



DESIGN IN BUSINESS: A FRAMEWORK FOR THE USE OF PARTICIPATORY TOOLS IN THE DIGITAL TRANSFORMATION OF SMES.

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Abstract

Purpose: The objective of this research is to develop a framework that shows how design thinking can be a tool in supporting SMEs with integrating new technology.

Methodology: This research was conducted through design and based on the main design stages (a) empathizing, (b) defining, (c) ideating, (d) prototyping and testing. The data collection included desk research as well as creative and ideation sessions. The framework was developed based on the insights gained in the previous steps.

Findings: This research has shown that digitalization is an organization-wide change that affects many different aspects of businesses and many different stakeholders. All the different groups of stakeholders should be represented in designing fitting digital solutions. The best results can be achieved by having them actively participate in the design process.

Added Value: The framework and research provided more insights into the perspective of companies going through digital transformation. Besides that, it suggests design practices as tools to empathize with the stakeholders and involve them in the solution-finding process. The framework showcases how design thinking and participatory design can be used in. The research demonstrates the relevance of participatory practices for supporting internal change management.

Limitations: In general it should be noted that this research was conducted as a graduation project with a set time frame. Therefore it was not always possible to adhere to design project standards to their full extent when it came to testing the prototype.

Keywords: design thinking, digitalization, industry 4.0, participatory design, empathizing, ideation, reframing, research through design

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Based on the case of Undagrid, Enschede

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1. Introduction

1.1 Topic Introduction

Digitalization and Industry 4.0 are big topics in the current business world environment. The fourth industrial revolution is based on the digitalization of industrial activities. It leads to the construction of fully integrated systems and complex compositions of machines. Part of it relies on the communication of virtual and physical objects. The Internet of Things (IoT) technology can assist organizations in assisting the monitoring and coordination of processes for example (Salento, 2017).

So-called SMAC technologies (social, mobile, analytics, and cloud computing) have caused a wave of digitalization that inspires innovation in business and society (Legner et al., 2017). The overall infrastructure of this new way of working is the system that manages the interaction between digital and physical environments (Salento, 2017).

However, with these new advancements, the most important but also most difficult part is the technological transition (Salento, 2017). **Digitalization** can be described as a 'manifold sociotechnical phenomena and processes of adopting and using these technologies in broader individual, organizational, and societal contexts (Legner et al., 2017). All kinds of institutions are expected to go along and facilitate transformation (Salento, 2017). Many companies are trying to adapt their business models and expand their capabilities accordingly, but not every organization can seamlessly adapt their business model by themselves. It involves more than just adding digital technologies to their existing product, production or distribution system (Freytag & Clarke, 2012).

The current wave of digitalization is driven by 'us', meaning that the power in IT is shifting to involved the user (Legner et al., 2017). Digitalization is not just an instrument but requires actual economic and social changes (Salento, 2017). This people factor entails that organizations need to keep up more with all the stakeholders involved. IT provides new opportunities for interaction but therefore also comes with new challenges (Legner et al., 2017). Faith in technology is not yet shared by everyone. Even though people are more immersed in technology and are becoming digital citizens that does not mean they are unaware of the dark side. They realize that technology puts them under unlimited control and means they lose some of their autonomy in their work. They know that adapting digital solutions in their workplace will transform their jobs and might also cost them (Salento, 2017). Organizations can face low trust and resistance from the employees which challenge the implementation of new technology. This is often a problem in companies that have not been born into the digital world (Legner et al., 2017).

To address these challenges organizations can adopt a more human-centric approach to digital transformation. Small and medium enterprises (SMEs) should not only work on staying innovative but

should also develop some user-orientated design capabilities that can be helpful with transformations (Legner et al., 2017). Design Thinking describes how basic design principles can be used for innovation and problem-solving (Gram, 2019). It is not restricted to physical features and products, but can also be applied with services, processes, solution finding (Brown, 2008). Design practices are being used more and more in management (Kolko, 2015). The human-centred design activities, challenge managers to learn more about their employees through experience and not necessarily through hypothesis validation. Their goal is to connect the users' needs and new technology (Brown, 2008).

Especially participatory design offers an approach where the users perspective is not only considered but they directly interact in the design process (Björgvinsson et al., 2010). Involving different stakeholders (Ehn, 2008) can lead to employees developing a better understanding of the new technologies and adopting ownership for the new solutions (Kang et al., 2015).

The objective of this research was to develop a framework that shows how design thinking can be a tool in supporting SMEs with integrating new technology. Since for them, the people involved are one of the biggest challenges human-centric design activities can provide support for digitalization. To investigate this topic further, this research will provide an answer to the following question:

RQ: How can Design Thinking support SMEs in the integration of IoT to enable Digitalization?

Conducting such research means addressing different topics that are currently highly relevant in business academics. On the one hand, it explores the areas of digitalization and Industry 4.0 transformation from the customer perspective. It also addresses how design thinking can on the one hand be used as a research method but also how it can provide a tool in user interaction.

The previously mentioned topics are not only relevant in academia and research, but also for practice. Many companies are currently struggling in their digital transformation and would benefit from more interactive support in implementing new technology in their business models to stay relevant. IoT companies are looking for ways to address these needs with the customers. For them, this research brings two advantages: on the one hand (a) it shows that design tool can provide a better customer experience to their clients and allows them to act more relevant; and on the other hand, (b) adding design thinking to their customer journey can provide new opportunities to reach out to new clients and convince them to transform their business models due to the support they receive. Companies gain a competitive advantage in their market by showing how design thinking tools can be used, not only in business transformation but also in customer support.

This research provides us with a 'how-to problem'. That means that the goal is to learn more about the topic and explore the concept. Whereas other research projects work with more strict and concrete hypothesis validation this research is more exploratory and moves from one insight to the next and generates new knowledge along the way. Therefore, the structure of this research is based on the basic design cycle and moves from empathizing with and defining the data collected to ideating and prototyping a framework that can be used to answer the research question.

1.2. Company Context

To research this topic the IoT company Undagrid will provide the case. The company and its customers will be explored from different perspectives to get a better understanding. The final result, however, will be a more generic framework that can be applied by other IoT companies as well.

1.2.1. Company Background

The IoT enterprise Undagrid was founded in 2014 and is located in Enschede. Their overall goal is to offer IoT solutions for tracking and managing different assets within the business processes of other companies. Undagrid's technology uses advanced data insights to improve the logistical processes of its customers. Their software visualizes information on the process and asset level and can localize assets globally from the last mile to meter, regardless if they are located indoors or outdoors. This enables their customers to enhance their performance and services, save money in their processes and stock management, and reduce their carbon footprint. The software is provided in a modular way so that assets can share information about their process state at any time.

Undagrid is active worldwide and has customers in different industries like aviation, harbour and shipping, agriculture, or railways. Undagrid challenges themselves to continuously think forward and offer their customers new ideas, which won them the award for best IoT idea in 2014.

1.2.2. Current Situation

The management of Undagrid decided to use the downtime during the Corona Pandemic to realign and specify their value proposition. Currently, the company offers its customers the complete solution for tracking their assets, which includes hardware, communication with positioning engine, cloud service and user interface. In the future, they want to specialize more in the tracking algorithm within the solution. They want to provide a positioning engine that can be embedded into any hardware. This change in their offering will create opportunities to reach new customers and enter new markets. Many of those opportunities will lead to digital transformations for their customers.

Currently, Undagrid only offers the technology, but they realized the need for support with their customers and therefore want to look into improving their service along with their technology that addresses this need for their customers. Since this service revolves around the customers and their

needs, Undagrid needs to emphasize with them to provide the best solution for their clients' situations.

The following chapters will dive deeper into the theoretical background of (a) design thinking, (b) participatory design, and (c) current trends and challenges in IoT and industry 4.0. The chapter after that will elaborate more on the underlying methodology of research through design and show how it enables this project. In the next chapter, the research process will be explained. The sub-chapters are based on different stages and activities in the design process and therefore do not only include a description of steps but also the insights collected here. The following chapter will present the framework that was created as a result of the insights collected through the research. After that follows a reflection and discussion of that framework and how it addresses the research question. The final chapter provides a conclusion to the research and shows academic and practical contributions as well as outlines points for future research and limitations of this one. Some concepts include more detailed visual materials which are included in the appendix.

2. Theoretical Background

This chapter provides some theoretical background on the topics of design thinking, participatory design and industry 4.0. The information has been collected from different academic articles, topic-related web pages and books.

2.1. Design Thinking

The topic of Design Thinking started to gain popularity after 1987 (Dorst, 2011) and describes how basic design principles are used in innovation and problem-solving activities. It is not restricted to the area of business or design but can be applied to any problem situation (Gram, 2019).

Looking back, the term 'design' is used to describe the aesthetics of products to boost their sales (Brown, 2008). In later years the meaning changed from visual aesthetics to problem-solving activity and became more human-centred. Today, it is seen as a way of thinking that can also work as a competitive asset for companies (Gram, 2019). Design Thinking is not only restricted to physical looks and manufactured products, but can also be applied to services, processes, and entertainment (Brown, 2008). In some cases, it is used to transform services or institutions from a current to the desired state (Gram, 2019).

In recent years there has been an upstream movement (Brown & Katz, 2011) and Design Thinking has moved closer to the centre of enterprises (Kolko, 2015), which means that managers should look into adopting more of a design attitude when approaching executive decisions. The difference between decision and design attitude comes from seeing decision making as an action where the manager needs to decide between alternatives and select the best, whereas in designing the best alternative is developed right away (Kimbell, 2009). This trend can be seen as a response to the increasing complexity of business and their modern technology and multi-faced problems (Kolko, 2015). To work on solutions, people need to interact with them and be able to make sense of it. Design Thinking offers a new approach to dealing with these (IT) problems (Dorst, 2011). The broad topic is involved in decision making and organizing (Gram, 2019) since it complements the established analytical techniques through the use of abductive reasoning (Kimbell, 2009). Organizations are challenged to create ideas at the outset of the development process and Design Thinking offers game-changing potential for that (Brown & Katz, 2011). It involves a shift from a cognitive to a more intellectual approach (Kimbell, 2009).

In general, Design Thinking in business is seen as a human-centred design activity, where the designers/employees/managers learn more about their consumers through experience and not necessarily through hypothesis validation. The goal is to connect the consumer needs with technology and business to address the customers where they need it (Brown, 2008).

Examples for the application of Design Thinking are the researches on technology use, strategizing, knowledge in organizations, accounting, or service innovation (Kimbell, 2009).

2.1.1. How it resembles the traditional design

The main takeaway from the traditional action of designing is the course of action for the change from the existing situation, to a more preferred one (Simon, 1969). Another thing that has been taken over from design practices is the stakeholder involvement in defining and reframing problems. This means that social interaction is located in the design process, which resembles the typical designer situation where the team works together around one big table.

Design practices shift the attention to anthropology and social perspectives to look less for meaning, but more for use. (Kimbell, 2009)

A distinction should be made between design as practice and design in practice. According to Kimbell (2009) design as a practice is often more habitual, rule-governed, shared, routine and can be conscious or unconscious. Even though it relates to organizational outcomes, it is not a rational problem-solving activity. The practice of design opens it up for others to participate. Design in practice means that design is a practical method that is enacted in practice. The design creates outputs like blueprints and models that are incomplete by nature and are constantly refined. (Kimbell, 2009).

2.1.2. Challenges for Design Thinkers

Change is never easy for companies, but necessary to stay relevant. One of the biggest challenges in designing new solutions is estimating the value of the effort and whether the return on the designing investment is sufficient. According to Kolko, companies need to embrace the risk that there is no guarantee for the outcomes. He explains that managers need to enable a company culture where employees feel comfortable taking this risk. It is also important to once in a while reset the expectations and accept that design does not always solve the problems (Kolko, 2015).

Another challenge in design thinking is the user perspective. As mentioned earlier, empathy is one of the most important aspects in designing thinking and enables the “designers” to see the situation from different perspectives and address it directly. Another important characteristic for Design Thinkers is integrative thinking, which means taking distance from the sole analytics. For that, they optimize as well and believe that there is at least one potential solution. This solution can be explored in experimental and creative ways and offers options for interdisciplinary collaboration which are incremental parts of the design process. (Brown, 2008)

2.1.3. Human-Centered – People First

One main characteristic of Design Thinking is the human-centred or people-first approach. The evaluation is less about quantitative data but more about observing the actual experiences. Everyday,

people like the customers of companies may not be able to exactly tell us what they are doing and therefore their situations need to be researched through phenomenological observations (Brown & Katz, 2011).

This way of handling research is often also called empathy and is what differs Design Thinking from academic thinking (Brown & Katz, 2011). The focus here lies on the emotional user experience. Through observing the behaviour of customers, the employees learn about their wants and needs that they express in emotional language. This includes their desires, aspirations, engagements, and experiences (Kolko, 2015). The process involves translating the observations into insights for products and services that generate value (Brown & Katz, 2011). For that, the employees need to look at every user-facing function within the company since these touchpoints shape the customer experience (Kolko, 2015).

2.1.4. Process

Design Thinking as a process is a continuous cycle with multiple loops of refinement. According to Brown, the cycle consists of the three main spaces of prototyping, testing, and refining. Instead of clear steps, the prototyping stage can be seen as three cycling spaces that enable continuous innovation. The first space is the inspiration which includes the circumstance that triggers the innovation. Another space is the ideation for generating, developing, and testing ideas which then will be implemented in the last space that forms the path to the market. (Brown, 2008)

Prototypes don't necessarily need to be physical objects. Even non-tangible problems can produce so-called design artefacts. This can include diagrams and sketches that explore the problem space. The visualizations provide fluid dimensions that enable the understanding of complex issues (Kolko, 2015). The prototypes themselves do not need to be complex or expensive. Oftentimes, the simplification clarifies the experience and leads to more concrete results. That means that the designers should only invest as much effort that will generate useful feedback. It is typical for prototypes, not to be perfect since that is the trigger for constant refining. The goal is not to finish the solution, but to have something to evaluate (Brown, 2008). This type of failure is part of the design thinking process and should be tolerated as a learning opportunity. Prototypes offer a way to explore the solution space and to communicate ideas (Kolko, 2015). Even though aesthetics elements are not necessarily the main focus in solution space, they should not be ignored, since looks are what appeals to the emotions and engages with the consumers. The emotional level is one of the biggest payoffs in the design process (Brown, 2008).

The Institute of Design at Stanford adds two more stages in front, namely the previously mentioned step to empathize with the consumers and the defining stage (Figure 1 Design StagesFigure 1). In this

step, the situation is clarified and gives an overview of the context (Siang & Interaction Design Foundation, n.d.).

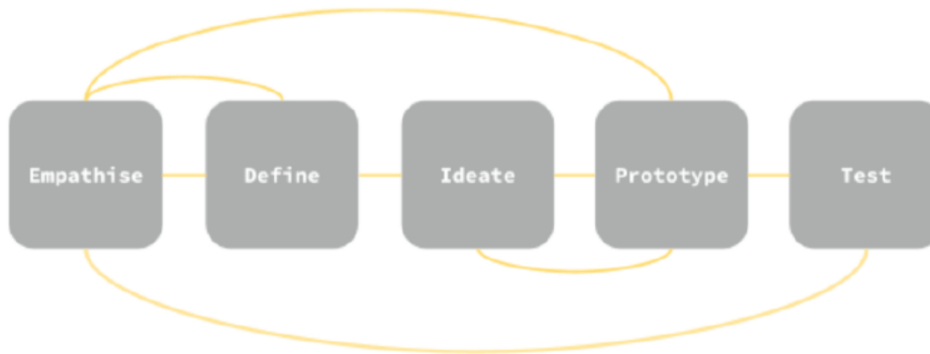


Figure 1 Design Stages

2.1.5. Abductive reasoning

Design Thinking is not just an activity within projects but works across projects. When starting the process the problems often need to be deconstructed to enable the analysis of the situation. The designers try to read the situation and find recurring themes in the broader problem situation. These themes can help capture the underlying phenomenon and can trigger the creation of frames for abductive reasoning (Dorst, 2011).

The core challenge is to a certain need and this can be visualized in a type of formula (Figure 2) (Dorst, 2011).



Figure 2: Abductive reasoning

There are two types of abduction and design problems usually start in the second type where the only known part is the result that corresponds to the previously observed needs. As part of the reasoning, we need to parallel develop the what and the how component (Dorst, 2011). This relates to the Concept-Knowledge theory of Hatchuel and Weil, which says that the important element in the process is one that you do not know yet (Kimbell, 2009).

To bring clarity into the unknowns, the designers need to work backwards and start with the known result and perform a form of inductive reasoning to define the working principle. Together, these two elements form a frame that can be used to observe the problem situation. This offers enough information to start designing what to complete the formula. After the design, the next step is to

reason forward and to perform the common deduction which tests whether the thing and the working principle lead to the results (Dorst, 2011).

2.1.6. Design Thinking as part of Innovation

When starting the innovation process, Design Thinking should be involved right from the beginning. The human-centred approach can reveal unexpected insights and helps the “designer” to directly reflect on their consumers’ needs, which is important to understand the situation. The process does not necessarily need to only involve designers. For innovation, talent should be looked for anywhere if a necessary outsider can be helpful as well and can expand through their expertise. The key players should stay involved throughout the whole process to ensure the continuity of learning and understanding (Brown, 2008).

It is possible to relate the rise in Design Thinking discussions to the observed cultural change in companies. It has been noticed that the focus is more towards applying skills to problems that matter, not necessarily due to collective altruism, but more because innovators are intrigued to work on the edge and achieve completely new things. This excitement is driven by the fast development of new technologies that offer opportunities to change the rules of the game completely and stand out from the crowd (Brown & Katz, 2011).

2.2. Participatory Design

Participatory Design (PD) is a designing attitude that engages with the community (*Our Approach — Participate in Design*, n.d.) and involves different stakeholders as co-designers (Ehn, 2008) in the designing process. This practice has emerged through the shift from product-oriented and being purpose-driven to a user-centered design that uses co-designing activities. It enables the exploring of different backgrounds and focuses on the users’ experiences, interests and roles (E. B.-N. Sanders & Stappers, 2008). Participatory design has its roots in the Scandinavian approach of democratization at work where stakeholders were involved more through participation and joint decision making (Ehn, 2008). It is a joined effort between professionals, community members, consumers, or end-users aiming to achieve something that fits with everyone (Moyers, 2018).

This does not necessarily mean that everyone makes the final decision but more that an idea and an understanding is created that can lead to a decision. The users get the chance to explain their perspective and show why they need things in a certain way. Instead of simply telling their story they can show what matters to them and make the solution more specific. (*Participatory Design in User Research*, n.d.). The shift in design approaches towards more user participation takes the form of ‘design-by-doing’ and ‘design-by-playing’ (Ehn, 2008). This means that there is not necessarily a strict separation between developing and testing but a combination of both simultaneously.

By adapting design practices in everyday work there is more engagement with the stakeholders. It provides an environment that focuses on learning from each other and combines doing, talking, thinking, feeling, and belonging (Ehn, 2008). The value builds on the shared understanding between the stakeholders. When different voices are heard, understood and integrated into a decision process, the solutions can be more flexible and robust (Kang et al., 2015).

Design practices like participatory design are appearing more and more in contemporary business practices. However, it is still met with skepticism. Within the organizational hierarchy, it is treated superficially and functional roles need to convince their peers and justify the practice. (Khan, 2020)

2.2.1 Benefits of Participatory Design

Design projects can be described as sociometric things that align people and technology within design activities. These projects have objectives, timelines, and work on some form of deliverables. By aligning the participants around a mutual point of interest the projects modify the space of interaction for the users and allow them to learn from each other (Ehn, 2008). This approach can support the understanding of the relationship between work and the use of technology in a workplace (Kang et al., 2015). Furthermore, it makes sure that existing skills are being integrated into the solution design and utilized in the process. Participatory design can enable a dialogue between technological knowledge and different kinds of traditional wisdom (Cortés-Rico & Piedrahita-Solórzano, 2015).

Additionally, participatory design enables a sense of ownership in the users, which can lead to higher acceptance of changes (Kang et al., 2015). Direct access to the design process can also boost the users' confidence and self-reliance. Participants develop realistic expectations and build up less resistance to change. PD strengthens the community bonds and can reduce risks and costs. (*Our Approach — Participate in Design*, n.d.)

The difficulties with design projects are the involvement of so many different perspectives at the same time and that they do not always align seamlessly. Besides that, designing as a tool in business is still not common and challenges the known ways of solving problems and dealing with uncertainties (Khan, 2020).

2.3.2. Meta-design Perspective

When looking at PD it can simply use to design a device or come up with a solution but it can also act as a tool to design an infrastructure for the designing process after design (design for use before use) (Ehn, 2008). Such an approach can lead to more open and flexible systems that give space for customizing and extending, Continuing design-in-use, Continuous design and re-design in the bigger picture. To simply: the meta-design is about establishing formats and protocols on formatting and protocolling, meaning it provides means for configuring (Ehn, 2008).

There are different strategies to build such an infrastructure. The component strategy is like playing with Lego blocks, where you have small pieces that you can combine in different ways to build unique solutions. You can also work with design patterns, where you follow a certain structure depending on the context of use, problematic situation, or proposed solution. This does not mean there is no space for thinking differently but more a frame of reference. Another way is to provide an ontology – domain-specific language – for the environments, concepts and relations that are part of the projects environment. This language provides a common way of communicating ideas and collecting thoughts.

Another aspect of the meta-design is the ecology of devices. Referring to the biological phenomenon this concept describes the interaction of people with devices in their environment. The main message is that no device can be realized without being meaningful to the people around it that can utilize it. When working on a design project it is also important to explore the cooperation, interdependence, competition, reproduction and retirement of the different actors and devices with each other (Ehn, 2008).

2.3.3. How to facilitate Participatory Design

There is no one straightforward recipe to participatory design but there are some general principles that can be used to facilitate. One focus point for participatory design sessions is connecting with the people involved. Facilitating sessions that give everyone a voice and build relationships between different actors strengthen internal bonds. As mentioned earlier the primary goal should be to understand what is going on. Therefore, it is important to go directly to the people and discuss with them but also to make information accessible for everyone and easy to understand. Participatory design sessions should encourage the creative spirit and therefore be less prescribing and more facilitating. It should not start with a perfect solution but with gaps, people can fill. The joined effort is the main tool and makes use of the individual strengths and potential. Eventually, you deliver a process that leads to a vision, designs, or a simple understanding of the situation (Kang et al., 2015)

2.3.4. Tools and Techniques of Participatory Design

The tools that can be used in PD differ across sessions and highly depend on the specific situation and context. In general, it makes use of verbal communication of ideas in the form of workshops. A common tool is cooperative prototyping. The involved stakeholders work with a prototype and collect experiences to improve the potential product or service. Another tool is mock-ups which stimulate the stakeholders to think about new ideas and become creative about the future. Card-sorting is also common and a process in which stakeholders write down relevant information cards or post- it's that can be sorted moved to combine different ideas. (Kang et al., 2015)

Sanders et al. tried to sort common tools among three dimensions: form, purpose and context (Sanders et al., 2010). Form refers to the type of action that is taking place between the involved participants in an activity:

- Making tangible things
- Talking, telling and explaining
- and/or enacting, acting and playing

The purpose explains why the tools and techniques are being used:

- probing participant
- priming participants
- get a better understanding of their current experience
- generation of ideas or design concept

The context describes where and how the tools and techniques are used and can determine which tool is more relevant than another tool:

- group size and composition
- face-to-face vs. on-line
- venue
- stakeholder relationships

2.3. Current trends and challenges in IoT and industry 4.0

The concept of industry 4.0 refers to the innovative concept in which organizations adopt technology to become more efficient and “smarter” (Akhil, 2019). Technologies enable them to automate processes, use machine learning and communicate more efficient across their business and with their market (Sjödín et al., 2018).

Recent developments in IoT and industry 4.0 includes automation of processes (Pandit et al., 2020), environmental monitoring (Dubey et al., 2020) and improved semantic models for common language (Steinmetz et al., 2018). The biggest development, however, is the better accessibility and availability of technology in recent years (Dubey et al., 2020). This includes falling costs for sensor and data storage, expanding internet connectivity, increasing computing power and the increased compatibility with smartphones and tablets. These developments lead to more opportunities for the adoption of IoT in organizations.

Unfortunately, the transformation is not as easy as on paper and many companies struggle with the change. This relates to different factors like the change management capabilities and level of tech readiness, but also financial and human resources. Next to that, not every company has necessarily the right tools and systems in place to adopt new technologies (Zhang & Chen, 2020). In other cases, the IoT technology is not able to integrate with the existing systems and technologies (Dubey et al., 2020). Implementing technology into an existing company requires expertise and attention. Next to that, companies’ internal processes and employees must be read to transform and adapt the existing

vision (Ray, 2016; Sjödin et al., 2018). After implementation, organizations also require support in maintaining the new system and growing their business through the change (Ray, 2016).

3. Methodology

As mentioned earlier this research addresses a 'how to' research question and therefore, the purpose is to explore the topic of digitalization further. One way to do this is with practice-based design through research.

3.1. Research through design

The aim of research through design is to generate knowledge through design activities (Stappers & Giaccardi, n.d.). This exploratory approach does not focus on the outcome but involves defining the problem while working on solving it (Motta-Filho, 2017). Often this methodology is misunderstood as preliminary research for designing a product but it is more than that since it can be used to contribute knowledge (Zimmerman et al., 2007).

Design is being used more and more as a research method. Through the focus on knowledge creation, it offers a more comprehensive approach to addressing complex problems (Bayazit, 2004). Activities like (re)framing and developing prototypes help develop a good understanding of such complex situations (Stappers & Giaccardi, n.d.). So-called 'Wicked Problems' are one example of a complex system. They relate to situations with conflicting perspectives of the involved stakeholders. Therefore, the challenges cannot be addressed with traditional research approaches like hypothesis validation (Zimmerman et al., 2007). These practices are like 'puzzle-solving' where researchers apply accepted theories to known problems or new domains (Gaver, 2012). Combining traditional research with design practices produces 'real' knowledge which reflects a more holistic picture (Zimmerman et al., 2007).

The empathizing and ideation activities reveal deep insights into the topic, of which some can be more unexpected than others. The act of designing and prototyping also generates knowledge (Stappers & Giaccardi, n.d.). Some are directly integrated and some can be fed back into the system and used in other projects (Stappers, 2007). The testing and reflecting facilitates an environment for discussion or the possibility for people and products to engage in interactions that were not possible before (Stappers & Giaccardi, n.d.). The resulting frameworks avoid setting a 'one true' solution but rather provide an ontology for describing the topics (Gaver, 2012).

3.2. Methodological Approach

The research process of this project was based on the main design stages (a) empathizing, (b) defining, (c) ideating, (d) prototyping and testing. The qualitative data collection took mostly place in the empathizing stage. Some of it was gathered through secondary research into the existing literature on the topics of design thinking, participatory design and industry 4.0. The biggest part was generated as

primary data through interviews with company representatives and creative sessions with customers and partners of Undagrid.

This approach proved to be relevant to the topic since digitalization and the challenges SMEs are facing are partly caused by wicked problems where the perspectives of the different stakeholders do not align. Besides addressing such problems research through design can also inspire new research and motivates the stakeholder's communities to discuss preferred states and to reflect on possible consequences (Zimmerman et al., 2007).

However, it should be noted, that research through design does not include clear standards for what counts as "good" research. Such protocols might restrict the form of the research and suppress the broad knowledge generation (Gaver, 2012).

3.3. Data Collection and Analysis

To start the knowledge generation for the ideation and the framework semi-structured creative sessions were conducted with five customer companies and five partner companies of Undagrid. These participants were selected by the company based on their customer journey and relationship. The sessions were conducted in online calls and lasted approximately 45 minutes each. The session was structured in five blocks and used an online whiteboard for visualization of questions and answers (Appendix A).

The sessions were transcribed and coded in a data analysis program. The codes were later on sorted into concepts and grouped into themes to create a data structure (see chapter 4.2). This allowed a structured review of all the data collected and acted as inspiration for the ideation session and designing of the prototype. (Appendix B and C)

3.4. Evaluation of Methods

Whereas other research projects work with more strict and concrete hypothesis validation this research is more exploratory and moves from one insight to the next and generates new knowledge along the way. The research process is based on the action. That means that the problem is being defined within the process of working on it and, like abductive reasoning, a frame is created based on desired value and working principles. Practices like this help uncover patterns and support a deeper understanding of the situation and the involved actors.

The biggest constrain in this research was the timeframe. Design projects tend to take up larger amounts of time to explore multiple perspectives. Besides that, the small time frame did not allow the running of multiple prototypes for further testing and exploring.

The next chapter will give some more detailed insights into the research process.

4. Process

As mentioned earlier this research followed the main design thinking stages of the Hasso Plattner Institute of Design at Stanford (Siang & Interaction Design Foundation, n.d.). Each stage involved different tasks and activities (see Figure 3).

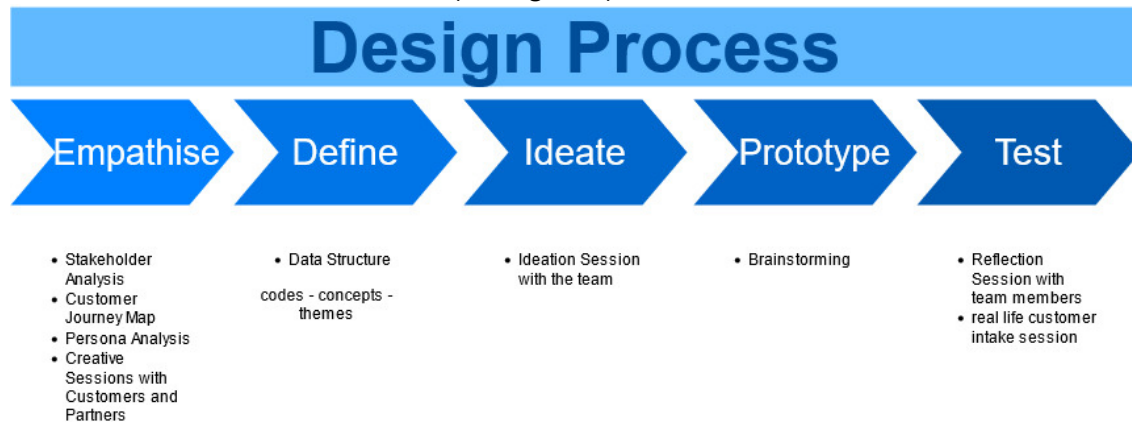


Figure 3: Research Design Process

In this chapter, we will take a closer look at the research process. The purpose is to show how the method from the previous chapter has been applied in practice. Each design-thinking stage includes a more in-depth description of the activities and the results they brought forward.

4.1. Empathise – Data Collection

In the beginning, the focus was on empathizing with the customers/partners, and the company. The main purpose during this stage was to understand what is going on, to look at the different perspectives and to frame the problem. For that purpose, data were collected in different ways. The desk research included a simple stakeholder analysis, mapping out the customer journey and learning about the already existing personas of Undagrid. The information collected here allowed a better understanding of the company dynamics and the current situation for interacting with the customers.

4.1.1. Stakeholder Analysis

Current design projects are highly human-centric and focus on the people interacting with the project. A stakeholder analysis can therefore shine a light on the people involved and their relationships (Stickdorn et al., 2018). This stakeholder analysis is based on the organizational structure of Undagrid and relates to their interaction with their partners and customers. The involved parties are arranged

on a matrix with four quadrants depending on their level of interest in Undagrid and the amount of power they have (see Figure 4) (Johnson et al., 2018).

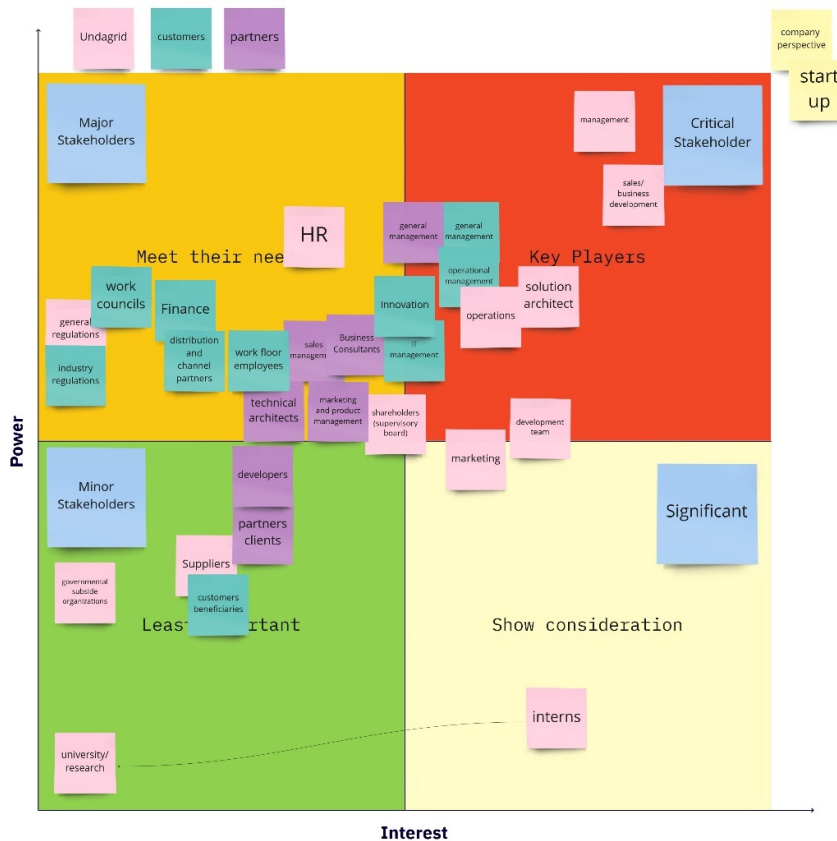


Figure 4 Stakeholder Analysis

When looking at the analysis it becomes clear that a potential service design should focus on the critical and major stakeholders.

For Undagrid that means that the key players are mostly from their team or the customers' management. Since the company is still in the start-up phase a potential service would involve someone from the management that is responsible for the sales and business development and has the needed expertise for the operational aspects of the project. Next to that, there would be a specific solution architect who is responsible for the concrete solution and implementation.

From the customers' side, the key players are the innovation teams and IT management. They mostly interact with Undagrid and work on the solution with them. Besides, the company's management might not be involved directly but needs to be kept in the loop with decision making.

Other major stakeholders might not directly be involved with Undagrid and the solution but are affected by the customer companies changes. Therefore, their needs should be included as well. On

the customers' side that includes the work floor employees and the other departments of the organization. Besides these, this category also includes different stakeholder groups from the partner organizations that work together with Undagrid in specific solution cases.

4.1.2 Customer Journey

The customer journey is a simple map of the steps that take place when a customer approaches Undagrid and starts working with them on a solution (see Appendix D) (Stickdorn et al., 2018). For them their customer journey can be described in four major stages:

1. Companies reaching out to them
2. Engagement
3. Proof of concept and pilot phase
4. We are in Business

The main focus of Undagrid throughout this journey is to relieve the 'headaches' of their customers. Headaches refer to their struggles in process and data management where Undagrid solutions can provide improvement or new opportunities. The company aims at improving their customer's mood throughout the stages from worried, to good, to excited. However, it does not always go as planned. Undagrid noticed that sometimes customers end up rather disappointed, due to them starting the journey with too high expectations which can't be fulfilled.

The customer journey map shows different opportunities to improve the customer experience with Undagrid. Overall the process of taking customers in and working together with them needs a bit more structure and maybe some more standardization in some places. This could improve the quality and efficiency of intakes but also help with more scalability in the future.

One thing to keep in mind is that from Undagrid's side there needs to be a more realistic sales approach. They find themselves sometimes dreaming too much about what could be instead of what they actually can deliver. This is one of the reasons customers get disappointed. They need their focus to be more on what they can do and to avoid losing sales.

Undagrid also aims at showing more initiative and collaboration after the implementation of a solution to guide their customers more through the change and journey.

4.1.3. Persona

As part of their, rebranding Undagrid has worked out some key client personas to help them adjust their value proposition and work on their marketing strategy.

The main persona Undagrid has contact with is Sally a logistics or operations manager in a company. She reaches out to Undagrid to address to find a solution for her 'head aches'. Sally faces challenges like inefficiencies with resources, finances, locations or planning. She hopes that Undagrid can help

her with creating an overview of her operations, insights into bottlenecks and support her in improving the processes.

As a logistics or operations manager Sally has a certain amount of technical knowledge and carries the responsibilities for her department. However, she is not taking decisions alone and reports to her CEO or higher ranked manager.

Overall to convince Sally, Undagrid needs to communicate clearly which specific tools they offer that can help her concrete situation.

4.1.4 Creative Sessions

The main activity in the empathy stage was conducting creative sessions with some of the customers and partners of Undagrid. In 45 minute sessions, the perspective of SMEs that go through the digitalization journey was investigated to gain an understanding of the needs and challenges. In total there were five customer sessions and five partner sessions, which all took place via online calls. The session was structured in five blocks and used an online whiteboard for visualization of questions and answers (Appendix A).

Before talking about digitalization each participant was asked to introduce their company by explaining their core business, elaborating on the overall mission and core values. The intention was to later put their answers in perspective and possibly explain trends or outliers.

The next block was aimed to get learn more about the current digital situation. First, they had to place their digitalization progress on a scale, ranging from just started, via working on it towards everything is digital. Next, they were given a list of common dimensions of digitalization and asked to pick the ones they were active in. If needed, they could add their own as well. The customers answered this for themselves, while Undagrid's partner companies generalized it for their experience with SMEs going through digital transformations.

After that, they were asked to elaborate more on their digital transformation (or their generalized observation) by describing the past state and the new (aimed for) situation.

The next block narrowed the focus and addressed the change and challenges that come with it. After listing aspects that needed to be changed throughout the company and explaining what in particular was difficult to change, the next block focused even more. First, the participants were asked to explain more why those aspects were difficult and how they affected the transformation or company as a whole. The next step was to come up with possible solutions that could help and would address the previously mentioned challenges. Eventually, participants could sort the proposed ideas based on who should be responsible: the provider company (Undagrid), the customer or both sides.

The last part of the session was intended to round off the session and summarize the result of the creative sessions. Participants were asked to formulate three ways to support a digitalization journey and share any further aspects they considered important in this topic.

These sessions intended to explore the perspective of the customers and not directly answer particular questions. The questions from the block were meant to guide the thinking process of the participant. Each participant had their own whiteboard where the results were collected on. Later on, the results were all collected anonymously in data software to prepare them to be analyzed. The insights of the sessions were further analyzed in the next stage.

4.2. Define – Data Analyzation

In this stage of the process, the results from creative sessions were analyzed more in-depth to formulate more concrete insights that could be used in the ideation and design phase. For that, the principle of a data structure was used. Therefore the input from the creative sessions needed to be sorted and coded into initial quotes based on the original terms and language from the sessions (Gioia et al., 2012). After that, the codes were developed into first-order concepts (Appendix B). This reduced the initial 156 codes by seeking similarities and differences. These 26 concepts were then transformed into 2nd order themes. These themes have been formulated as conclusive terms. The data structure acts as a visualization of the insights gathered and helps make sense of the input (Appendix C).

The main takeaway from the sessions about the customer perspective was that most of the difficulties within the digital transformation arise within the implementation of technology and their own change management. That means there is not only a change in their internal processes or new data available but also changes in many different aspects of the company. For some organizations, the digital transformation changes their way of working. This can extend to new business and sales models or new finance models. The timeline for such a transformation can therefore be quite extensive.

These aspects are all things that can be implemented and adjusted. However, the difficulties mostly arise in the employee change that comes with these organizational changes. The new way of working causes worries for the employees and they feel excluded from the decision. Not all of them understand the added benefits of using technology and can't trust the computer to do their job. For many, their tasks change and require new training or a shift in responsibilities. Some employees feel they might lose their job and others have to leave. These aspects worry and sometimes anger the employees and can result in resistance to the change and failed implementation.

With lots of organizational changes and low employee support, digital transformation can be a tough task for managers and innovation teams. Often this results in losing projects or bad implementation

of new technologies. They are constantly trying to pull everything together simultaneously. Since this part of the change requires all the manager's attention and efforts they rarely utilize the full potential of their organization. That means that the efforts to bring everyone and everything on the same line take up all the energy, which otherwise could be used to support and further drive the further growth and full filling of company goals. Solutions like the ones provide new value which due to the difficulties can not always be realized. One aspect that is often missed out on is the perspective of the companies customers and the needs.

From the customers perspective, the most important thing in handling the digital transformation is managing the change. This refers to the behaviour of the initiating department or manager but also the organization's overall management. On the one hand, the person or team that is in charge of the transformation needs to have a clear vision and not be afraid to make changes but also still bring everyone together and appropriately guide them through the change. One important element in taking the whole organization along is the convinced upper management. They can actively support the innovation team and guide the organization through the transformation. This, however, means they need to be convinced to begin with and need to be involved in the transformation. The management levels should get involved in the transformation and not only delegate and sign off to ensure better alignment. Their role of leadership should act as guidance to the rest and facilitate equal teamwork.

The general advice for going through the transformation is that the company and leading manager need the right attitude to the change. That means they need to adopt a powerful mindset that is motivated and positive towards the transformation. Managers should stop being their worst enemy step out of their comfort zone. Overall some general challenges come with a change and they should be properly recognized and addressed.

The data structure includes one group of concepts that stand beside the insights (a) categories of digitalization, (b) digitalization progress, (c) reason for transformation and (d) requirements for technology. Those concepts either relates to extra information gained from the session or includes general information that helped get to know the customer of the partner company and make sense of potential outliers or trends. Therefore, these concepts are not included in the structure.

4.3. Ideate

This stage is intended to formulate some requirements for the final design. The main activity was an ideation session with several team members of Undagrid. Before the session, they received the first results from the previous stages to learn about the customer perspective. Similar to the creative

sessions the ideation took place as an online call and used a digital whiteboard and workspace (Appendix E). The main purpose was to put the previously formulated insights into a context and stimulate new ideas.

The ideation session took place with 4 team members from Undagrid who work in different departments of the company. The purpose of the session was to discuss the insight gained in the previous stage and start the creative thinking process towards addressing the problems. The session took two hours and was a mix of individual work and joined the discussion. Before the session, the team members received a summary of the insights so that everyone would be on the same page.

At the beginning of the session, the team members looked at the insights from the customer perspective sessions and selected three topics that they experienced as the most urgent.

Together they choose employee management, learning about the digital environment and transforms the way the company is working. They had a short discussion about their experiences with topics and added more details to each insight from their perspective.

The next step was to dive deeper into the topics so the team took some time to generate 'how-might-we' questions (Stickdorn et al., 2018). Later on, the team sorted these questions into clusters based on similarities. Within each cluster, the questions were prioritized to indicate which questions are most urgent to be answered. These questions formed the starting points for the creative thinking process. The top questions from each cluster were selected and used in the next step. The team members started brainstorming ideas for solutions to those questions. After that they were tasked to arrange their ideas in an idea portfolio (Stickdorn et al., 2018), to evaluate them based on feasibility and impact.

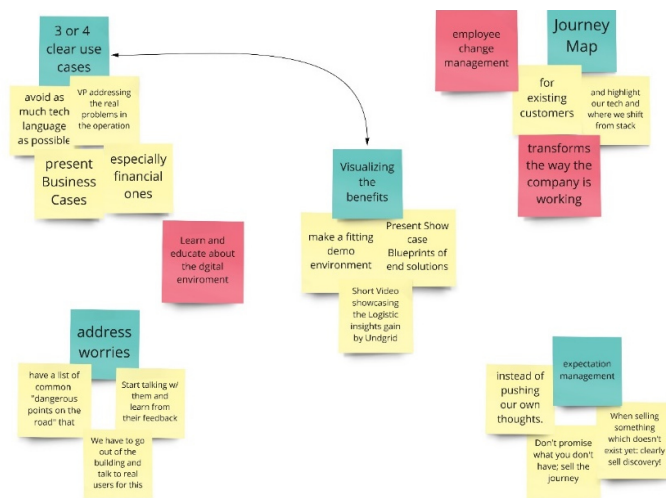


Figure 5 Design Requirements

Based on the idea portfolio some design requirements could be derived (see Figure 5). The team thought that they could support the understanding of the technology by providing clear use cases to new customers. These use cases could be part of the strategy to visualize benefits more. Meaning not only showing how it works but how the company can benefit. For this purpose, the team considered visual materials like videos, blueprints and demo environments the most effective.

Next to addressing the positive sides of their service Undagrid also saw the need for addressing the worries of their customers and its employees. One way to do that could be addressing common worries already with their presentations. Another option would be to be more interactive with the users of their solution to understand the real problems and worries and address them in a direct conversation.

Even though it is not Undagrid's business to consult their customers in general change management the team thought that clear journey maps could help them in their transformation. These maps could also be implemented with existing customers as well and help visualize the shift they are going through.

During the ideation, it was also pointed out that there is a need for more realistic expectation management. Similar to the customer journey the team realized that to keep their customers grounded and make the transformation easier for them Undagrid needs to be more realistic with what they can do. Meaning the company needs to think with customers within their boundaries and not dream of new ideas.

4.4. Prototype and Testing

4.4.1. Prototyping

The next stage in the designing process was to create a prototype of the framework. This was the only individual activity throughout this process. I collected all the results from the ideation session and data collections and started mapping them out on a service road map.

This required some more desk research into the topic of participatory design, which arose based on the gathered insights. Therefore, I needed to collect some more academic resources on this topic (see chapter 2.2.). The papers helped gain a better understanding of participatory design and some included some tools or approaches. However, most contents was on how to use participatory design in education and social environments. Nevertheless, the literature provided the base for the following step.

The main focus in this stage was on putting together the pieces and generate a solution to the design problem. The creative brainstorming and designing were done based on the example of Undagrid and

its defined persona. Later on, this was transformed into a generic framework (see chapter 5) that can be used by other companies as well.

4.4.2. Testing

An important part of designing is continuous testing and refinement. Due to the scope of this assignment, there was not much space to do multiple cycles of testing and refinement. However, there was one reflection session with two team members from Undagrid. The framework was presented to them so that they could give feedback and discuss the companies perspective on the ideas. In general, they agreed with the results, however, they had some smaller remarks regarding the concrete activities. The feedback was used to adapt the framework.

The team members from Undagrid noted that in their opinion it is good to have the 'Henk' employees on from the first session, not only for their perspective but also because they usually understand the whole process better than for example the innovation managers, who have a really specific task. Next to that, they pointed out that the focus of the first session should be on finding the "nitty-gritty" annoyances of the different stakeholders. These hidden gems provide good starting points for the change. Their biggest remark was regarding the scope of this framework. Undagrid noted that the results were mostly relating to the change management in the employee companies. They noted that eventually for them and other IoT companies the complete participatory process would exceed their core businesses and expertise. The team members pointed out that there is no Swiss knife to approach these problems and it might be more realistic to have different partners involved in this process. Each partner would fill in their expertise to the whole framework.

Another point of feedback was a customer intake session conducted by Undagrid with a new customer. This session was not based on the framework, however, it already included some elements of participatory activities. The session was based on discussing the relevant personas and take a first look at how the customer's process could be transformed. Next to some general observations, there was also a feedback round in the end with the participants.

The observations were more about the practical setup and facilitation. For example that it was great to have a basic process map prepared in advance so that during the meeting the focus could be on discussing details rather than the complete process. The session also demonstrated how important it was for the employees to discuss with each other and have the Undagrid responsible there as a facilitator but not leading the discussion too much. This gave space for the employees to explore different angles and learn from each other's experiences.

After the session, the participants from the customer company had a positive impression. They were missing some more details about the technology and had some unanswered questions on how the

different elements would work together. Overall they would have liked it to already have a comparable business case introduced to them as an example so that they could envision the project a little better.

The feedback from both sessions was used to adjust the framework and gave the first opportunity for review. However, much more testing and reviewing is should take place in the future to improve the concept and make it more relevant.

5. Results - Framework

In this chapter, I will demonstrate a framework that can be used to facilitate a service for implementing digital solutions in organizations. This framework is based on the principles of participatory design as described earlier.

Looking back on the data collection and the ideation session it becomes clear that there are two main perspectives when looking at a possible service. On the one hand, there is the sales perspective that refers to the IoT company (in this case Undagrid) needing to convince the innovation manager or IT lead to becoming a customer. The other perspective is more on the customer companies side where the manager needs to be supported with the digital transformation of the company and convincing the team.

That means when thinking about service or service elements they should now only address a manager or innovation team but should also the work floor employees and the other departments in the customer organization. This depends on the company that is involved and that needs to be addressed. These employees are involved in the bigger picture and for them, the change can be difficult. If not addressed properly they can hinder the digital transformation

5.1. Henk as a quasi persona

For this project, the problematic employees will be collected under the persona of 'Henk'. The name has no significance but acts as a representation of involved employees that have difficulties coping with a digital transformation and therefore can hinder the process.

Henks are stakeholders that are affected by the changes of the digital transformation. However, in comparison to employees in the process management or innovation team, they might have not chosen for the transformation to take place and would prefer things to stay as they are.

Henks create additional headaches for their managers and block the solving of her primary problems. When the managers approach an IoT company like Undagrid their primary focus is to address problems in their process management or to improve their services. When Henks are overrun with the transformation, they make more problems for the managers by showing resistance and slow or even bad adaptations. With those other problems, the managers might be hesitant to go into business with Undagrid or testing a solution might fail.

Henks can block the progress because of low understanding and acceptance of the need for a digital transformation. By involving them more in the solution building process they might be able to understand the situation better and get a sense of the use of technology. Besides that, the interaction

in the process could help their manager to understand the situation better and gives space to find a solution that fits everybody and makes use of the complete potential in an organization.

This approach of including all sorts of involved stakeholders and users can be seen as a form of participatory design

5.2. Framework

The framework consists of seven steps (Figure 6) which refer to the different purposes of participatory tools: priming (blue), understanding (green), generation of ideas (purple), and probing (pink) and other activities (yellow) (Sanders et al., 2010). In the following section, each step includes a description of its focus and some guidelines for activities that could take place in this step. Each IoT company would need to decide the details for themselves depending on their structure of customer interaction and of course their customer's needs.

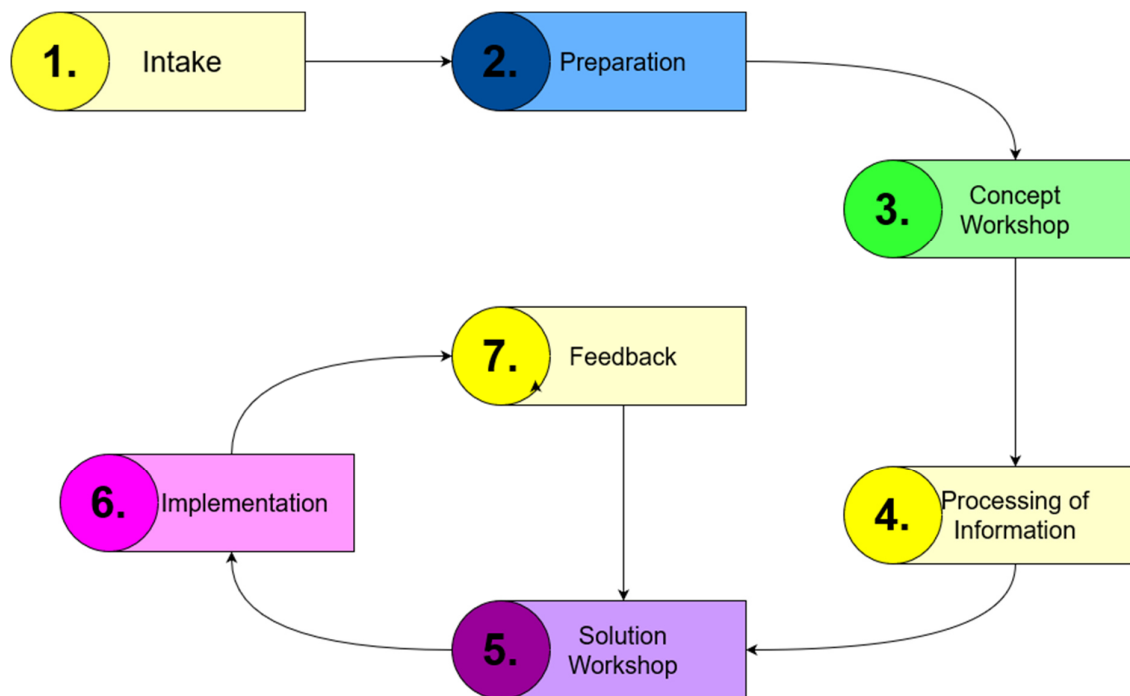


Figure 6 General steps

To simplify the description the framework has three main actors: the technology provider, the manager of the customer company, the Henks of the customer company.

The framework is based on the current customer journey of Undagrid. It has not been implemented yet. For demonstration, I will illustrate the framework on the company and its manager persona Sally.

Step 1: Intake

This step is the beginning of the customer journey with an IoT company and more a formality step that starts off the process. A manager (Sally) reaches out to an IoT company, like Undagrid that offers

an IT solution that could address the managers professional headaches. In a first call, they can get to know each other and make a first superficial problem assessment. This first impression is important for the IoT company to have an idea in which direction this partnership could go and whether they can provide a solution. After this brief introduction, Sally receives some information material from the IoT company containing more details and instructions to prepare for the first workshop.

Step 2: Prepare for Concept Development

This steps main purpose is to prime the stakeholders for the workshops and to get everybody affected on board. Undagrid is not involved here and the main responsibility lies with Sally. Based on the intake talk she had, Sally should map out the stakeholder across the organizations and determine who would be affected. Based on this she can form the team that will work on this project. During the intake, Undagrid should make it clear to Sally how important it is that every one that is affected by this project should be represented in the team.

To prepare (priming) the team for the first workshop, Sally can share the information material received from Undagrid. This material should include information about the company, easy understand explanation of the technology and a relatable business case. The information package should be easy to understand for everybody and make sure that the participants are informed to think along.

Before the workshop, the team can already sit together and maybe prepare by discussing a general goal or share their worries.

Step 3: Concept Workshop

In this step, all three parties come together: Undagrid, Sally and her team. The workshops session are formed through talking and telling each other about experiences since it brings together people with different amounts of knowledge. Since the topic is more or less intangible this dimension fits the best because it does not involve any physical objects or focuses on social relationships (Sanders dimensions 2.3.4.). The goal of this workshop is to gain a better understanding of the situation (Kang et al., 2015), the headaches, how it affects the employees and departments involved and what goals everybody envisions. Undagrid and Sally can use the insights to map the ecology of the project (see 2.3.2).

After a small introduction of everyone involved, the group should be split into smaller groups. If possible these groups should be formed based on the participants' backgrounds so that they can describe personas affected by this project and connect. Each group could take the position of one persona and introduce them to the rest based on the personas goals, pains and needs. This exercise would deepen the understanding of each other's situation and enable Undagrid to get an idea of where this project could head to and who the possible Henks are (Kang et al., 2015).

The next exercise should be a mix of understanding and thinking further (generation of ideas). Undagrid could present a use case of a previous customer that is quite similar to Sally's organization. Afterwards, the whole group could ask their questions and share their worries (understanding). If possible Undagrid could already address some of the worries based on their experience and expertise.

The goal at the end of the workshop is to have everyone involved in the thinking process and excited for the next workshop.

Step 4: Processing of Information

Between the two workshops, the team should have some time to process the information they received. This can mean different things for everybody. Some people might want to discuss the project within their departments, some might want to do more research some might just need time to think over it. Undagrid could choose to share some more detailed information with them to work through. This could include some insights into possible changes in finances, business or sales models or some other use cases.

Step 5: Solution Workshop

The focus of the second workshop session lies in the generation of ideas. One way to start this session could be to list the main headaches and biggest worries. Again the group should split up into smaller ones but this time more mixed backgrounds. Within the groups, the team members can brainstorm on possible solutions how to address the worries and work on solving the headaches. These discussions should be based on their insights into the technology options and the understanding of each other's situation. Afterwards, all ideas can be presented to each other and discussed within the whole team. Through these activities, the team can build a strong bond and confidence in starting the journey (*Our Approach — Participate in Design*, n.d.). The different team members learn from each other's ideas and might find compromises or new ideas (Ehn, 2008).

This workshop should be joined by a solution architect from Undagrid. After listening to the brainstorming of the team this solution architect can give an overview on how Undagrid could support the project. He/she can present possible solutions and directly respond to questions from the team. The solution architect is the expert for the technology and can facilitate according to patterns of implementation based on his/her experiences. All together they can work out an ideal blueprint. No matter how it is set up this activity should enable the participants to play around with ideas and to envision how they and their skills would interact with different ideas (Ehn, 2008).

Step 6: Implementation

In this step, the big group work stops for now. The project has reached a point where it will become very technical. Now it is time for Undagrids solution architect to work out a concrete solution based on the input he/she received from the workshop sessions. Together with the main responsible from the customer company, they can work on the implementation of a pilot.

Depending on the nature of the transformation Sally should consider working with a change management expert as well. IoT companies like Undagrid have their expertise in their technology a change management expert would be able to support Sally and her team with the changes in their internal structure that might come with the technology implementation.

Step 7 Feedback:

After implementing the pilot, the transformation should be monitored closely. Not only for performance but also the change. This task is mostly for Sally, to collect feedback from everybody. Sally can pass the feedback on to Undagrid and they can make adjustments. Depending on the feedback it might be necessary to have another session like in step 5. Otherwise a back-and-forth between Undagrid and the companies responsible should be sufficient.

6. Reflection and Discussion

After data collection, ideation and prototyping it is time to come back to the original research question. In this chapter, I will reflect on the question posed in the beginning and look back on what has been learned through this research and how it addresses the problem.

The question was

RQ: How can Design Thinking support SMEs in the integration of IoT to enable Digitalization?

The complete research process was an explorative journey to understand the problem better and to be able to reframe the problem by learning from a prototype. Therefore there is no straightforward answer to the question but more insights are collected throughout the process. To reflect on the results we will look at the separate elements of the research question.

The first element to look at is the object 'to enable Digitalization'. In this research, we explored the customer perspective on digital transformation. Through empathy, we gained a better understanding of the topic and how such a transformation challenges companies and their employees. Based on the empathy sessions we could define difficulties where such companies would require support. Having heard about the troubles with getting all employees on board with the change and the frustrations of unused potential we know that SMEs need support with the people to factor in the transformation. Dealing with 'Henks' would not only eliminate frustrations but also enable the organization to make use of the full potential an IoT solution could provide.

This people factor can be addressed with the subject of the question 'Design Thinking'. We learned that design thinking is a human-centred approach to problem-solving. The abductive reasoning addresses the context from the back starting with the aspired result which in this case would mean satisfied and motivated employees. By putting the people as the starting point of the thinking process the managers can properly reframe the problem. Investigating their perspective helps understand the situation and defining the 'real' problem. In the case of digitalization, we learned that for the involved employees the transformation comes with many more changes, that they do not necessarily trust or understand. Therefore the design approach needs more than insights into the perspective. The stakeholders of the transformation need to participate in coming up with the solution. Therefore participatory design practices offer different tools to work together with the employees.

The framework offers a blueprint for a potential service IoT companies can offer to support their customers. In this framework, participation is the main element and ensures that all stakeholders can give their input directly and discuss together how to approach the solution. The workshops enable that employees can share their worries and frustrations and learn from each other. By working

together in the different workshops they get the chance to make use of the teams full potential and consider the different relationships and activities involved. This process provides the stakeholders with a sense of ownership in the end solution. The goal is that through the participation and ownership in the solution generation the employees have an easier time going through the transformation and therefore leave more focus towards the original goal of implementing an IoT technology in their organization.

For IoT companies, this means that this framework can help them support their customers and ensure more conversions in their customer journey. The framework can be implemented into the customer journey, offered as a service or used for inspiration when facing problems. The main idea is that the interaction should not only be with an operations manager but with the whole team. Ideally, that team consists of representatives for all stakeholders. Besides that IoT companies should have a more interactive contact and less one-sided presenting of solutions. Their goal should be to facilitate joined decision-making and collaborative solution creation.

This framework is based on the customers and their journey of Undagrid and can be applied by other IoT companies as well. However, when modelling it against the IoT company perspective it becomes clear that this framework is more driven by the situation of the customer companies.

As mentioned earlier the framework is mostly based on the insight that internal change management poses the biggest difficulty for SMEs going through digitalization. Of course, IoT companies like Undagrid can choose to support their customers in the transformation. However, this support is part of the bigger picture, whereas Undagrid and other IoT companies are only interested in a small subpart. Their core business revolves around providing specific technology. Besides the focus of their value proposition, these companies do not necessarily have the capacity or expertise to be so involved in their customers' digital transformation.

Combining these observations that the customers can be supported through participatory sessions and that IoTs like Undagrid cannot fully take this responsibility upon them we can conclude that a service as proposed by this research needs to be approached slightly different than originally intended. Eventually, that means that there is a need for partners or a shift in responsibilities. One option is change management consultants that can use the insights from this research to offer support for SMEs. Another option is for the SME manager to use the insights and take the main responsibility to facilitate the participatory sessions.

7. Conclusion

This research has looked into the topic of digitalization from a design perspective and explored ways to support SMEs going through the transformation. With research through design, it has become clear that such a transformation is an organization-wide change that affects many different aspects of the business and many different stakeholders. All the different groups of stakeholders should be represented in designing fitting digital solutions. The best results can be achieved by having them actively participate in the design process. IoT companies can recognize this in their customer journeys and support their clients. They should offer good materials that can be used in participatory sessions and point their customers' attention towards the importance of participation. If necessary they can set up helpful partnerships with change management consultants who can provide more expertise.

7.1. Contributions to Academics and Practice

The framework provided with this research provides the following practical contributions. a) The data collection provided more insights into the perspective of companies going through the digital transformation. It focuses on the challenges and needs of the companies and provides some concrete examples. b) The framework suggests design practices as tools to empathize with the stakeholders and involve them in the solution-finding process. c) It showcases how design thinking and participatory design can be used in business and with that clears up some misconceptions towards the approach. d) The research demonstrates the relevance of participatory practices for supporting internal change management.

The framework provides a basis for service designs and customer journeys that can be adapted to specific situations and expanded in different contexts. Therefore it provides lots of space for future innovation and new developments. The results from this research are relevant for managers in charge of digitalization but also for companies providing digital solutions and consultants looking into the topic.

The results of this research provide academic contributions as well. a) The insights in the customer perspective can be used to shine a light on the people factor in digitalization and underlines the struggles of companies going through the transformation. b) The research showcases the use of research by design and gives an example for the method. c) The thesis directs more attention towards the topic of participatory design in the business sector. Overall the resulting framework provides a base that can be expanded and refined through future research.

7.2. Future Research

Possibilities for future research include the application and relevance of the framework in other industries and topics. There is space to further explore some aspects like the workshops or the activities within them in other contexts. When reading up on the topic of participatory design it became clear that there is a need for more research on design practices in business fields. Research that showcases how it can be used to support innovation, business development but also change management and problem-solving. Especially on the topic of participatory design, there is not too much literature on tools that can be used in commercial organizations to create value and innovate.

7.3. Limitations

The results of this research should be viewed under the following limitations. In general, it should be noted that this research was conducted as a graduation project with a set time frame. Therefore it was not always possible to adhere to design project standards to their full extent.

In principle, the prototype of a design process should be tested and refined before presenting the results. Due to the nature of this research, the testing aspect had to be limited. There was only one testing cycle that leads to feedback for adjustments. Furthermore, this feedback was more theoretical and not based on a practical implementation. Therefore, there is still more space for future research to be conducted.

Secondly, the framework was conducted based on the context of one company and its customers and partners. Hence the results should be viewed under consideration of their situation and are not by default an average or standard for the industry. Besides that, the data collection was done with existing customers of Undagrid and did not include potential customers. They could have given more details on the matter and maybe could have brought up points that they are looking for in a company. However, in the scope of the project, this was unfortunately not possible.

Finally, it should be said that design research like this one is an explorative process to learn about a topic and understand the underlying perspectives. As mentioned earlier there is no concrete validation but more a flexible cycle of learning and adjusting. Therefore, the results should be viewed as a developing insight.

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Appendix

- Appendix A – Creative Sessions
- Appendix B – Code Report
- Appendix C – Data Structure
- Appendix D – Customer Journey
- Appendix E – Ideation Session

Creative Sessions - Blank Whiteboard

0 Introduction

Let's get started! This first exercise is meant to get to know you and your company.

5 min

In your own words:

What is your core business?

[Pink sticky note]

What is your mission?

[Pink sticky note]

What are your core values?

[Pink sticky note]

1b Details on the Digitalization

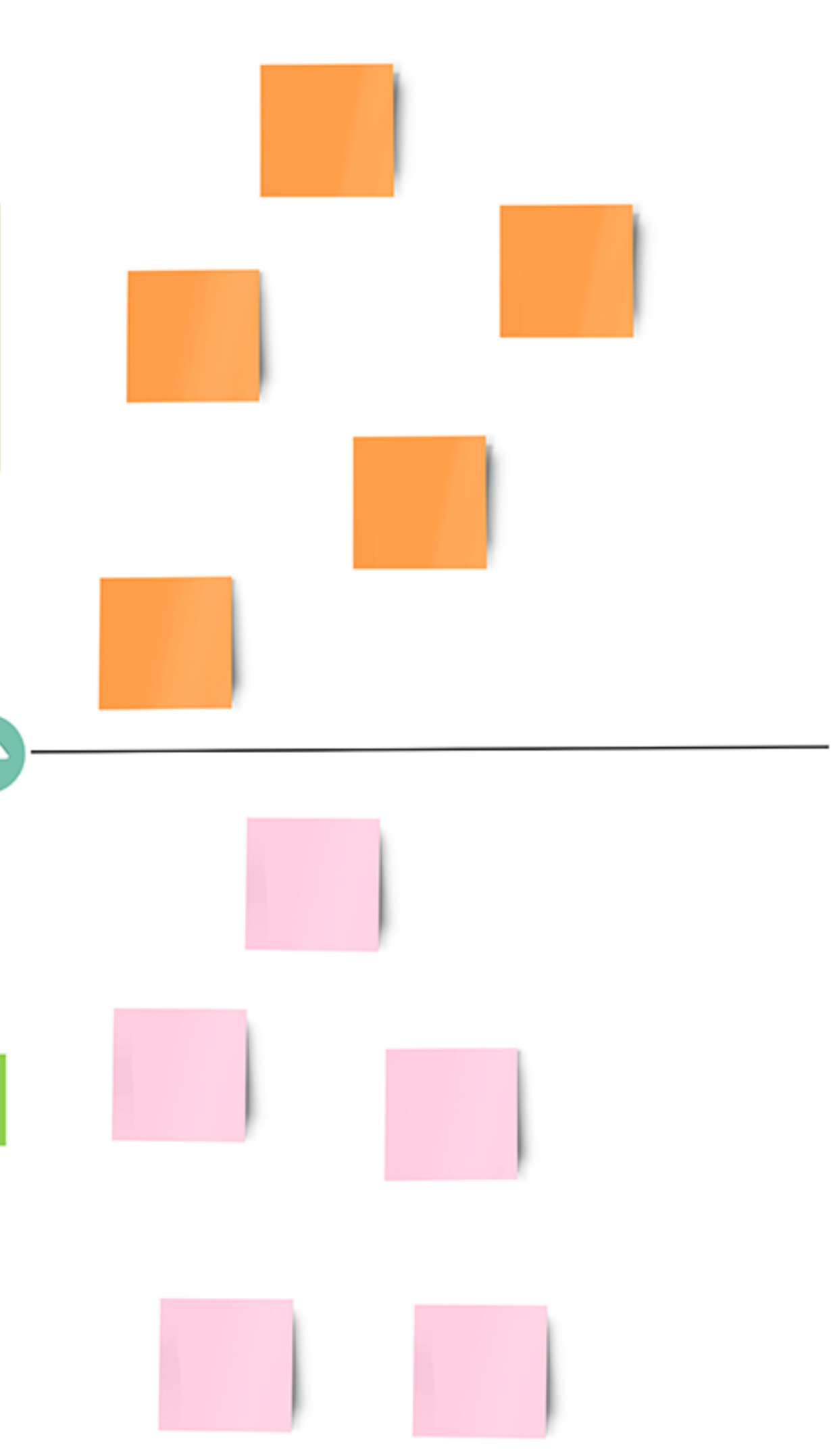
Let's get more specific!

How did Undegradrid transform your business?

5 min

Past

New Situation

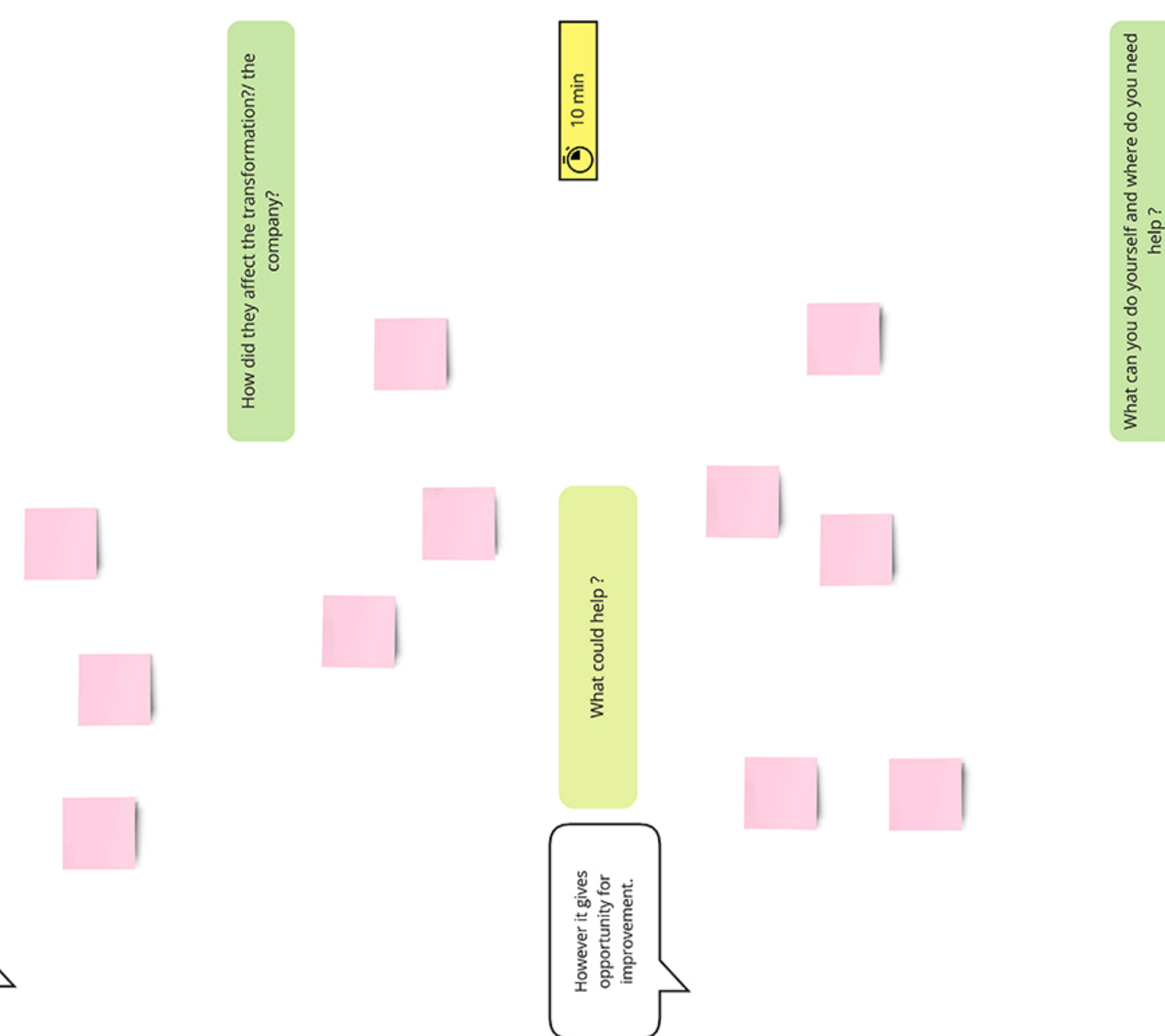


2b Understanding the change

Nobody said it was gonna be easy!

Why are/were these things difficult?

5 min



1a Digitalization

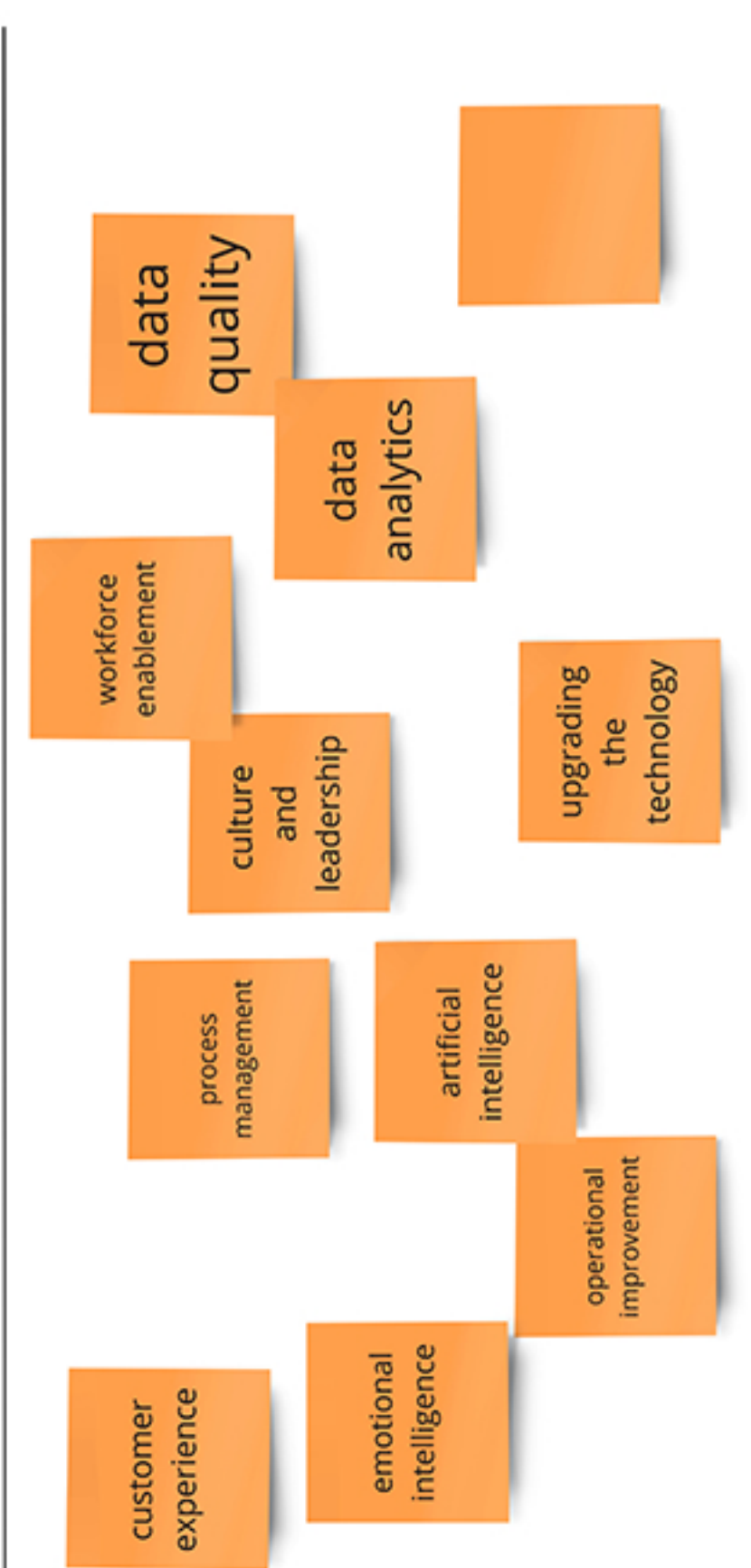
Okay good to know. Let's talk about digitalisation.

How digital is your company? We just started

5 min

Everything is digital

In which areas did you go digital?

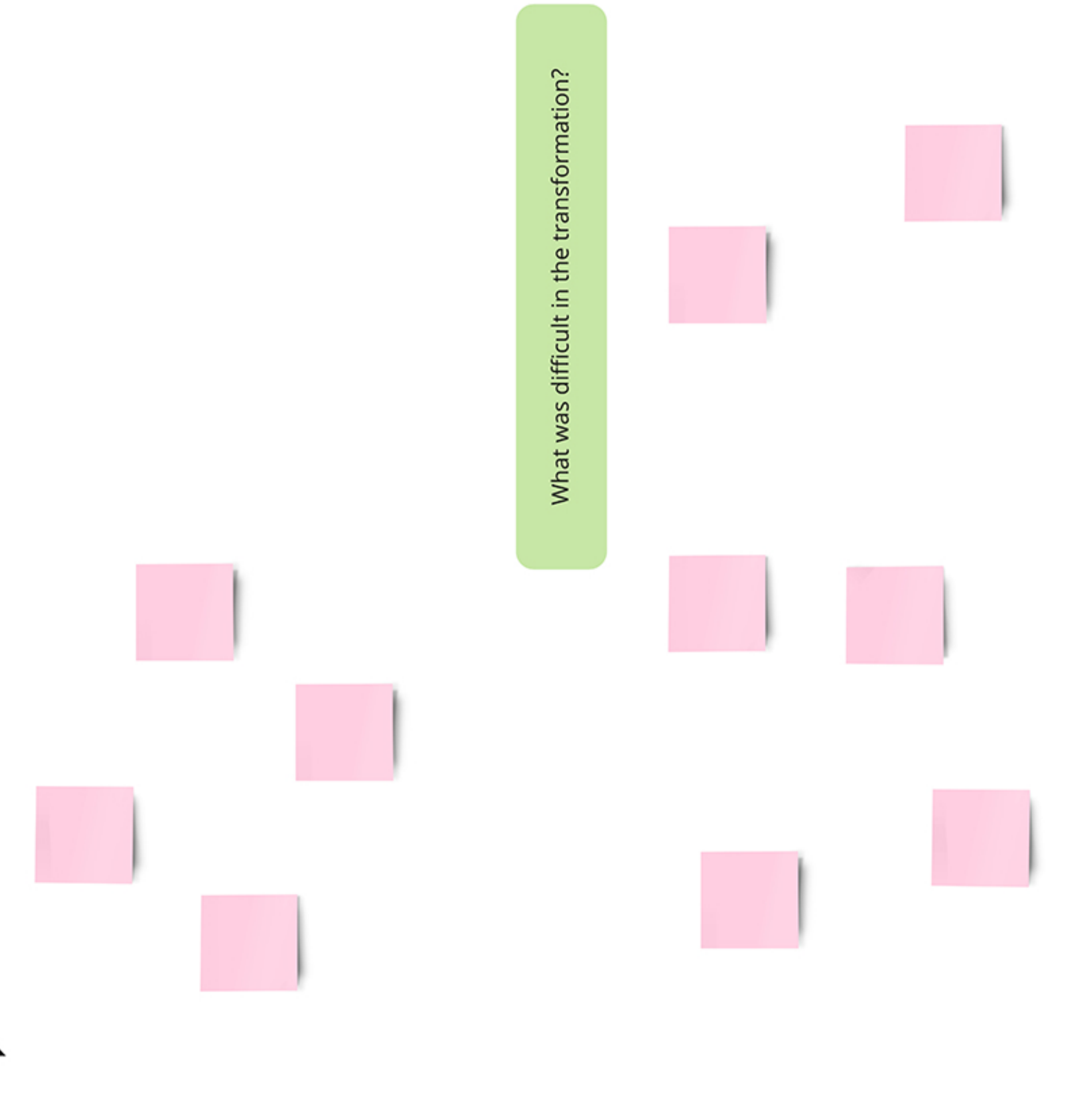


2a Transformation

Now we can talk about change.

What did you have to change?

10 min

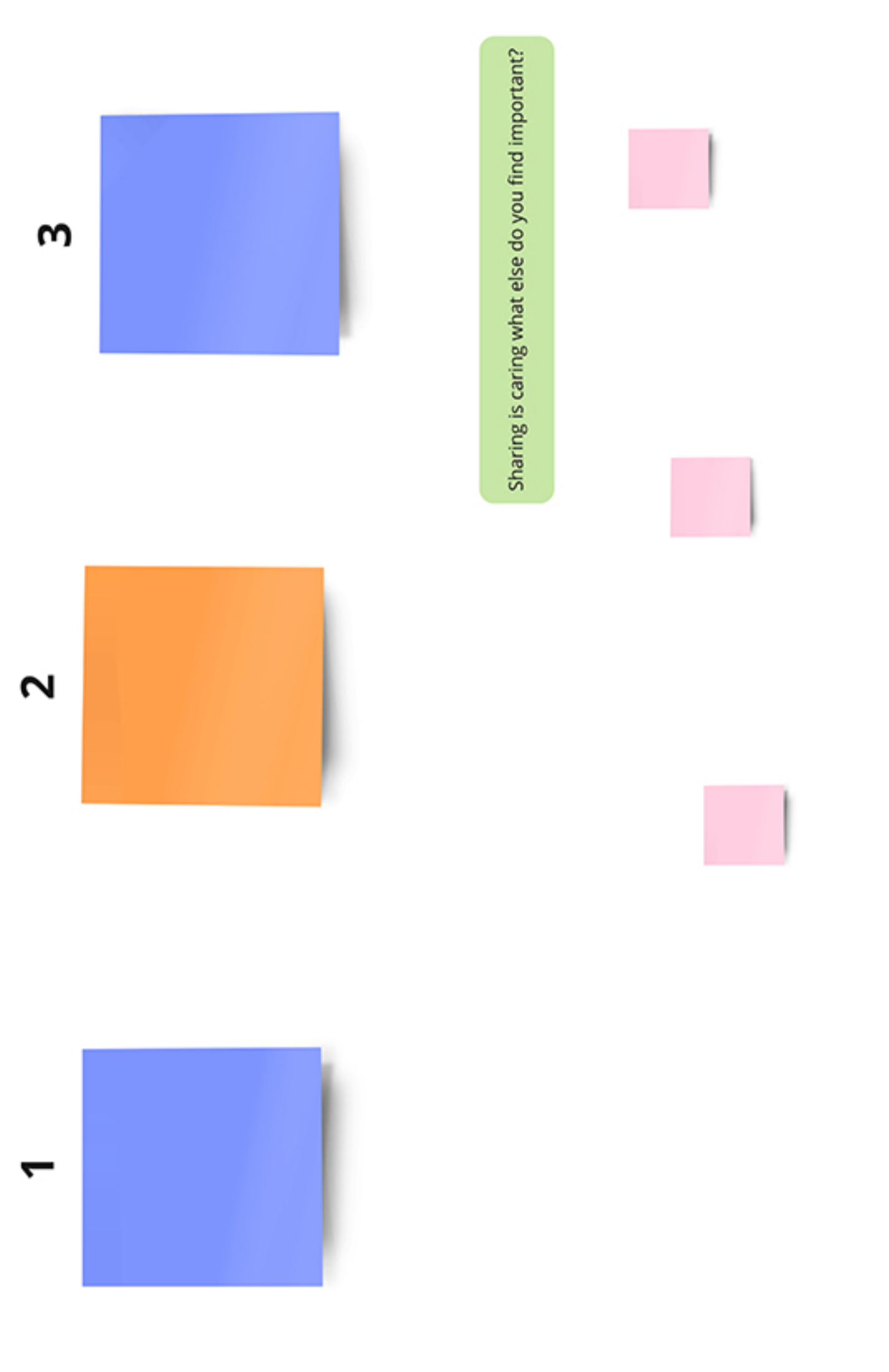


3 Close off

Final Words

3 Ways to Support Digitalisation

5 min



Code Report – Grouped by concepts and based on their themes

All (156) codes

Organizational Change Management

- changes in organisational structure - 6 Codes:
 - change in organizational structure
 - changes in (manual) operational processes
 - changes in product development
 - need to invest into new/ better infrastructure
 - new value proposition and new pricing strategy
 - siloed systems make it difficult
- extensive time line - 2 Codes:
 - individual approvals are needed from different third parties and can take time
 - testing and convincing people takes time
- new finance model - 3 Codes:
 - change of financial model (pay for use)
 - financial risk
 - opportunity based financing
- transform the companies way of working - 13 Codes:
 - analyse own company to understand what it takes to undertake the training
 - companies need to become more agile to cope with the transformation
 - companies still use staff and employee powered work
 - decision making changes
 - everything is changing which means everything needs be reevaluated
 - finding a starting point is difficult
 - less autonomy
 - make the transformation customer (client) centric
 - need to align different resources
 - new way to look at things\
 - reallocation of task and time management
 - upgrade IT security
 - you need somebody to feed the digital system
- transformation to servitization - 4 Codes:
 - change in business model
 - new sales and service models
 - now selling solutions instead of only products
 - use digitalisation as part of their servitization
- transforms internal processes - 11 Codes:
 - companies need to become more agile to cope with the transformation
 - companies still use staff and employee powered work

- companies used to have reactive and static processes that were not necessarily open to future processes
- digital change management = 1/3 technology + 2/3 process transformation
- new internal processes
- operational processes became much more intimate
- processes become proactive
- processes used to be manual and a lot of effort
- processes used to involve multiple intermediates and actions
- requires more or different maintenance
- underestimating the reshaping of the complete process

Employee Change

- employee resistance - 9 Codes:
 - accepting the concept of servitization is difficult
 - discussions make transformation difficult
 - employees try to protect own position
 - feeling monitored and observed
 - increased complexity
 - more visibility for values and errors
 - people make transformation difficult
 - solution can reduce the amount of employees
 - technology mal function - feeds into disbelief
- employee worries - 5 Codes:
 - employees struggle with taking risks
 - safety risk
 - transformation is difficult and scary
 - uncertainty of experimenting is difficult
 - worries that solution tracks employees
- involve employees in change - 4 Codes:
 - change management within employee heads to understand digitalization
 - lots of promises but the implementation is not as easy
 - need for expectation management (personal, company, stockholders)
 - people need to understand what is going on
- learning about the use of technology - 7 Codes:
 - Leverage the data
 - lots of theoretical knowledge but missing the practical insight
 - missing skills provide difficulties
 - need for alignment between (existing) systems\
 - need for simple instructions
 - need to understand how to better use data and be more efficient
 - to support understanding provide real insights on the operational process
- need for trust - 6 Codes:
 - difficulties with providing transparency for employees and clients
 - employees need to trust in technology and process

- safety risk
- transformation needs patience and trust
- trust managers and experts in their decisions
- worries that solution tracks employees
- shift in responsibilities - 5 Codes:
 - decision making changes
 - less autonomy
 - often no organizational responsibility is defined for the transformation
 - requires autonomy for the executing employee
 - shift in responsibilities
- transforms the employees jobs - 8 Codes:
 - companies still use staff and employee powered work
 - employee tasks and routines are transformed
 - employees need to leave the automated processes alone
 - missing skills provide difficulties
 - processes used to be manual and a lot of effort
 - processes used to involve multiple intermediates and actions
 - reallocation of task and time management
 - workforce needs to be trained

Realizing the full Potential

- unused potential
- encourage further growth - 6 Codes:
 - collect more information from other companies and stay updated
 - employees are encouraged to generate own ideas (how to use the technology for improvement)
 - implementation provides possibilities for scaling up
 - look for a boring market and see how this can be improved or very cheap
 - requires constant improvement including assesment of opportunities and threads
- growth potential and goals - 5 Codes:
 - companies want to grow through data
 - goal to better understand the total cost of ownership for GSE
 - goal to improve data quality and analytics
 - goal to make data visible
 - there are many more spots for digitalisation like sustainability
- need to collaborate with clients on the transformation - 4 Codes:
 - clients culture provides difficulties with the implementation, they need to change as well
 - educate the customers
 - make the transformation customer (client) centric
 - more customer interaction
- solution provides new values - 20 Codes:
 - applied GSE tracking solution

- can rent out their equipment
- digitalization for continuous data access
- insights are valuable
- Leverage the data
- need to register information correctly
- new product capabilities
- now have a system of records
- now they do more with less
- solution collects immediate insights and collaborates with sensor that can measure more than location
- solution enables automated warehouse that makes stock transparent and reduces loss of products
- solution forecasts the demand and requests actions
- solution increases functionality and provides added value to the clients
- solution makes information available and transparent
- solution makes operational processes more efficient
- solution reduces costs
- solution saves time and enables just in time deliveries
- there was no system to the employee tasks
- used to have lost stock
- used to rely on 3rd parties for tracking

Managing the change

- convincing and addressing people - 7 Codes:
 - address the people concerns and questions to convince them
 - difficulties with providing transparency for employees and clients
 - individual approvals are needed from different third parties and can take time
 - making benefits visible
 - management needs to be convinced and therefore needs to properly understand the positive effects of digitalisation
 - somebody who did not develop the solution himself needs to approve the plan (wrong people in charge)
 - to support understanding provide real insights on the operational process
- involvement of management - 4 Codes:
 - impulses and vision need to come from the top level
 - link the transformation to the highest rank in the organization
 - management needs to be convinced and therefore needs to properly understand the positive effects of digitalisation
 - presence of the management team
- role of leadership - 7 Codes:
 - analyse own company to understand what it takes to undertake the training
 - manage by outcome and not by task

- requires autonomy for the executing employee
- risks need to be balanced
- set priorities and go through them step by step
- think fast and make realistic plans
- trust managers and experts in their decisions
- teamwork - 2 Codes:
 - employees and managers need to be partners in the transformation from the beginning and stay in close contact
 - frustrations from the believers when they do not see progress

Attitude to change

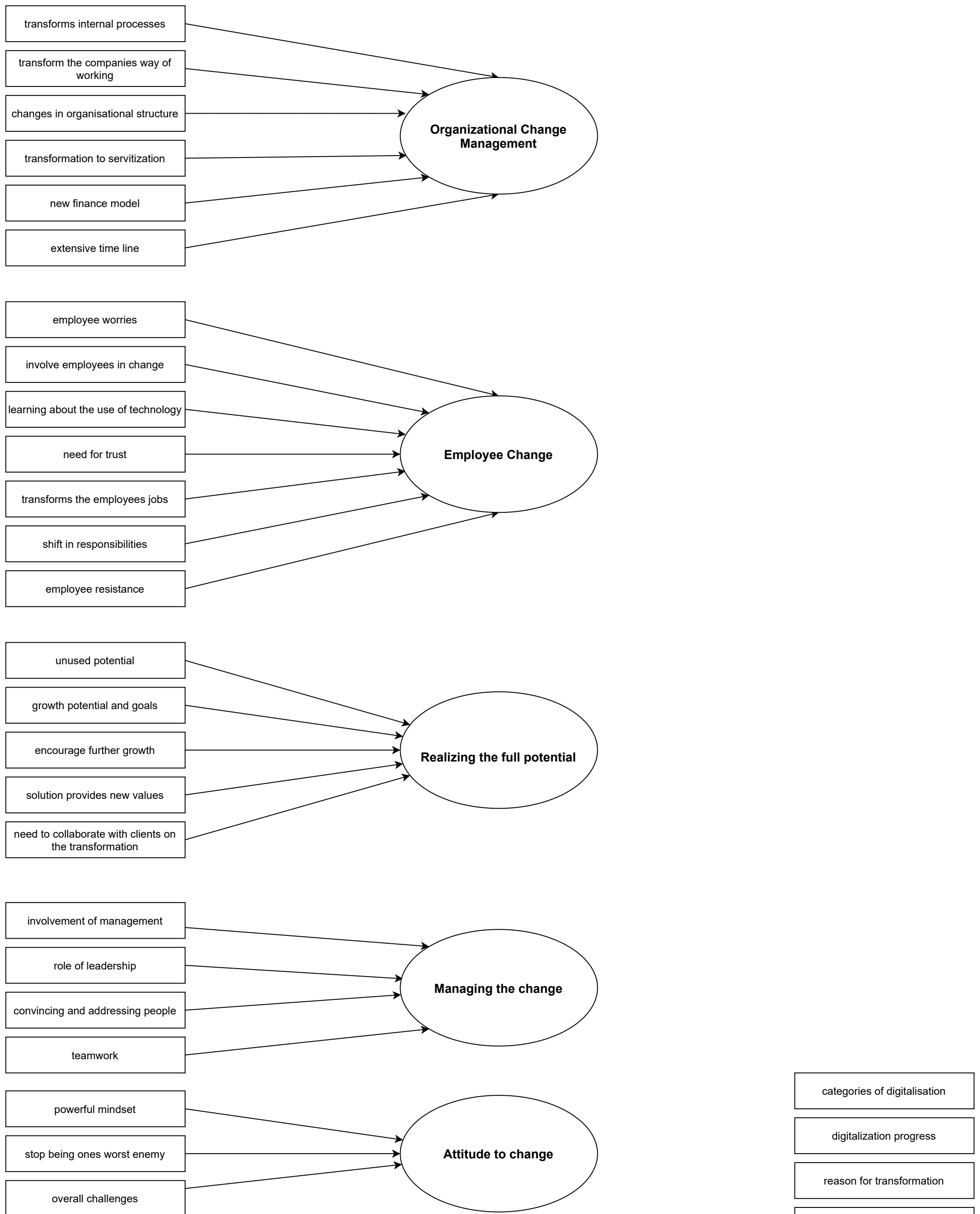
- powerful mindset - 4 Codes:
 - digitalization makes the differentiator for success is the organization
 - don't wait too long with transformation
 - if you can dream it you can do it
 - keeping an open mind and focus on what you don't know yet
- overall challenges - 5 Codes:
 - everyone is waiting for the best technology
 - local and country specific limitations
 - snowball effect with problems in the transformation
 - transformation raises additional questions
 - waiting for good results of other customers
- stop being one's worst enemy - 3 Codes:
 - difficulties delay the implementation process and hamper the progress
 - understanding and accept that mistakes are part of the transformation
 - You cannot do everything yourself

Extra Categories

- digitalization in ... - 14 Codes:
 - digitalization in: AI
 - digitalization in: culture and leadership
 - digitalization in: customer experience
 - digitalization in: data analytics
 - digitalization in: data quality
 - digitalization in: forecasting/ prediction
 - digitalization in: integrating systems
 - digitalization in: new products and services
 - digitalization in: operational improvement
 - digitalization in: process management
 - digitalization in: staffing solutions
 - digitalization in: timestamp optimization
 - digitalization in: upgrading the technology
 - digitalization in: workforce enablement
- digitalization progress - 6 Codes:

- between small and medium progress with digitalization
- close to medium progress with digitalization
- digitalisation progress depends on companies core business, industry and different perspectives
- medium progress with digitalization
- more than medium progress with digitalization
- small progress with digitalization
- reason for transformation - 2 Codes:
 - most of the time legacy companies that transform
 - shocking events like Corona can motivate a decision and transformation
- requirements for technology - 5 Codes:
 - IoT acts as linking machine
 - keeping the solutions state of the art
 - need for alignment between (existing) systems
 - solution is missing another indicator
 - technical issues need to be overcome

Data Structure - Concepts and Themes



1st order
concepts

Themes

Extra
Categories

Phase of Journey	Stage 1: Individuals reach out to Undagrid	Stage 2: Engagement	Stage 3: Proof of Concept, Pilot Phase	Stage 4: We are in Business	THEORETICAL STAGE
Actions What does the customer do?	reach out beneath the internet currently (low)	meeting respond process food for thought	see whether it works internal approval steps active monitoring procurement	roll out align and integrate into daily operations we need middle management operations manager	
Company Actions	respond to the request	collecting information first solution drafts find out what is recommended	executing the first set up for the customer procurement first step of implementation	involvement depends by size fully operative stop inventing account management and regular follow ups	
Touchpoint What part of the company do they interact with?	personal contact, phone email word of mouth webform	meetings workshops	(online) meetings emails currently reactive customer operations	daily business emails phone calls slightly depend on the customer	
Resources Needed	attractive website (young people are looking for) reliable partners that know the customers email	(software creation) user journey create epics solution architect	success criteria internal team partners	Business AS Usual success criteria internal team solution partners	
Customer Thought What is the customer thinking?	excited for innovation challenge Undagrid is here to help with headaches	see a reduction in headaches wrong assumptions	trust on the promises expects the final solution validates the expectations	see results maybe feedback without results they might phone you as well nothing... dangerous	
Customer Feeling What is the customer feeling?	it depends on their situation well away with a good feeling, understand the problems	happy neutral excited confused	with good expectation management too high expectations or a mess run interest in the customer	business owner business owner	
Process ownership Who is in the lead on this?	personal to the management	business owner depends on the expertise	business owner	business owner	
Opportunities	standardize the intake have a good filing solution example the Vodafone form difficult to sponsor like time attention	capture outcomes structure the process sell what we have if you sell the you cannot sell today	more active and in-lining approach internal and external what's in your head that you don't have normally trends here	more online community marketing engagement customer interaction keep to the promises we make	



neutral



good



bad / disappointed



confused



annoyed



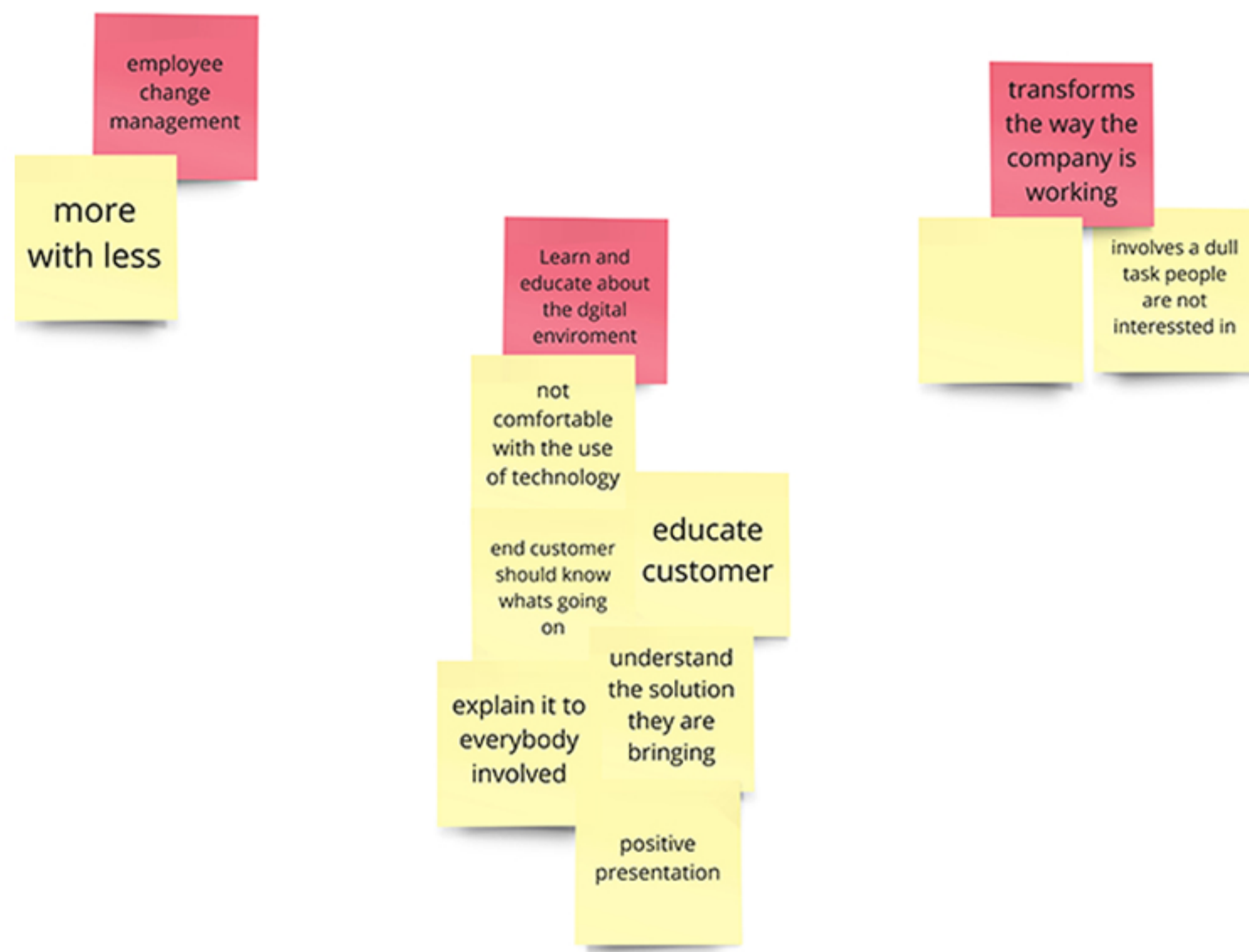
neutral



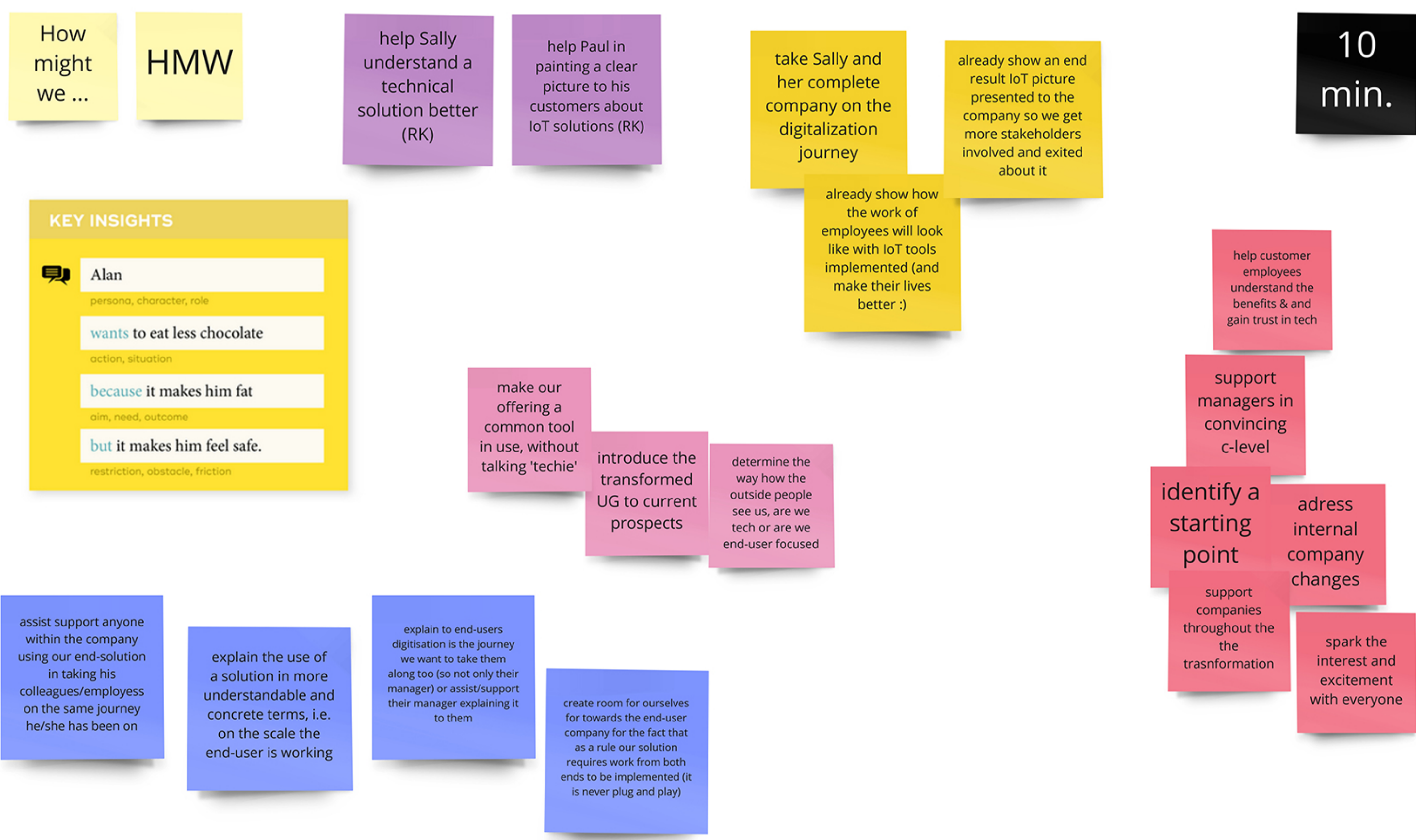
excited

Ideation Session - Results part 1

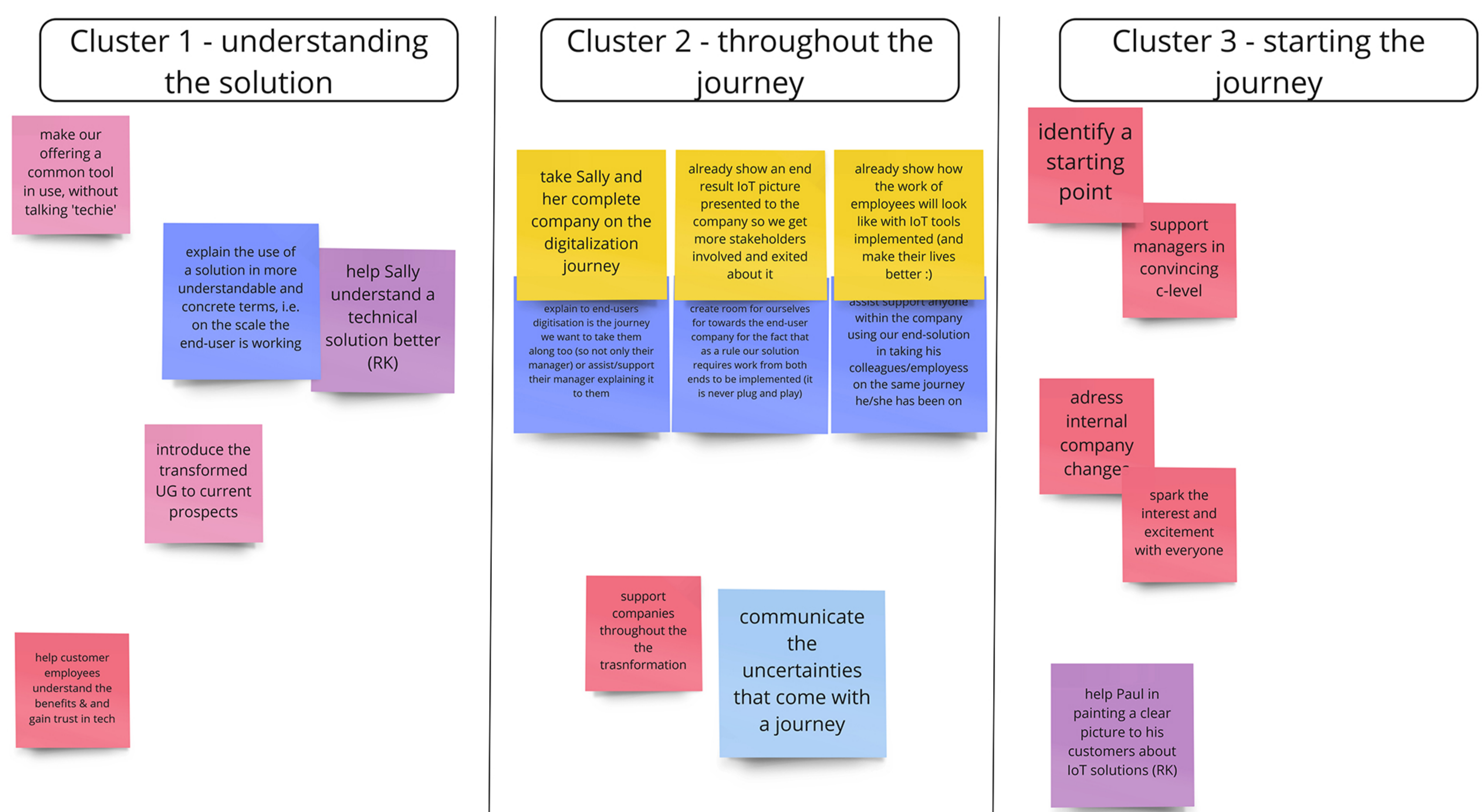
1. Main Insights



2. How might we questions



3. and 4. Clustered and prioritized questions



Ideation Session - Results part 2

5. Brainstorming answers



6. Idea Portfolio

