
            - How does Metro Mapping compare?

Phase 3: Experiences & Perceptions of Metro Mapping (10-15 minutes) （assume the participant have used Metro Map）

- How did you first get introduced to **Metro Mapping**?
- From your perspective, what aspects of **Metro Mapping have been particularly helpful…**
    - for patients?
    - for other healthcare professionals?
- Do you feel Metro Mapping has improved…
    - workflow efficiency?
    - patient understanding?
    - If yes → Are there **any specific cases?**
    - If no → Are there **any examples**?
- Have you noticed **any limitations** in how Metro Mapping is currently applied?
    - Have you faced **any challenges** when using Metro Maps for patients' treatment journey?

Phase 4: Decision-Making & Information Accessibility (5 minutes)

- When using Metro Mapping, **what types of information** do you find most valuable for decision-making?
- Are there any **gaps in information** that would make Metro Mapping more effective?

Phase 5: Feasibility & Implementation (10-15 minutes)

- Have you received **feedback either from patients or other healthcare professionals** of Metro Mapping?
- Do you have **any general idea about improving Metro Mapping**?
    - If yes →
        - What is it?
        - Have you suggested improvements to Panton or your organization before?
            - **If yes, were they implemented?**

- Based on your experience, **what specific refinements** would improve Metro Mapping?
    - Especially the **usability** of it?
- Do you foresee any **barriers to further adoption** of Metro Mapping?
- Would you be interested in **actively testing and providing feedback** on updated prototypes of Metro Mapping?
    - If yes, why?
    - If no, why?
- Is there **anything else** you would like to share that hasn't been mentioned in the interview?

Phase 6: Adoption & Wider Implementation (10-15 minutes)

- If Metro Mapping is improved, would you be willing to **use it more frequently** in your work?
    - If yes, why?
    - If no, what **factors influence your willingness to adopt Metro Mapping** long-term? *(Ease of use? Patient feedback? Institutional support?)*
- What do you think are **the main challenges in promoting Metro Mapping** within your organization?
- Do you believe **hospital management would support the implementation** of Metro Mapping? Why or why not?
- From your perspective, what factors could **facilitate the wider adoption** of Metro Mapping in healthcare institutions? *(More training programs? Clearer using guidelines? Policy or financial support from healthcare institutions?)*
- From your view, if your hospital were to officially implement Metro Mapping, what key conditions would need to be met?

Phase 7: Wrap-Up & Next Steps (5 minutes)

- Thank the participant for time and insights.
- Ask if they would like to be involved in the **design iteration and usability testing phases**.
- Provide contact information in case they have further thoughts or want to follow up.

B. The screenshots of the coding file

Main Code	Mid-level Category	Initial Code
EXPERIENCE	Tool usage behavior & preference	Preference for Miro over Visio
EXPERIENCE	Tool usage behavior & preference	Using Excel-style format in Miro
EXPERIENCE	Tool usage behavior & preference	Copy-paste behavior in Miro
EXPERIENCE	Color/icon customization	Personalized Metro Mapping usage
EXPERIENCE	Color/icon customization	Self-define colors
EXPERIENCE	Color/icon customization	Creating and applying custom colors
EXPERIENCE	Color/icon customization	For pregnancy, seperating care-path by 'Weeks' works better than by 'Phases'
EXPERIENCE	Color/icon customization	Tend to keep metro lines in a same color for easier understanding
EXPERIENCE	Color/icon customization	Changing shared decision icon to flowchart symbol
EXPERIENCE	Layer customization	Selective layer usage in Metro Mapping
EXPERIENCE	Layer customization	Integrating design method (pains and gains) into Metro Mapping
EXPERIENCE	Layer customization	People often customize Layers
EXPERIENCE	Layer customization	Write all types of comments in one layer
EXPERIENCE	Layer customization	Adding extra information in unused space
EXPERIENCE	Layer customization	The layers that are always used in hybrid care Metro Mapping: patient, metro line, informatic
EXPERIENCE	Layer customization	Highlighting measurement layer importance for hybrid care
EXPERIENCE	Layer customization	Adding patient-filled hospital system layer
EXPERIENCE	Collaboration & Co-creation	Using printed Metro Mapping drafts for co-creation
EXPERIENCE	Collaboration & Co-creation	Viewing Metro Mapping as a collaboration tool
EXPERIENCE	Collaboration & Co-creation	Metro Mapping co-creation mainly with healthcare professionals
EXPERIENCE	Collaboration & Co-creation	Sharing Metro Mapping enthusiasm among colleagues
EXPERIENCE	Collaboration & Co-creation	Using Metro Mapping for hybrid care co-creation
EXPERIENCE	Collaboration & Co-creation	Using Miro for collaboration
EXPERIENCE	Collaboration & Co-creation	Using Metro Mapping to invite co-creation
EXPERIENCE	Process understanding	Helping healthcare professionals understand complete care pathways
EXPERIENCE	Process understanding	Using Metro Mapping to facilitate pathway changes
EXPERIENCE	Process understanding	Metro Mapping helps discussing and improving healthcare
EXPERIENCE	Process understanding	Metro Mapping helps process understanding
EXPERIENCE	Process understanding	Application of Metro Mapping across fields
EXPERIENCE	Process understanding	Visualizing hospital processes using Metro Mapping templates
EXPERIENCE	Decision-making Process	The decision-making moments are not always the shared decision-making moments.
EXPERIENCE	Decision-making Process	Identifying shared decision points in Metro Mapping
EXPERIENCE	Professional Usage	People, e.g. healthcare professionals, have difficulty in using metro mapping templates.
EXPERIENCE	Professional Usage	Using Visio due to organization availability
EXPERIENCE	Professional Usage	People from different field are using MM
EXPERIENCE	Perception & Clarity	Patients might move non-linearly between Metro Mapping points
EXPERIENCE	Perception & Clarity	Metro Mapping visualizations help making changes in process
EXPERIENCE	Perception & Clarity	Metro Mapping is clearer than regular process maps
EXPERIENCE	Perception & Clarity	The visual style of Metro Mapping is quite clear
EXPERIENCE	Perception & Clarity	Metro Mapping is clearer for healthcare professionals
EXPERIENCE	Implementation Gaps	Metro Maps created but not yet patient-tested or implemented
EXPERIENCE	Implementation Gaps	Large metro mapping pathways are not always helpful in patient appointments.
EXPERIENCE	Implementation Gaps	Limited Metro Mapping usage with patients
EXPERIENCE	Implementation Gaps	Limited Metro Mapping usage with patients
EXPERIENCE	Implementation Gaps	Haven't identified the way to better change healthcare workflow
EXPERIENCE	Feedback & Sentiment From Professic	Positive feedback from healthcare professionals
EXPERIENCE	Feedback & Sentiment From Professic	Enthusiasm for both digital and printed Metro Mapping
EXPERIENCE	Feedback & Sentiment From Professic	People are entusiastic with using Metro Mapping
EXPERIENCE	Organizational Context & Field Use	Involvement of multiple healthcare roles in Metro Mapping
EXPERIENCE	Organizational Context & Field Use	People working on hybrid care added a phone call icon
EXPERIENCE	Organizational Context & Field Use	Metro Mapping emphasized as non-static during co-creation
EXPERIENCE	Organizational Context & Field Use	Pathways differ between healthcare professionals
EXPERIENCE	Organizational Context & Field Use	Consistent visualization style helps pathway understanding
EXPERIENCE	Organizational Context & Field Use	Providing Metro Mapping manuals for users
EXPERIENCE	Organizational Context & Field Use	Focusing detail on specific service parts due to time/resource limits
EXPERIENCE	Organizational Context & Field Use	Using Metro Mapping to visualize care pathways
EXPERIENCE	Organizational Context & Field Use	Using Metro Mapping at a higher level due to time constraints

NEED	Visual & layout-related	Need for more built-in color options with preview
NEED	Visual & layout-related	Need for large layout space for visualization
NEED	Visual & layout-related	Need more space
NEED	Function & content requirement	Want to use Metro Mapping to calculate cost
NEED	Function & content requirement	Need to visualize patient experiences for feedback
NEED	Function & content requirement	No need to show patient experience in layout
NEED	Function & content requirement	Separate dicision-making-moment and share-decision-making-moment with different icon n
NEED	Function & content requirement	Need for more icons in Metro Map
NEED	Function & content requirement	No need for extra icons
NEED	Collaboration & support	Need for pre-prepared Metro Mapping templates
NEED	Collaboration & support	Need for working on a same board together
BARRIER	Usability of Visio & complexity	Difficulty for non-designers in customizing Visio
BARRIER	Usability of Visio & complexity	Difficulty for non-designers in customizing Visio
BARRIER	Usability of Visio & complexity	Non-designers have difficulty in using Visio
BARRIER	Usability of Visio & complexity	Collaboration issues when using Visio
BARRIER	Usability of Visio & complexity	Have no space for text if there are many (3) metro stations
BARRIER	Usability of Visio & complexity	Current interaction of moving a group of elements is annoying
BARRIER	Usability of Visio & complexity	Difficulty for identifing 'Stop' gray box quickly
BARRIER	Mismatch between design and reality	Disconnect between actual practice and ideal care-path in Metro Map
BARRIER	Mismatch between design and reality	Static Metro Mapping fails to capture department/time changes
BARRIER	Mismatch between design and reality	Metro Mapping is static, but practice is not
BARRIER	Mismatch between design and reality	Static visualization limits dynamic process display
BARRIER	Emotional/cognitive confusion	People are not sure if their using way of Metro Mapping is right
BARRIER	Emotional/cognitive confusion	Mismatch between how people are taught and their actual using way
BARRIER	Space/Layout Limitation	Limited space prevents full context display
BARRIER	Space/Layout Limitation	A huge MM is not really patient/healthcare professional friendly
BARRIER	Space/Layout Limitation	Don't have enough space vertically in Metro Mapping
ENABLER	Vision for Future Improvement	Moving Metro Mapping from linear to network structure
ENABLER	Vision for Future Improvement	Would be nice to see how patients flowing through the Metro Map with the help of data
ENABLER	Practical Process Applications	Personal opinion on bringing data in Metro Mapping
ENABLER	Data integration potential	Could visualize patient flows using real data
ENABLER	Data integration potential	Need for more detailed data in Metro Mapping
ENABLER	Data integration potential	Possible data types to be added into Metro Mapping
ENABLER	Data integration potential	Showing the actual context or things might help making Metro Map richer
ENABLER	Organizational support	Organizations will be willing to implement Metro Mapping if it's easy to implement
ENABLER	Organizational support	Would be nice to make it more applicable to different users
ENABLER	User-side vision & expectation	It would help if patient can know next steps and do preparation
ENABLER	User-side vision & expectation	Showing what patient expect might help with decision-making
ENABLER	User-side vision & expectation	It would be more interactive if people can discuss with others when making it

C. Co-creation session plan

Purpose

The goal of this co-creation session is to **gather hands-on feedback and new ideas** from potential Metro Mapping users **on a series of initial design concepts**. These concepts are derived from the previously identified needs of core Metro Mapping teams, and aim to address issues related to collaboration, human insight integration, and data interaction. Participants will be invited to explore and respond to concepts and compare them with the current Metro Mapping experience.

Participant Recruitment (ideal situation)

Participants will be selected from mainly three types of user groups identified in the earlier research and staffs from Panton, who are familiar with Metro Mapping design and Metro Mapping users.

Three types of user groups identified in the earlier research:

- Researchers who work with healthcare pathway structures using Metro Mapping.
- Designers who use Metro Mapping to visualize and redesign processes.
- Healthcare professionals (e.g., nurses, oncologists, care coordinators) who use or contribute to care pathways.

Recruitment will be conducted through:

- Direct outreach via existing contacts from earlier research interviews.
- Coordination with Panton to connect with ongoing MM teams.

Target number: 3–6 participants, ideally from diverse roles within the same or related organizations to encourage cross-perspective discussion.

Session Format

- Preferred format: In-person workshop (60-90 min)
- Backup format: Online session (Miro + Zoom/Teams, split into two 45-min blocks if needed)

The in-person format will be prioritized due to the physical and visual nature of the prototypes and collaborative tools. If in-person is not feasible, an online adaptation will include digital whiteboards and guided screen sharing.

Session Materials

Each participant will receive:

- A simplified prototype set of selected design concepts (hand-sketched or printed interface mockups, with short description)
- A printed original Metro Mapping example as baseline comparison
- Stickers and comment cards to annotate, mark, and react to elements
- Voting dots and “trash bin” markers to indicate which elements feel interesting or unnecessary

- A questionnaire with 7 ranking questions
- Empty Metro Map layout
- Visual shapes and elements from Metro Map
- Blank cards or paper to express new ideas or variations
- (If online: Miro board version of all the above)

Session Structure

1. Introduction (5-10 min)
2.
    a. Quick intro to Metro Mapping & the design goal for my graduation project (if the participants are familiar with Metro Mapping, this step could be skipped)
    b. What we're testing, and why
3. Guided Exploration by Concept (40 min)
4.
    a. If the participants are not familiar with Metro Mapping, they are asked to browse the sample original Metro Map; If the participants are familiar with MM, they can skip this step
    b. The three initial concepts with description cards are presented and described briefly; participants will walk through the concepts one by one
    c. After presenting and walking through the concept, participants' first reactions are discussed, **in which the topics might be (but not necessarily):**
    d.
        i. Describe what they understand
        ii. Imagine how it might work in their context
        iii. Suggest additions or changes
    e. During the discussion, participants might be asked with several questions. Example questions include (but not necessarily):
    f.
        i. For participants who are researchers working in healthcare:
        ii.
            1. "Which concepts best support your way of documenting or analyzing healthcare pathways?"
            2. "What concept features would help you combine different types of input more effectively?" *(*Different types of input might include qualitative human comments and quantitative data)*
            3. "What are important things to consider if the concepts/features are selected for further development?"
        iii. For participants who are staffs (designers or Metro Map developers) working in Panton:
        iv.
            1. "Which concepts make it easier to collaborate with different stakeholders when creating Metro Maps?"
            2. "How well do these concepts support your current way of collecting feedback from clients?"
            3. "What do you think is missing or still needed to turn these concepts into tools you would actually want to use?"
    g. Participants are asked to place vote dots on the most interesting aspects of the concept according to their thoughts
    h. Participants are asked to write down their extra input for the concept on commenting cards and place them near the feature
    i. If participants think that there are concept elements/features that need to be cancelled, they are asked to place "trash bin" dots on the elements/features

5. Free Co-Creation (20–30 min)
6.
    a. Participants are encouraged to remix elements, sketch alternatives, or add entirely new ideas or concepts on papers
    b. A set of visual elements will be provided for physical ideation, including:
    c.
        i. Blank Metro Map layout
        ii. Visual shapes and elements from Metro Map
        iii.
            1. Phase rectangles
            2. Day rectangles
            3. Station dots
            4. role stickers
            5. Blank paper
    d. Example question prompts to guide this phase include:
    e.
        i. “Why would you like to have this new idea/concept?”
        ii. “What would make this easier to use in your workflow?”
        iii. “How would your team contribute or interact with this?”
7. Wrap-up & Reflection (15-20 min)
8.
    a. Participants can reflect on:
    b.
        i. “Which ideas would you feel most usable or valuable?”
        ii. “Which concept fits your team best?”
        iii. “From the other concepts, which feature would also be helpful for your team?”
        iv. “Is anything important missing from all three concepts?”
    c. Gather overall impressions
    d. Ask what’s missing and how they would prioritize next steps

Output & Analysis

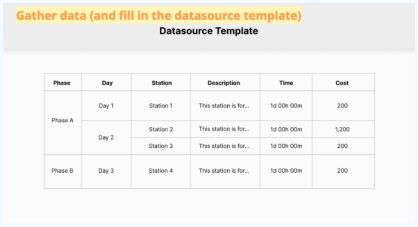
- All annotated materials (digital or physical) will be collected.
- Photos or scans of sketches, commenting cards, sticker, etc. and modified concept boards will be collected.
- Personal notes will be taken during the session.
- The session will be recorded only for reviewing the unsure parts after the session. The recording won’t be transcribed.
- Questionnaires will be collected and analyzed.
- Insights will be clustered under three aspects of the design goal: **Collaborative Creation, Human Insights Integration and Quantitative Technical Data Integration** to guide the next iteration phase.

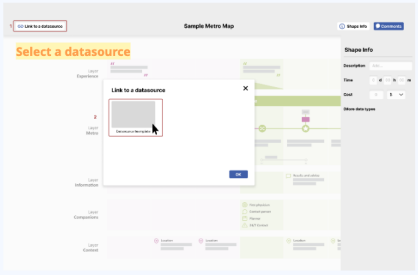
D. Detailed co-creation diagram

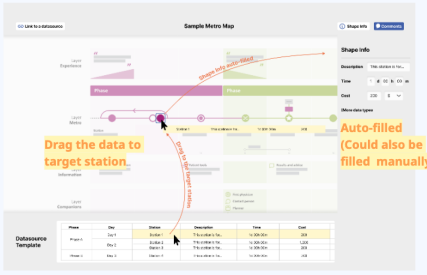
Concept 1 – Structured Mapping for Data-Rich Documentation

This concept is meant for researchers who want to accurately document and analyze existing care pathways. It supports creating a Metro Map step by step, **linking each step/station to data like cost, time, or responsibilities.** The researcher works mostly independently but can also **collect inputs from others through comments or interviews.** Once the map is complete, it can be used in reports or presentations, and also **turned into a simplified version** for others to understand. The focus here is on precision, clarity, and making data easier to explain and share.

Linking each step/station to data

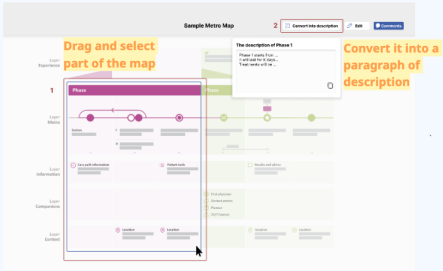


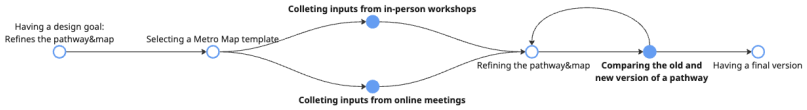




Collect inputs

Turn the map into a simplified version

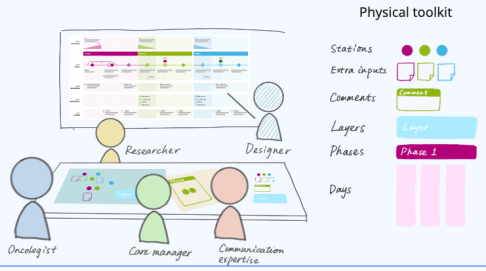




Concept 2 – Collaboration Management and Visual Revision

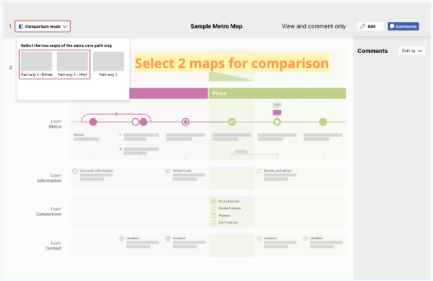
This concept helps **designers** gather input from different stakeholders and turn it into clear, improved versions of a care pathway. It combines **in-person workshops using printed Metro Maps and physical collaboration toolkit** with elements such as stickers, commenting cards, and color-coded layers, which match with the visual language of Metro Maps, with follow-up digital editing. Stakeholders can give feedback by writing on cards or **adding comments digitally**, while the designer keeps control over the main structure. The concept also supports **comparing the old and new version of a pathway** to clearly present the differences between them.

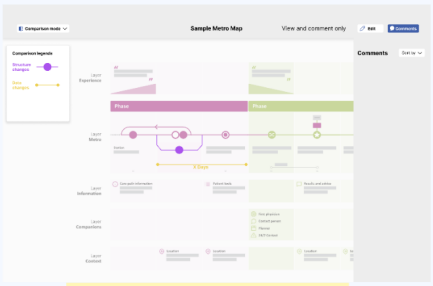
Collets inputs from in-person workshops



Collets and manage inputs online

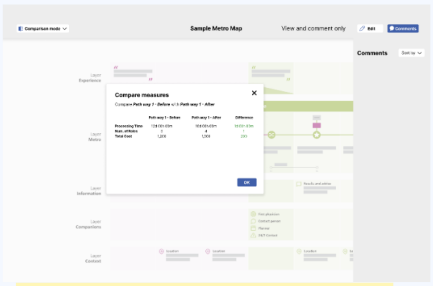
Before-after comparison



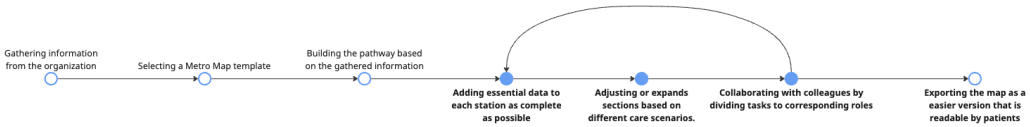


Version 1: Present the difference of 2 maps

OR



Version 2: Present the difference of the data from 2 maps

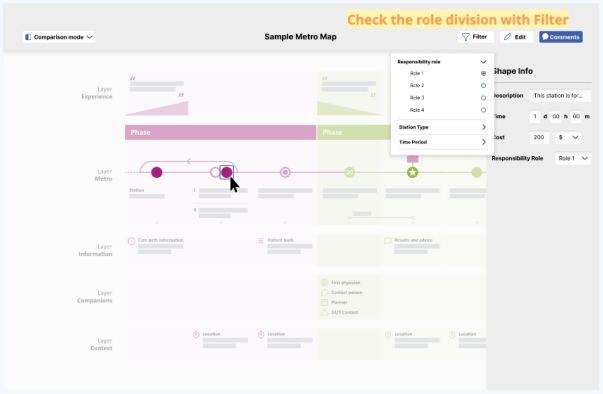


Concept 3 – Modular Pathway Maintenance with Branching Logic

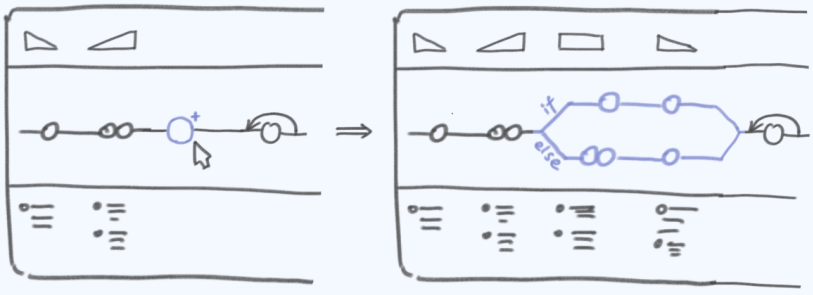
This concept helps healthcare professionals work together on care pathways in a way that is easy to manage, and clear and easy for both teams and patients. The map is l**inked to datasource, and each department adds or updates the parts/information they're responsible for**, and the pathway can be adjusted depending on different patient scenarios. **Complex structures** like treatment loops or condition-based branches can be shown clearly by **expanding and collapsing nods**. The final map can be shared with patients or exported to connect with other hospital tools. This concept supports modular teamwork and makes sure the map stays both accurate and easy to understand.

Linking each step/station to data

Each department adds or updates the parts/information they're responsible for



Expanding and collapsing nods



E. Evaluation plan

1. Purpose and evaluation questions

Purpose: Verify that a core Metro Mapping team member can build, adjust, link data, and collaborate with others on a simple healthcare pathway using the MVP prototype with high success and acceptable speed.

Key questions:

1. Can participants complete the scenario from a blank template with minimal assistance?
2. Are structure editing, station placement, data linking, and basic collaboration actions performed accurately and efficiently?

2. Hypotheses

H1: The participant will achieve at least 80 percent of task success without intervention.
H2: Time to complete the full scenario of the participant is under 30 minutes.

3. Participants

Participants from the core Metro Mapping team, who could be a designer/researcher/healthcare professional. All participants have prior experiences to Metro Mapping and Visio.

4. Materials and setup

For the participant:

- A computer with Visio Plan 2 account installed and a blank MVP prototype template pre-shared and downloaded.
- A brief guideline of the template for users.
- One document describing a simplified oncology healthcare pathway.
- One pre-filled Excel file with 10 rows of Station level fields pre-shared and downloaded.
- A checklist of the tasks (defined in section 5).

For the conductor (me):

- A computer with Visio Plan 2 installed and a blank MVP prototype template.
- One document describing a simplified oncology healthcare pathway.
- One pre-filled Excel file with 10 rows of Station level fields pre-shared and downloaded.
- Timing sheet and checklist of the tasks.
- A simple error log template.
- Screen recording, audio recording (for both online and offline) and picture taking (only for offline).

5. Scenario and tasks

Scenario: For each participant, he/she needs to build a simplified oncology healthcare pathway in Visio using a blank MVP template and collaborate with other participants on it. The simplified oncology healthcare pathway will be described by structured paragraphs in a document. If there is only one participant in the session, the participant

will be asked to collaborate with the conductor. Participants are asked to think aloud, and they can ask the conductor for hints if they get stuck.

Tasks:

1. Template setup: fill map title and the goal of the map.
2. Structure: Structure the map with 3 Phases, 3 Layers and reorder 1 Phase.
3. Days: generate 4 Day columns for Phase 1 and Phase 2, 2 Day columns for Phase 3, and verify auto column codes.
4. Stations: place 9 Stations in total according to the description document of pathway with alignment and snapping.
5. Type and color: set station types and colors and verify auto color matching to Phase and Day.
6. Shape Data: edit Shape Data for 5 Stations including role and description.
7. Data linking: link 8 Excel rows to the correct Stations and refresh values.
8. Restructuring: insert a new Phase while keeping existing Stations aligned.
9. Connect Stations with the connector and change the color of connectors.
10. Collaboration: add 4 comments on specific Stations, solve 2 of them and leave 2 open.
11. Export: export the full map to PDF.

6. Measures and pass criteria

Primary measures.

- **Overall task success**: percent of tasks completed without intervention. Target at least 80 percent.
- **Total completion time**: time from T1 start to T11 end. Target under 30 minutes.

Supporting measures.

- **Time by task**: record start and end time for T1 to T11.
- **Assistance count**: number of times the conductor gives a hint. Target at most 1 per task.
- **Accuracy checks**
    - Map accuracy against a checklist for structure, codes, colors, and placement. Target at least 80 percent.
    - Data linking accuracy out of 8 links. Target at least 80 percent.
    - Comment placement precision. Target 100 percent attached to intended targets.

7. Procedure per session

Total duration for each session is about 45 to 60 minutes.

1. Welcome and consent, a background capture of participants' role and their Visio experience. (5 minutes)
2. Scenario introduction and guideline reading. (5-10 minutes)
3. Conduct tasks T1 to T11 with time and assistance noted down. (20 to 30 minutes)

4. Guide participants through 3 extended features in the final concept.
5. Participants fill in a questionnaire on their experience and feedback on the MVP template and extended features. (3 to 5 minutes)

8. Data capture

- Timing sheet and assistance log
- Task completion checklist
- Final Visio file, exported PDF, and screen recording

9. Analysis plan

- Compute success rate and compare thresholds defined in H1 and H2.
- Count time by task, assistance counts, and accuracy percentages.
- Identify the top three usability issues that occurred in the session by frequency and impact. Link each issue to the corresponding feature and propose how to fix it.

10. Deliverables

- Timing sheet, assistance log and checklist per participant
- Screen recording and final files
- Participants' answers to the questionnaire
- Findings based on metrics, key issues, proposed fixes and answers to the questionnaire

F. Project Brief

Personal Project Brief – IDE Master Graduation Project

Name student	Xinjie Li	**Student number**	6,033,334

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT
Complete all fields, keep information clear, specific and concise

Project title Advancing Metro Mapping: A Usability-Focused and Data-Driven Approach for Healthcare Workflows

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

This project takes place in the healthcare service design domain, specifically focusing on workflow visualization and optimization. Metro Mapping (see figure 1 for a sample metro map) is used in hospitals to structure and communicate complex processes, helping professionals analyze and improve patient care pathways.
The main stakeholders:
- Healthcare professionals who use Metro Mapping to analyze, optimize, and communicate healthcare workflows.
- Patients, who benefit indirectly from more efficient, well-coordinated healthcare workflows, leading to better patient experiences and outcomes.
- Metro Mapping Foundation (MMF), which develops and promotes the method as an industry standard.
- Design studio Panton, a key collaborator in advancing Metro Mapping's usability and implementation.

Interests that are at stake:
- Healthcare professionals need a tool that is easy to use, flexible, and supports real-time updates to reflect evolving patient care needs.
- MMF and Panton seek to improve Metro Mapping's adoption and effectiveness by integrating modern digital capabilities.
- Hospitals and healthcare institutions require improved workflow management tools to increase efficiency, reduce errors, and enhance patient care quality.

Opportunities: Enhanced usability will make Metro Mapping more accessible, leading to wider adoption by healthcare professionals and ensuring that workflows are easily understood and used by different stakeholders. It can help in structuring change processes within care, and it helps to focus on patient needs.
Limitations:
- Healthcare workflows are highly complex and differ between institutions, requiring a flexible yet standardized solution.
- Stakeholders have varying levels of technical expertise, meaning the tool must balance functionality and simplicity.
- Data privacy and compliance regulations may limit how healthcare data can be integrated into Metro Mapping.

→ *space available for images / figures on next page*

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

Metro Mapping is widely used in healthcare to visualize and analyze workflows, but its current implementation in Microsoft Visio lacks adaptability, usability, and real-time data integration, limiting its effectiveness.
This project focuses on enhancing Metro Mapping's usability, ensuring that a broader range of stakeholders can independently use and modify the tool without requiring expert assistance. Key challenges include:
1. Integrating Dynamic Data to Improve Flexibility – Metro Maps are manually created and cannot dynamically update with process-related data. Linking maps with databases would allow for real-time modifications and better organization.
2. Simplifying Complexity Through User-Centered Design – Many healthcare professionals rely on Metro Mapping to communicate and analyze processes, but navigating and modifying maps remains challenging for those without technical expertise. Bridging complex technical implementation with intuitive user experience will be essential to ensuring that different stakeholders can use the tool effectively, without requiring a Metro Mapping specialist.
3. Optimizing Visual Structure for Clarity and Communication – As maps grow, they can become overwhelming. Optimizing visual design will enhance clarity and communication, making workflows easier to interpret.
By addressing these usability-first improvements, this project aims to transform Metro Mapping into an adaptable, user-friendly system that better supports healthcare workflows.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Design an improved Metro Mapping tool that integrates dynamic data, simplifies complexity, and improves visualization to support healthcare professionals in optimizing workflows.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

system design, and prototyping. A group of 5-8 breast cancer healthcare professionals, recruited through healthcare institutions and Panton networks, will be involved throughout the entire project, providing insights, feedback, and validation at different stages of the research. The key methods include:
- User Research: Conduct interviews with 5-8 healthcare professionals to understand their experiences, needs, and challenges in using metro mapping for patient journeys.
- Technology feasibility study: With the help of Panton and bVisual (who can advise on Visio-based solutions), explore the possibility of integrating Metro Mapping with databases to allow dynamic updates and real-time data visualization.
- Co-Creation & Iterative Prototyping: Recontact and work closely with the same 5-8 professionals to refine the metro mapping tool based on their feedback and real-world insights.
  - Testing: Professionals will interact with early prototypes to provide feedbacks, and modifications will be made.
  - Co-design sessions (if applicable): Professionals may be asked to suggest refinements based on real-world use cases.
- Evaluation & Validation: Evaluate the usability and effectiveness of the refined metro mapping tool in real-world healthcare workflows with the same recontacted 5-8 professionals.