Marika Hardy-Linna

Collecting User Feedback for an MVP in Agriculture – Case: Smart AG Volume Tractors, AGCO

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Abstract

Author: Hardy-Linna Marika

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The purpose of the thesis is to provide the commissioner insights about how an MVP in agriculture should be developed to better match users' needs. The work also outlines recommendations on how authentic user feedback could be systematically collected in other projects in the future.

Smart AG Volume Tractors is a team inside AGCO that brings customer focused products to market much faster than traditional product development. Their hardware product X has been designed to help farmers use the equipment on their tractors more efficiently. The research explores how users experience product X and how it should be developed further to better match their needs. Also, to provide the case team useful perspective of how to collect feedback in its future projects, recommendations are drawn from a collaborative evaluation of the process performed in the thesis.

The research was conducted as qualitative case study. Data was collected through online questionnaire and semi-structured interviews with farmers in Denmark, Spain, Holland, Germany, and Finland. Results were analyzed by using an inductive approach and allowing themes emerge from the data. For the development part, service design tools of empathy map, journey map and service blueprint were used in workshops with the case team.

As a result, a true need for product X was found to exist, and areas of development were discovered, regarding automatization and improved setup solutions. The feedback collection process was experienced overall useful by the case team, yet points of improvement were identified. As an output, recommendations regarding minimum viable user experience, user experience process, use of resources and methods, and collaborative conclusions were created.

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1 Introduction

In the field of agriculture, farmers run businesses with a variety of tasks they perform themselves. Weather and ground conditions, animals, machinery, engineering, labor, markets, finance and economics, and rules and regulations are all closely related to their work. Farm managers need to have a reasonable understanding of all these subjects to run a successful business. (Nuthall, 2018, Chapter 1). It has recently been discovered that one of the factors for top performance in arable business is focus on detail when observing points of improvement in the farm's operation (Allison, 2022, p. 53).

AGCO, the commissioner of this thesis, is a global leader in the design, manufacture, and distribution of agricultural equipment (AGCO, 2022a). The corporation aims to help farmers increase their productivity by providing solutions to improve efficiency across its tractor brands, Challenger, Fendt, Massey Ferguson and Valtra, and 17 other brands involving different areas of agriculture (AGCO, 2022c, 2022b). They globally deliver agricultural solutions such as "tractors, combine harvesters, hay and forage equipment, seeding and tillage implements, grain storage and protein production systems, as well as replacement parts" (AGCO, 2022a).

A new initiative inside AGCO, called Smart AG, aims to bring customer focused products to market much faster than traditional product development. There are five Smart AG teams globally of which Smart AG Volume Tractors, based in Finland, this thesis is focused on. The team applies agile, lean start up practices in its operation, yet it has access to the resources of a huge global corporation. (Hardy-Linna, 24.2.2022 & 12.4.2022).

Smart AG Volume Tractors (later referred to as SAVT) started to operate in the summer 2021 and as its first project the team developed an idea of a new product, called product X in this thesis. Product X helps farmers use the equipment on their tractors more efficiently and allows them to perform tasks that require accuracy and focus on detail more easily. SAVT had come to a phase where they had built a prototype and needed user feedback to define a final Minimum Viable Product. (Hardy-Linna, 24.2.2022 & 12.4.2022.) Minimum Viable Product (MVP) can be described as "the least expensive created product or service released to the market while making a profit" (Baker, 2018, Chapter 7).

Customers had been involved by several informal ways in earlier steps of the engineering process and the team had an understanding of their needs to some extent. However, more solid evidence

was required to determine whether product X matched a true need and if it did, how it should be developed further. (Hardy-Linna, 12.4.2022). This thesis aims to solve that problem by performing a systematic feedback collection process, for the first time in the project of product X, and providing recommendations on how to collect feedback in other projects in the future.

Consequently, the objective of the thesis is to explore and evaluate how the MVP of product X should be developed further, based on feedback from potential customers. The thesis also outlines recommendations on how SAVT could systematically collect feedback on other early-stage products in the future. The engineering process of the product X was at a phase where systematic feedback collection was needed for deciding, whether to continue the development process and if yes, how. The main purpose of the research is to find out if the potential customers need the product to an extent, they will pay for it and how they experience using it.

To gain understanding about the potential customers' need for the MVP and experience of using it, the following research questions were asked:

1. How do the users experience the MVP of product X?
    a. What is their current solution to the problem the product X addresses?
    b. Do they need product X?
    c. How do they experience the functionality of product X?
    d. Would they buy product X and how much would they pay for it?
2. How should product X be developed further?
3. How to collect authentic feedback systematically and efficiently on other MVPs in the future?

The first and second research questions were answered by collecting and analyzing customer feedback on the product X and visualizing and structuring the findings with the team. The third research question guided collaborative development with the team to map out the current process and identify points of improvement for the future.

As a result, evaluation of how to proceed with the MVP of product X was made in terms of further development. Also, based on collaborative experience and views of the feedback collection process performed in the thesis, recommendations for future projects were made.

The research was conducted as case study of the Smart AG Volume Tractors team. Since case study focuses on a phenomenon in context and develops detailed, intensive knowledge about the case (Eriksson & Kovalainen, 2015, Chapter 11; Robson & McCartan, 2016, Chapter 7), the research strategy matched the objectives of the thesis. Experiences of the users regarding product X were explored by using "an in-depth description and analysis of a bounded system", as Merriam and Tisdell (2015, Chapter 2) define qualitative case study.

In addition to case study, tools from service design were borrowed for the development part of the thesis. Design thinking provided a beneficial perspective on the task because, especially in the context of user experience, it "combines the understanding of the context of the problem and taps into empathy for the user to access the tools that are appropriate to a successful solution" (Rosenzweig, 2015, p. 20).

Qualitative research is interested in descriptions, interpretations, and meanings instead of measurements (Eriksson & Kovalainen, 2015, Chapter 7; Merriam & Tisdell, 2015, Chapter 2). To collect such data in this thesis, survey and interviews were used as data collection methods. To seek answers about facts and behaviors (Farquhar, 2012, Chapter 5), the users were asked to fill in an online questionnaire for any problems that occured during the testing. After the testing, the users were asked deeper, overall feedback via semi-structured interviews that are flexible in form but explore specific information from all the respondents (Merriam & Tisdell, 2015, Chapter 5). These two methods were triangulated to gain more accuracy, reliability, and credibility for the case study (Eriksson & Kovalainen, 2015, Chapter 11; Robson & McCartan, 2016, Chapter 7; Saunders, Lewis, & Thornhill, 2009, p. 146).

Ten users who represent different types of farmers or contractors in Spain, Germany, Holland, Denmark, and Finland were interviewed. Each user tested product X in their farm for from one to seven days and was requested to give feedback through an online questionnaire and an interview.

The key aim of this research is to explore how the users experience product X and understand their needs regarding the problem that product X addresses. Therefore, inductive approach was chosen as data analysis method because it opens opportunities to discover common themes, categories, activities, and patterns that emerge from the natural data (Eriksson & Kovalainen, 2015, Chapter 11; Farquhar, 2012, Chapter 6).

In collaboration with SAVT, the findings were visualized by creating a persona of the users and a journey map of the UX. Developing personas that are "archetypical users of a product" raise empathy toward users (Sharon, 2016, Chapter 2) and help better understand them (Rosenzweig

2015, p. 48). Journey maps make all relevant steps of user activities visible in the UX and help to identify pain points, that cause the user confusion, and moments of truth, that provide either a good or bad impression (Faranello 2016, Chapter 7).

For the third research question of how to collect authentic feedback systematically and efficiently on other MVPs in the future, service blueprint of the current process was used to develop a basis for further recommendations. The current process, which was considered a service in this context, was comprised of the steps taken in this thesis to collect user feedback and the team's input to support it. In addition to visualizing and structuring the UX, service blueprint supports improvement of also internal, "behind-the-scenes" processes of the delivery (Flowers & Miller, 2015, p. 4).

2 Customer Centric Approach

According to the study of Damázio, Soares, Shikagi, Goncalves and Carvalho de Mesquita (2020, p. 14), literature regarding customer centricity addresses constructs from customer satisfaction, consumer loyalty, customer relationship management, and consumer orientation to customer experience. Customer centrality strategies aim for better understanding of the customers, and themes of UX and cocreation of value are opportunities to enhance reaching this goal, especially in the field of business marketing. The following sub-chapters focus on areas of value cocreation in service-dominant logic, user experience, customer experience and business-to-business relationships.

2.1 Service-Dominant Logic

Service-dominant (S-D) logic is a theoretical framework of service-for-service exchange (Vargo & Lusch, 2019, Chapter 1) and it challenges another, more traditional and widely applied perspective of goods-centered view, named as goods-dominant (G-D) logic by Greer, Lusch, and Vargo (2016, p. 1). In G-D logic, the qualities of goods are viewed from the manufacturer's perspective, leading to production without consumer involvement, and therefore, often ending up being perishable and nonresponsive to the changing needs of the consumers. The approach in S-D view instead, is to recognize consumers as coproducers and aim for maximized consumer involvement in customizing offerings to better fit their needs. (Vargo & Lusch, 2004, p. 12).

There are five foundational concepts in the theory of S-D logic: actors, service, resources, value, and institutions. Actors are entities that do resource integration and service exchange in the exchange system. Business-to-consumer (B2C), business-to-business (B2B) and consumer-to-consumer (C2C) can all be included in an actor-to-actor (A2A) rubric. Service is exchanged in value cocreation and can be defined as "the process of using one's resources for the benefit of another actor". It is different from the traditional understanding of "services" in G-D logic and is rather related to application of resources by one party to create benefit for another or oneself. Service can be provided directly, indirectly or through money. (Vargo & Lusch, 2019, Chapter 1.)

Resources are seen tangible or intangible source for an actor to draw on to increase value. Operand type of resources are often static and tangible and require other, operant type of resources

that are intangible and dynamic, to act on them to provide benefit. Benefit to a particular actor in distinct context is called value, which is a result of cocreation and the reason for exchange. (Vargo & Lusch, 2019, Chapter 1.) When comparing S-D logic and G-D logic in terms of resources, Table 1 illustrates their distinction (Vargo & Lusch, 2004, p. 7). Institutions enable value cocreation and can be described as "actor-generated rules, norms, meanings, symbols, and similar aides of communication, collaboration, and decision-making" (North, 1990; Scott, 2008; Vargo and Lusch, 2016 according to Vargo & Lusch, 2019, Chapter 1).

	Traditional Goods-Centered Dominant Logic	**Emerging Service-Centered Dominant Logic**
Primary unit of exchange	People exchange for goods. These goods serve primarily as *operand resources*.	People exchange to acquire the benefits of specialized competences (knowledge and skills), or services. Knowledge and skills are *operant resources*.
Role of goods	Goods are *operand resources* and end products. Marketers take matter and change its form, place, time, and possession.	Goods are transmitters of *operant resources* (embedded knowledge); they are intermediate "products" that are used by other operant resources (customers) as appliances in value-creation processes.
Role of customers	The customer is the recipient of goods. Marketers do things to customers; they segment them, penetrate them, distribute to them, and promote to them. The customer is an *operand resource*.	The customer is a coproducer of service. Marketing is a process of doing things in interaction with the customer. The customer is primarily an *operant resource*, only functioning occasionally as a n operand resource.
Determination and meaning of value	Value is determined by the producer. It is embedded in the *operand resource* (goods) and is defined in terms of "exchange-value".	Value is perceived and determined by the consumer on the basis of "value in use". Value results from the beneficial application of *operant resources sometimes* transmitted through *operand resources*. Firms can only make value propositions.
Firm-customer interaction	The customer is an *operand resource*. Customers are acted on to create transactions with resources.	The customer is primarily and *operant resource*. Customers are active participants in relational exchanges and coproduction.
Source of economic growth	Wealth is obtained from surplus tangible resources and goods. Wealth consists of owning, controlling, and producing *operand resources*.	Wealth is obtained through the application and exchange of specialized knowledge and skills. It represents the right to the future use of *operant resources*.

Table 1. Operand and operant resources help distinguish the logic of the goods- and service-centered views. A reproduced table of Vargo and Lusch (2004, p. 7).

In G-D the resources are mainly operand, whereas in S-D they are operant (Table 1). When people exchange for goods or services, in G-D they gain tangible goods, whereas in S-D, knowledge and

skills are the sources of benefits. In G-D goods are the end products, but in S-D they are intermediate "products" that are used in value-creation processes. When it comes to the role of customers, in G-D they are seen recipients of goods, while S-D considers them coproducers of service. Consequently, in G-D the producer determines value and in S-D the consumer perceives and determines what value is. (Vargo & Lusch, 2004, p. 7.)

When considering the firm-customer interaction, customers are acted on to create transactions (G-D) or viewed as active participants in relational exchanges and coproduction (S-D). In the end, source of economic growth is seen as wealth obtained from surplus tangible resources and goods in G-D and through application and exchange of knowledge and skills in S-D. (Vargo & Lusch, 2004, p. 7.) To place these points about resources to a wider picture of S-D logic, Figure 1 illustrates the core principals of the theory, with its five axioms and 11 foundational premises (FPs). (Vargo & Lusch, 2019, Chapter 1.)

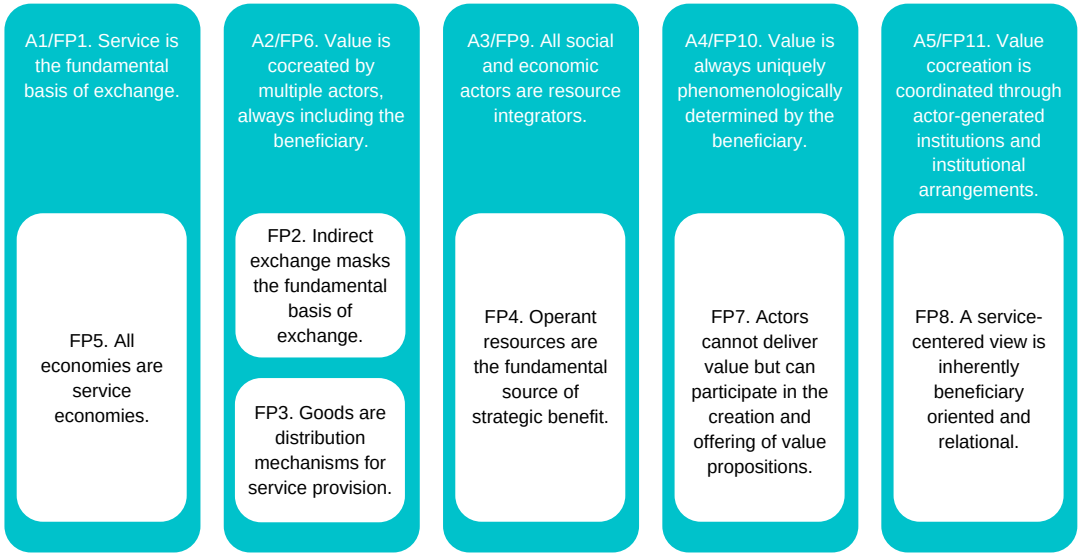

Figure 1. Axioms and foundational premises (FPs) of service-dominant (S-D) logic. A reproduced figure of Vargo and Lusch (2019, Chapter 1).

The first axiom and FP argue that a process-and-benefit orientation is stronger than a units-of-output one, because goods are not seen as outputs but rather inputs that assist the beneficiary in the value-creation process (Figure 1). Also, service is understood as a benefit-providing process and not just an add-on to a good or a particular type of good. Service is exchanged for service and there is two-way dynamics in the exchange. Therefore, service is the fundamental basis of exchange (axiom 1) and all economies are seen service economies (FP5). (Vargo & Lusch, 2019, Chapter 1.)

Axiom 2 states that multiple actors cocreate value, always including the beneficiary. They increase wellbeing (viability) by integrating many resources, yet no single actor can create value. Often, indirect exchange masks the fundamental basis of exchange (FP2) because many individual actors are involved in exchanging their applied knowledge and skills with others to get the service they need. Goods are related to the exchange as distribution mechanisms, tools, for service provision (FP3), meaning that sometimes service is provided through them, based on what they can do for the beneficiary. (Vargo & Lusch, 2019, Chapter 1.)

When it comes to resource integration, all social and economic actors are engaged in it (axiom 2/FP9). In addition to the division of operand and operant resources, categorization can be made into market, private and public resources. No act of service provision is possible without drawing upon and integrating a variety of resources. Operand resources require operant resources such as knowledge and skills to extract, transform or experience them so that they can provide benefit. Therefore, operant resources are the fundamental source of strategic benefit (FP4). (Vargo & Lusch, 2019, Chapter 1.)

Value is cocreated by multiple actors, but it is assessed by a particular beneficiary in a distinct context. Thus, axiom 4/FP10 deduces that value is always uniquely and phenomenologically determined by the beneficiary. Given that value is always cocreated, from the perspective of a single firm, it cannot alone create or deliver value to another actor, for example a customer but instead, it can participate in making value propositions (FP7) which are assurances of potential value or benefits. (Vargo & Lusch, 2019, Chapter 1.) Helkkula, Dube and Arnould (2019, Chapter 7) complement that when value cocreation is analyzed from a customer's perspective, his/her expectations, situations, location, and time define the context that delineates how value cocreation is experienced.

Cocreation of value is coordinated through actor-generated institutions and institutional arrangements (axiom 5/FP11). Their role is to avoid and reconcile conflicts in the exchange system. The beneficiary actor in the process is always considered primary and therefore no concept of "customer orientation" is needed in S-D logic. The service-centered view is inherently beneficiary oriented and relational, as stated in FP8. (Vargo & Lusch, 2019, Chapter 1.)

2.2 User Experience

The concept of user experience (UX) was originally introduced by Don Norman in 1990s, and it has been applied and developed in many industries ever since. In 2010s, UX became a central factor in design, and nowadays it is seen as a person's overall experience with any technology, product, or service, including physical, mental, and mechanical interactions. (Rosenzweig, 2015, pp. 8, 11–14.)

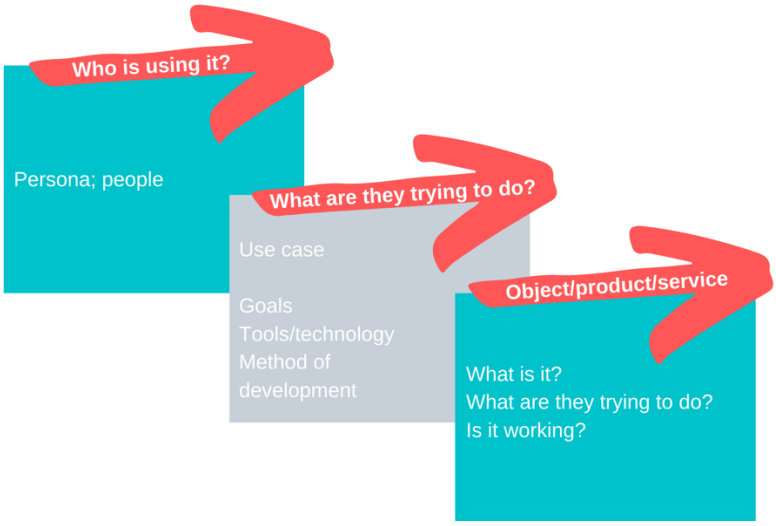

Figure 2. UX process (a reproduced figure of Rosenzweig, 2015, p. 15). The first step is to identify who uses the product, then what their goals and ways are, and finally evaluate the solution and its purpose and functionality.

UX aims to help people solve problems when they use a product, service, or technology, covering all the touch points of the interaction. People are constantly affected by mechanisms that have physical and emotional influence on their day-to-day living. When the UX is designed holistically, it contributes improvements to both, personal experience, and societal experience. Aspects of the UX process is illustrated in Figure 2: who uses it (persona), what they are trying to do (use case) and what the object, product or service is. (Rosenzweig, 2015, p. 8, 14–15.) Persona and use case will be further explained in sub-chapter 3.3.

Morville (2004) has created a diagram of UX to help companies understand why it is important to move beyond usability, especially in web design. User Experience Honeycomb is comprised of seven qualities of UX: useful, usable, desirable, findable, accessible, credible, and valuable (Figure 3, p. 10).

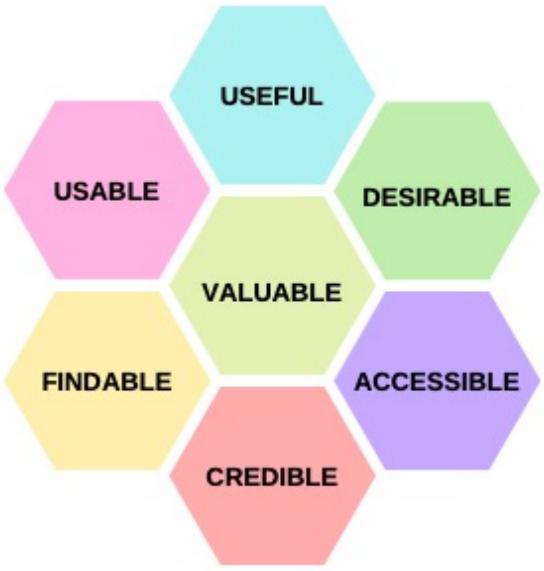

Figure 3. User Experience Honeycomb illustrates different facets of user experience (a reproduced figure of Morville, 2004).

Useful communicates the importance of courage and creativity to ask whether the product or system is useful and to define innovative solutions. Usability and ease of use is a vital part of UX, yet not sufficient to cover the whole concept. Desirable represents the power and value of elements of design such as image, identity, and brand. Findable advocates navigable sites and locatable objects, whereas accessible points out the relevance of considering people with disabilities and enabling accessibility to all users. Credibility affects whether users trust the company, and valuable is the core of the honeycomb. It means delivering value to the sponsors, improving customer satisfaction for businesses and advancing the mission for non-profit organizations. (Morville, 2004.)

Minimum Viable User Experience (MVUX)

Hokkanen, Kuusinen and Väänänen (2015) introduce a concept of Minimum Viable User eXperience (MVUX) that has been developed to support the evaluation and validation of early product ideas in startups. The purpose is to provide the users sufficient UX so that they can get a sense of the intended product value and give reliable feedback of the product idea. The aim is to prevent a general problem of the users focusing on disturbing issues in the design, that is of secondary value in further development of the product version.

A qualitative study was conducted to find out "which UX elements are essential when building early product versions in small software startups" (Hokkanen et al., 2015). Eight Finnish startups of a size from one to six persons were interviewed. One of them was focusing only on B2B, four only on B2C and three on both B2B and B2C markets. Hokkanen et al. (2015) point out that there was an assumption for the research that MVUX is achieved when the following criteria is fulfilled:

1. User can perform the core use cases to gain value.
2. Basic hygiene factors for usability and appearance are in place.
3. The startup gets enough of feedback and data to validate and further develop the product idea.

Based on the interviews about the startups' goals and core elements for UX of early product versions, four main elements of MVUX were found (Figure 4.).

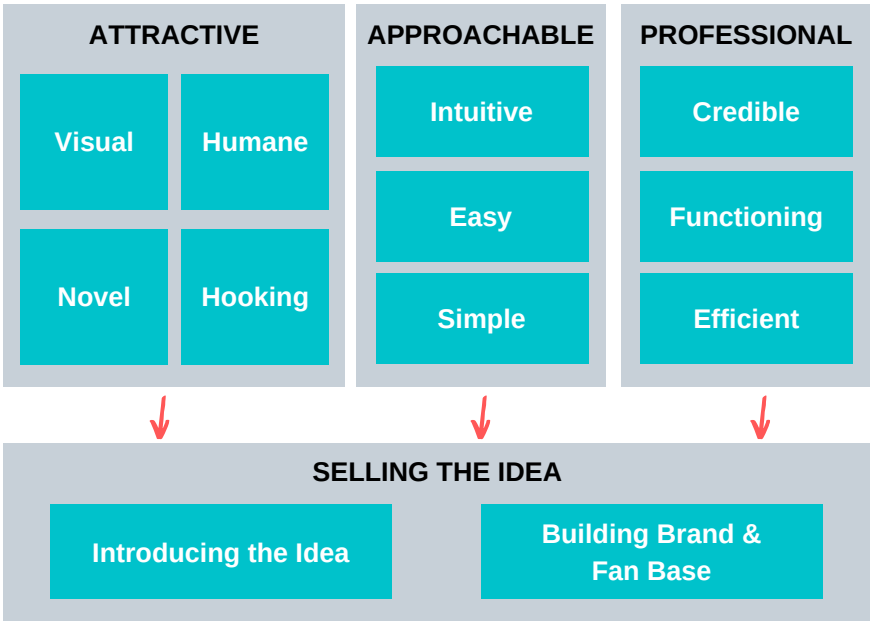

Figure 4. Elements of Minimum Viable User Experience (MVUX), based on goals and core elements for UX of early product versions in eight Finnish startups (a reproduced figure of Hokkanen et al., 2015).

Selling the Idea enables the startup to get feedback from users who understand the product idea, which is the main aim of MVUX (Figure 4). Attractive, Approachable and Professional encourage the user becoming interested in the product, affect how the user gets to know it, and influence the user's experience of using the product. When these elements are in place, the startup can be considered ready to introduce and sell the idea to the customer. (Hokkanen et al., 2015.)

Comparison of Purchase and Usage Brands

Bonchek and Bapat (2018) conducted a study of what makes a brand successful in the digital age. They asked more than 5 000 consumers in the USA about 50 different brands. Some of the brands were traditional, with a focus on the minds of their customers, and others were digital, with interest in the lives of their customers. The traditional brands were found to be brands that "people look up to" but the digital brands were perceived to make consumers' lives easier. (Bonchek & Bapat, 2018.)

Bonchek and Bapat (2018) observed that a big difference of these two types of brands is that the traditional brands engage their customers as buyers, but the digital brands aim to create a relationship with them as users. For the digital brands, pre-purchase promotion and sales are not the key focus, but they invest in post-purchase renewal and advocacy instead. As a result of the study, they categorized brands into purchase brands and usage brands (Table 2).

Purchase brands	**Usage brands**
Create demand to *buy* the product	Create demand for the *use* of the product
Emphasize *promotion*	Emphasize *advocacy*
Worry about what *they* say to customers	Worry about what customers say to *each other*
Aim to shape what people *think* about the brand	Aim to influence how people *experience* the brand
Focus on "moments of truth" *before* the transaction	Focus on "moments of truth" *after* the transaction
Usually *traditional* brands	Usually *digital* brands

Table 2. Comparison of purchase brands and usage brands (a reproduced table of Bonchek & Bapat, 2018). The categorization is based on B2C brands, but the mindsets are also applicable for B2B brands because business solutions have a tendency of longer life cycles.

Purchase brands create demand for buying the product and is concerned what the customer thinks about the brand (Table 2). Usage brands see the customer as a user who experiences the brand and communicates it to other people. Most purchase brands would likely be traditional brands, and most usage brands digital brands, but there are also exceptions such as Visa, FedEx, Lego, and Costco, which are considered traditional but exhibit characteristics of usage brands.

Interactions in customer service that have a highly emotional meaning to the customer and therefore, provide the company a great opportunity to earn trust and loyalty by handling the situation excellently, are called "moments of truth" (Davidson, Madge, & Beaujean, 2006). Purchase brands put more efforts in the "moments of truth" before the transaction, for example researching,

shopping, and buying the product, whereas usage brands focus on the after-transaction moments such as delivery, service, education, and sharing.

The survey respondents showed stronger advocacy, a higher preference over competitors in making the purchase, and willingness to pay a premium price for usage brands, than for purchase brands. Even though the survey was conducted within B2C brands, the categories of purchase and usage mindsets are relevant also for B2B brands due to tendency of longer life cycles of business solutions. (Bonchek & Bapat, 2018.)

2.3 Customer Experience

The concept of customer experience (CX) has become increasingly popular in the past decades as customers have acquired more power in their relationships with companies. However, it has been acknowledged as a key component of business strategy only recently. CX can be physical or virtual or both at the same time, for example shopping in an online store and receiving a physical delivery. (Pennington, 2016, p. 449).

Pennington (2016, pp. 449–450) compares concepts of customer centricity, UX, customer service, and CX, and concludes that CX has the widest definition involving the end-to-end experience with a company, product, or service. Customer centricity drives strategic choices and day-to-day actions in a company placing the customer agenda at the core of company thinking. UX is usually associated with systems testing and user acceptance aiming to develop the effectiveness of an online experience. It does not cover the wider elements of, for example, physical experience, customer expectations, and how the customer ended up to the web page. Customer service is seen in isolation and focuses specifically on interaction.

Compared to the other customer-related terms, CX is seen more of a holistic approach including all channels and both the physical and virtual dimensions of those experiences. According to Pennington (2016, p. 450), CX is “about the consistent delivery of the brand-driven customer promise and resulting customer expectations through the physical experience”.

Problems that occur at different levels of customer experience are called pain points. They can be identified at interaction level, customer-journey level, and relationship level. Pain points can be easily observable or hidden, and the level of specificity and significancy varies depending on the case. It is crucially important to identify these problems to find out the users’ real needs and

create relevant solutions to them. The effects of the pain points can be classified into costs that the user pays for an unsatisfactory experience (Table 3). (Gibbons, 2021.)

Cost	Explanation
Interaction cost	The user needs to take additional steps to fix an occurred error or call for assistance.
Cognitive load	The user's mental resources are challenged by the system features and content.
Time cost	The user needs to spend time on waiting for a process to complete.
Financial cost	The user needs to spend money to replace a service that has outages, e.g. internet connection.
Loss of trust and confidence	The user has a non-satisfactory interaction with a company and feels being betrayed.

Table 3. The effects of pain points on users (based on Gibbons, 2021 and Whitenton, 2013).

Interaction cost and cognitive load require the user to make extra effort to find out how to solve a problem or an occurred error regarding the product (Table 3). Time cost is caused by a long waiting time, and financial cost requires the user to spend money on replacing a service or solution that does not work as it should. If the user gets disappointed in the interaction with the company, trust and confidence are at risk of being lost. (Gibbons, 2021.)

The gap between asking questions of what it is like to be a customer of a company and what it should be like, can be defined as customer experience management (CXM) (Pennington, 2016, p. 449). Atif (2019) argues that in the present time, having a solid CX strategy before a product launch, is crucially important to a company. It helps the company differentiate from competitors, but even more, it determines whether the product will be accepted in the market. Especially the early adopters serve as the best marketing strategy, when provided excellent UX. (Atif, 2019.)

When considering cut-through, "the ability to get a message through to potential customers who take actions as a result", there are five different levels that the CX should ideally meet: acquisition (1), activation (2), revenue (3), repeat (4), and referral (5). Acquisition requires attractive CX to draw new customers. Activation is focused on efficiency, whereas revenue postulates effective CX to increase spending. Repeat is a result of better CX that enhances loyalty, and referral can be reached by remarkable CX that prompts advocacy. (Dew et al., 2021, Chapter 3.)

2.4 Business-to-Business Customers

There are big differences in business-to-consumer (B2C) and business-to-business (B2B) markets, and therefore also the CX in these environments is often profoundly different. In the recent times, the key areas of focus in B2B markets have been products and supplier technology, yet the spotlight is developing towards more customer-facing functions involved in CX. Table 4 describes the large transactional and offering differences that have historically been considered between the two markets. (Dew et al., 2021, Chapter 6.)

Dimension	B2C	B2B
Orientation	Marketing promotion	Manufacturing/Tech focus
Customer segments	Large	Small
Market Complexity	Less complex	More complex
Value perceptions	Emotional then rational	Rational then emotional
Transaction size	Tends to small	Tends to large
Purchase time	Short	Often long to very long
Branding	Extensive/sophisticated	Often limited
Buyer/seller interdependence	Limited	Often significant
Relationship use	Limited	Often significant
Relative size of buyer/seller	Seller larger	Often similar
Offering complexity	Tends to be simpler	Tends to be more complex
Decision maker	Individual consumer/couple	Web of decision makers
Time period for value delivery	Often short	Often long
Customer experience	Individualised	Institutional

Table 4. The large transactional and offering differences between B2C and B2B markets historically (a reproduced table of Dew et al., 2021, Chapter 6).

When it comes to value perceptions, in B2C emotional comes before rational, whereas in B2B value is perceived in the opposite order (Table 4). Also, buyer seller interdependence as well as relationship use is limited in B2C and more significant in B2B. Decision is often made by an individual or a couple in B2C, while more decision makers are involved in B2B. Altogether, the concept of customer experience is delineated differently, focusing on individuals in B2C and institutions in B2B. (Dew et al., 2021, Chapter 6.)

Four major trends and driving forces have influenced B2B markets in the 2020s: the need to focus on an increasingly global marketplace (1), the need for organic growth (2), dramatic increases in customer power due to digital information and manufacturing (3), and the need to harness the potential of B2B big data and analytics. (Dew et al., 2021, Chapter 4.)

When considering B2B relationships, numerous factors can be used to characterize them. It is common that even though suppliers and customers sought mutual goals, they could have different expectations for the relationship and the counterpart's role and way of operating. Therefore, openness and trustworthiness are important in resolving conflicts in the relationship. (Sundberg, 2015, p. 15). Powers and Reagan (2007, p. 2) introduce five stages for a buyer-seller relationship (Table 5).

Relationship stages	
Partner selection	Identifying an appropriate partner is a critical first step in the relationship development process. During this stage, the process of assessing the quality of a potential partner begins the development of the relationship.
Defining purpose	The defining the purpose stage of relationship development provides organizational sanctioning of the relationship that gives legitimacy between the partners and within each organization. The partners must develop a common understanding of the purpose of the relationship.
Setting relationship boundaries	Boundary definition defines the degree to which each partner penetrates the other's organization and achieves joint action. A new set of informal rules defining how much each partner may call upon the other develops as the partners begin to adapt processes, products or services to accommodate the other partner. In this stage the level of performance satisfaction is determined by the resources committed to the partnership and by the degree of commitment of those involved.
Creating value	Value creation is the process by which the competitive abilities of the partners are enhanced by being in the relationship. This value is created by the synergy from the partnership whereby each partner gains from the relationship. This value may come in the form of technology, market access, information, lower prices and operating costs, knowledge; often the partners will adapt their processes or products to meet a partner's specific need.
Relationship maintenance	Relationship maintenance is the stability of the relationship that has developed as the previous stages have been developed and have been positive outcomes. When the relationship has developed to this stage, working with the partner is very much like working within your own company.

Table 5. Stages of a B2B buyer-seller relationship (a reproduced table of Powers & Reagan, 2007, p. 2).

Partner selection (1) starts the relationship development process by identification and assessment of an appropriate partner (Table 5). On the phase of defining purpose (2), the partners develop a common, legitimate understanding of the purpose of the relationship. When setting relationship boundaries (3) the organizations define, how much they penetrate each other to achieve joint action, what resources they provide and how committed they are to shared goals. Creating value (4) means enhanced competitive abilities for both partners regarding for example,

technology, market access, information, knowledge, lower prices, and operating costs. The last stage, relationship maintenance (5) is a positive outcome of the success of the previous phases and establishes stability; working with the partner is almost as working within one's own company. (Powers & Reagan, 2007, p. 2.)

In determining how to best structure CX activities, a company should first assess which type of buying relationship it is engaged in: Transactional Buying Operations (TBOs), Routine Exchange Relationships (RERs), or Organic Buying Relationships (OBRs). Then it is worth identifying the customers who help the company grow most over time, considering the value the B2B buyers are looking for, and mapping different types of buying journey that a spectrum of customers undertakes. Also, it is recommended to anticipate possible future changes in buying processes and consider structuring for Lean CX. (Dew et al., 2021, Chapter 4.)

When it comes to customer development, there are three critical areas of differences between B2B and B2C relationships. Firstly, since a B2B transaction is considered an investment in future profitability, cost reduction, timesaving, productivity or customer satisfaction, expectations of Return on Investment (ROI) are a crucial factor affecting decision making and evaluation of different options. Secondly, client relationships play an important role in B2B markets that in general are considerably smaller than B2Cs. In relationship-building, trust and stability are essential for landing long-term agreements and growing existing relationships. The third critical area is the decision-making process that is much more complex in B2B than B2C purchases. For a large transaction, approval of several different stakeholders is needed, and the end user may not even participate in the process. In addition, the stakeholders from CEO to budget operator often have very different, and sometimes conflicting, motivations for the purchase. (Garbugli, 2014, pp. 16–19.)

Many large B2C businesses have succeeded to deliver excellent CX, but when it comes to B2B firms, the bigger the company the harder it is to thrive in great CX. B2B companies are generally strong in processes, quality control, Six Sigma, and logistics, but customer experience and consideration of emotions are typically delegated to sales staff only. (Hague & Hague, 2018, Chapter 1.)

When looking at CX in the B2B channel, merchant and distribution companies in different industries operate as a form of logistics outsourcing. Unlike manufacturers themselves, the channel partners' key role is to look after customers and their needs. They are not under the direct control of the supplier, but they have a great potential to deliver excellent CX. (Hague & Hague, 2018, Chapter 17.) According to Ross (2008, pp. 176–178), this pipeline mechanism for the delivery of

value for the supplier looks very different, when approaching it from the eyes of the customer. The following perspectives describe how the customer perceives the supply value chain:

- Receiving total value – to an immediate or ongoing need with a feeling of total satisfaction regarding delivery, timing, and ease of effort.

- Finding the ultimate buying experience. The content and intensity of the experience of interacting with the supplier matters as much as the quality and completeness of the product/service solution.

- Building supplier relationships. Experiences at each buying occasion throughout the whole network of possible intermediaries affect brand loyalty more than features and functions of the product or service itself.

- Conditions of loyalty – affected by (1) past experiences with products, purchasing processes and support, (2) attitudes about brands, and (3) conscious and unconscious beliefs about a brand, product or service.

- Alignment of channel offerings and customer expectations – regarding pricing, product, service standards and experiences.

Sundberg (2015, pp. 45–46) presents that the design and provision of positive UX avails all three stakeholders: the buyer, the customer, and the supplier (Figure 5, p. 19).

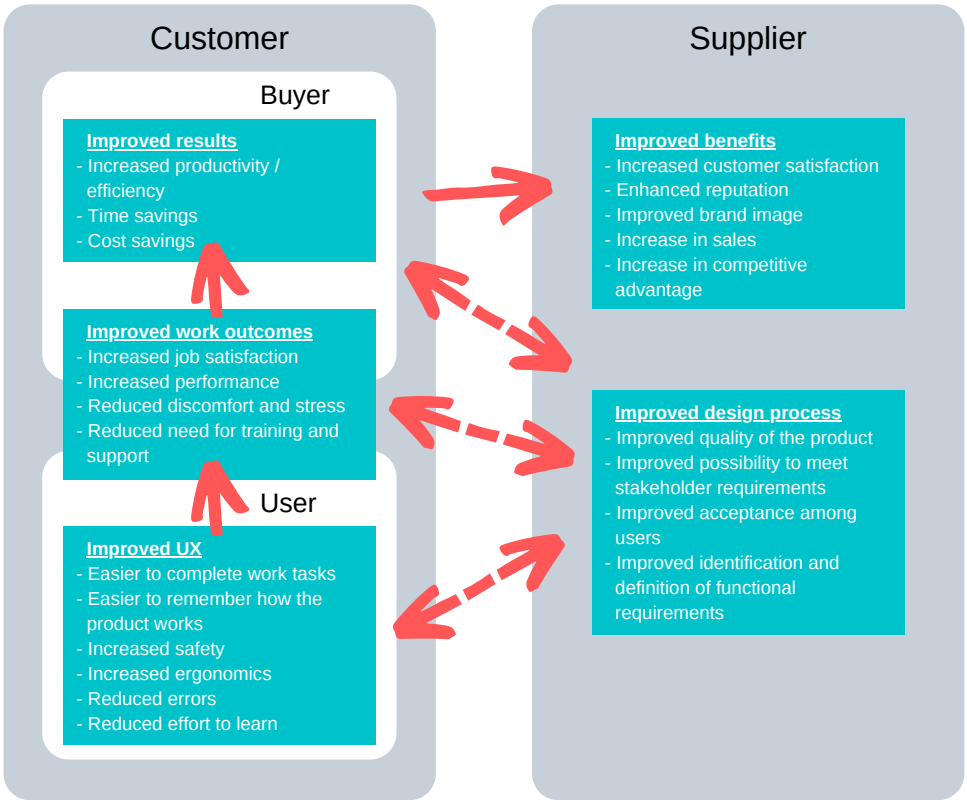

Figure 5. The benefits of UX for different stakeholders (a reproduced figure of Sundberg, 2015, p. 46). Positive UX results in better product quality, functional requirements, and product acceptance among users.

When the needs and requirements of customers and users are considered valuable, so that they influence the development process of new products, superior value can be produced (Figure 5). Especially in technology investment decisions, customers expect increased productivity and efficiency, as well as savings in time and effort when purchasing new equipment. (Sundberg, 2015, pp. 45–46.)

Dashed arrows in the figure illustrate that a user-centered design (UCD) process should be selected based on the improved UX, work outcomes and results for customers and users. Also, the UCD strategy itself can improve all these three areas with better usability, safety, ergonomics, job satisfaction, work performance, productivity and savings in cost and time. As a result, product quality, functional requirements and product acceptance among users can be improved and, in the end, resulted in better sales. (Sundberg, 2015, pp. 45–46.)

3 Lean Start Up and Design Thinking

Lean start-up and design thinking are focused on short iteration cycles and the consideration of customer feedback (Lewrick, Link, & Leifer, 2018). The following sections introduce principles of both concepts and related methods and tools for testing early products.

3.1 Principles of Lean Start Up

Koen (2015, Chapter 19) describes the lean start up process being iterative in nature and involving four parts: the business model, customer development, agile development, and minimum viable prototype, also known as minimum viable product (MVP), that is the main experimental tool to validate hypotheses.

The original idea of Lean management is to reduce waste that can be categorized into eight sources, developed by Toyota's Chief Engineer, Taiichi Ohno in 1970s and other lean practitioners later on. These eight sources apply to production within a company, and they are defects, over-production, waiting, unused talent, transportation, inventory, motion, and extra-processing. Lean CX expands beyond production and covers waste relevant to CX that occur in different touch-points. (Dew et al., Chapter 2.)

Dew et al. (2021, Chapter 2) define Lean CX as an approach to improve CX for cut-through by using agile management techniques. Lean CX can improve a company's current go-to-market approach and simultaneously explore new concurrent opportunities, which makes it a new perspective among lean approaches that were not originally developed for this purpose.

Lean UX focuses on the experience that is being designed, collects feedback early and integrates it quickly – valuing more the actual experience than any deliverables such as reports (Rosenzweig, 2015, pp. 165–166). Rosenzweig (2015, p. 166) describes that lean UX is built on three principals:

1. Design thinking, which applies design principals to all aspects of business;
2. Incorporation of agile development principals;
3. Lean startup methods.

Agile software development values “individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation”, and “responding to change over following a plan” (Rosenzweig, 2015, p. 159).

Minimum Viable Product

The concept of a Minimum Viable Product (MVP) has been intensely debated, and there are different views of what qualifies as an MVP (Olsen, 2015). Baker (2018, Chapter 7) defines the term as “the least expensive created product or service released to the market while making a profit” (Baker, 2018, Chapter 7).

MVP is often misinterpreted as “an excuse to build a partial MVP that has too little functionality to be considered viable by a customer”. In this context, a product’s attributes of reliability, usability, and delightfulness are ignored, and an attribute of functionality is limited. However, while functionality is correctly limited in an MVP, all the other attributes should already be “complete” instead. (Olsen, 2015, Chapter 7.)

Reif (2017) conducted a study of how new innovative high-tech startups manage time to market and user experience of their MVPs. He interviewed six startup companies in the areas of event planning, IT security, device remote management, construction industry, data security, and education. The companies had various versions of MVP, as well as perceptions of its definition and use, ranging from initial user testing to getting customer feedback and obtaining seed funding.

In his conclusion, Reif (2017) describes that time to market for the startups was connected to the core functionality of the product. Their development cycle was not defined so much by competition pressure but more by concrete customers and industry standards. The user experience was considered much more important than the time to market. Most startups used user-centered design practices, yet they were not always complete.

Regarding development of an MVP, Välke (2019) examined how customer experience, user experience and design thinking theories can help in creating an MVP of a digital service and measuring its success. In the case study she concluded that the iterative process of applying the theoretical framework using both qualitative and quantitative approaches enabled to gain useful understanding of the customer perspective. She concluded that the outcome of her master’s thesis is applicable to other software development projects as well.

When it comes to taking research results into practical use of the end customers in the field of agriculture, usability arises as a problem. Usability is closely connected to user experience and acceptance and therefore it affects, whether the product is taken into wide use or not. (Haapala, Nurkka, Kaustell, Mattila, & Suutarinen, 2006.)

Haapala et al. (2006) conducted a study of usability as a challenge in agricultural engineering. Focusing on results of usability issues in Precision Agriculture (PA) and an evaluation of the Human-Machine Interface (HMI) of a precision combined drill, they concluded that usability issues are crucially important when developing successful products for PA. It was also specified that when evaluating usability of a product the complexity of agricultural work needs to be taken into consideration, especially regarding the user, environment, work practices, tasks, and equipment.

3.2 Principles of Design Thinking

IDEO, a pioneering organization of design thinking and forerunner of the user-centric design movement in the 1990s, names three concurrent goals of a new design: economic viability, consumer desirability, and technological feasibility (Figure 6). Viability involves with profitability to the firm, desirability aims to meet what the customers want, and feasibility considers whether the improvements are possible to incorporate with current technologies. (Mishra, 2021.)

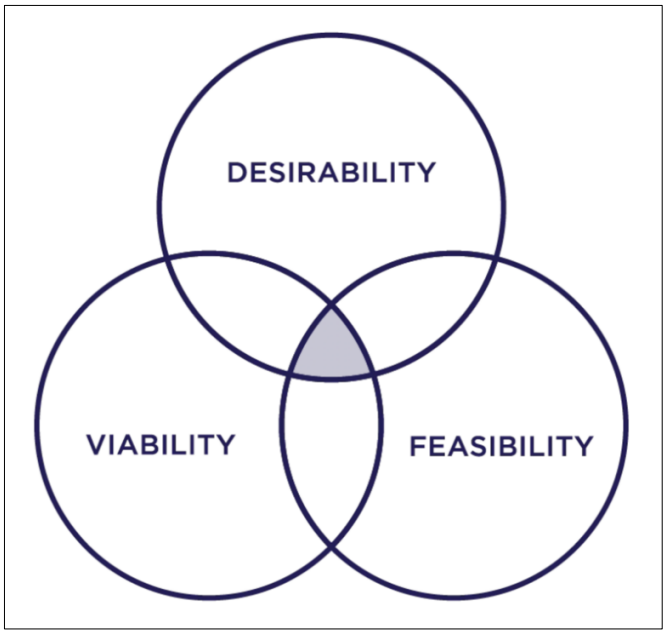

Figure 6. Design thinking combines desirability from a human point of view, feasibility in terms of technology, and viability that aims for economic sustainability (Ideo U, n.d.).

To gain these goals of desirability, viability and feasibility, there are numerous different models for design thinking processes. However, it is common for all of them to include iterative loops back and forth between different steps (Ball, n.d.; Ideo U, n.d.; Lewrick, Link, & Leifer, 2018; Mishra, 2021). The most widely shared model of the design thinking process is the Double Diamond (Figure 7) of Design Council, from 2004.

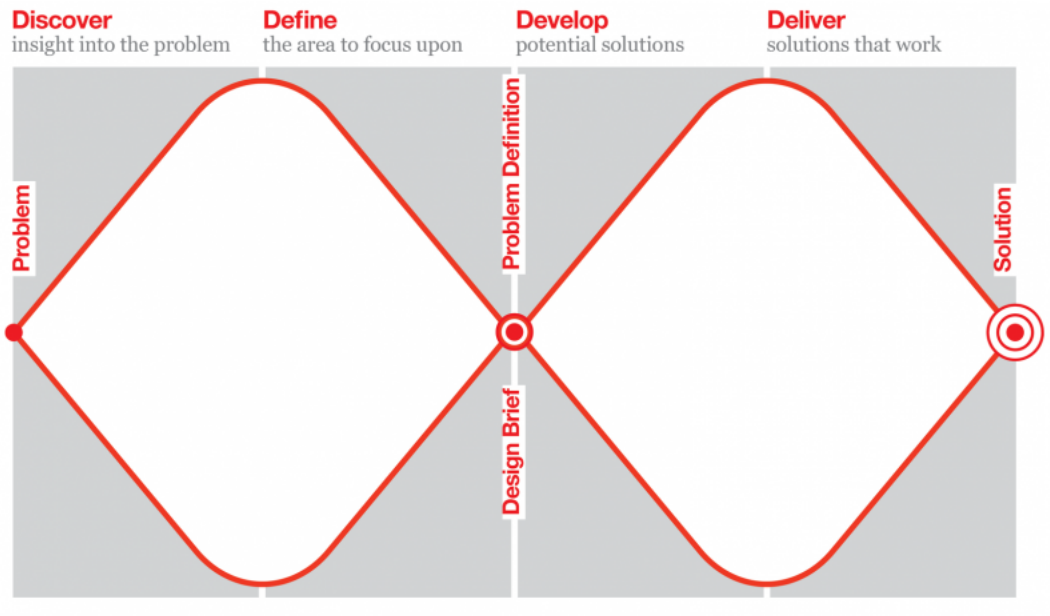

Figure 7. Double Diamond is an iterative process of Discover, Define, Develop, and Deliver (Justinmind, 2018).

The steps of the Double Diamond process (Figure 7), according to Justinmind (2018) are the following:

1. Discover – questioning the challenge and quickly moving on to research to identify user needs

2. Define – understanding how user needs and the problem align and creating a design brief to define the challenge based on these insights

3. Develop – developing, testing, and refining multiple potential solutions

4. Deliver – selecting a single solution that works and preparing it for launch

The Double Diamond can be used for many purposes, such as a method for starting and shaping the strategy and management of a project, or for checking in on a project to clarify “where we

are in the process", to name a few. (Ball, n.d..) Another, slightly more specified, example of such process is illustrated in Figure 8 (Ideo U, n.d.).

Figure 8. Six steps of IDEO design thinking process (Ideo U, n.d.).

Design thinking process from IDEO (Figure 8) includes the following steps (Ideo U, n.d.):

1. Frame a question – "To whom are you designing a solution for and what do they actually need?"
2. Gather inspiration – go into the world to observe and discover what people really need
3. Generate ideas – push past the obvious and create fresh solutions to the problem
4. Make ideas tangible – build rough prototypes
5. Test to learn – test the prototypes, gather feedback, and iterate
6. Share the story – craft and share the right solution to colleagues, clients, and customers

In the context of UX, Rosenzweig (2015, p. 20) explains that design thinking "combines the understanding of the context of the problem and taps into empathy for the user to access the tools that are appropriate to a successful solution". UX design thinking applies design thinking to UX by taking the best out of both concepts and putting them together. The approach involves interface (UI) and interaction design, which are the elements between a person and the technology, and participatory design that includes the stakeholders in the process to allow user-centered innovation and creative development atmosphere. Also, prototypes and wireframes are important for testing designs. (Rosenzweig, 2015, p. 42–45.)

Interaction Design Foundation (n.d.) uses the term UX design for creating products that provide meaningful and relevant experiences to users. UX design begins before the product is in the user's hands and covers the entire process of acquiring and integrating the product. UX design involves

aspects of branding, design, and function. Also, usability and user interface (UI) design are subsets of the concept, even though they are often used interchangeably with the term.

UX design focuses on creating products that are usable, efficient, fun and bring pleasure. According to Interaction Design Foundation “a good user experience is one that meets a particular user’s needs in the specific context where he or she uses the product. (Interaction Design Foundation, n.d..) Rosenzweig (2015, pp. 46–47) specifies principles of UX design as the following:

- Easy to use: not too many clicks, functions are easy to find;
- Easy to understand: the user does not have to get help to do the tasks;
- Visual focus: the call to action;
- Clarity: information is easy to understand, directions are clear;
- Effective: the users can perform their task efficiently and correctly;
- Works for the user.

Figure 9 illustrates how Interaction Design Foundation (n.d.) outlines UX design process into three simple questions: Why, What and How.

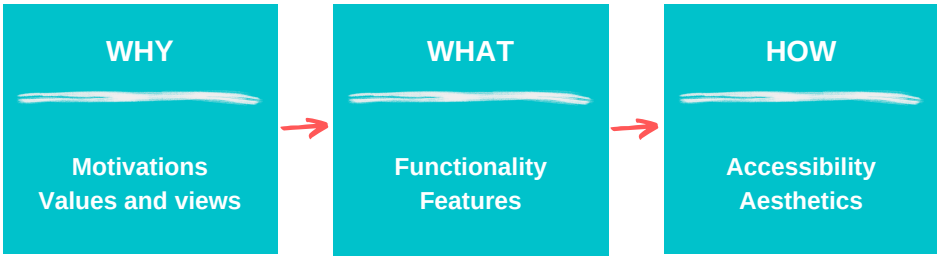

Figure 9. The Why, What and How of UX design (a reproduced figure of Interaction Design Foundation, n.d.).

UX design process (Figure 9) starts with a phase of Why which means finding out the users’ motivations, values, and views for adopting a product involving the task they wish to perform with it and ownership and use of the product. The What describes the functionality of the product and what can be done with it. Accessibility and aesthetics are considered in the phase of How, where the design aims for a pleasant use. (Interaction Design Foundation, n.d..)

3.3 Methods and Tools for Early Product Testing

The following section introduces some useful methods and tools that can be used for testing early products.

Prototyping

Prototyping "allows both builders and potential customers to evaluate whether the product is being developed correctly". It has been long used in manufacturing, design, computer programming, and electronics in the form of a simulation or an early version of the end product. There are numerous viability tests to find out for example, whether the dimensions are correct, whether the design is usable or fits aesthetically, does the core technology work, and how close the product is to solving the problem. (Cooper & Vlaskovits, 2013, p. 146.)

Olsen (2015, Chapter 9) introduces two different types to test a prototype of an MVP in a Lean Product Process: quantitative test (1) aggregating results of a large number of customers and qualitative approach (2) focusing on details heard from a small number of respondents. These types are further specified in Figure 10.

Figure 10. MVP Tests categorized by type (a reproduced figure of Olsen, 2015, Chapter 7).

The quantitative and qualitative types can be categorized into marketing and product tests (Figure 10). Quantitative marketing MVP tests capture user behavior, and they can be used to validate

demand for the product. With providing large sample sizes, they are useful for remarkable learning. In qualitative marketing tests different marketing materials are shown to customers for feedback to gain understanding of how compelling the materials are and why. (Olsen, 2015, Chapter 7.)

When it comes to product testing and ensuring that customers see value in the product, quantitative tests can be conducted after having a live product with a meaningful amount of usage. The tests measure the customers who are using the product, using typically large sample sizes. Conversely, qualitative product tests focus on smaller numbers of customers and are interested in their opinions. They are the most valuable way to assess and improve the product-market fit, especially when developing a new or redesigned product. Qualitative product tests can be conducted at two valuable phases, before and after building the product. (Olsen, 2015, Chapter 7.)

Olsen (2015, Chapter 9) argues that qualitative user feedback is extremely valuable, because it uncovers blind spots that only a new user can see. Those blind spots can be best explored by one-on-one interviews, when it is able to have a richer and more in-depth conversation than in group interviews where negative dynamics can hinder authentic feedback. (Olsen, 2015, Chapter 9). Authenticity is significantly important, as asking for feedback from customers is an invitation for them to participate in the product design instead of just an effort to validate the developers' existing thoughts (Cooper & Vlaskovits, 2013, p. 158).

It is recommended to start the interview with discovery questions to explore the problem space and value proposition with customers. For finding out the customers' needs and current solution, questions about their behavior and feelings, regarding the key benefit the new product is aiming to provide, are useful. After the discovery questions and conversation about the users' current situation, it is more natural to transit to the product feedback portion of the test. At this part, it is important for the interviewer to ensure objectivity and refrain from any commentary, or leading questions. (Olsen, 2015, Chapter 9.) When validating specific assumptions, Cooper and Vlaskovits (2013, p. 150) introduce a useful template for tracking prototyping experiments (Table 6, p. 28).

Segment:		
Assumption Viability Test	**Hypothesis**	**Result**
Persona exists / details correct:		
Customer has problem/pain/passion:		
Customer will respond to solution (high level):		
Customer will be satisfied with specific functionality *x, y, z*:		
Customer will become passionate when:		
Customer will make final decision to buy when:		
Customer will trust the company when:		
Customer will trust the product when:		
Customer will want to learn more when:		

Table 6. Template for tracking experiments when validating specific assumptions (a reproduced table of Cooper & Vlaskovits, 2013, p. 50).

The template (Table 6) categorizes hypothesis and result for each assumption viability test regarding persona, customer problem, response to solution, satisfaction, passion, purchase decision, trust and willingness to learn more. After gathering data for understanding how deeply the customers feel the problem addressed, how likely they adopt different solutions based on current behavior, and whether the customers are early adopters for the specific type of product, viability can be tested. This means running experiments on customer believability, product fit and business model viability. (Cooper & Vlaskovits, 2013, p. 150, 159.)

Usability Evaluation

When a real person interacts with a product, service, or system, it is called usability testing. The aim is to evaluate and understand several UX dimensions, such as design, learnability, efficiency, user satisfaction, and errors. Many different empirical methods can be used to collet relevant data, and the evaluations can be qualitative or quantitative. Typically, qualitative data, with less than ten users, is collected in the earlier stages of development or prior to a new release, whereas quantitative research, with more than 10 participants, takes place on further steps of the lifecycle. (Rosenzweig, 2015, pp. 132–134.)

Lean User Research

The most important question to ask before starting to build a product is “What do people need?”. Without finding out the need, a company is in risk of wasting time, money, resources, and reputation. Often, teams ask themselves if they can build a product, although they should consider,

whether they should build it or not. The question of peoples' needs is particularly important in the beginning of strategizing a product and at the assessment phase after launching. Useful methods to find out needs are experience sampling, interviewing, observation, and diary study (Sharon, 2016, Chapter 1.)

Another relevant question is to identify, who the users are, including information on their demographics and behaviors. An example of differences between these two types of information is provided in Table 7. (Sharon, 2016, Chapter 2.) Human behavior is more descriptive information whereas demographics can be classified into labels.

Behavior	Demographics
Owns an iPhone and Android	Alpha male
Online 20–30 hours every week	Above-average user
Uses a product similar to ours	Millenial
Open to trying new things	Average income
Reads five "self-help" books a year	East or West Coast U.S.

Table 7. Human behavior vs. demographic labels (a reproduced table of Sharon, 2016, Chapter 2).

Table 7 provides a comparison of the characteristics of two types of information that can be used to identify who the users are. Behavior describes what the users own or do and how they do things, whereas demographics are more solid labels that communicate specific and sometimes categorized information. (Sharon, 2016, Chapter 2.)

Defining, who the users are, is important in the early strategizing phases and after launch, to find out possible new audiences. For collecting qualitative data about the users' behavior and motivations, interviewing allows direct dialogue to uncover feelings, desires, struggles, delights, attitudes, and opinions. In-person interview is the best option for learning, but remote alternatives also provide a chance for discussion.

Persona development combined with interviewing is a priceless lean user research technique to answer questions such as who the users are, what are their different lifestyles, what motivates them, what is their workflow, and is there a need for the product or feature. The technique embraces direct setup for in-context research and challenges perceptions and assumptions about users by aiming to uncover the reality. It also increases empathy towards users and builds credibility to decision-making processes in the eyes of investors, senior executives, paying customers etc. (Sharon, 2016, Chapter 2.)

Persona and Use Case

Sharon (2016, Chapter 2) defines a persona as “a description of an archetypical user of a product” and emphasizes the importance of basing it on research instead of assumptions and imagination, so that it can be used properly. Persona is not a research methodology itself but a communication tool for raising empathy toward users within an organization, so that teams can be aligned with different types of users.

Developing personas is helpful to better understand the user. A persona represents a group of users that include information of specific demographics, goals, motivations, frustrations, behaviors and tasks, and constraints or limitations. (Rosenzweig, 2015, p. 48).

Use cases describe the task the user carries out with the object, and they include detailed information on the goals, user touch points, environment, actionable steps in order of execution, and user flow journey. They also explain the formulaic for “in order to do this, the user must first do this”. (Rosenzweig, 2015, p. 50.)

4 Research Design

The research was conducted as a qualitative case study, and data was collected via semi-structured interviews and survey. The analysis of the findings was made inductively and focusing on a conventional content approach. Journey map and service blueprint were used as collaborative development methods in two different workshops.

4.1 Case Study as Research Strategy

Case study was chosen as research strategy because it helps to reach the research objective in a specific context (Robson & McCartan, 2016, Chapter 7): to explore and evaluate how product X should be developed further, based on feedback from the users, and to outline recommendations for collecting feedback in other projects in the future, based on experiences in this thesis. Typically, the design of the strategy gets defined further when data collection and analysis are in progress (Robson and McCartan, 2016, p. 16). The core feature of the process is to first define and then solve the chosen case (Eriksson & Kovalainen, 2015, Chapter 11).

The characteristic of the strategy aims to avoid overly simplistic research designs, but it gives space for diversity and complexity instead. As an outcome, holistic and contextual in-depth knowledge can be generated of the case (Eriksson & Kovalainen, 2015, Chapter 11.), which provides valuable insight about the needs of the users regarding product X. Furthermore, case study that is appropriately constructed can be used to challenge an existing theory and inspire new research questions for further study (Saunders et al., 2009, p. 146), leading to beneficial conclusions about further development of product X.

Case study is regarded more accurate, reliable, and rich when several sources of data is used (Eriksson & Kovalainen, 2015, Chapter 11). It is typical for case study to involve multiple methods of evidence and data collection techniques (Robson & McCartan, 2016, Chapter 7 & Saunders et al., 2009, p. 146). Triangulation, a method that is often used in case study (Saunders et al., 2009, p. 146), was chosen to ensure that the data tells what the researcher thinks it tells.

Eriksson and Kovalainen (2015, Chapter 11) state that in triangulation different data collection techniques are used to cross-check the content Farquhar (2012, p. Chapter 3) outlines four different types of triangulation that can be used in research: data gathering from different sources

(1), use of more than one investigators (2), use of more than one theoretical perspective (3), and triangulation within-method or between-method (4). Between-method is the most common version of triangulation in case studies. It uses different methods with the same object, for example a survey or a document analysis.

To gain more accuracy, reliability, and credibility for the case study (Eriksson & Kovalainen, 2015, p. 20; Robson & McCartan, 2016, p. 16; Saunders et al., 2009, p. 146), two data collection methods, survey and interviews, were triangulated. Also, more than one investigator was involved in the data collection (attending interviews) and analysis (assisting in interpretation): the SAVT team provided support in technical details regarding the use of product X.

When collecting empirical data, both quantitative and qualitative data can be used in case study. Quantitative data is typically measurable, whereas qualitative data needs to be interpreted (Eriksson & Kovalainen, 2015, Chapters 7 and 11). Qualitative research approach was chosen for this thesis, because it aims to understand "how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (Merriam and Tisdell 2015, Chapter 2). This is crucial in terms of understanding the users' needs regarding the problem product X addresses. As Merriam and Tisdell (2015, Chapter 2) complement, qualitative case study can be defined as "an in-depth description and analysis of a bounded system", meaning the context of SAVT's current and future projects, in this thesis.

4.2 Data Collection and Development Methods

Qualitative research is interested in descriptions, interpretations, and meanings (Eriksson & Kovalainen, 2015, Chapter 7; Merriam & Tisdell, 2015, Chapter 2), which aligns well with the thesis objectives. To gain understanding about the UX of the product X, qualitative data was collected through survey and interviews. Survey is useful in seeking answers about facts and behaviors (Farquhar, 2012, p. 16), so the users were asked to fill in an online questionnaire for any problems that occurred during the testing. After the testing, semi-structured interviews that are flexible in form but explore specific information from all the respondents (Merriam & Tisdell, 2015, Chapter 5), were used to collect deeper, overall feedback of the UX.

These two data collection techniques were chosen to complement each other. Survey was provided to the users for quick, "in the moment", feedback about the functionality of the product. They had a chance to instantly report and describe any problems they faced while using the

product, providing details that would likely be difficult to remember afterwards. Interviews, instead, focused on the overall experience, evaluation and opinions about the product after the testing period was over.

Collaborative development methods were used to structure and visualize the findings of the user research and map out the feedback collection process performed in the thesis. Journey map, a method that makes steps of a transaction, interaction, communication, or other relevant activities visible in UX (Faranello, 2016, Chapter 7), was used in a workshop to illustrate the findings emerged from the data and identify opportunities of improvement. Service blueprint, a visualizing and structuring method for service processes (Lewrick et al., 2018, p. 234.), was created in another workshop to identify strengths and weaknesses of the process of collecting the user feedback.

Interview

In the range of interview types, Merriam and Tisdell (2015, Chapter 5) introduce a comparison of three different options (Table 8). Semi-structured interview is placed in the middle between highly structured, questionnaire-driven interviews and informal, open-ended, conversational formats (Table 8).

Highly Structured/Standardized	Semistructured	Unstructured/Informal
• Wording of questions is predetermined • Order of questions is predetermined • Interview is oral form of a written survey • In qualitative studies, usually used to obtain demographic data (age, gender, ethnicity, education, and so on) • Examples: U.S. Census Bureau survey, marketing surveys	• Interview guide includes a mix of more and less structured interview questions • All questions used flexibly • Usually specific data required from all respondents • Largest part of interview guided by list of questions or issues to be explored • No predetermined wording or order	• Open-ended questions • Flexible, exploratory • More like a conversation • Used when researcher does not know enough about phenomenon to ask relevant questions • Goal is learning from this interview to form questions for later interviews • Used primarily in ethnography, participant observation, and case study

Table 8. Interview structure continuum (a reproduced table of Merriam & Tisdell, 2015, Chapter 5). Semi-structured interview was chosen for the thesis due to flexibility in form.

In semi-structured interviews, the questions are partly more and partly less structured or the wording of all questions in general is more flexible than in highly structured formats, yet the aim

is to gain specific information from all the respondents (Table 8, p. 33). (Merriam & Tisdell, 2015, Chapter 5.) This option was chosen for the thesis because the users tested the product and answered the questions in different circumstances and flexibility in form was necessary.

According to Farquhar (2012, Chapter 5), semi-structured interviews for qualitative data collection typically follow an interview guide, yet simultaneously allow for flexibility and contextual adaptation. Basic elements for preparing a semi-structured interview guide include questions aligned with the research objectives, adherence to ethical research principles, and logical order of questions and option for flexibility when needed. Also, comprehensible and appropriate language and records of relevant background information of the interviewees (who, when, where, and how long) are important parts of the guide. After each interview, it is recommended to make brief notes for a preliminary means of analysis.

This thesis applied the above guidelines and the 11-step process to conduct a lean user research technique from Sharon (2016, Chapter 2), by following the latter in most steps that were relevant to the case: finding 10 interviewees, preparing the interview, preparing for data collection, establishing rapport, obtaining consent, conducting the interviews, and analyzing collected data. Some steps that were not seen as relevant, were left out or adapted to match better the context of the case, such as creating a persona only in the end of the research instead of creating one also in the beginning.

Survey

Another data collection technique used in the thesis was survey, which according to Farquhar (2012, Chapter 5.), is a suitable method to be triangulated with for example, interviews or observation in case study. When having a clear idea of the straightforward questions that need to be asked, it is an appropriate choice for seeking opinions, attitudes, facts, or behaviors. A common example of an instrument for survey is a self-administrated questionnaire. (Farquhar, 2012, Chapter 5.) Such type of questionnaire is typically completed by the respondents, and it can be posted to respondents, delivered to them by hand, or administered electronically using intranet or the Internet (Saunders et al., 2009, pp. 362–363).

As Saunders et al. (2009, p. 363) recommend, when choosing a type of questionnaire, a variety of factors were considered, such as characteristics of the respondents, how to reach them, and how to prevent from contamination or distortion of the answers. Also, the required response rate and

likely response rate were estimated, as were the types and number of questions that needed to be asked to collect the data.

The online questionnaire (appendix 1) used in the thesis had one relevant question. The users were asked to explain in their own words what had happened in the situation they wanted to give feedback on. They also had a chance to download pictures or a video to illustrate their situation. The qualitative data of the open question was used in the analysis, together with the data from interviews. The other questions of the questionnaire were background information regarding the date, time, product number and use case related to the given feedback. That data was only used to connect the data to the right use case.

Journey Map and Service Blueprint

Journey maps help to identify pain points, that cause the user confusion, and moments of truth, that provide either a good or bad impression. (Faranello, 2016, Chapter 7.) Bohlmann and McCreery (2015) describe experience mapping as seeking understanding, synthesizing and forming insights about the total CX or UX. They introduce an "as is" map, for UX as it currently exists, and "to be" map for UX with improvement ideas emerging from identified pain points and opportunities. To identify and collaboratively discuss improvement ideas of the product, an "as is" map was created in the thesis. To illustrate the output of the discussion with a "to be" map was not seen necessary or possible to make due to a limited amount of time reserved for the workshop.

As Faranello (2016, Chapter 7) points out that the visual layout of journey maps varies in shapes and sizes, numerous templates were found available for use. Bohlmann and McCreery (2015) recommend to develop personas as part of the process so that the journey map will be a useful tool for innovating new solutions Personas are not research methodology but communication tools to raise empathy towards users (Sharon, 2016, Chapter 2) and help better understand them (Rosenzweig, 2015, p. 48). To make the most out of the collaborative view on the collected feedback and to provide the SAVT team an illustration of "archetypical users of a product" (Sharon, 2016, Chapter 2), a persona for a selected use case was created together with the journey map. The use case was selected based on the amount of collected data: out of three use cases one had remarkably more data than the other two.

In addition to visualizing and structuring the user journey, service blueprint is a method that includes also internal, "behind-the-scenes" processes of the delivery of a service. It provides critical surface-to-core information on the underlying actors, systems, touchpoints, and policies.

(Flowers & Miller, 2015, p. 4.) To develop recommendations on how to collect feedback on other MVPs in future projects, a service blueprint was created in another workshop. The process of collecting feedback in the thesis was considered as the service for blueprinting. The steps taken in the process, including the SAVT team's input to support it, were mapped out and points of improvement were identified.

4.3 Qualitative Analysis Process

The thesis explores how the users experienced product X and seeks to understand their needs about the problem that product X addresses. Inductive approach was chosen as data analysis method because it allows the data "build the theory". Discovering common themes, categories, activities, and patterns that emerge from the natural data is the core idea in inductive analysis (Eriksson & Kovalainen, 2015, Chapter 11; Farquhar, 2012, Chapter 6, Saunders et al., 2009, p. 490).

Qualitative content analysis that can be described as "a method for systematically describing the meaning of qualitative material" (Schreier, 2012, p. 1) was conducted by focusing on a conventional content approach. This approach is generally used for studies with an aim to describe a phenomenon and allow new insights flowing from the data (Hsieh & Shannon, 2005, p. 3), which was the purpose in here as well. The analysis was conducted by applying the steps Hsieh and Shannon (2005, pp. 3–5) outline for a qualitative analysis process, which is described in more detail in chapter 5.3.

5 Research Process

The aim of this case study was to evaluate how the MVP of product X should be developed further, by collecting feedback from potential customers. Also, based on the performed feedback collection process, recommendations on, how Smart AG Volume Tractors could systematically collect feedback on other MVPs in the future, were made. The overall research process is illustrated in Figure 11 (p. 38).

There were three main research questions in the beginning:

1. How do the users experience the MVP of product X?
2. How should product X be developed further?
3. How to collect authentic feedback systematically and efficiently on other MVPs in the future?

To define the first question more specifically, four sub-questions were created:

   a. What is their current solution to the problem the product X addresses?
   b. Do they need product X?
   c. How do they experience the functionality of product X?
   d. Would they buy product X and how much would they pay for it?

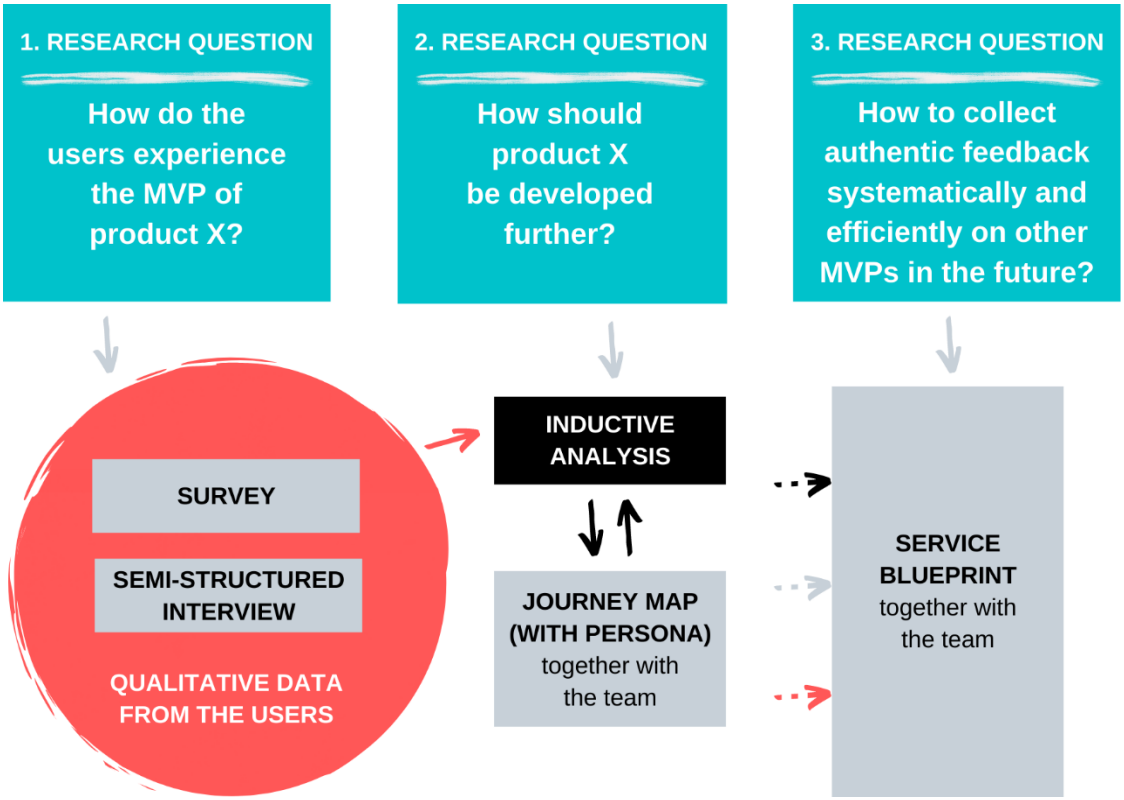

Figure 11. The overall research process of the thesis, including main research questions, source of qualitative data, data collection techniques, analysis, and development methods.

The research process (Figure 11) started with exploring answers to the first research question by collecting qualitative data from the users through survey and interviews. The data was analyzed with inductive approach and visualized and structured by using collaborative development method of journey map with personas. Answers to the second research question were concluded based on the analysis and development task. The last part of the thesis was to create a service blueprint with the team to map out the feedback collection process performed in the thesis and identify points of improvements. Based on the collaborative evaluation of the process, recommendations for future projects were created.

5.1 Case: Smart AG Volume Tractors, AGCO

Being a farmer requires a variety of management skills to lead a successful business in agriculture. Production systems involve a wide range of subjects as listed by Nuthall (2018, Chapter 1):

- Soils, rainfall and climate, plants

- Animals, harvesting and machinery in general, engineering (buildings, structures, irrigation…)
- Labor and personalities
- Markets, finance and economics
- Politics and the resulting impacts on the rules and regulations that must be complied with

AGCO, a global leader in the design, manufacture, and distribution of agricultural equipment (AGCO, 2022a), outlines that "farmer's work is about productivity". Therefore, the corporation focuses on efficiency across all its tractor brands, Challenger, Fendt, Massey Ferguson and Valtra, and 17 other brands involving different areas of agriculture (AGCO, 2022c, 2022b). Improving efficiency covers maximizing uptime of machinery, grain storage solutions and network hardware and software. Also, machine optimization, leading to more precise and improved work, and logistics management with data analysis for better service delivery and uptime maximization, together with reduced waste while maximizing value are part of the farmer-centric efficiencies. (AGCO, 2022c.)

AGCO delivers agricultural solutions such as "tractors, combine harvesters, hay and forage equipment, seeding and tillage implements, grain storage and protein production systems, as well as replacement parts" to farmers around the world (AGCO, 2022a). A new initiative inside the corporation, called Smart AG, has been created to bring customer focused products to market much faster than traditional product development. Out of five Smart AG teams around the world, Smart AG Volume Tractors (SAVT), the case of this thesis, is based in Finland. The team applies lean start up practices in its operation but unlike most startups, it does not struggle with scarce resources but has the resources a huge global corporation in use. (Hardy-Linna, 24.2.2022 & 12.4.2022.)

SAVT focuses on hands-on and price sensitive, B2B customers who are, for the most part, farmers and would usually buy Massey Ferguson or Valtra tractors. In developing new products, the team follows the steps of Smart AG Engineering Process (Figure 12, p. 40). (Hardy-Linna, 24.2.2022.)

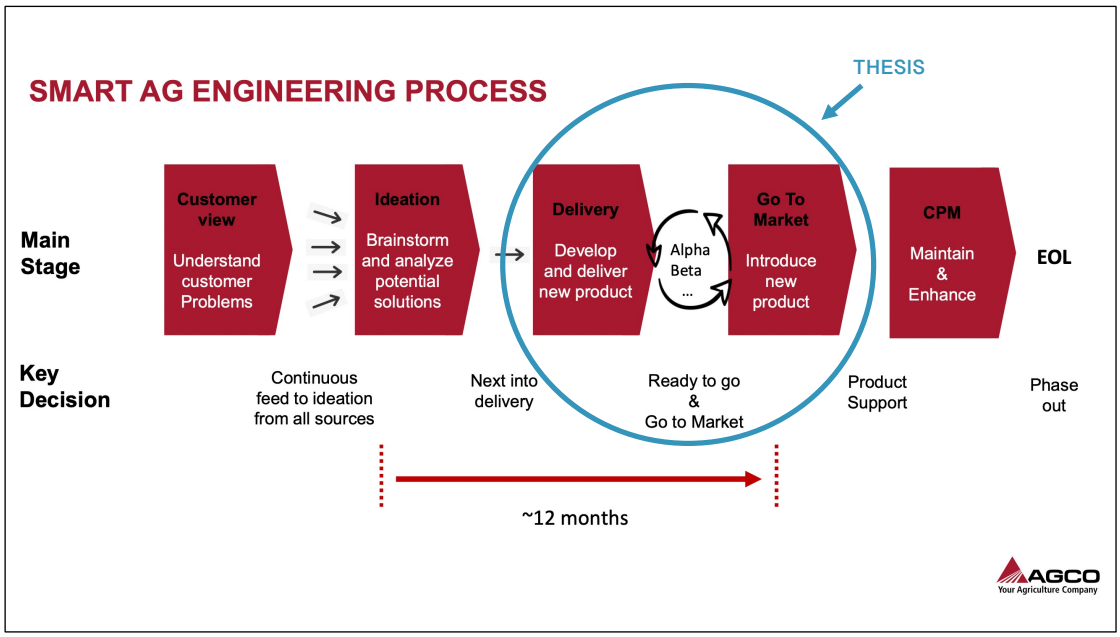

Figure 12. Smart AG Engineering Process (Hardy-Linna 24.2.2022). The placement of the thesis has been added in the original figure. A prototype was taken to users for testing and feedback was collected to learn how it should be developed further.

In Smart AG Engineering Process (Figure 12), everything starts from identifying the customer need which an MVP can be built on. Quick release of the MVP to the users and collecting feedback allows learning what the customer truly wants and building the next, improved version of the product. In practice, a cycle of "Build-Measure-Learn" is used as long as needed before Go To Market phase. The thesis took place in a "Measure" and "Learn" part of the cycle, at the Alpha testing phase between Delivery and Go To Market steps of the engineering process. (Hardy-Linna, 24.2.2022.)

The first step, Customer view, is about understanding the customer gains and pains and creating a "farmer filter" based on them. All ideas of a product are put through the filter and the one(s) that match the criteria is chosen for Ideation. After brainstorming and analyzing potential solutions, an MVP hypothesis is created for the Delivery step. A prototype is built and taken to the customers to test and measure the hypothesis. Analysis will be made based on the feedback whether to tweak, pivot or kill the product. This cycle of "Build-Measure-Learn" is repeated until an MVP that the farmers need and will buy is clearly known. Then, a Smart AG product is built and introduced at Go To Market phase. After this, the process continues by maintaining and enhancing the product until the End Of Life (EOL) is reached and the product is no longer in the market. (Hardy-Linna, 1.9. 2022.)

The MVP hypothesis for the project of product X was not clearly communicated or even defined when the research plan for the thesis was made. Instead, the main points of the hypothesis reflected through the commissioner's goals that were discussed in the beginning and especially in the phase of considering what is relevant to ask from the users: about benefit, price and functionality. As the project as well as the research process of the thesis proceeded, a more specific hypothesis was formed by the commissioner: "Visualization of the working depth and angles of the implement will give farmers the info they need to more accurately perform field tasks, and they will be willing to pay 2000 euros for it" (Hardy-Linna, 5.9.2022). Due to the late timing, this was not considered in the research plan, but it was discussed in the conclusions at the end.

Allison (2022, p. 53) writes about recent research of the eight main factors that affect the success of arable businesses. Seven of them involve minimizing overheads, setting goals and budget, comparing business, understanding the market, having a mindset of trying new things, managing people well, and specializing. One of the eight factors for top performance is focus on detail. It is useful especially when the farmer discovers points of improvement by taking the time to research and challenge what they do.

When it comes to improving a farm's operation in a larger scale by paying attention to specific details, product X has been developed to help tractor operators use the equipment on their tractors more efficiently. Product X is a hardware product and the first MVP from SAVT. In the spring 2022 four prototype kits were sent for testing to farmers in Spain, Czech Republic, Germany, Norway, Holland, Denmark, and Finland. The key aim was to gain a clear understanding of whether the users need product X or should the team perform a pivot to develop an entirely different form of product to match another need. (Hardy-Linna, 24.2.2022.)

Nuthall (2018, Chapter 1) argues that to be an excellent farm manager one needs to have a reasonable understanding of a variety of subjects from physics and chemistry to biology and psychology (listed on pages 38–39). Relevant skills that are required in the job he lists as the following:

- Understanding the technology and what lies behind it (sowing rates, fertilizer outcomes, the sciences – biology, physics, etc. involved)
- Observation and recording (soil conditions through to international markets)
- Planning (risk management, cash flows, job priorities, time management, economic principles, etc.)

- Anticipation (possible outcomes and their chances)
- People skills (labor management, network maintenance, negotiations, etc.)
- Personality management (stress management, motivation, objectives, and so on)

SAVT's aim is to build solutions for customers' real needs. Therefore, they want to gain a better understanding of the users' world and life as farmers and have them involved in the development process as much as possible. This principle had been applied in earlier stages of the engineering process in several ways, but the research of the thesis was the first time feedback was collected systematically in the project. SAVT wanted to learn from this experience and improve their testing process to be as fast and as accurate as possible in future projects. (Hardy-Linna, 24.2.2022.)

Another Smart AG team, located in Denmark and focused on developing solutions for harvesting, has applied different ways of collecting user feedback in their projects. One of the most successful ways of getting in-depth feedback has turned out to be visiting the user, observing him or her to do the work while asking questions about the experience. (Lund, 23.3.2022; Whittaker, 17.3.2022.) This was considered as a possible data collection method in the thesis but due to Covid-19 traveling restrictions, fluent international traveling was not possible. Therefore, the data collection techniques described in the following chapter were chosen.

5.2 Data Collection

Qualitative data was collected 19.4.–8.6.2022 through survey and semi-structured interviews. Survey focused only on the functionality of the product whereas interviews also covered the need and willingness to buy. 15 users from different European countries were asked to test the product and give feedback on their experiences. They were invited to fill in an online questionnaire in Webropol to report any possible challenges they faced during the testing period and participate in a phone or Teams interview after the testing was finished.

The aim of the online questionnaire (appendix 1) was to collect instant feedback during the testing, with possible details that could have been difficult to remember afterwards. If the users faced any problems regarding functionality of the product, they could report them in the moment by filling in a short questionnaire. The users were instructed to access the online form via a QR-code or a direct link that had been provided to them both, before and during the testing.

Survey was used to supplement interviews (appendix 2) in terms of functionality of product X. The interviews took place after the testing period and focused on the overall experience of using the product, including the users' evaluation and opinions of different themes: benefit, willingness to buy, and functionality. Survey instead, involved only the theme of functionality. Numbers of received responses for both data collection techniques are illustrated in Table 9.

	Online questionnaire during the testing	Interview after the testing
Number of responses	8	10
Number of responded users	4	12

Table 9. Numbers of online questionnaires and interviews received from the testers.

11 out of 15 users tested the product successfully for 1–7 days within 12.4.–6.6.2022, and four were not able to test due to technical problems. Nine of the users who tested the product and one of those whom testing had failed, gave feedback. A total number of eight responses from four different users were received for the online questionnaire. 12 users agreed to give an interview after the testing, comprising 10 interviews in total (Table 9).

To make answering as easy as possible, the online questionnaire (appendix 1) was very brief, including only one open question where the user was asked to describe the situation in his/her own words. Other information that was collected in the form was the product number, date, time, use case and possible pictures and videos of the situation. The form was translated into seven different languages, but only one used a German version and the rest answered in English. Online questionnaire was available to the users via a QR code that had been printed in the instructions packed along with the product. It was also available at the user interface of the product. In addition, a reminder with a direct link to the form was sent to the users via an SMS during the testing period. Each user was instructed to fill in as many forms as needed, one problem per form, depending on the number of challenges they faced.

Content of the interviews were designed based on the recommendations from the literature and in co-operation with the Smart AG team, based on its needs. Three main themes were created:

(1) background information of the informant and the farm or company he/she works for,

(2) benefit of the product with willingness to buy, and

(3) functionality of the product.

For each theme, a set of questions were prepared (appendix 2), and they were flexibly discussed in the interviews according to the relevance for each case. Interview questions were tested in advance with one user to find out whether they were easy to understand and how long the session would take. In the beginning of each interview session, informants were explained about the purpose of the research, privacy policy and an outline of how the interview would proceed. When the actual interview sections started, the sessions were recorded. A summary of further details of the interviews is presented in Table 10.

Interview	Days between last day of testing and interview	Channel	Length (min)	Language	Translation	Number of informants
1	10	Teams	50	English	Danish	1
2	14	Teams	75	English	Danish	2
3	17	Teams	24	English	–	1
4	1	Teams	55	English	–	2
5	12	WhatsApp	30	Finnish	–	1
6	12	WhatsApp	35	English	–	1
7	17	Teams	42	Finnish	–	1
8	3	Phone	25	Finnish	–	1
9	7	Phone	25	Finnish	–	1
10	2	Phone	30	Finnish	–	1

Table 10. Summary of the interviews. They lasted from 24 to 75 minutes, were conducted 1–17 days after the testing periods, in English or Finnish via WhatsApp/phone call or Teams session.

Interviews were conducted 1–17 days after each user's testing period had ended, on phone or Teams (Table 10). The sessions lasted from 24 minutes to an hour and 15 minutes. Most interviews in English or Finnish took approximately 30 minutes, but two were in English with Danish translation, and they took approximately an hour. Interviews were led by the researcher of the thesis with a prepared set of themes to be covered in each session. Also, one of Smart AG team members was always present as a product specialist to ask for further technical details, if needed. In two interviews, a member from Danish Smart AG team participated as a translator. Eight interviews were conducted with one informant at a time and two sessions had two informants present simultaneously.

5.3 Qualitative Analysis Process

Survey and interviews were analyzed by applying a qualitative analysis process as Hsieh & Shannon (2005, pp. 3–5) outline it (Table 11, p. 46). First, all data was read through twice. Based on the sense of the whole, interview data was divided into three use cases and data of each use case was divided into three main themes, each with smaller sub-themes, to form a clearer structure for analysis. The steps of the qualitative analysis process were taken inside these sub-themes. Interview data of background information was left out from the themes and summarized into a separate table.

<table>
<tr><th>Qualitative analysis process (Hsieh & Shannon, 2005)</th><th>Steps taken for survey</th><th>Steps taken for interviews</th></tr>
<tr><td>1. Read data repeatedly to achieve immersion and obtain a sense of the whole.</td><td>Data of the open question from the online questionnaire forms were combined and read through twice.</td><td>Interviews were transcribed and read through twice.

Based on the sense of the whole, data were divided into 3 use cases:
Tillage / cultivation
Fertilizer spreader
Reversible plough
Data inside each use case were divided into 3 themes:
Benefit of Product X compared to the current solution for the problem Product X addresses
Willingness to buy
Functionality
Each theme was divided into smaller sub-themes.

Data of background information was left out from the qualitative analysis and summarized into a separate table.</td></tr>
<tr><td rowspan="3">2. Read data word by word to derive codes.</td><td>Key words were highlighted, and initial coding scheme created. Smart AG team was consulted about technical details to gain deeper understanding of the meaning of the data.</td><td>Key words were highlighted, and initial coding scheme created. Smart AG team was consulted about technical details to gain deeper understanding of the meaning of the data.</td></tr>
<tr><td colspan="2">Survey and interview data were combined into two tables for each use case:
Table 1 with codes only
Table 2 with codes and highlighted raw data</td></tr>
<tr><td colspan="2">Tables were discussed in a workshop with Smart AG team. Persona and journey map of a chosen use case were created.</td></tr>
<tr><td>3. Sort codes into categories based on how different codes are related and linked.</td><td colspan="2">Most codes were organized into categories, except for those in small sub-themes with only one or two codes in each.</td></tr>
<tr><td>4. Use the categories to organize and group codes into (10–15) meaningful clusters.</td><td colspan="2">Some of the categories were grouped into bigger clusters, depending on the number of codes in each sub-theme.</td></tr>
<tr><td>5. Based on the relationships between sub-categories, combine or organize sub-categories into a smaller number of categories if needed.</td><td colspan="2">This step was not needed.</td></tr>
<tr><td>6. Develop definitions for each category, sub-category and code.</td><td colspan="2">Since the names of codes, categories and clusters were all very descriptive, definitions were created only by each theme (Appendix 3)</td></tr>
<tr><td>7. To prepare for reporting the findings, identify exemplars for each code and category from the data.</td><td colspan="2">Quotations were identified for each theme.</td></tr>
<tr><td>8. Identify the relationship between categories and subcategories further based on their concurrence, antecedents, or consequences, if needed.</td><td colspan="2">This step was not needed.</td></tr>
<tr><td>9. Address relevant theories or other research findings in the discussion section of the study.</td><td colspan="2">Research results were discussed in the light of relevant theories.</td></tr>
</table>

Table 11. Analysis of the research was conducted by applying a qualitative analysis process according to Hsieh and Shannon (2005, pp. 3–5).

For both, survey and interview, codes were created by highlighting key words in the text and consulting Smart AG team about technical details to gain a deeper understanding of the meaning of the data. Codes from both sources were combined into two tables for each use case: the first, with codes only and the second, with both codes and highlighted raw data. Since survey data comprised only of problems that the users had faced during the testing, it was placed under the Functionality theme. As a result, the combination of both data sources consisted of three themes:

Benefit of product X compared to the current solution for the problem product X addresses (1), Willingness to buy (2), and Functionality (3). The first two themes included only interview data and the third had both, survey and interview data.

To provide the SAVT team an initial report with enough details about the original feedback and to gain a collaborative perspective of the meaning of it, a workshop was arranged at this point. The feedback was discussed together, and a persona and a journey map were created to illustrate the initial results in the project's context. Further description of the workshop is given in the next sub-chapter (6.4).

Based on the previous steps of the analysis process and the insights gained from the workshop, codes were modified when necessary and organized into categories, and again grouped into bigger clusters. For some themes with only one or few codes/categories, grouping was not needed due to consensus or scarcity of data. All codes, categories and clusters of all use cases are presented in a table with explanations of each theme in appendix 3. More precise definitions for each code, category and cluster were not created because their names were very descriptive and informative.

Exemplars for most codes and categories were identified and presented in the form of quotations from the raw data in the Results chapter. Quotations for every code was not possible to report due to poor foreign language skills of the informant leading to tattered pieces of sentences or confidentiality issues. Lastly, the research results were discussed in the light of relevant theories in the Discussion section of the thesis.

5.4 Development Workshops

Two workshops were arranged as a development task of the thesis. Both workshops were held at the SAVT team's office, where some participants were present and part of them attended remotely via Teams. Sessions were not recorded. The first workshop took place on 20.6.2022, lasting for three and a half hours, with seven Smart AG team members and the second on 23.6.2022, of one and a half hours, with six attendants from the team. Five of the attendants participated both workshops and the rest took part in only one session. Tools of empathy map, journey map and service blueprint were used to structure and visualize collaborative perspective on the topics. Empty templates were used for each tool for notes and reporting the output of collaborative

discussions. The first topic discussed the feedback collected from the users and the second was about the feedback collection process conducted in the thesis.

The researcher facilitated both workshops, but all team members participated actively, and the collaborative work consisted mainly of their voice. The team's perspective provided the researcher helpful insight regarding the research questions and conducting the next steps of the thesis:

1. To better evaluate the meaning of the collected data, especially technical details, in the project's context, for finishing the qualitative analysis.

   Related research questions:

   1. How do the users experience the MVP of product X?

   2. How should product X be developed further?

2. To consider the team's experience about the feedback collection process when developing recommendations for similar processes in its further projects.

   Related research question:

   3. How to collect authentic feedback systematically and efficiently on other MVPs in the future?

Persona and Journey Map

The first workshop took for three and a half hours, plus an hour break in the middle. The codes and raw data of three different use cases were discussed in the beginning. An example of the presented material is seen in table 12 (p. 49) and appendix 4.

USE CASE NAMED HERE

Benefit of Product X Compared to the Current Solution for the Problem Product X Addresses				
Current Solution	**Satisfaction with Current Solution**	**Benefit of Product X**	**Improvement Ideas for More Benefit of Product X**	**Ideas for Other Use of Product X**
• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*

Willingness to Buy				
Sufficient Benefit for Purchase	**Price**	**Retrofit Kit / Along with a Machinery Purchase**	**One Kit for All Implements / Separate Kit for Each**	**Other Farmers around the Area**
• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*

Functionality			
Ease of Set up	**Ease of Use**	**Clarity of User Interface**	**Improvement Ideas of Better Functionality**
• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*	• *Code 1* • *Code 2 etc.*

Table 12. Structure of a summary of codes that was discussed in the first workshop.

Table 12 consists of a summary of the codes that had emerged in the early stages of analysis, and appendix 4 includes also the highlighted raw data with original comments from the users. Due to a limited timetable, the workshop mainly focused on the summary (Table 12), but all team members were handed out the raw data as well. Raw data was included in the material because it included lots of technical details. The purpose was to give the team a chance to check the original feedback in case of any questions regarding the codes.

Based on the material of user feedback and the team's other knowledge on the users, such as previous conversations with farmers, visits to farms, and their own experiences of working in a farm, a persona was created. By using an empathy map tool, a user with relevant demographics, behavioral considerations, frustrations, goals, and tasks was created for tillage / cultivation use case. This use case was selected for collaborative elaboration, because eight out of ten interviews involved this type of work. For the other two, fertilizer spreader and reversible plough, there was only one interview per each use case.

The next step was to create a journey map of the persona using Product X for the selected, tillage / cultivation use case. The journey was divided into four phases starting from the setup of the product in the beginning until evaluation of benefit for purchase in the end. For each phase, the user's actions were listed, and a summary of his thoughts and emotions were concluded in the end. When all phases had been mapped out, the team looked at the whole journey and identified

opportunities for further development. Two major areas of improvement were determined, and because the time was already up, the team decided to discuss them more thoroughly in another meeting the following day. Therefore, the last section of internal ownership in the journey map template was not completed in the workshop.

Service Blueprint

Seven participants took part in the second workshop that lasted for an hour and a half. A service blueprint of the feedback collection process was created collaboratively. Levels of evidence, user actions, front stage interactions, backstage interactions, and support processes were identified and described in the template. Also, roles for each action were named. When the whole process had been mapped out, the team discussed and evaluated what had worked well and what needed to be done differently in the future.

5.5 Development Ideas

Development ideas were created based on literature on the subjects and research findings and workshop outputs of the thesis. For further development of product X, ideas were discussed by reflecting the collected user feedback and collaboratively created persona and journey map with relevant theoretical framework. Recommendations on how to collect authentic user feedback in future projects of SAVT were outlined by assessing theoretical principles, concepts and methods in the light of the output of the service blueprint.

6 Results of User Feedback and Development Workshops

The research results consist of user feedback that was collected via survey and interviews and comments on feedback collection process performed in this thesis. The process was evaluated collaboratively with SAVT by using service blueprint to uncover points of improvements.

6.1 User Feedback

Eleven users tested product X successfully for 1–7 days within 12.4.–6.6.2022, and qualitative data was collected 19.4.–8.6.2022 via survey and semi-structured interviews. A summary of interview informants and survey respondents who participated in the research are presented in Table 13.

	TILLAGE / CULTIVATION		REVERSIBLE PLOUGH		FERTILIZER SPREADER	
Data Source	8 interviews 10 informants	6 online questionnaire forms 3 respondents	1 interview 1 informant		1 interview 1 informant	2 online questionnaire forms 1 respondent
Country	Denmark (2) Spain Germany Finland (4)	Spain Finland (2)	Finland		Holland	Germany
Type of Business	Arable (5) Dairy (2) Dairy/livestock/ forestry/arable		Arable		Contractor	
Size of the Farm	70–600 ha / 160–600 cows		30 ha		–	
Role at the Farm / Business	Owner (2) Owner operator (4) Operator (4)		Operator		Owner	
Number of Staff (Including Owners)	1–14		2		40	
Willingness to Test Other Products	Yes		Yes		Yes	

Table 13. Summary of interview informants and survey respondents who participated in the research. A more detailed table of participant information is found in Appendix 5.

Four respondents answered to the survey, resulting in a total number of eight answers (Table 13). Twelve informants gave feedback via interview, including one user whose testing had failed, comprising ten interviews in total. The users were in Denmark, Spain, Germany, Finland, and Holland.

The informants of interviews were arable, dairy, and mixed farmers with 70–600 hectares of land and/or 160–600 cows and 1–14 staff members. One informant was a contractor with 40 employees working for the company. Five of the informants worked as operators doing practical work at

the farm, four were owner operators doing practical work while holding ownership of the farm, and two of the farmers and one contractor were owners of the businesses. All informants were interested in testing also other products in the future.

Most of the data concerned tillage / cultivation (TC) use case. Reversible plough (RP) use case had only one interview, as did fertilizer spreader (FS), with additionally two survey responds. (Table 13, p. 51). Tables 14–16 (p. 52–53) illustrate summaries of the main clusters or categories of all use cases in each theme. Majority of the data is from interviews. Survey results are included in the Functionality theme (Table 16, p. 53) in a sub-theme of Improvement ideas of better functionality.

More detailed results of each use case are presented later in the following three sub-chapters. Each sub-chapter includes themes with clusters of categories introduced in this section (Tables 14–16), slightly more descriptive categories of codes, and even further specified codes that have been derived from the raw data. The results present only the themes and topics that arose from the qualitative data and no calculations of frequencies have been made. Therefore, the results do not show, how common or rare certain codes were. Nor do they assume that different codes came from different users, but several different codes may have emerged from the same informant's comments, as well as one code can include several different user's perspectives.

	TILLAGE / CULTIVATION	REVERSIBLE PLOUGH	FERTILIZER SPREADER
Current Solution	Solution exists	Solution exists	Solution exists
	No solution		
	Use and importance of solution depends on circumstances		
Satisfaction with Current Solution	Satisfied with current solution	Satisfied with current solution	
	Not fully satisfied with current solution	Not fully satisfied with current solution	Not fully satisfied with current solution
Benefit of Product X	Beneficial	Beneficial	Beneficial
	No benefit		
Improvement Ideas for More Benefit of Product X	Automatization		
	More advanced use of information		More advanced use of information and fuel
	Solutions for specific implements	Solutions for plough	
Ideas for Other Use of Product X	Agriculture		Agriculture
	Road maintenance	Road maintenance	
	Sports and leisure		
		Earthmoving	

Table 14. Clusters of theme: Benefit of the product X compared to the current solution for monitoring depth or setup of the implement. Summary of interview results of all three use cases.

In all use cases, a current solution for the addressed problem was found, but in TC, also "no solution" was reported (Table 14). In this use case, the use and importance of the solution varied between circumstances. FS lacked satisfaction with the current solution, but the two other use cases had also satisfying experiences. Product X was found beneficial in all use cases, with also

comments of “no benefit” in TC. Most of the improvement ideas for more benefit of product X regarded advanced use of information (TC, FS), solutions for specific implements (TC, RP) and automatization (TC). Ideas for other use of product X were discovered among agriculture (TC, FS), road maintenance (TC, RP), sports and leisure (TC) and earthmoving (RP).

	TILLAGE / CULTIVATION	REVERSIBLE PLOUGH	FERTILIZER SPREADER
Sufficient Benefit for Purchase	Yes		Yes
	No	No	
Price	300–5000 €	–	1500 €
	Additional comment on price impact regarding automatization		
Retrofit Kit / Along with a Machinery Purchase	Retrofit kit	–	Retrofit kit
	Along with a machinery purchase		Along with a machinery purchase
One Kit for All Implements / Separate Kit for Each	One kit for all implements	–	–
	Separate kit for each		
Other Farmers / Contractors around the Area	Yes, they would buy	Yes, they would buy	–
	No, they would not buy		

Table 15. Clusters of theme: Willingness to buy. Summary of interview results of all three use cases. Subjects with no feedback is marked with a dash.

There was willingness to buy product X in TC (also unwillingness) and FS use cases, with a price range of 300–5000 euros, unlike in RP where the user was not interested in purchase at all (Table 15). An additional comment of a price effect regarding a certain type of solution for automatization was discovered in TC. Both types of products, a retrofit kit and along with a machinery purchase were found in demand in TC and FS, as were the number of products in TC. According to informants in TC and RP, other farmers or contractors in the area would buy the product. Also, an opposite view of them not wanting to buy was found in TC.

	TILLAGE / CULTIVATION	REVERSIBLE PLOUGH	FERTILIZER SPREADER
Ease of Set up	Depends on tractor*		
	Difficult installation*	Difficult installation**	Difficult installation**
			Fluent installation**
Ease of Use	Easy to use	–	–
Clarity of User Interface	Clearly presented information	–	–
	Unclearly presented or lacking information		
	Challenges with fluency of use		
Improvement Ideas of Better Functionality	Easier set up	Easier set up	Easier set up
	Better accuracy		Better accuracy
	Better fluency of use		
		Easier use of information	

**Only one informant set the kit up himself. Two had help from the Smart AG team. For the rest five, Smart AG team set it up for them.*
***Smart AG team member was helping the testers with the set up.*

Table 16. Clusters of theme: Functionality. Summary of interview results of all three use cases. Also, survey results have been included in improvement ideas of better functionality. Subjects with no feedback is marked with a dash.

Table 16 (p. 53) illustrates a summary of the functionality of product X experienced by the interview informants, with also results from the survey, included in the improvement ideas. In only one interview, the informants set the product kit up by themselves. In four, the users received assistance from the Smart AG team, and in the rest five, the team took care of the whole setting up process. In all use cases, installation was experienced difficult, and in FS also fluent. In TC, the ease of setup was discovered to depend on the tractor. Feedback on ease of use and clarity of user interface were found positive in TC. Also, unclear and lacking information and challenges with fluency of use were discovered. Improvement ideas of better functionality covered easier setup in all use cases, better accuracy in TC and FS, better fluency of use in TC and easier use of information in RP.

Summary of Key Findings

It seems that even though solutions already exist for the addresses problem, there is a need for a better option. Product X fulfills that need to some extent, but for more benefit, it requires development in terms of automatization, more advanced use of information and fuel, and solutions for specific implements. The product has potential to benefit also other use cases in agriculture and additionally other industries such as road maintenance, sports and leisure and earthmoving.

Those who found product X beneficial enough for purchase would pay 300–5000 euros for it. Both types of product, a retrofit kit and along with a machinery purchase, seem to fit the users' needs, as well as the number of kits, whether just one for all implements or separate ones for each. Also, other farmers/contractors around the area might find it useful enough to buy.

Even though only half of the informants took part in setup, most of them with help from the SAVT team, it is clear that the current way of installation is too challenging. In addition to this, improvement needs for better functionality are focused on better accuracy, better fluency of use and easier use of information.

6.1.1 Use Case: Tillage / Cultivation

Results of eight interviews regarding tillage / cultivation use case are illustrated in Tables 17–19 (p. 56, 59, 61). Table 19 (p. 61) includes also results of six survey responses about development ideas of better functionality. Informants (10) were arable, dairy or mixed farmers in Denmark,

Spain, Germany and Finland with 1–14 staff members, 70–600 hectares of land and/or 160–600 cows. Four were operators, four owner operators and two owners of the farm (Table 13, p. 51).

	CODE	CATEGORY	CLUSTER
Current Solution	Depth scale in harrow	Using implement, tractor or tool for measuring	Solution exists
	Cultivation for wheat or barley to 8 cm after potatoes		
	Cultivating for corn without depth measure but adjusting roller and disc		
	Tractor setting		
	Measuring stick		
	Planting potatoes as deep as possible without measuring	Using rough estimation instead of measuring	
	”By-eye” measurement		
	No solution	No solution	No solution
	Rejected solution of inaccurate measure system of cultivator		
	Using current solution out of accustomed habit	Current solution accepted without competition of other alternatives	Use and importance of solution depends on circumstances
	Using current solution due to lack of other options		
	Importance of correct depth for work performance	Importance of correct depth for work performance depends on task	
	Unimportance of correct depth work performance		
Satisfaction with Current Solution	Satisfied with planting potatoes as deep as possible without measuring	Satisfied with current solution of measurement and/or inaccurate estimation	Satisfied with current solution
	Satisfied with depth scale in harrow		
	Satisfied with “by-eye” measurement and depth scale in harrow		
	Satisfied with measuring stick		
	Need for automatization in planting potatoes	Need for automatization	Not fully satisfied with current solution
	Need for automatization due to different expertise level of users		
	Need for more precision compared to “by-eye” measurement and tractor settings	Need for better solution	
	Need for improvement compared to “by-eye” measurement and depth scale in harrow		
Benefit of Product X	Beneficial for corn seeding with combination drill	Beneficial in specific implements	Beneficial
	Beneficial in harrow		
	Beneficial in fertilizer spreader		
	Beneficial in drill		
	Beneficial in several implements		
	Beneficial for corn or sugar beet seeding	Beneficial for specific types of work	
	Beneficial for planting potatoes		
	Beneficial for planting sugar beets		
	Beneficial in shallow cultivations		
	Beneficial in hilly land		
	No benefit in harrow	No benefit in specific implements	No benefit
	No benefit in springtine harrow		
	No benefit for subsoiling	No benefit for specific type of work	
	No benefit in flat land	No benefit in specific type of land	
	No beneficial information	No benefit in terms of information	
	Difficult to see benefit due to flaws of prototype	No clear benefit due to flaws of prototype	
Improvement Ideas for More Benefit of Product X	Automatically adjusting tractor hydraulics or linkage	Automatization	
	Automatic top link while ploughing		
	Automatically controlling booms of sprayer		
	Automatic top link or implement sideways (for the 1st version)		
	Saving depth information for documenting carbon emissions	More advanced use of information	
	Integrating information on the second ISObus user interface		
	Solution for implements with spikes	Solutions for specific implements	
	In multi-section implements depth sensor for each section and monitoring values simultaneously		
Ideas for Other Use of Product X	Potato planter	Agriculture	
	Fertilizer spreader		
	Plough		
	Potato / sugar beet harvester		
	Rice harvest		
	Combiner on header table for height		
	Road grader	Road maintenance	
	Horse-riding fields	Sports and leisure	
	Golf course		

Table 17. Codes, categories and clusters of theme: Benefit of the product X compared to the current solution for monitoring depth or setup of the implement.

Several different solutions were discovered for the addressed problem, such as using an implement, tractor or tool or a rough estimation instead of measuring for monitoring depth or setup of the implement (Table 17, p. 56). Some did not have a solution at all.

> *There's a scale on the harrow.*
>
> *Completely "by-eye".*
>
> *In practice, I don't measure the depth in any way.*

The importance of having a solution varied between informants and tasks. Some experienced it crucial, whereas others did not see value of it in their own work.

> *If you don't set properly an implement, it kills your field consumption and it kills your performance. It depends on how you set it, but it has a big impact.*
>
> *With the flat fields… It doesn't affect the business if it is one centimeter deeper on one point, than on the other one.*

It was discovered that sometimes the solution that had been in use for a long time, had never been questioned or compared to other alternatives. Also, for some tasks, no other solutions existed.

> *They haven't tried anything else. It's just the way they used to do. (Translator's line.)*
>
> *I have never even thought whether I'm satisfied with it or not. There has never been anything else, so I cannot really think about it.*
>
> *We don't have anything else.*

Some satisfaction with the current solution was found, yet also a need for more precise and automatic solutions.

> *Well yes, this is quite good because usually the areas to be cultivated are quite big and field segments we have are reasonably homogeneous. Adjustment [of an implement] a few times a day is enough, so timewise is not much. By checking the harrow every couple of hours, I have reached quite sufficient and good precision so far.*

The problem is that if they get the potato down too deep, then they can get rotten or there can be some kind of diseases. A correct depth, it's just to avoid them getting rotting. If everything's perfect, then they don't have problem with the seeds or the potatoes getting rotten. Avoid it getting too deep, then they maybe save 10% of the whole outcome.

Product X was evaluated beneficial especially in different implements and for specific types of work. However, in some implements, types of work, type of land or in terms of information no benefit was experienced.

For a corn seeder or a sugar beet seeder, there could be a big benefit.

This [product X], you can use it in not just one implement, you can use it in more implements.

My land is really flat. It's not so important for me.

Automatization, more advanced use of information and solutions for specific implements arose as main themes of improvement for more benefit of the product.

The product is good, but… I think it should be a base for maybe more complex systems to do things… More automatic.

It might be the first step to be able to show exactly what we have been doing. To make some test and show what we had been cropping and doing…

To set some offset to compensate the springs of the… In this case, the cultivator.

Ideas for other use of product X were discovered for different tasks in agriculture, road maintenance and sports and leisure.

Maybe at a combiner.

Road maintenance. Finnish countryside roads are in a horrible condition and the situation is getting worse all the time.

A horse-riding place.

Based on the findings, it seems that the problem product X addresses is relevant to specific types of work in tillage / cultivation, and users have some solutions in use to solve it. However, more

advanced systems are needed to make the farmers' work easier and business more profitable. Product X was experienced useful to some extent, yet further improvements, especially automatization, is needed. The product could also have potential to bring value for other use cases in agriculture or in completely other industries such as road maintenance and sports and leisure.

	CODE	CATEGORY	CLUSTER
Sufficient Benefit for Purchase	Depends on the price	Yes, under certain conditions	Yes
	Depends on the implement		
	Yes, if improved installation		
	Yes for saving fuel	Yes, for specific purpose	
	Yes for fertilizer spreader		
	Yes for plough		
	Not for harrow	No, not for specific purpose	No
Price	300 – 400 € compared to price of sprayer sensors	300–1000 €	300–5000 €
	500 – 1000 € like a normal update to tractor		
	500 – 1000 €, possibly more for further benefit in other implements		
	1500 – 2000 € mainly for know-how	1500–2600 €	
	2000 € if bought with new cultivator		
	2600 € as automatic		
	3000 – 5000 €	3000–5000 €	
	5000 € as automatic for saving in driver costs		
	No negative price impact of using LS hydraulics to achieve automatization	No price impact of using LS hydraulics	Additional comment on price impact regarding automatization
Retrofit Kit / Along with a Machinery Purchase	Retrofit kit	Retrofit kit	
	Retrofit kit installed by dealer		
	Retrofit kit for transferability between implements		
	Retrofit kit for cheaper installation		
	Along with a machinery purchase for better functionality and reliability	Along with a machinery purchase	
One Kit for All Implements / Separate Kit for Each	One kit for all implements for current need	One kit for all implements	
	One kit for all implements with cables as separate parts for each implement		
	One kit for all implements with sensors as separate parts for each implement		
	Separate kit for each in the future depending on experienced value of the first kit	Separate kit for each	
Other Farmers / Contractors around the Area	Yes depending on implement	Yes, for specific type of work	Yes, they would buy
	Yes for seeder		
	Yes for vegetable farming		
	Yes for easier working	Yes, for specific value	
	Yes for survival in fast developing environment		
	Yes for saving fuel		
	Yes after discovering value from other farmers		
	No due to lack of compatible ISObus machines	No, due to lack of sufficient equipment	No, they would not buy

Table 18. Codes, categories and clusters of theme: Willingness to buy.

When it comes to willingness to buy, the product was not seen beneficial enough for purchase for a harrow, but for some other implements or the purpose of saving fuel instead (Table 18). Certain conditions, such as price, implement and future improvements, affected whether the product was worth buying or not.

At least for harrowing, I don't see any benefit of it.

When cultivating a couple of hundred hectares, assumably twice a field at our farm, it [Product X] can be paid in a year or two by saving in fuel costs alone.

It will depend on the price, but yes.

The price range that the informants were willing to pay varied between 300 and 5000 euros.

500–1000, something around that. Like a normal update when you are updating the tractor.

Around 2600 euros… For a potato planter it has to be automatic, even to have interest.

If it really detects and adjusts the height, then we can go really close to 5000…

When considering the type of product, both retrofit kit and along with a machinery purchase were seen appropriate ways to purchase. Buying one kit for all implements was found to meet the informants' current needs more than getting a separate kit for each machine.

Since we have now several own tractors and rented machinery, it would be the transferable retrofit kit.

When it [Product X] comes factory fitted, it communicates better with the machine. But if there was no such problem, I wouldn't see it being a problem to buy a retrofit kit. Based on our own experience, the reliability of retrofit products is not always necessarily the same as of factory fitted ones.

If he sees a good value in it and he's happy about the product, then he would consider to buy one more for another implement. (Translator's line.)

When the users were asked to estimate whether a regular farmer around the area would buy the product, many types of work and value were mentioned with a "yes". However, an opposing comment was also received with and argument of lacking compatible machinery.

Why not. Nowadays we can see even more that developing farms sustain in business and unfortunately other farms don't. It's true that we need to try to develop ourselves all the time, so I'd say that it could be useful for them.

Not many have compatible ISObus machines yet, so I don't believe in a quite big enthusiasm about it.

It seems that Product X is beneficial enough for purchase for several purposes, especially with further improvements regarding automatization. Buying a transferable retrofit kit to be used in multiple implements seemed to match the current needs the best. Also, other farmers in the area were evaluated to find benefit from the product, depending on the purpose and machinery they have in use.

	CODE	CATEGORY	CLUSTER
Ease of Set up*	No signal in Fendt 714	Depends on tractor	
	Easy in Valtra T235		
	Difficult installation	Difficult installation	
Ease of Use	Easy to use		
Clarity of User Interface	Information clearly presented in the user interface	Clearly presented information	
	Unclarity of crop and soil height	Unclearly presented or lacking information	
	Too big numbers on night screen		
	No notifications of calibration		
	Unclear targets		
	Menu not simple enough for different levels of users	Challenges with fluency of use	
	Delays		
Improvement Ideas of Better Functionality	Better accuracy of depth measurement	Better accuracy	
	Better accuracy of depth measurement with bending spikes		
	Better accuracy for implement set up		
	More specific information on depth measurement	Better fluency of use	
	Speed adjusted sensitivity		
	Two menus: for beginners and advanced users		
	Better installation solutions	Easier set up	
	Confirmation of calibration on user interface		
	Better functionality of settings		
	Better functionality of calibration		
	Better functionlity of loading		

**Only one informant set the kip up himself. Two had help from the Smart AG team. For the rest five, Smart AG team set it up for them.*

Table 19. Codes, categories and clusters of theme: Functionality.

Most of the users did not set the product kit up themselves (Table 19). For two interviews, the setup was made together with the Smart AG team, and for one interview, the users set the product kit up by themselves. However, an overall comment, also from those who had got help in setup, was that the installation was difficult.

Kind of difficult, complicated system.

Otherwise, the product was experienced easy to use, as was the user interface found mainly clear. Some challenges of delays had occurred, and unclear or lacking information.

When it's a new system, you just have to get used to it. But it was user-friendly.

User interface was clear and easy to interpret.

Night screen. The numbers were so big that he couldn't really see any of them. (Translator's line.)

Targets. I don't know if this is clear enough for everybody.

The main themes that arose as improvement ideas of better functionality were more accuracy, better fluency of use and easier setup.

It has to be more accurate. With the sensor. Of the scale.

Of course, this is a prototype now, but it must be at least very easily transferable from one implement to another.

The menu. Two levels: one with precise adjustments and settings and another more higher-up with "start and go".

Based on the findings about functionality, it seems that setup has been problematic, even with the team's assistance. Also, better accuracy of both, depth measurement and implement setup, and more fluency of use including presentation of information need improvement to gain better functionality. However, the overall use of the product seemed to be unanimously easy.

Workshop Output: Persona and Journey Map

Further insights about the meaning of the collected user feedback were gained in a workshop 20.6.2022 when a persona (Figure 13, p. 63) and journey map (Figure 14, p. 64) were collaboratively created with the Smart AG team. Both illustrations were built based on the codes emerged from the raw material of the interviews and survey data and the team's other knowledge on the users.

PERSONA
USE CASE: TILLAGE / CULTIVATION

Name: Klaus Neuhausen
Age: 40
Role at the farm: Owner operator
Location: Germany

Type of business: arable / mixed
System: conventional
Size of farm: 200 ha
Number of staff: 2
Number of tractors: 3
Automatic guidance in use: Yes

About Klaus:
A 5th generation farmer with a wife and two kids. One son also works for the farm. Traditional values and local community are very important to him. Interested in keeping the countryside alive and new technologies in agriculture.

Behavioral considerations:
- Uses "by-eye" measurement for monitoring the working depth of the implement
- Old habits define solutions
- Easily underestimates benefit of new solutions and doesn't want to spend money
- Strong relationship with a specific tractor dealer whom he trusts more than the rest

Frustrations:
- Market conditions
  - Spending money
    - Fuel price
    - Fertilizer price
  - Income
- Down-time
- Paperwork
- Tightening regulations
- Unnecessary software applications
- The weather
- Lack of skilled labor

Goals:
- Yield maximization
- Overhead reduction
- Ease of operation
  - Save time and stress

Tasks:
- Business planning
- "Agronomist"
  - Crop cycles
- Livestock management
  - "Vet"
- Machine operation
- Machine maintenance

Model adapted from: https://www.nngroup.com/articles/persona/

Figure 13. A persona for tillage / cultivation use case. Empathy map adapted from: nngroup.com/articles/persona.

A persona with relevant demographics, behavioral considerations, frustrations, goals, and tasks was created for tillage / cultivation use case: a 40-year-old German owner operator who does most of the work at the farm himself, including business planning, crop cycles, livestock management and machine operation and maintenance (Figure 13). He is a fifth-generation farmer with reserve towards new solutions and spending money. Old habits define solutions for different tasks, such as "by-eye" measurement for monitoring working depth of an implement. He has a strong relationship with his tractor dealer though, whom he trusts more as a person than other representatives of the brand. His main goal is yield maximization, and while he's aiming to reach it, there is a long list of factors that tend to cause frustration, such as market conditions, tightening regulations, the weather and lack of skilled labor.

USER JOURNEY
USE CASE: TILLAGE / CULTIVATION

Persona: Klaus Neuhausen
Scenario: Works on a land with gentle slopes. Wants to mix the plant residue and loosen the topsoil to 15 cm to ensure a good seedbed for the next crop. He uses Product X with a 3,5 m cultivator and a 170 hp tractor.

EXPECTATIONS:
- Easy set-up of the implement
- Skeptical of benefits
- Easier and more precise working depth monitoring
- To see some variation in the working depth

AT THE FARM **1. SET UP AND CALIBRATE**	ON THE FIELD **2. ADJUST IMPLEMENT SET UP AND START CULTIVATION**	ON DIFFERENT SOIL TYPES **3. MONITOR AND ADJUST WORK DEPTH**	AFTER FINISHING / DURING THE WORK **4. EVALUATE BENEFIT FOR PURCHASE**
Actions: **1.** Unboxes, sees what's inside and reads instruction **2.** Installs the sensors and ECU box to cultivator **3.** Runs cables and finds out cables are too long/short **4.** Plugs into the tractor **5.** Starts the tractor and explores user interface **6.** Measures and enters implement dimensions **7.** Drops the machine on hard surface and calibrates. Finds no confirmation of calibration and is confused "Too difficult to install, especially the cables are pain in the ass. Magnets are pretty good, but the box is too big and heavy. Other than that, it was easy to understand the user interface."	**Actions:** **1.** Starts driving and checks how the implement works **2.** Gets out of tractor and manually checks working depth **3.** Compares the working depth to values that DS shows and finds them different, so calls Smart AG team member/the dealer for reasons **4.** Repositions sensor, drives to find a hard surface to recalibrate on, recalibrates and finds more accurate readings "Too difficult and time-consuming but seems to be working better now."	**Actions:** **1.** Drives up and down the field doing the work **2.** Reaches an area with different soil type **3.** Sees that implement is going too deep **4.** Confirms the situation from Product X readings and is more confident that it works **5.** Adjusts the implement using the values from Product X **6.** This cycle is repeated throughout the day and confidence in Product X is slowly increased "Oh, it actually works! Less manual work and head turning while driving than usual."	**Actions:** **1.** How much is this helping me? Does it help me save fuel? Does it make my work easier? Can I see if the work quality improvement (now and in the future)? **2.** How much does it cost? Is the return of investment good enough? **3.** What else could I use it for? Can it make me even more money? "It was actually surprisingly useful, but it would be better if it adjusted itself automatically."

OPPORTUNITIES
- Improvement of installation idiot-proof so that it works straight away, no need for extra adjustments
- What is the MVP – automatic or non-automatic?

INTERNAL OWNERSHIP
Who owns what change? How do we measure improvements we implement?

Model adapted from: https://www.nngroup.com/articles/journey-mapping-101/

Figure 14. A journey map of the persona using Product X. Template adapted from www.nngroup.com/articles/journey-mapping-101.

A journey map that illustrates the persona using Product X for the chosen use case was developed, consisting of four phases with the user's actions, thoughts and emotions and opportunities for further development of the product (Figure 14). In the scenario Klaus Neuhausen works on a land with gentle slopes. He wants to ensure a good seedbed for the next crop and uses Product X to mix the residue and loosen the topsoil to 15 centimeters. He is skeptical of the actual benefits of the solution but is looking forward to easier and more precise working depth monitoring, while preparing to see some variation in the working depth. He expects the setup being easy.

At the first phase, Neuhausen sets up and calibrates the product at the farm. After performing different actions to get everything done, he concludes that the practical part was too difficult, yet the user interface was easy to understand. He goes through different emotions from neutral to angry and okay. The second phase happens on the field where Neuhausen adjusts the implement setup and starts cultivation. He thinks it is still too difficult and time-consuming but discovers that the solution seems to be working better now. His feelings vary between neutral, disappointed and angry.

When the soil types change, he gets to see the benefit of monitoring and adjusting the work depth. He turns from neutral into happy, when realizing that it actually works and there is less manual work and head turning than usual. When he evaluates benefit for purchase in the end, he ponders how much the product actually helps him in his work and business, if the return on investment is good enough, and whether it could be used for other purposes as well to gain even more financial benefit. He admits that Product X was surprisingly useful, but automatization would make it even better, and his emotions turn from neutral into happy.

Based on the illustrated journey of the persona, opportunities for improvement of Product X were identified. Setup was seen important to develop idiot-proof and easy. Also, automatization was an issue to be seriously considered. Would the MVP be automatically adjustable and how? The team scheduled another meeting to further discuss this matter and determine the internal ownership as well.

Summary of Key Findings

To make the users' work easier and business more profitable in tillage / cultivation use case, product X seems to have potential to match their needs better than their current solutions. The product was experienced useful to some extent, also in terms of willingness to buy regarding the users themselves and their evaluation of other farmers / contractors around the area. However, improvements, especially in terms of automatization, setup, better accuracy and fluency of use including presentation of information, is needed. In addition to this use case, the product could be used in other fields of agriculture and for the benefit of road maintenance and sports and leisure industries as well.

The user feedback and collaborative perspective of the SAVT team imply that a typical user (Figure 13, p. 63) for tillage / cultivation use case is a Central European farmer who runs a conventional system with only a few staff members. His values are deep in family and local community, and old habits define most solutions used at work. New technologies and solutions need to show clear value before given time and accepted for use. The farmer's main goal is yield maximization and his tasks as well as frustrations cover a variety of areas from business planning to machine maintenance.

The journey map (Figure 14, p. 64) created for the persona illustrates the farmer's experience of using product X in the chosen use case. He is skeptical of the benefits in the beginning but looking forward to easier and better working depth monitoring. He faces challenges with the practical

use of the product but discovers benefits as the process goes on. His emotions vary from frustration, disappointment and angry to neutral, okay and happy. As a conclusion, he admits that the product is surprisingly useful, yet automatization would make it even better.

Based on the observations from the user feedback and collaboratively created persona and journey map, the SAVT team identified opportunities for improvement of product X. Setup and automatization arose as the main issues to seek better solutions for.

6.1.2 Use Case: Reversible Plough

Results of reversible plough use case are based on one interview of an operator working for a Finnish 30-hectare arable farm with two staff members. The output of the interview regarding different themes is illustrated in Tables 20–22 (p. 66–68).

	CODE	CATEGORY	CLUSTER
Current Solution	”By-eye” measurement	Using rough estimation instead of measuring	Solution exists
	Depth wheel	Using implement or tractor for measuring	
	Rear linkage		
	Top link		
Satisfaction with Current Solution	Ease of use based on experience and implement settings	Satisfied with ease of use of current solution	Satisfied with current solution
	Need for automatization of width adjustment	Need for automatization	Not fully satisfied with current solution
	Need for automatization of depth wheel		
	Need for automatization of implement setup (left-right balance)		
	Need for automatization on bigger fields		
	Need for automatization on smaller fields		
Benefit of Product X	Implement angle adjustment	Beneficial for implement angle adjustment	Beneficial
Improvement Ideas for More Benefit of Product X	Adjustment of plough according to ground conditions	Solutions for plough	
Ideas for Other Use of Product X	Road grader	Road maintenance	
	Earthmoving equipment	Earthmoving	

Table 20. Codes, categories and clusters of theme: Benefit of the product X compared to the current solution for monitoring depth or setup of the implement.

Current solution for monitoring depth or setup of the implement consisted of “by-eye” measurement and using an implement or a tractor for measuring (Table 20). The solution was experienced easy to use, but automatization was needed.

I use “by-eye” measurement. Depending on the soil.

I'm satisfied [with the current solution] because I have learned how to do it… So, it's quite quick to do.

If automatization could be used to adjust the output [of the implement] homogeneous, basically on small fields, the repeatability that is now done by hand, would disappear and the work would get a lot easier. The likeliness of the driver getting tired would decrease.

Product X was experienced beneficial for implement angle adjustment. For even more benefit, adjustment of a plough according to ground conditions was presented as an improvement idea. Ideas for other use of the product were discovered for a road grader and earth moving equipment.

It was beneficial because I could see the angle, the angle of the implement.

The soil changes and then it causes a need for kind of re-calibration, so that you need to lift the plough up a bit… You need to adjust it manually. And then it requires re-calibration again into the new type… This could probably be removed by some sensor-algorithm-system, so that it would sense the plough setup even more accurately, regarding its position in terms of the soil.

Any implement that is used in the ground.

Based on the findings about benefit of Product X, compared to the user's current way of solving the addressed problem, a more automated solution is needed. Product X provides benefit with implement angle adjustment, but further accurate adjustment of plough according to ground conditions would make it even better. Also, other industries working with different types of soil, such as road maintenance and earthmoving, could benefit from the product.

	CODE	CATEGORY	CLUSTER
Sufficient Benefit for Purchase	Not enough return on investment	No, due to lack of return on investment	No
Price	–	–	
Retrofit Kit / Along with a Machinery Purchase	–	–	
One Kit for All Implements / Separate Kit for Each	–	–	
Other Farmers / Contractors around the Area	Plough's automatic adjustment for contractors	Yes, contractors	Yes, they would buy

Table 21. Codes, categories and clusters of theme: Willingness to buy.

The user was not willing to buy Product X due to lack of return on investment. However, he evaluated that contractors around the area could see value in the plough's automatic adjustment and be interested in the product (Table 21, p. 67).

> *I wouldn't buy yet. The return on investment is not enough yet.*
>
> *For example, contractors could be interested. If it was possible to automate the system in a way that the tractor would lift the plough up automatically.*

It seems that there is not enough benefit for purchase for a reversible plough use case yet, and therefore, no estimation of a price range that the user would be willing to pay. However, with further development of automatization, contractors could potentially find value of the plough's automatic adjustment and be interested in buying the product.

	CODE	CATEGORY	CLUSTER
Ease of Set up*	Challenging installation of sensors	Difficult installation	
Ease of Use	–		
Clarity of User Interface	–	–	
Improvement Ideas of Better Functionality	ISObus and sensors / connectors damage	Easier set up	
	Installation of sensors		
	Switching between screens	Easier use of information	
	Error report of damaged sensor		
	Height adjustment		
	Implement angle adjustment		

**Smart AG team member was helping the tester with the set up.*

Table 22. Codes, categories and clusters of theme: Functionality.

When it comes to functionality of the product, setup was experienced challenging, even with the help of the Smart AG team (Table 22). Improvement ideas concerned installation of the sensors and easier use of information.

> *There was no tape in our use, so it required some planning to make it [installation] work. We had enough cable ties for some type of attachment, but especially reversal, reversal of the plough, caused problems.*
>
> *Installation of sensors is worth paying a lot of attention to… I'm not a huge fan of cords, so if a better solution was found, that would be great.*
>
> *Height sensor… I just looked at it, but I found it too sensitive… There were too many images or something on the screen so that I didn't see the line.*

Based on the results of functionality in reversible plough use case, it seems that the setup of Product X, especially installation of sensors, is too challenging. Also, display of information regarding adjustments, damaged items or switching between screens need attention for further improvement.

Summary of Key Findings

Product X clearly has potential to match a need for better monitoring depth and setup of the implement in reversible plough use case, provided that it had more accurate adjustment according to ground conditions. Also, setup and display of information need attention for further improvement.

For now, the product is not beneficial enough for purchase due to lack of return on investment. However, with improvements, the benefit could possibly reach other industries working with different soil types, such as road maintenance and earthmoving. Also, contractors around the area might see value in the plough's automatic adjustment.

6.1.3 Use Case: Fertilizer Spreader

In fertilizer spreader use case, the informant was not able to fully test the product and therefore some topics lacked answers, but valuable feedback was received in spite of all. The informant was an owner of a contractor company in Holland, with 40 staff members. Results of the interview are illustrated in Tables 23–25 (p. 70–71). Table 25 (p. 71) also includes survey results about development ideas of better functionality from two online questionnaire responses.

	CODE	CATEGORY	CLUSTER
Current Solution	”By-eye” measurement	Using rough estimation instead of measuring	Solution exists
	Tractor settings	Using tractor for measuring	
Satisfaction with Current Solution	Time-consuming adjustment of implement settings on different fields	Need for automatization	Not fully satisfied with current solution
	Need for automatization of tractor settings		
Benefit of Product X	Better quality of work with improvement of tractor and implement settings	Beneficial for better quality of work	Beneficial
Improvement Ideas for More Benefit of Product X	Saving depth information for monitoring compaction and utilizing data as task map	More advanced use of information and fuel	
	Saving fuel consumption and carbon credits		
Ideas for Other Use of Product X	Integration with soil mapping	Agriculture	

Table 23. Codes, categories and clusters of theme: Benefit of the product X compared to the current solution for monitoring depth or setup of the implement.

The informant had a solution for the problem but was not fully satisfied with it (Table 23). Automatization was needed especially for implement and tractor settings. As Product X would improve the use of these settings, the user estimated to gain benefit from it in terms of quality of work. To make the product even more beneficial, more advanced use of information and saving fuel consumption as well as carbon credits were suggested as improvement ideas. Integration with soil mapping was seen as a potential other use of the product.

> *I'm not happy… Each time you must have auto settings on your machine on the field. That costs time, 15 minutes… Time is money and I’m a contractor so we must do a lot of hectares in a short time… They must have auto settings of the machine on each field.*

> *We do a lot of farming… If my drivers in the tractor can easier setup the machine into the cabin or into the cloud farming, then… your work will be better on the field so the customers will be satisfied…*

> *If [Product X], now or in the future, ables that the farmers can save on fuel consumption... The fuel on this moment is very high and if you can save 20% or 30% of the fuel consumption, you can have the sensor paid in a couple of years back… If you can save fuel consumption you can save in your carbon credits…*

The findings indicate that compared to “by-eye” measurement and tractor settings for monitoring depth or setup of the implement, Product X would improve the quality of work in fertilizer spreader use case. Further improvements regarding use of information and fuel would possibly

make the product even more beneficial. The product could also bring value in another use case in agriculture, soil mapping.

	CODE	CATEGORY	CLUSTER
Sufficient Benefit for Purchase	Depends on the price	Yes, under certain conditions	Yes
Price	1500 € if mountable on several machines	1500 €	
Retrofit Kit / Along with a Machinery Purchase	Retrofit kit for current need for ease of use and easier to reason the price for clients	Retrofit kit	
	Along with a machinery purchase in the future	Along with a machinery purchase	
One Kit for All Implements / Separate Kit for Each	–	–	
Other Farmers / Contractors around the Area	–	–	–

Table 24. Codes, categories and clusters of theme: *Willingness to buy*.

The informant was willing to buy the product if it was mountable on several machines and the price was appropriate, around 1500 euros (Table 24). A retrofit kit seemed more suitable for the current need because it would be easier to use, and the price would be easier to reason to the contractor's clients. The other option, along with a machinery purchase, might be possible in the future.

> *Now at this moment, I think it [Product X] is replaceable on each machine, it is easier to use. And you can bring out the costs easier to the farmers.*

The user did not comment on any other topics regarding purchase since he had not been able to fully test the product. As a conclusion, it seems that a retrofit kit would bring enough benefit for a fertilizer spreader use case if it was easy to mount on several machines and the price would be around 1500 euros.

	CODE	CATEGORY	CLUSTER
Ease of Set up*	Fluent installation of sensors	Fluent installation	
	Easy calibration		
	Failed installation of the box	Difficult installation	
Ease of Use	–		
Clarity of User Interface	–	–	
Improvement Ideas of Better Functionality	Bigger cables to avoid blowing fuses	Easier set up	
	Better installation solutions		
	Better accuracy of data when machine is stationary	Better accuracy	

**Smart AG team member was helping the tester with the set up.*

Table 25. Codes, categories and clusters of theme: Functionality.

The informant was not able to comment on functionality due to failed setup, but a few improvement ideas emerged from the situation and the two other survey responses, such as longer cables and better installation solutions (Table 25, p. 71). Also, data should be more accurate when the machines is stationary.

> *…there was not a problem to mount the sensors on the machine… The only problem was with the box… The cables are too short to have the box in the tractor… the box is very big…*
>
> *In the end we got a fuse damaged on the ISObus of the tractor…*
>
> *Failure height. Machine height was stable but [Product X] was giving wrong measurements.*

Summary of Key Findings

As a conclusion, the feedback on fertilizer spreader use case indicates that even though the user was not able to fully test product X, a clear benefit was identified. Compared to the user's current solution, the product has potential to improve the quality of work, especially with improvements regarding use of information and fuel. In terms of functionality, better installation solutions and more accurate data when the machine is stationary is needed. A retrofit kit that is easy to mount on several implements would be worth 1500 euros to the user. It could also be valuable in soil mapping which is another use case in agriculture.

6.2 Feedback Collection Process

Based on the feedback collection process performed in this thesis, a service blueprint was created in a workshop with the Smart AG team (Figure 15, p. 73). The aim was to map out the user's journey and illustrate different levels of evidence, user actions, front stage interactions, backstage interactions, and support processes related to it. Also, roles for each action were identified and named.

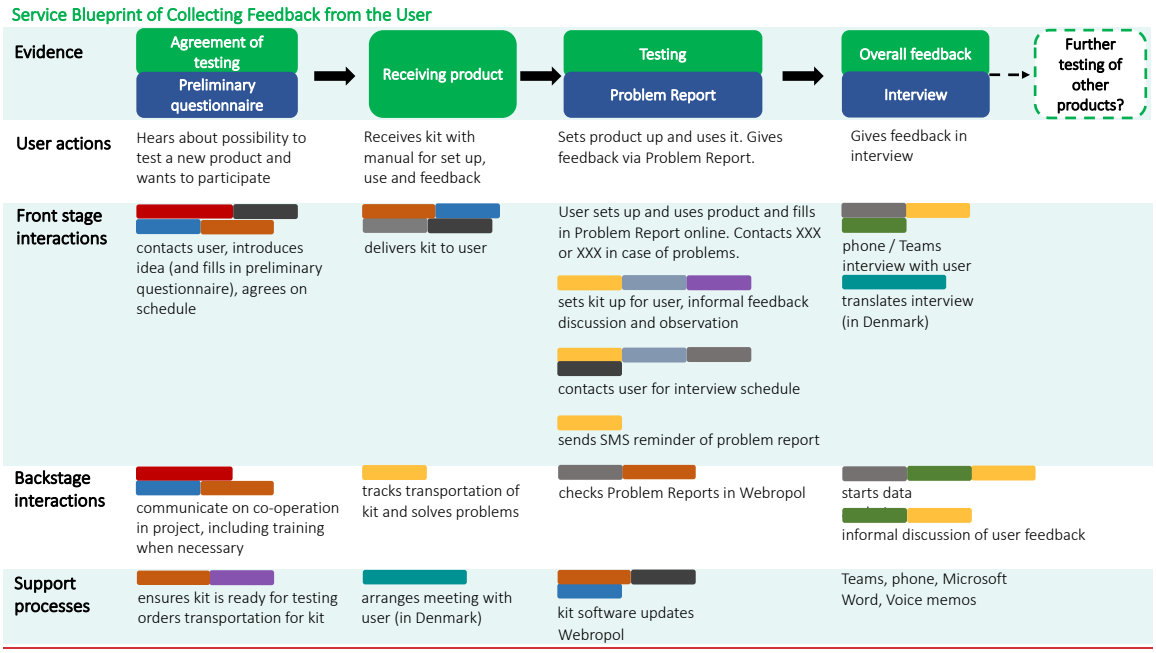

Figure 15. A service blueprint of the feedback collection process. Names of teams and team members have been omitted from the colored labels indicating roles for actions. Template adapted from https://miro.com/guides/service-blueprints.

The evidence level consists of four main steps of the user's agreement of testing, receiving the physical product X, testing the product, and giving overall feedback of the experience (Figure 15). On this level, three different data collection methods were applied at different steps. A preliminary questionnaire was a set of background questions regarding the user's willingness to test the product. It was a tool that was occasionally used by partners who worked for different departments in AGCO and cooperated with the Smart AG team in finding suitable farmers to test the product. The preliminary questionnaire was not included in the thesis because it was not about the feedback of the product. Instead, the feedback about the user experience was collected during the testing via online questionnaire called Problem Report and after the testing via interviews.

User actions describe what the user did at each step of the journey. Front stage interactions illustrate moments when the user interacted with the Smart AG team, a partner, the researcher, the product, or the online questionnaire. Different roles are marked with colored labels in the template, but names of teams and persons have been omitted. Backstage interactions describe what happened in the background that the user did not see or know about. Support processes illustrate the deepest systems and actions that enabled the upper levels to happen.

When it comes to roles, the Smart AG team was very closely involved in the data collection. Members of the team assisted the researcher in preparing the questions for both, survey and interview

and scheduling interviews. In the interviews, there was always a team member present, providing support in technical details of the product when needed. The team also assisted in the beginning of the analysis by explaining meanings of technical details mentioned in the feedback. Also, partners assisted the team in contacting the users for agreement of testing, delivering the product to the tester, scheduling interviews, and translating interviews when needed. The researcher took part in informing the users about the feedback collection and scheduling interviews, but the focus was on collecting the data and preparing for analysis.

In some cases, the Smart AG team went to deliver the product to the users and assisted or did the setup for them. Meanwhile, they had informal conversations with the users and received valuable feedback on the spot. However, this data was not included in the thesis, except for indirectly in a workshop where the team's previous knowledge of the users contributed to creating a persona and a journey map. An outline of the team's evaluation of this whole process is presented in Table 26.

What was good?	What did not work?
• It is good to have a model to start with. • The process as a whole was successful when the kit worked well. • Academic perspective brings helpful structure.	• Partner X did not "own" the project and therefore cooperation did not work. • Problems with ISObus splitter caused challenges in the testing. • QR-code to the online questionnaire was too difficult for the users to find from the packaging material. • "How to make people read instructions?"

Table 26. Smart AG team's evaluation of what was good and what did not work in the feedback collection process.

Based on the experience and illustration of the feedback collection process the team evaluated that it was good to have a model to start with in their first project (Table 26). Academic perspective brought helpful structure and the process was successful in cases where the kit worked well. However, there were technical problems that caused challenges in the testing. Also, a QR code that had been printed in the packaging material of the kit was too difficult for the users to find and enter the online questionnaire. Another challenge about the kit material was that the users did not seem to read the instructions that had been included in it. When it comes to the bigger picture of the process, cooperation with a partner did not work due to lack of commitment.

The team's main comments regarding collecting feedback in future projects were the following:

- Co-operation with tractor dealers is important, as is to find the right contacts.
- What metrics to use for measuring the feedback and the amount of received answers?

- A need for an additional team member focusing on UX.
- It is important to meet the user face-to-face in the beginning of the testing.
- The kit should be tested more carefully before taking it to the user.
- Testing should be started in Finland or with other Smart AG teams first because it is easier to fix emerging problems that way.
- A lighter version of the feedback collection process and methods would be helpful for earlier stages of the project.

Summary of Key Findings

The blueprinted feedback collection process with the SAVT team's comments shows that having a structured model for collecting feedback is helpful, especially in pilot projects as of product X. Feedback collection was successful in cases where the product worked well, but technical problems caused difficulties or even failure in testing. Challenges were faced also in communication to the users. The online questionnaire via a QR code did not turn out accessible or easy enough, nor did the instructions included in the packaging of the product.

Even though the researcher took responsibility for carrying out the actual research, including survey, interviews and analysis – with the support of SAVT– there was a network of partners inside and outside AGCO involved in the bigger picture of organizing and enabling the testing of product X. With some partners, cooperation did not work due to lack of commitment, and it was found fruitless. With others, cooperation was found crucially important, whether it had worked well or not. For both, it was agreed that it is important to find the right contacts in the future for more fluent and beneficial cooperation.

Other identified needs for the future were metrics to measure the feedback and amount of received answers and additional team member focusing on UX. Also, for earlier stages of a project, a lighter version of this feedback collection process could be useful. Regarding the testing itself, it was considered important to meet the user face-to-face in the beginning and hand out a more carefully prepared product for use. This means that the team should test the product more thoroughly themselves and start the user testing from Finland or other Smart AG teams first, so that problems would be easier to fix.

7 Conclusion

The aim of the thesis was to explore and evaluate how the MVP of product X should be developed further and outline recommendations on how SAVT could systematically collect feedback on other early-stage products in the future. The main purpose of the research was to find out if there is a true need for the product and how the users experience using it.

The problem was approached by the perspective of S-D logic, in which customers are recognized as coproducers of value and they are being involved in customizing offerings to better fit their needs (Vargo & Lusch, 2004, p. 12). The customer perceives and determines what value is and tangible goods are not the end products but rather intermediate "products" that are used in value-creation processes. (Vargo & Lusch, 2004, p. 7.) Consequently, the customer's expectations, situations, location, and time define how value cocreation is experienced (Helkkula, Dube & Arnould, 2019, Chapter 7).

When the needs of customers and users influence the development process of new products, superior value can be produced to the buyer, the customer, and the supplier (Sundberg, 2015, pp. 45–46). Before starting to build a product, it is important to ask, "What do people need?". Otherwise, the business may waste time, money, resources, and reputation in useless efforts. (Sharon, 2016, Chapter 1.) With these principles in mind, research questions were formed to explore answers to the research problem:

1. How do the users experience the MVP of product X?
    a. What is their current solution to the problem the product X addresses?
    b. Do they need product X?
    c. How do they experience the functionality of product X?
    d. Would they buy product X and how much would they pay for it?
2. How should product X be developed further?
3. How to collect authentic feedback systematically and efficiently on other MVPs in the future?

User Feedback on the MVP of Product X

Relevant, yet limited conclusions can be drawn from the overall summary of the research results. Moreover, the deepest and most important findings regarding further development of product X are in tillage / cultivation use case. The data of this use case consists of eight interviews and six survey responses, whereas reversible plough has only one interview and fertilizer spreader one interview and two survey responses.

When looking at the findings of all use cases, solution for the addressed problem already existed but it was not experienced fully satisfying. Product X was found beneficial, yet automatization, more advanced use of information and fuel, and solutions for specific implements were wanted. The product was seen potentially useful also in other fields of agriculture as well as road maintenance, sports and leisure, and earthmoving industries. When it comes to willingness to buy, product X was experienced both, beneficial enough and not beneficial enough for purchase. The biggest issues with functionality were within setup and installation that were experienced difficult in all use cases and had failed in fertilizer spreader use case. Easier setup and use of information and better accuracy and fluency of use arose as improvement ideas for better functionality.

This output of all use cases answers to the first research question of how the users experience the MVP of product X and the four sub-questions regarding current problem, need, functionality and willingness to buy. The findings address that there is a true need for product X, and the product is worth developing further. The second research question of how it should be developed, can be answered based on the user feedback and the collaboratively created persona and journey map regarding tillage / cultivation use case.

The user feedback of tillage / cultivation shows that even though product X was experienced useful to some extent, and perceived beneficial enough for purchase for several purposes, further improvements, especially in terms of automatization are needed. A transferable retrofit kit that can be used in multiple implements seems to match the users' current needs and willingness to buy better than a pre-fitted one or a kit that needs to be bought separately for each implement. The overall use of the product was experienced easy but issues about functionality were found in setup, accuracy and fluency of use.

Both, the user feedback, and the opportunities for improvement identified in the journey map by the SAVT team, point out that setup needs to be developed much easier and automatization is

clearly an issue to be seriously considered. This output answers the second research question – yet regarding only tillage / cultivation use case.

When considering the MVP Hypothesis the commissioner communicated in the end of the research, the results provide sufficient information to evaluate its validity. The hypothesis being: "Visualization of the working depth and angles of the implement will give farmers the info they need to more accurately perform field tasks, and they will be willing to pay 2000 euros for it", can be confirmed true. However, the price range discovered in the research was from 300 to 5000 euros, so it does not unambiguously match the 2000 euros. Also, even though product X was found to provide farmers information they need to perform field tasks more accurately, further needs were discovered to improve their work even more.

Feedback Collection Process

The other aim of the thesis, outlining recommendations on how SAVT could systematically collect feedback on other early-stage products in the future, was approached with the third research question. The question was answered based on the output of a development workshop with the SAVT team and literature of customer-centric approaches to developing a new product.

The service blueprint created in the workshop represents a collaborative view of the feedback collection process performed in the thesis. It includes actions and actors outside the actual framework of the research, such as partners assisting with finding the right type of users for the testing and SAVT's technical updates of the product. It also excludes some parts relevant for the academic research design, such as preparation of questionnaire and interview questions and conducting qualitative content analysis. Consequently, the output of the workshop does not evaluate the research design of the thesis but focuses on the larger yet not as in-depth process that the team and the researcher experienced together in the context of the project of product X. This way, the team's perspective of the past, present and future needs were taken into account in the development task of outlining recommendations for the future.

The team's needs and insights created a basis for reflecting views from the literature. Concepts of UX and CX together with some principles and tools of design thinking and lean start up were explored to find solutions for future projects. As a result, a set of useful options that is not all-encompassing but fulfills the aim of the thesis of outlining recommendations, were compiled (Sub-chapter 8.2).

8 Discussion

Powers and Reagan (2007, p. 2) describe value creation in a B2B relationship as “synergy from the partnership whereby each partner gains from the relationship”, in the form of for example, technology, market access, information, lower prices and operating costs or knowledge, depending on the partner’s need. The persona created for tillage / cultivation use case implies that in terms of new solutions for a tractor, farmers consider the relationship with their tractor dealer crucially important, because they trust that person more than other representatives of the brand. Also, one of the collaborative conclusions of the created service blueprint was that tractor dealers play a crucial role in how successful a prototype testing and feedback collection process turn out in practice.

It seems that tractor dealers are an important link that build and enhance trust between the customer and SAVT/AGCO, so that value can be created both ways. As Sundberg (2015, pp. 45–46) outlines value creation between all three stakeholders, when the needs of customers are enabled to influence the development of new products, superior value can be produced to the customer, the seller and the supplier.

In the context of product X, this means that as SAVT/AGCO receives beneficial user feedback, it leads to development of new innovations and improved solutions for the customer, which potentially results in sales for AGCO and again leads to a product/service that better matches the customer’s needs in a longer term. In other words, to a “consistent delivery of the brand-driven customer promise and resulting customer expectations through the physical experience” as Pennington (2016, p. 450) describes CX.

When it comes to improving CX of product X also after the launch and developing cooperation with dealers for collecting feedback in future projects, the relationship with dealers and potentially other relevant partners is worth to invest in. Hague and Hague (2018, Chapter 17) emphasize that these channel partners are in a key role for looking after customers and delivering excellent CX.

Ross (2008, pp. 176–178) points out that the pipeline mechanism for the delivery of value should be approached from the eyes of the customer instead of the supplier, so that the customer’s perception of the supply value chain can be understood. This covers areas of receiving total value to an ongoing need, finding the ultimate buying experience – in which interaction with the

supplier is as important as the actual product – and building supplier relationships that are evaluated based on the whole network of intermediaries more than the features or functions of the product itself. Also, conditions of loyalty – with past experiences, attitudes and beliefs – and alignment of channel offerings and customer expectations, regarding for example pricing and product, are part of the customer's perception. Considering these aspects in SAVT's relationships with dealer partners would likely enable cooperation with mutual understanding of the importance of better CX and ways to aim for it – eventually resulting in superior value to all stakeholders.

8.1 Improvement Ideas for the MVP of Product X

Nuthall (2018, Chapter 1) argues that farmers need to have a variety of different skills to perform their work, involving different subjects from physics and chemistry to biology and psychology. Also, the persona created for tillage / cultivation use case uncovers several needs that farmers have in their business. They aim for yield maximization, overhead reduction and ease of operation while performing tasks of business planning, crop cycles, livestock management, machine operation and maintenance. Allison (2022, p. 53) points out that especially in the field of arable business, attention to detail is very important and one of the eight factors of top performance. In the light of this context, and given that necessary improvements are made, product X has potential to help farmers in reaching their goals by providing a more accurate, time and fuel saving, and easier solution for monitoring depth and setup of their implements.

When it comes to the necessary improvements emerging from the research results, their significance can be examined through the framework of pain points that are problems that occur at different levels of CX (Gibbons, 2021). When looking at the customer-journey level, the effects of the pain points can be classified into costs that unsatisfactory experience causes to the user. Table 27 (p. 81) presents how Gibbons (2021) and Whitenton (2013) categorize these costs and their effect in the UX of product X. The content is derived from the tillage / cultivation use case that comprised the most data.

Cost	Effect on UX of Product X
Interaction cost	The user needs to take additional steps or seek for assistance to get the setup done.
Cognitive load	The user's mental resources are challenged by the lack, unclarity or inaccuracy of information and the visual presentation on the user interface.
Time cost	The user needs to spend time on repeating actions for a process to complete, such as calibration.
Financial cost	No financial cost identified at this point, except for taking the time to learn and test a new solution.
Loss of trust and confidence	No loss of trust and confidence identified at this point.

Table 27. Classification of the costs of pain points (based on Gibbons, 2021 and Whitenton, 2013) and their effect on the UX of product X in tillage / cultivation use case.

Interaction cost is mainly related to the setup part of testing where it took some time and effort for the user and assisting party to get the setup successfully done (Table 27). Cognitive load touches the lack, unclarity and inaccuracy of information that communicated what the product was doing and how. Partly due to this, time cost appeared, when the user needed to repeat certain actions, for instance calibration. The research results do not indicate any specific financial cost or loss of trust and confidence that the user would have experienced. These areas are recommended to examine in further user research in the future.

When it comes to pondering whether and which type of further research is needed, Morville's (2004) User Experience Honeycomb provides useful perspective on seven different facets of UX: useful, usable, desirable, findable, accessible, credible, and valuable (Figure 3, p. 10). In terms of usefulness, it has been confirmed that a true need for product X exists. Usability has been explored and emerged problems identified. Improvement areas for both have been discovered, especially in terms of automatization and better installation solutions. Desirability, findability, accessibility and credibility have not been directly examined. However, the results imply that the tractor dealers as reliable sources of information and solutions in the eyes of the users, at least partly affect these. Valuable, being the core of the honeycomb, can be considered the most relevant aspect of UX. Regarding product X, it certainly exists and has potential to be increased as development proceeds.

One of the steps toward better CX and consequently, increased value, is building a solid CX strategy before the product launch, as Atif (2019) argues. He points out that it has a crucial role in determining whether the product will be accepted in the market. According to his view, when considering marketing strategies, especially early adopters serve the purpose the best when provided excellent UX.

8.2 Recommendations for Collecting Feedback in Future Projects

When considering the effort to better understand the users for developing better solutions for them, this study has agreed with the literature presented in chapters 2 and 3 and confirmed that collecting feedback is crucially important. SAVT's aim is to learn from this experience and improve their testing process to be more fluent and accurate in future projects.

When looking at similar aim in a bigger picture, challenges can be found in B2B companies in general. Hague and Hague (2018, Chapter 1) point out that even though large B2C businesses have succeeded to deliver excellent CX, in B2B, the bigger the company the harder it is to thrive in excellent CX. These companies are generally strong in other areas such as processes, quality control and logistics, but CX and consideration of emotions are usually limited to sales only. Smart AG teams are relatively small start-up style units that have freedom to operate independently to some extent, but they are part of the massive AGCO corporation and their input in the whole company is notable (Hardy-Linna, 12.4.2022).

As Hardy-Linna (12.4.2022) describes, SAVT has a freedom to apply lean start up practices in its operation and therefore also prioritize and simplify its focus when needed. The UX process of Rosenzweig, (2015, p. 15) that reflects through the feedback collection process in this thesis as well, can be considered as a clear and solid framework for user research in a phase of testing a prototype. The three steps of persona, use case and object/product/service (Figure 2, p. 9) provide a straightforward structure for a logical approach to the aim of understanding the user better.

Another useful perspective is the concept of Minimum Viable User eXperience (MVUX), introduced by Hokkanen et al. (2015). The researchers created MVUX to support the evaluation and validation of early product ideas and provide sufficient UX so that the users can give reliable feedback of the product. This was based on a qualitative study that was conducted in small startups in Finland and as an outcome, four main elements of MVUX were identified: attractive, approachable, professional, and selling the idea (Figure 4, p. 11).

Based on these two main frameworks, together with some other tools and methods, and the output of the service blueprint created together with SAVT, the following recommendations have been developed for future projects.

1. **Evaluate whether the product matches the requirements of MVUX before the testing starts.**

   It was concluded in the development workshop regarding the blueprinted feedback collection process that the product should be tested more carefully before taking it to the user. Also, the first tests should be performed in Finland or in other Smart AG teams so that emerging problems are easier to fix.

   To ensure that the product is ready for user testing and reliable feedback can be gained, the following aspects of MVUX according to Hokkanen et al. (2015) is useful to consider.

   1. Is the product attractive to the user? This affects whether the user becomes interested in the product. Consider aspects of visual, humane, novel and hooking.

   2. How approachable the product is? This means, how the user gets to know the product. Consider aspects of intuitive, easy and simple.

   3. Is the product professional? This influences how the user experiences using the product. Consider aspects of credible, functioning and efficient.

   4. When the above elements are in place, the product idea can be considered clear enough for the user to understand it and consequently give useful feedback. You are ready to introduce and sell the idea.

   Since this model was originally created based on small Finnish software startups (Hokkanen et al., 2015), it can be applied to SAVT – a bigger, international corporation developing also hardware products – as a starting point to test which elements are relevant to them. The model can be modified as the process of learning in different projects continues.

2. **When preparing for collecting feedback, consider persona, use case and solution.**

   The output of the collaboratively created service blueprint shows that a structured model for collecting feedback is helpful and the SAVT team needs a UX-focused team member to perform feedback collection in future projects. Therefore, the steps of UX process defined by Rosenzweig, (2015, p. 15) are recommended to consider as a structure for research in other projects as well. The following steps include the UX process and examples of how they were applied in this thesis.

1. Persona

   Define what you want to know about the user. For example, in this thesis the user was asked about background information related to his/her work and current solutions for the addressed problem.

2. Use case

   Decide in which use cases you want the user to test the product. For example, in this thesis three use cases were defined in advance and the user got to choose a suitable option from them. The user was asked about the type of work, machinery and circumstances related to the testing.

3. Object / product / service

   Consider what is important to know about the product at this point of the project. For example, in this thesis the main themes were defined: benefit of product X compared to the current solution for the problem product X addresses, willingness to buy, and functionality.

3. Consider relevant resources and methods in collecting feedback.

As it was concluded in the development workshop of the feedback collection process, the network of partners cooperating in the testing play an important role in terms of succeeding in feedback collection. Especially tractor dealers were found important due to their close relationship with the users. Therefore, finding the right connections who understand the importance of collecting user feedback and commit to the process is important.

When it comes to choosing the methods to collect data, it was found that meeting the user in person in the beginning of the testing is very helpful for a better testing experience. Also, based on the experience of two UX designers of another Smart AG team in Denmark, accompanying the user while he/she is testing the product, is one of the best ways to collect authentic feedback (Lund, 23.3.2022; Whittaker, 17.3.2022). In determining data collection techniques, it is recommended to consider which type of information is needed and how to best connect with the users and make answering easy for them.

Given that the feedback collection of other projects is placed at the same phase of the Smart AG Engineering Process (Figure 12, p. 40) as this thesis, qualitative data is recommended over quantitative data. As Olsen (2015, Chapters 7 & 9) states, quantitative tests are useful after having a live product with a meaningful amount of usage comprising large sample sizes, whereas qualitative product testing is focused on smaller numbers of users and uncovers blind spots that only a new user can see. His perception of qualitative tests being the most valuable way to assess and improve the product-market fit of a new product is recommended to be considered.

The service blueprint also revealed that communication to the users can be challenging, such as the QR code of the online questionnaire and product manual included in the packaging. Both were communicated to the users, but they did not get enough attention, leading to fewer survey responses and ignorance of setup instructions. Therefore, ways of communication are worth to pay attention to, so that the "the correct idea can be sold" as referred to in MVUX.

4. **Share insights and create collaborative conclusions.**

   For making the most out of collected user feedback, tools such as empathy map, journey map and service blueprint, can be useful for illustrating the findings in the project's context – as done in this thesis. Even though the research would be made by a specific team member, a richer perspective of the meaning of its findings can be reached by sharing insights as a team and making collaborative conclusions for further steps of development.

8.3 Reliability and Validity

The thesis was conducted by following the principles of responsible conduct of research of Finnish National Board on Research Integrity TENK (2021). The research design was selected, and the study conducted by conforming to scientific criteria. The research results were openly and responsibly communicated, and all sources of previous research and other information was cited appropriately.

Triangulation of data collection techniques strengthened the validity of the results to some extent. Survey was used to supplement interviews and it provided additional data in terms of functionality of product X. However, for other studied themes regarding benefit and willingness to

buy product X, no triangulation of data collection techniques was applied. However, regarding all studied themes of the UX, in addition to the researcher of the thesis, team members from SAVT assisted in interviews and analysis. Therefore, triangulation of more than one investigator was used.

As a case study, the results of the thesis are not meant to be transferred to other contexts outside the case team, SAVT. The benefit of the research for the commissioner instead, can be considered remarkable. SAVT gained useful user feedback of the team's pilot project of product X. The whole team was invited to ponder the meaning of the findings in the project's context and collaborative conclusions were drawn regarding further steps of development. Also, SAVT's involvement in the feedback collection process and evaluation of the experience of it, together with the recommendations produced in the thesis, will give the team useful guidelines for collecting feedback in future projects.

As a personal learning experience, the thesis was a great opportunity for the researcher to develop competencies in the field of learning skills, ethical competencies, working life, innovation, and internationalization, as referred to in master's degree competencies of Kajaani University of Applied Sciences (n.d.). Exploring and gathering information on relevant former research and reporting the process and results of the research were the most challenging parts of the process. However, they turned out very useful in structuring thoughts into a logical form in the light of the theoretical context. The most enjoyable and rewarding part was to collect and analyze the data and organize workshops for the team. Especially interviewing users from different countries and business environments brought interesting perspective to the meaning of the research. Also, cooperation with the SAVT team was a refreshing and enjoyable bonus to the scenery of independent remote work from home.

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Online questionnaire for survey

Problem Report

Mandatory questions are marked with a star (*)

Did something go wrong with the [redacted]? You can report any faults and problems in here.

Please, fill in a new form for each situation.

The data is used only for developing the [redacted] in AGCO, and it is not handed to anyone else. This research is made as part of a master's thesis for Kajaani University of Applied Sciences.

1. Which kit were you using? *

- ◯ Kit 1
- ◯ Kit 2
- ◯ Kit 3
- ◯ Kit 4

2. When did the problem occur? *

dd.mm.yyyy

3. What was the time? *

4. What type of work was the problem related to? *

- ◯ Tillage
- ◯ Reversible plough
- ◯ Fertilizer spreading / Spraying

5. Describe the problem and explain what happened. *

6. Pictures of the situation

Choose file No file chosen

Submit

Interview questions/themes for semi-structured interviews

Background Information / Demographics

1. What country are you in?
2. What is your role at the farm?
3. What type of business is the farm?
4. Do you run a conventional or an organic system?
5. What is the size of the farm?
6. How many staff do you have?
7. How many tractors do you have on the farm?
8. Do you use automatic guidance?

Testing

1. What was the testing period?
2. How many hectares/acres did you cover for the testing?
3. What type of work did you use product X for?
4. What implement(s) did you use product X with?
5. What tractor did you use?

Benefit and Willingness to Buy

1. How do you currently monitor the machine depth or setup of the implement in your work?
    - *If has a solution:*
        - Why do you use this solution?
        - Have you tried other solutions earlier?
        - Are you satisfied with the solution? Why?
        - What is the end result for your business?
        - Estimate how much money it costs every year.
    - *If doesn't have a solution:*
        - Why not?
        - Have you ever tried any solutions?
        - Would it be important for you to have a solution?
        - What is the end result for your business when you don't have it?
        - Estimate how much money it costs every year.
2. Was product X useful to you? How?
    - *If has a solution:*
        - If you compare it to your current solution, does it bring benefits to your work?
        - If so, are the benefits enough for you to buy it?
            - If so, how much would you pay for it? Why?
            - What possible future improvements would make it even more useful?
            - If not, why?

What possible future improvements would make it useful?

If doesn't have a solution:

Are the benefits enough for you to buy it?

If so, how much would you pay for it? Why?
What possible future improvements would make it even more useful?

If not, why?
What possible future improvements would make it useful?

If the user would buy:

3. Would you buy it as a retrofit kit or along with a machinery purchase?
4. Would you rather buy one kit and use it for all your implements, or a separate kit to each implement?

Everyone:

5. Do you think a regular farmer around your area would buy this?
6. Can you think of any other use for the product, other than your own work?

Functionality

1. Was product X easy to set up?
2. Were the instructions clear?
3. How easy was it to calibrate?
4. Was product X easy to use?
5. Was the information clearly presented in the user interface?
6. How did the following features work?
    - Work depth
    - Work height
    - Crop height
    - Implement setup

If all worked "well":

What do you mean by that?
How would you describe that in more detail?

Ask for possible clarifications of Problem Report(s) if needed.

Other

1. Do you have any other comments or improvement ideas on the product?
2. Would you be interested in testing other products in the future?

Summary of codes, categories and clusters

CODES	CATEGORIES	CLUSTERS
Benefit of the Depth Sensor Compared to the Current Solution for Monitoring Depth or Setup of the Implement *The following section describes whether the user has a current solution to the addressed problem and if yes, what the solution is. It includes descriptions of the use and importance of the solution. The experienced benefit of product X is described, including improvement ideas for even more benefit in the future. Also, other ideas of on what and how the product could be used are listed and categorized into different industries.*		
Current Solution		
Tractor settings	Using tractor for measuring	Solution exists
Depth wheel	Using implement or tractor for measuring	
Rear linkage		
Top link		
Depth scale in harrow	Using implement, tractor or tool for measuring	
Cultivation for wheat or barley to 8 cm after potatoes		
Cultivating for corn without depth measure but adjusting roller and disc		
Tractor setting		
Measuring stick		
"By-eye" measurement	Using rough estimation instead of measuring	
Planting potatoes as deep as possible without measuring		
No solution	No solution	No solution
Rejected solution of inaccurate measure system of cultivator		
Using current solution out of accustomed habit	Current solution accepted without competition of other alternatives	Use and importance of solution depends on circumstances
Using current solution due to lack of other options		
Importance of correct depth for work performance	Importance of correct depth for work performance depends on task	
Unimportance of correct depth work performance		
Satisfaction with Current Solution		
Satisfied with planting potatoes as deep as possible without measuring	Satisfied with current solution of measurement and/or inaccurate estimation	Satisfied with current solution
Satisfied with depth scale in harrow		
Satisfied with "bye-eye" measurement and depth scale in harrow		
Satisfied with measuring stick		
Ease of use based on experience and implement settings	Satisfied with ease of use of current solution	
Need for automatization in planting potatoes	Need for automatization	Not fully satisfied with current solution
Need for automatization of tractor settings		
Need for automatization of width adjustment		
Need for automatization of depth wheel		
Need for automatization of implement setup (left-right balance)		
Need for automatization on bigger fields		
Need for automatization on smaller fields		
Need for automatization due to different expertise level of users		
Time-consuming adjustment of implement settings on different fields		
Need for more precision compared to "by-eye" measurement and tractor settings	Need for better solution	
Need for improvement compared to "by-eye" measurement and depth scale in harrow		
Benefit of Product X		
Beneficial for corn seeding with combination drill	Beneficial in specific implements	Beneficial
Beneficial in harrow		
Beneficial in fertilizer spreader		
Beneficial in drill		
Beneficial in several implements		
Implement angle adjustment	Beneficial for implement angle adjustment	
Beneficial for corn or sugar beet seeding	Beneficial for specific type of work	
Beneficial for planting potatoes		
Beneficial for planting sugar beets		
Beneficial in shallow cultivations		
Beneficial in hilly land		
Better quality of work with improvement of tractor and implement settings	Beneficial for better quality of work	
No benefit in harrow	No benefit in specific implements	No benefit
No benefit in springtine harrow		
No benefit for subsoiling	No benefit for specific type of work	
No benefit in flat land	No benefit in specific type of land	
No beneficial information	No benefit in terms of information	
Difficult to see benefit due to flaws of prototype	No clear benefit due to flaws of prototype	
Improvement Ideas for More Benefit of Product X		
Automatically adjusting tractor hydraulics or linkage	Automatization	
Automatic top link while ploughing		
Automatically controlling booms of sprayer		
Automatic top link or implement sideways (for the 1st version)		
Saving depth information for documenting carbon emissions	More advanced use of information	
Integrating information on the second ISObus user interface		
Saving depth information for monitoring compaction and utilizing data as task map	More advanced use of information and fuel	
Saving fuel consumption and carbon credits		
Solution for implements with spikes	Solutions for specific implements	
In multi-section implements depth sensor for each section and monitoring values simultaneously		
Adjustment of plough according to ground conditions	Solutions for plough	
Ideas for Other Use of Product X		
Potato planter	Agriculture	
Fertilizer spreader		
Plough		
Potato / sugar beet harvester		
Rice harvest Combiner on header table for height		
Integration with soil mapping		
Road grader	Road maintenance	
Earthmoving equipment	Earthmoving	
Horse-riding fields	Sports and leisure	
Golf course		
Willingness to Buy *The following section explains whether the user finds the product beneficial enough to buy and why. It shows, how much the user is willing to pay for it and which type of kit would be suitable for the user's purpose. The user also comments on whether a regular farmer / contractor around the area would buy the product and why.*		
Sufficient Benefit for Purchase		
Depends on the price	Yes, under certain conditions	Yes
Depends on the implement		
Yes, if improved installation		
Yes for plough	Yes, for specific purpose	
Yes for fertilizer spreader		

Sufficient Benefit for Purchase		
Yes for saving fuel		
Not for harrow	No, not for specific purpose	No
Not enough return on investment	No, due to lack of return on investment	
Price		
300 – 400 € compared to price of sprayer sensors	300–1000 €	300–5000 €
500 – 1000 € like a normal update to tractor		
500 – 1000 €, possibly more for further benefit in other implements		
1500 € if mountable on several machines	1500 €	
1500 – 2000 € mainly for know-how	1500–2600 €	
2000 € if bought with new cultivator		
2600 € as automatic		
3000 – 5000 €	3000–5000 €	
5000 € as automatic for saving in driver costs		
No negative price impact of using LS hydraulics to achieve automatization	No price impact of using LS hydraulics	Additional comment on price impact regarding automatization
Retrofit Kit / Along with a Machinery Purchase		
Retrofit kit	Retrofit kit	
Retrofit kit installed by dealer		
Retrofit kit for transferability between implements		
Retrofit kit for cheaper installation		
Retrofit kit for current need for ease of use and easier to reason the price for clients		
Along with a machinery purchase in the future	Along with a machinery purchase	
Along with a machinery purchase for better functionality and reliability		
One Kit for All Implements / Separate Kit for Each		
One kit for all implements for current need	One kit for all implements	
One kit for all implements with cables as separate parts for each implement		
One kit for all implements with sensors as separate parts for each implement		
Separate kit for each in the future depending on experienced value of the first kit	Separate kit for each	
Other Farmers around the Area		
Yes depending on implement	Yes, for specific type of work	Yes, they would buy
Yes for seeder		
Yes for vegetable farming		
Plough's automatic adjustment for contractors	Yes, contractors	
Yes for easier working	Yes, for specific value	
Yes for survival in fast developing environment		
Yes for saving fuel		
Yes after discovering value from other farmers		
No due to lack of compatible ISObus machines	No, due to lack of sufficient equipment	No, they would not buy
Functionality *The functionality section shows how the user experienced the setup and use of the product. Also, improvement ideas are drawn from the problems the user faced using the product or the user's comments on further development ideas.*		
Ease of Set up		
No signal in Fendt 714	Depends on tractor	
Easy in Valtra T235		
Fluent installation of sensors	Fluent installation	
Easy calibration		
Failed installation of the box	Difficult installation	
Difficult installation		
Challenging installation of sensors		
Ease of Use		
Easy to use		
Clarity of User Interface		
Information clearly presented in the user interface	Clearly presented information	
Unclarity of crop and soil height	Unclearly presented or lacking information	
Too big numbers on night screen		
No notifications of calibration		
Unclear targets		
Menu not simple enough for different levels of users	Challenges with fluency of use	
Delays		
Improvement Ideas of Better Functionality		
Better accuracy of depth measurement	Better accuracy	
Better accuracy of depth measurement with bending spikes		
Better accuracy for implement set up		
Better accuracy of data when machine is stationary		
More specific information on depth measurement	Better fluency of use	
Speed adjusted sensitivity		
Two menus: for beginners and advanced users		
Better installation solutions	Easier set up	
Bigger cables to avoid blowing fuses		
Confirmation of calibration on user interface		
ISObus and sensors/connectors damage		
Installation of sensors		
Better functionality of settings		
Better functionality of calibration		
Better functionlity of loading		
Switching between screens	Easier use of information	
Error report of damaged sensor		
Height adjustment		
Implement angle adjustment		

Structure of codes and raw data that were discussed in the first workshop

USE CASE NAMED HERE

Benefit of Product X Compared to the Current Solution for the Problem Product X Addresses

Current Solution

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Satisfaction with Current Solution

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Benefit of Product X

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Improvement Ideas for More Benefit of Product X

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Ideas for Other Use of Product X

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Willingness to Buy

Sufficient Benefit for Purchase

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Price

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Retrofit Kit / Along with a Machinery Purchase

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

One Kit for All Implements / Separate Kit for Each

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Other Farmers around the Area

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Functionality

Ease of Set up

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Ease of Use

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Clarity of User Interface

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Improvement Ideas of Better Functionality

RAW DATA	CODE
Original highlighted comments from raw data	***Code 1***
Original highlighted comments from raw data	***Code 2 etc.***

Participant information of interviews

Use case	Tillage / cultivation								Fertilizer spreading	Reversible plough
Interview no.	1	2	3	4	5	8	9	10	6	7
Implements used in testing	Præstbro subsoiler cultivator, 3 m	Horsch Terrano cultivator, 5 m	Pastor cultivator, 5 m	Hatzenbichler springtine harrow	Multiva TopLine, 8 m	Väderstad NZ Aggressive harrow, 600 m	Väderstad NZ Aggressive harrow, 600 m	Potila SPH 550, 5,5 m	Kverneland Geospread fertilizer spreader	Kuhn plough, 1,7 m
Tractors used in testing	Fendt 818	Fendt 942	Massey Ferguson 7622	Valtra T235	Valtra T254 Versu	John Deere 6250R	John Deere 6250R	Massey Ferguson 7499 Dyna Vt	Valtra T174	Valtra N175 Versu
Area covered for testing	5 ha	10 ha	3 ha	5-10 ha	10-15 ha	–	100 ha	18 ha	20 ha	2 ha
Testing period	12.4.2022	13.4.2022	19.4.2022	17. – 22.5.2022	11. – 13.5.2022	25. – 27.5.2022	25. – 31.5.2022	6.6.2022	12. – 18.5.2022	13. – 14.5.2022
Country	Denmark	Denmark	Spain	Germany	Finland	Finland	Finland	Finland	Holland	Finland
Type of business	Arable	Arable	Arable	Arable	Arable	Dairy	Dairy	Mainly dairy, also livestock, forestry and arable	Contractor	Arable
System	Conventional	Conventional	Conventional	Partly conventional, partly organic	Conventional	Conventional	Conventional	Conventional	–	Conventional
Size of the farm	200 ha	600 ha	400 ha	70 ha	340 ha	600 ha 600 cows	600 ha 600 cows	230 ha 160 cows	–	30 ha
Role at the farm/business	Owner operator	(1) Owner (2) Operator	Owner operator	(1) Owner operator (2) Operator	Operator	Operator	Owner operator	Owner	Owner	Operator
Number of staff (including owners)	1	3	2	4 part-time	5 + 1 part-time	14	14	4	40	2
Number of tractors in the farm	5	4	4	6	4	7	7	6	1	2
Automatic guidance in use	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No
Willingness to test other products	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Thesis material management plan

KAMK • University of Applied Sciences

Thesis material management plan

Attached to the **thesis plan**

1. General description of the material

What type of research material (e.g. interview, survey, observation) is collected or used in the thesis?

Interview and survey.

2. Documentation and quality of the material

How is the research data documented, for example, what kind of identification information is used? How is the quality of the material and its documentation ensured?

In the survey, online questionnaires are saved in Webropol. The respondents are identified based on the date and kit (number) they use for the testing.

Teams and phone interviews are recorded and transcribed.

3. Storage and backup

How is the material saved? How is data security ensured (e.g. access to the material) during the thesis process? Who can access the material?

The interview material is saved on the student's laptop and the commissioner's Teams cloud. Only the student and the commissioner can access the material.

The survey material is saved on the commissioner's Webropol account, and also the student can access the material during the research process.

4. Ethical and legal issues related to storage

How are any possible ethical issues related to the material storage considered (e.g. sensitive personal information, access by others)? How are the ownership and user rights of the material managed?

The material does not include any personal details or sensitive information. The respondents are identified by date, kit (number) and/or country. The commissioner has ownership of the material.

5. Opening the material and long-term storage

Would it be possible to use the material later? How is any further use of the material enabled?

The material is used only for developing product X.