Exploring the constraints and enablers for value-in-use creation during the adoption of SaaS solutions: a case study of controlled environment growers

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Abstract

The increasing demand for food and nutrition security has raised the need for smart farming to improve the efficiency in food production. New technologies, such as Software as a Service (SaaS), offer support in decision making in farming. However, SaaS solutions are not consistently adopted, compared to other new technologies, and have a low utilization rate in the horticulture sector. Despite these existing challenges, little is known about the constraints and enablers of value-in-use creation for these SaaS solutions in the adoption phase. This study comprises a qualitative case study including eight interviews of Dutch, Mexican and Moroccan growers. The study established a framework consisting of the facilitating and minimizing practices performed by the agricultural technology providers (ATPs), and constraints and enablers of value-in-use creation as defined by growers. The key findings reveal that (1) it is important for ATPs and growers to collaborate and invest in long-term relationships, (2) ATPs must facilitate interoperability between different SaaS solutions, and (3) the low and mid-tech markets demand more support throughout the adoption phase compared to high-tech farms. The findings guide ATPs and growers in creating a fruitful environment for value-in-use creation with SaaS. Opportunities for future research are proposed, especially ones considering relational aspects in the adoption of knowledge intensive service solutions.

Keywords

SaaS solutions; Controlled Environment Agriculture; Smart Farming; Value-in-Use; Netherlands; Mexico; Morocco; Micro-foundations

1. INTRODUCTION

The agriculture industry is facing one of the biggest challenges in the world - food production must rise by 70% in 2050 to be able to feed the growing world population (FAO 2009). The rising globalization, climate change, the shift from a fuel-based towards a biobased economy and the competing claims on land, fresh water and labor will all add complications to the challenge of feeding the world without continuing to overuse the Earth's capacity (Sundmaeker, Verdouw, Wolfert & Pérez Freire 2016).

With the rise of smart agriculture, there is an opportunity to improve efficiency in world food production (Madushanki, Wirasagoda, & Halgamuge 2019). Growers can make data-driven decisions and generate value through the intuition, intelligence, efficiency, and insights this provides (E.g., Sparapani 2017; Rands 2017; Lioutas, Charatsari, La Rocca, & De Rosa 2019). As the agriculture sector is considered the most inefficient sector of today's value chain (Ayaz, Ammad-Uddin, Sharif, Mansour, & Aggoune 2019), smart farming, including digitalization, can facilitate quicker and more optimal decision making (Porter & Heppelmann 2014) to increase productivity and maintain cost efficiency (Madushanki, Wirasagoda, & Halgamuge 2019). Big data technology tools provide the opportunity for dynamic exchange relationships

where the agricultural technology providers (ATPs) supply customized and integrated combinations of goods and services that meet the grower's business needs (Jayashankar, Johnston, Nilakanta, & Burres 2019).

Big data technology tools are knowledge-intensive service solutions and product-service bundles that facilitate for the growers/farmers (used interchangeable), ATPs and other actors to cocreate value (Jaakkola & Hakanen 2013). Technology providers have shifted from selling products towards providing integrated solutions that deliver value-in-use, which can be described as the servitization of their business model (Baines, Lightfoot, Benedettini & Kay 2009, p. 547). However, the changes to knowledge-intensive service solutions and the new business model comes with challenges due to complexity, information asymmetry, unsupportive organizational structure, poor development processes, immature customer management and risk management frameworks (Aarikka-Stenroos & Jaakkola 2012; Zhang & Banerji 2017). These changes also challenge the value creation. To co-create value, the growers, ATPs and other (potential) actors must collaborate. Whereas on the other side growers themselves can actualize the value by using past and present experiences with resources and processes in different concepts to create value-in-use. (Grönroos & Voima 2013). Both value co-creation and value-in-use are part of the Service Logic (SL) approach, which is managerial in its emphasis, and aims to make the service perspective more useful for managers (Grönroos & Gummerus 2014).

Big data tools are a cloud service, and part of the Software as a Service (SaaS) offerings. Even though more organizations adopt SaaS, the utilization has not yet reached its full potential (Yang, Sun, Zhang & Wang 2015). Whereas the adoption process of technologies has been studied widely (Pierpaoli, Carli, Pignatti, & Canavari 2013), SaaS adoption comes with the extra challenges of being intangible and poor at combining solutions. Researchers have been trying to understand the SaaS adoption process from different perspectives, by utilizing different frameworks (E.g., Benlian, Hess & Buxmann 2009; Oliveira, Martins, Sarker, Thomas & Popovič 2019; Palos-Sanchez, Arenas-Marquez, & Aguayo-Camacho 2017). Previous research created a multidimensional understanding of how important the technology, organization and environmental readiness is during different phases of the SaaS adoption process (E.g., Yang et al. 2015; Oliveira et al. 2019; Wu 2011a;). However, because SaaS adoption is dynamic, and SaaS knowledge subject to change, there is a need for deepening the understanding into SaaS development stages across countries and cultural backgrounds (E.g., Oliveira et al. 2019; Palos-Sanchez et al. 2017; Wu 2011a). With only some of the studies based on substantial empirical basis (Benlian et al. 2009), and nearly all studies adopting an organizational view, no research has been found that departs from the individual perspective. Also, Aarikka-Stenroos and Jaakkola (2012) have identified a gap in empirical research on "*value-in-use experienced by actors within knowledge intensive service contexts*" (p. 17). Despite of SaaS becoming more common, there is still a lack of adoption in the agriculture sector. Therefore, it is of interest to research where the constraints and enablers are located and how they are experienced by the growers.

By researching SaaS adoption in controlled environment agriculture, two birds can be killed with one stone: providing more in-depth research in SaaS adoption, in multiple countries at the same time, while adopting the case to one of the world's most important sectors which is facing the biggest challenges. The current research adopts a micro-foundational perspective. By doing so, the research acknowledges the importance of the individual actions taken by the growers and the dyadic relationship that is taking place between the ATP and the grower on a micro level (Felin, Foss & Ployhart 2015). The purpose of the study is to investigate and uncover the constraints and enablers for facilitating the value-in-use of growers during the adoption phase of SaaS solutions.

In this light, two research questions are defined.

RQ1	What constraints limit and what enablers facilitate the creation of value-in-use for growers during the adoption of SaaS solutions?
RQ2	How can an agricultural technology provider (ATP) facilitate the growers value-in-use during adoption of SaaS solutions?

To provide structure to the research process, a case study is conducted on Dutch, Moroccan and Mexican controlled environment growers. The research setting applies markets with different technology development stages (low tech, mid tech, and high tech), cultural backgrounds, and growth potential. The studied markets make it possible to examine if there is a difference between the experienced constraints and enablers for the different growers. The study also makes use of a case company, that offers a crop management software and a climate monitoring system. And even though the benefits of farm management software are proven, they observed that many growers are still held back by the platform subscription model (SaaS) that they use. Their own observations make it interesting to investigate whether their concerns about the SaaS business model are justified and create a setting to study the SaaS adoption in the horticulture sector.

This study makes three contributions to technology adoption and service marketing literature. First, the study contributes to the technology adoption literature (e.g., Pierpaoli et al. 2013) by proposing a deeper – microfoundational – understanding of adoption barriers that are specifically present for SaaS solutions. Second, the study updates and expands empirical support to the SaaS adoption literature through a diverse set of countries and sectors, each with different development stages and cultural backgrounds (Yang et al. 2015; Oliveira et al. 2019; Palos-Sanchez et al. 2017; Benlian et al. 2009; Wu 2011a). Lastly, the study fills the gap in service marketing literature by providing empirical research on the value-in-use as experienced by the actor (grower) in a knowledge intensive service context (Aarikka-Stenroos & Jaakkola 2012).

Based on the findings, three managerial implications are offered, which are geared to the industry organizations and growers. First, the study advises industry organizations with different levels of SaaS maturity by offering data to identify the early adopter segments, develop their marketing campaigns, and identify the needs for their (potential) customers. Second, the study facilitates the growers understanding of SaaS solutions by informing them on the barriers and benefits of SaaS solutions by providing them the testimonials of other growers (Moons, De Pelsmacker, Pijnenburg, Daems, & Van de Velde 2022). Finally, the study deepens the current understanding of the unique, complex, demanding, and dynamic sector of horticulture (Ayaz et al. 2019; Pierpaoli et al. 2013) and seeks to distinguish the sector from other sectors and their actors when it comes to technology adoption.

In the remainder of this thesis the available literature on SaaS & servitization, value-in-use, and the adoption to new technologies is analyzed (section 2). Whereafter the methodology of the case study research is further described (section 3) and the main results from the collected data are presented (section 4). Section 5 will continue with the discussion of the research, including its limitations. The final section will also conclude the case study by providing the recommendations for SaaS providers in (covered) horticulture, for further research and the actions that need to be taken.

2. THEORETICAL BACKGROUND

This section describes the theoretical concepts that are applied in the research. First, the servitization of businesses and the SaaS model that comes with it will be described. Then, the value creation of SaaS will be explained by the value-in-use perspective. Lastly, literature on the general adoption of new technology in the

agriculture sector will be discussed. By integrating the concepts, a theoretical framework is created to visualize the core elements that are part of the decision-making process of growers for SaaS adoption.

2.1 SERVITIZATION & CLOUD SERVICES

The servitization of sectors and markets has been studied for over more than 50 years already (Kowalkowski, Gebauer, Kamp & Parry 2017). The process of servitization, where the innovation of the organization's capabilities and processes is shifting from selling products towards integrated products and services that deliver value-in-use (Baines et al. 2009, p. 547), is also winning terrain in smart farming. Within SL, service, a multifaceted phenomenon, can be defined as a support for the everyday process to facilitate (or contribute to) the value creation of the individual or organization (Grönroos & Gummerus 2014, p. 208). More products need complementary services to create value. For example, cloud services need products, like sensors, to collect data. As defined by Cisco (2009), cloud services can be divided into 4 subcategories: (1) IT as a Service (ITaaS), which provides subscribers with network connectivity, (2) Software as a Service (SaaS), which gives access to a software application on the web for subscribers, (3) Platform as a Service (PaaS), gives raw computing data and disk space on a platform of resources in the cloud, and (4) Infrastructure as a Service (IaaS), gives subscribers access to the use of virtual computer infrastructure. Catteddue and Hogben (2009) have studied the adoption of cloud services and found that (1) the main reasons for using cloud services are to avoid capital expenditure in hardware, software and IT support, followed by the utilizing flexibility and scalability of IT resources; (2) the most commonly used cloud service is SaaS; and (3) the main concerns around cloud services include privacy, availability of services and/or data, integrity of services and/or data, and confidentiality of corporate data. The concerns here showcase the issues on how to advance the SaaS adoption, but also the need for enterprises to understand the pros and cons of SaaS adoption, while SaaS providers should aim to understand the users' needs and concerns about SaaS adoption (Wu 2011a).

2.1.1 Software as a Service

SaaS can be defined as "*applications and computer-based services delivered and managed from a remote center to multiple customers via the Internet or a VPN. SaaS shares common themes with On-Demand Service*" (Lee, Park & Lim 2013, p. 553). The available IT literature states that SaaS enables organizations to access software applications in an outsourcing arrangement (Goode, Lin, Tsai & Jiang 2015; Oliveira et al. 2019). Where it allows the providers to offer on-demand access to several software products, it is thus a business model based on a multi-tenant platform architecture (Benlian & Hess 2011, p. 237). With SaaS, the responsibility of regular development and software maintenance stays at the service provider (Cho & Chan 2015), while the firms access the software that is hosted in an off-premise location on the internet remotely (Espadas, Molina, Juménez, Molina, Ramírez & Concha 2013). The benefits of SaaS range from the lower implementation costs towards the improvement in software quality (Choudhary 2007; Benlian & Hess 2011).

Next to looking at SaaS from the technology perspective, it can also be looked at from a business perspective. SaaS, or any X as a Service, is also a business model. A business model is seen as the "*simplified and aggregated representation of the relevant activities of a company. It describes how marketable information, products and/or services are generated by means of a company's value-added component*" (Wirtz, Pistoia, Ullrich & Göttel 2016, p. 41). When companies decide to implement the service business model, they commit to improving the customers' value-in-use, which means they take a greater responsibility in the overall value-creation process compared to a product central, transactional-based business model (Kowalkowski et al. 2017, p. 7). The service

business model also changes the company's revenue stream, as the revenue mechanism depends on the outputs of the customers value-creation process (Kowalkowski et al. 2017, p. 7). The change in business model does not only request a change from the company offering SaaS, but also from their customers. The firm's absorptive capacity and their adaption to the SaaS model, will increase the operational and innovational benefits that is gained from the use of SaaS (Loukis, Janssen & Mintchev 2019). So, before firms can benefit from using SaaS, substantial adaption is needed. Be that as it may, what the research by Loukis et al. (2019) is lacking is the change that is needed on an individual/micro-level. When looking at the individual that in the end will use the SaaS application, it is important to research what the added value is for them and how this value can influence the usage of SaaS solutions.

2.2 VALUE CREATION

Maximizing the customer value is seen as the eventual goal for organizations, along the creation of shareholder value (Bolton, Grewal, & Levy 2007). Value is also considered the main driver of marketing and purchasing decisions in the B2B settings (Prohl & Kleinaltenkamp 2020; Eggert, Ulaga, Frow & Payne 2018). Often the value outcome is measured on what the customer receives versus what the customer gives (Gummerus 2013), however, this is a rather static way of looking at the customers value, which is almost impossible to apply to the dynamic solutions of services, like SaaS.

Due to the shift of business offerings from products towards integrated service solutions, there is also a relocation of where and how the value creation takes place. With the relocation of value creation, value becomes more of a joint process between the producer and customer. Grönroos and Voima (2013) have visualized this (new) way of value creation by creating the *value creation spheres model*. The model is built up out of three value creation spheres: the provider sphere, the joint sphere, and the customer sphere. The provider sphere generates potential value that the customer can turn into real value(-in-use) (Grönroos & Voima 2013, p. 141). The activities performed in that sphere facilitate the value creation by the customer. In the joint sphere, the customer oversees the value creation, but by using direct interaction, the provider can influence the value creation and serve as a co-creator. Without the interaction, there would be no value creation within the joint sphere. The interactions create a platform for joint co-creation of value between provider and customer. However, in some cases there is less or no direct interactions, which entails that the (real) value is solely created in the customer sphere. In this situation, the provider is seen as a value facilitator, where they facilitate the "*customers' fulfilment of value-in-use*" (Grönroos 2008, p. 298). In the customer sphere, the value creation is independently done by the customer, with the resources provided to them (Grönroos & Voima 2013). An example for the value creation being solely done by the customer could be SaaS solutions which are generally not customized in a way that requires interaction between the provider and customer but is rather an 'off the shelf' software solution.

The value creation spheres as defined by Grönroos and Voima (2013) are of value to this research due to the importance recognized for understanding the behavioral logic of the customers to create value in the customer processes, rather than destructing the customers value. The ATP must try to enter the customer's value sphere for them to influence the customer's value creation. Furthermore, the value creation spheres model can help ATPs to visualize where and when they can access the growers value creation process, to together co-create the value (Grönroos & Voima 2013) or facilitate the growers value-in-use.

2.2.1 Value-in-Use

The value created by the customers in the customer sphere, is referred to as value-in-use. When following the Service Logic (SL), as opposed to the Service-Dominant Logic (SDL), value-in-use is the only type of value present (Grönroos & Gummerus 2014). As defined by

Grönroos and Gummerus (2014, p. 209), value-in-use is "*the value for customers, created by them during their usage of resources*." And the "*value is both created and determined by the customers*". As stated in the managerial principles of SL, value-in-use is "*uniquely, experientially and contextually perceived and determined by customers*" (Grönroos & Gummerus 2014, p. 207). Value-in-use comes in a cumulative process, where the value can also be destroyed, throughout the value-creating process. Especially because customers, in this research the growers, can have a limited understanding of their needs, the service provider, ATPs, is needed as a value facilitator in the provider and joint sphere.

The importance of collaboration and interaction is also identified by the research from Aarikka-Stenroos and Jaakkola (2012). Their research shows that within the context of knowledge intensive services, like SaaS, value co-creation will occur through a dyadic problem-solving process. This process contains five key activities: diagnosing needs, designing and producing the solution, organizing the process and resources, managing value conflicts, and implementing the solution (Aarikka-Stenroos & Jaakkola 2012). Here, diagnosing the needs, designing and producing the solution, and managing the value conflict have a notably positive or negative impact on the creation of value-in-use.

Nonetheless of the benefits of co-creating value to reach an optimal value-in-use, the complexity of it also brings an increase of financial and operational risk for the service provider (Kowalkowski, Windahl, Kindström & Gebauer 2015). As the service providers are more involved in the value-adding process of the customer, the service providers also take over part of the risk for achieving the contractually agreed on outcomes (Ulaga & Reinartz 2011). And with the customers using their resources and activities to contribute to their experienced value-in-use during the joint integration processes that are part of the complex offerings, the service provider can only partially control the outcomes (Macdonald, Kleinaltenkamp & Wilson 2016). There is thus a risk involved where the service providers can be held responsible for not reaching the value promised whereas they are not (or only partially) involved in the value creation (Prohl & Kleinaltenkamp 2020).

Despite the risk that could be present when co-creating value, or letting the customer create his own value, value co-creation also increases the customers value and thus satisfaction. By efficiently aligning the provider and customer processes, resources, and competencies, both of the parties can enjoy a joint gain in their productivity (Jayashankar et al. 2019). Within the agriculture sector, when ATPs would offer big data tools which are relevant to the growers' crop management practices, the ATP can increase the growers monetary value-creation opportunities (Jayashankar et al. 2019). Furthermore, Jayashankar et al. (2019) found that the epistemic value-in-use was an important outcome of the co-creation of value between growers and ATPs. Epistemic value-in-use arises from growers that use digital agriculture tools which helps them to increase their knowledge for taking data-driven decisions and let them intelligently combine operant and operand resources (Jayashankar et al. 2019, p. 511). Thus, their value-in-use was that they gained more knowledge on data from using the digital agriculture tool.

It is important to know what the customers themselves identify as the value that is created through using the software solutions on the farm, to be able to understand their incentives for using them. Aarikka-Stenroos and Jaakkola's research (2012) identified that there is very little empirical research available, within the knowledge intensive service context, on value-in-use as experienced by the actor at the individual/micro level. This gap is also identified by the author of the present research, as there is no research found on the value-in-use of decision-support SaaS solutions within the agriculture sector. Identifying the barriers and accommodators of growers for SaaS, will thus help ATPs to become a better value facilitator in the growers value-in-

use creation, and will stimulate the joint problem-solving process. Due to value-in-use only being created while using the software, it is hard to identify the value-in-use before adopting SaaS. That is why it is important to distinguish between the promised or potential value-in-use and the perceived value-in-use (Prohl & Kleinaltenkamp 2020; Grönroos & Gummerus 2014). Learning about the potential and perceived value-in-use by customers, can help facilitate the adoption process of SaaS solutions (or even other technologies), as there is a clear distinction between value-in-use before and after adopting to SaaS solutions.

2.3 ADOPTION OF NEW TECHNOLOGIES

Within the agriculture sector, the adoption of new technologies is rarely immediate, as many factors influence the decision-making processes. For this reason, the adoption process of (new) technologies in the agriculture sector has been widely studied.

The technology adoption process often involves uncertainty and learning. Uncertainty is a central aspect for technology innovation in the agriculture sector, as the relevance and the suitability of the new technology for a specific farm depends on the farmer's human capital and the local (agronomic and climatic) conditions (Chavas & Nauges 2020; Marra, Pannell & Ghadim 2003). Ex-ante, the farmer does thus not know if the new technology will be suitable for their specific operation. Due to the presence of many uncertainties, it is important for farmers (growers) to collect information on the suitability and profitability of the new technology. This information can either come from their own experience, from peers through social network and/or by observing the early adopters (Chavas & Nauges 2020).

Pierpaoli et al. (2013) have done a literature review on the adoption of precision agriculture (PA) technologies among farmers, in both the ex-ante and the ex-post context. The increase of profitability was found as the main motivation that stimulated the use of new technology (Pierpaoli et al. 2013, p. 65). Other features affecting the attitude towards adopting PA technologies are the (perceived) ease of use, (perceived) usefulness, the farm size, and the quality of soil. The ex-post research focuses on the farmers that already have adopted PA technologies. The literature on this shows that the most important parameters that influence the adoption of PA technologies are: farm size; cost reduction or higher revenues that justify a positive benefit/cost ratio; total income; land tenure; farmers' education; familiarity with computers; access to information; and location (Pierpaoli et al. 2013, p. 64). Out of these, farm size seems to be the most frequently cited parameter that affects the use of PA technology. Additionally, Ayaz et al. (2019) has identified that higher yields, automation, the climate effects, and the resource optimization are the key drivers for technology in agriculture. The many aspects affecting the technology adoption among growers makes it a complex process to market technology products and/or services to growers. The complex marketing process thus means that the ATPs must be modest when marketing the solutions and must consider their target audience when communicating about the solutions. In the case of a technology solution with a service that is not tangible, it becomes even more complicated to get growers to adopt to SaaS solutions.

2.3.1 Adoption of SaaS solutions

Only a few researchers have addressed the SaaS adoption topic (Wu 2011b; Oliveira et al. 2019). Whereas SaaS seems to be the most tempting solution among the different cloud services options, it has not been adopted as much as it was originally expected (Wu 2011b). The literature that is available on SaaS adoption covers three broad areas: economic savings and strategic concerns, quality assurance and risk concerns, and application domains (Cho & Chan 2015).

By utilizing the TOE framework, the adoption process can be explored from three angles: technology, organization, and environment (Yang et al. 2015; Oliveira et al. 2019). For example, Benlian et al. (2009, p. 366) have found three things to consider when facilitating the adoption process of SaaS solutions. Firstly, when

choosing which application(s) to offer as SaaS-based model, they should go for software that does not impact the core functions of the organization's process and is easy to standardize (technology level). Secondly, expert opinions and peer pressure influences the attitude towards SaaS (environmental level). The SaaS providers should thus engage in targeting opinion-leaders and third parties (like associations or lobbies). And thirdly, SaaS providers should address their (potential) customers through mitigating technical and economic risks (organizational level). Other researchers, i.e. Wu (2011a 2011b), have exploited the TAM (Technology Acceptance Model) framework. By doing so, Wu (2011a) has found that there should be a focus on the external variables of perceived usefulness, perceived ease of use and behavioral intention. As far as the knowledge of the author goes, the current research does not look at the SaaS adoption context in combination with the constraints and enablers for value-in-use creation.

2.4 TOWARDS A THEORETICAL FRAMEWORK FOR VALUE CREATION DURING THE ADOPTION OF SAAS

The value creation spheres as defined by Grönroos and Voima (2013) are used as inspiration for the creation of a theoretical framework (Figure 1). The framework will serve as a theoretical foundation for creating a clear overview of the constraints and enablers of value-in-use creation and the facilitating and minimizing practices carried out by the ATP for facilitating value-in-use. By utilizing these results, a conclusion can be drawn on what the constraints and enablers are for value-in-use creation during the SaaS adoption among the growers. Furthermore, the framework will create a foundation for showcasing what practices executed by the ATP facilitate and what practices minimize the value-in-use creation during the SaaS adoption process. The adoption of the new SaaS solutions is a linear process, where the value creation starts at the provider and moves along towards being completely adopted and the value creation being in the hands of the customer. How long the adoption takes, and the challenges that come with it, depends on the practices conducted by the ATP that make it easier for the growers to adopt the new SaaS solutions. Marketing literature shows that practices allow to clarify the routinized and non-routinized behaviors and actions of service providers (e.g. Echevveri & Skålén 2021; Sahhar, Loohuis & Henseler 2021; Jaakkola, Helkkula & Aarikka-Stenroos 2015). Involving such practices is useful to better understand the actions that minimize and facilitate value-in-use of the grower.

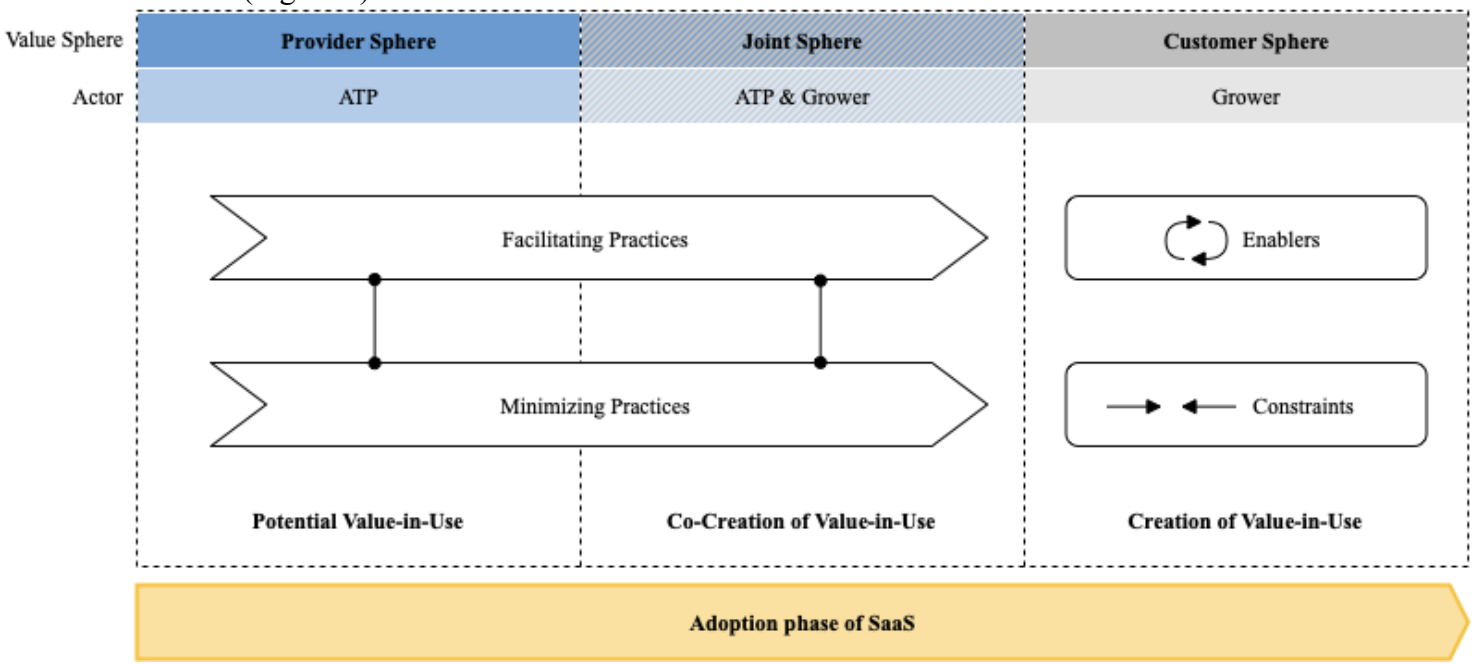

Figure 1 Theoretical Framework

The framework is divided into the three value creation spheres as defined by Grönroos and Voima (2013): The *provider sphere* (ATP), the *joint sphere* (ATP and Grower), and the *customer sphere* (Grower). The *provider sphere* is where the ATP performs facilitating and minimizing practices that create potential value-in-use. The potential value is created by the ATPs resources, so the company's SaaS solution in this case. By looking at how the ATP can be a value facilitator for the grower, RQ2 will be answered. The *joint sphere* is where the ATP and grower directly interact with each other to co-create value. By performing the facilitating and the minimizing practices, the ATP can influence and/or join the growers value creation process. Within the *customer sphere*, the grower will utilize the resources from the ATP to create their value-in-use. This is the sphere where the ATP will have no influence on the value creation. Within the customer sphere, it becomes visible what the enablers and constraints are, as identified by the growers, for the creation of value-in-use. Identifying the constraints and enablers of value-in-use creation in the customer sphere will make it possible to answer RQ1. The three spheres are not a linear process, as value can be created in different spheres at different times (Grönroos & Voima 2013). Hence why the value creation can always move back and forth between the spheres. By combining the (co-) created (potential) value(-in-use), the overall value for SaaS solutions is created.

3. METHODOLOGY

The methodology chapter explains and describes in further detail the research methods, consisting of the research design, the case selection, and the data collection and analysis.

3.1 RESEARCH DESIGN

The research aims to examine the constraints and enablers for facilitating the creation of value-in-use for growers during the adoption process of SaaS solutions. The study uses a qualitative research method, to get a deeper understanding of the growers attitude (Granot, Brashear & Motta 2012) and to get deeper insights in the constraints and enablers for creating value-in-use. The qualitative research method entails the collection, analysis, and interpretation of non-numerical data (Denzin & Lincoln 1994) and makes use of an interplay between data collection and theory (Babbie 2020, p 385-390). As the collected data involves the thinking and behavior of the growers, the data is non-numerical and thus qualitative data. By applying an abductive approach to the research, the study leaves room for creativity and creates an interplay between the conceptual and empirical domains for finding the optimal explanation of the constraints and enablers of value-in-use creation for SaaS solutions (Nenonen, Brodie, Storbacka & Peters 2017).

The research acknowledges the importance of looking at the individual (grower), rather than using the firm as the unit of analysis. This is in opposition with previous studies on SaaS adoption, who neglected the agential capabilities of managers, instead of the entity of a firm (Contractor, Foss, Kundu & Lahiri 2019). The micro foundation literature states that macro-concepts and macro-outcomes need to be understood in terms of the underlying actions, interactions, and the characteristics of the micro-level entities (Contractor et al. 2019; Locatelli, Greco, Invernizzi, Grimaldi & Malizia 2021; Barney & Felin 2013). Behavioral foundations of organizations and decision-making have been defined as an interesting research area for future work in the micro foundation's domain (Felin et al. 2015), to which this study can therefore contribute.

As the research is exploratory in nature, the case study method is adopted. The case study method is chosen due to the complex phenomenon studied, in this case the constraints and enablers for the creation of value-in-use during the adoption of SaaS, in a specific industry, namely the agriculture sector. The case study method makes it possible to study the holistic and meaningful characteristics of SaaS adoption (Yin 2019).

3.2 CASE SELECTION & DESCRIPTION

The research focuses on the agricultural sector, a complex sector facing the challenge to feed the world. However, even though smart farming is needed to increase food safety, the positive emotional reactions from growers and the many opportunities it offers, the implementation itself can bring some hurdles. Notably, fear of new technology, often-high investments needed, sometimes poor internet coverage and connectivity, lack of clarity in data ownership, concerns with privacy issues and the growing marketing consolidation of ATPs are all major hurdles that need to be overcome before growers start to invest in technology on their farm (Ayaz et al. 2019; Jayashankar, Nilakanta, Johnston, Gill, & Burres 2018; Wolfert, Ge, Verdouw, & Bogaardt 2017; and Grassi 2018).

There are many companies currently offering SaaS solutions in the agriculture sector, among which is the selected case company for this study. Their solution is a knowledge-intensive service solution and is thus a good fit for the research.

3.2.1 Case Company

The company is focused on offering digital farm solutions for large scale, multi-site farms (Anonymous 2022a). Their expertise in data, artificial intelligence, and plant science is embodied in their Controlled Environment Agriculture (CEA) farming solutions. (Anonymous 2022a). The current offering consists of two solutions: a crop management software and a climate monitoring system (Anonymous 2022b). the crop management software is a platform to collect and visualize data and transform this into insights by using machine learning and artificial intelligence. The software is offered as SaaS, with a subscription fee.

The company's SaaS is a decision support tool. Decision support tools have a disappointing low utilization rate (Michels, Bonke, & Musshoff 2020; Oteyo, Marra, Kimani, Meuter, & Boix 2021; Rose et al. 2016), and this makes it imperative to investigate the barriers hindering adoption of these software solutions.

3.2.2 Focus Markets

The research focusses on three markets: Mexico, Morocco, and the Netherlands. This provides a global coverage of the SaaS agritech markets and can offer a holistic and representative view.

Mexico has a strongly developing horticulture sector, ranking sixth in the world on production value (Sijmonsma 2021a 2021b; Victoria, van der Valk, & Elings 2011). The market grew in 20 years' time from 132 protected hectares (Ha) to more than 54 thousand Ha (Agtech América 2021), however there is still a lot of room for further development (Sijmonsma 2021a). This is especially evident on technology development, as currently they use relatively passive to semi-active technology (Transfer LBC 2020), which limits them in control and automation implementation. In addition, well respected institutions, like the World Bank, Deloitte, and the Bank of Mexico, project a bright future for the Mexican protected horticulture (Transfer LBC 2020). The market is important to incorporate in the research, due to its current and future relevance for technological developments.

Another developing market is Morocco. The market has an ideal climate to grow, is strategically close to Europe, and has low cost of wages and land, which makes it internationally competitive (Hortidaily 2019; Agency for Agricultural Development 2015). The greenhouse cultivation is growing, with some areas seeing a growth of 179 percent in greenhouse area (Bazza 2018). The market requires modern technological advancement to move it from heavy dependence on erratic rainfall patterns. As a result, the Moroccan government is investing and collaborating internationally to modernize the industry and aims to become the regional technology hub in agriculture (Ministerie van Landbouw, Natuur en Voedselkwaliteit 2022a 2022b; Agency for Agricultural Development 2015). The growth, development, and the need for modernizing the market makes Morocco an important market to consider for the research.

Third, the Dutch market is studied. The Netherlands is the world's number two exporter

of food (measured by value), which is remarkable due to their small land area (Viviano 2021). The market has a fast development and application rate for technology innovations, with generations of protected horticulture knowledge and infrastructure investment. The combination of knowledge and innovation, together with the cooperative approach within the agriculture industry and support from the government gives the Dutch market a strong position in the industry worldwide (Breukers, Hietbrink, & Ruijs 2008; Ministerie van Landbouw, Natuur en Voedselkwaliteit 2022c). The market is thus important to incorporate as it is the most advanced horticulture market in the world.

The combination of the three markets makes it possible to compare markets with different technology advancement levels and show which market has the most potential for offering and adopting SaaS solutions (Figure 2).

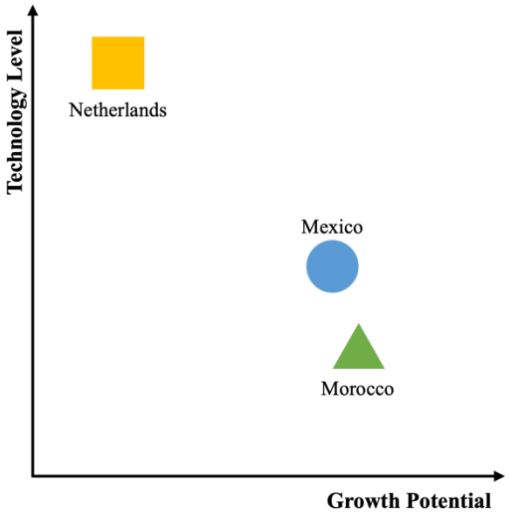

Figure 2 Growth potential in the Greenhouse Sector vs Technology level Matrix

3.3 DATA COLLECTION AND ANALYSIS

The research applies an abductive approach, which allows for creativity and intuition in the process of theorizing while facilitating to identify the most plausible explanation for the identified low utilization rate of SaaS among growers (Nenonen et al. 2017; Dubois & Gadde 2002). Part of the studies abductive approach is the systematic combining of the theoretical framework, the available literature and collected data. By matching theory with reality, and going back and forth between the framework, data, and literature, the study allows a fruitful environment for discovering new relationships, patterns, and variables. (Dubois & Gadde 2002).

To get firsthand insights on the enablers and constraints for value-in-use, the research will collect data via semi-structured interviews. Interviewing provides the best way to collect data as the research goal is to understand the constraints and enablers as they are experienced by the growers (Granot et al. 2012). Semi-structured interviews are used as they are both versatile and flexible (Kallio, Pietilä, Johnson, & Kangasniemi 2016; Robert Wood Johnson Foundation 2008). An interview guide is created following the steps of Kallio et al. (2016, p. 2959), to make sure that all the important subjects are covered, and to facilitate homogeneity between the different interviews (Appendix A). The role of the interviewee is to help explain and better understand the growers thought process on the value-in-use creation. The interviewees can describe their opinions and experiences during the SaaS adoption and further clarify their needs for (potential) value-in-use creation. All interviews are conducted online, and transcribed. A total of eight interviews took place (Table 1). The interviews took between 24 and 72 minutes.

Table 1 Conducted Interviews

Interviewee	Active on Market	Tech Level
Interviewee 1	Mexico	Mid Tech
Interviewee 2	Mexico	Mid Tech
Interviewee 3	Netherlands / Africa	Low Tech
Interviewee 4	Netherlands	High Tech
Interviewee 5	Netherlands	High Tech
Interviewee 6	Netherlands	High Tech
Interviewee 7	Morocco	Low Tech
Interviewee 8	Morocco	Low Tech

3.3.1 Sampling

The study followed *purposive sampling*. By doing so, the researcher can identify and select individuals that are proficient and well informed about the phenomenon studied. Furthermore, the researcher can select participants that are available and willing to participate (Etikan, Musa & Alkassim 2016).

The participants are selected based on a few criteria. First, they must be growers, or in a decision-making role in cultivation companies. Second, the organization represented must operate in at least one of the focus markets. The focus markets are critical case samples, as they represent all technology advancement levels of growing organizations (Etikan et al. 2016). Third, the participants do not have to currently use SaaS. For an equal level of data among the markets, at least two and maximum four interviews are conducted per market.

3.3.2 Thematic Analysis

The data is analyzed according to the principles of *thematic analysis*, a method to identify, analyze and report patterns (or themes) within data (Braun & Clarke 2006). The method organizes and describes a data set in detail. The method is easily grasped and relatively quick to learn (Nowell, Norris, White, & Moules 2017). A disadvantage of the method is the high level of freedom in interpreting the results (Nowell et al. 2017). This disadvantage will be minimized by verifying the results with the interviewees.

The coding is conducted following the *inductive coding* approach. The inductive coding approach starts with collecting the raw data; the interview transcripts. The first step is also referred to as *open coding* or *first-order coding* (Chandra & Shang 2019). Through open coding, the researcher can review the data, make notes, and combine the data into broader themes and theoretical dimensions. The data-driven approach allows "*the theory to emerge from the data*" (Strauss & Corbin 1998, p.12), and is thus suitable to analyze data in areas with limited knowledge. Thereafter, *axial coding* is used to show similarities and differences between the previously identified themes (Strauss & Corbin 1998). The themes and patterns are utilized to identify the constraints and enablers of value-in-use creation of SaaS adoption for growers, and for mapping out the steps that ATPs must take to facilitate the growers value creation.

4. FINDINGS

This chapter will explain the findings from the interviews conducted. A total of 8 interviews took place, divided over the three focus markets.

4.1 VALUE-IN-USE ENABLING AND CONSTRAINING THEMES

By conducting a thorough data analysis, three overarching themes are identified based on eight second-order themes and a multitude of first-order themes (Figure 3). The overarching themes are classified as: (1) inter-actor collaboration in the sector, (2) materiality in the IT sphere, and (3) business management. The following paragraphs will elaborate further on the identified overarching themes and the constraints and enablers that are identified for these themes.

4.1.1 Inter-actor Collaboration in the Sector

Collaboration is a crucial practice to facilitate and create value-in-use during the adoption process of SaaS solutions. By discussing the inter-actor collaboration within the sector, it is recognized that growers and ATPs should cooperate between each other and among themselves.

SaaS solutions within agriculture demand a different customer and provider relationship compared to off the shelf products. The following extracts of the interviews show how interviewees have identified the current way of *relationship building between grower and ATP* as a constraint on their value-in-use creation.

> "*So, they need to be a little bit more flexible to spend probably more hours to build a relationship. Then just charging, like, money for extra time*." - *Interviewee 2*

> "*The tech companies are almost all naturally inclined to work towards a project, put it down and deliver it and then leave. Whether that means building a cabinet, running a climate computer, in fact everything. And by nature they are simply unable to have a long-term relationship with a customer through subscriptions or forms thereof. […] This is*

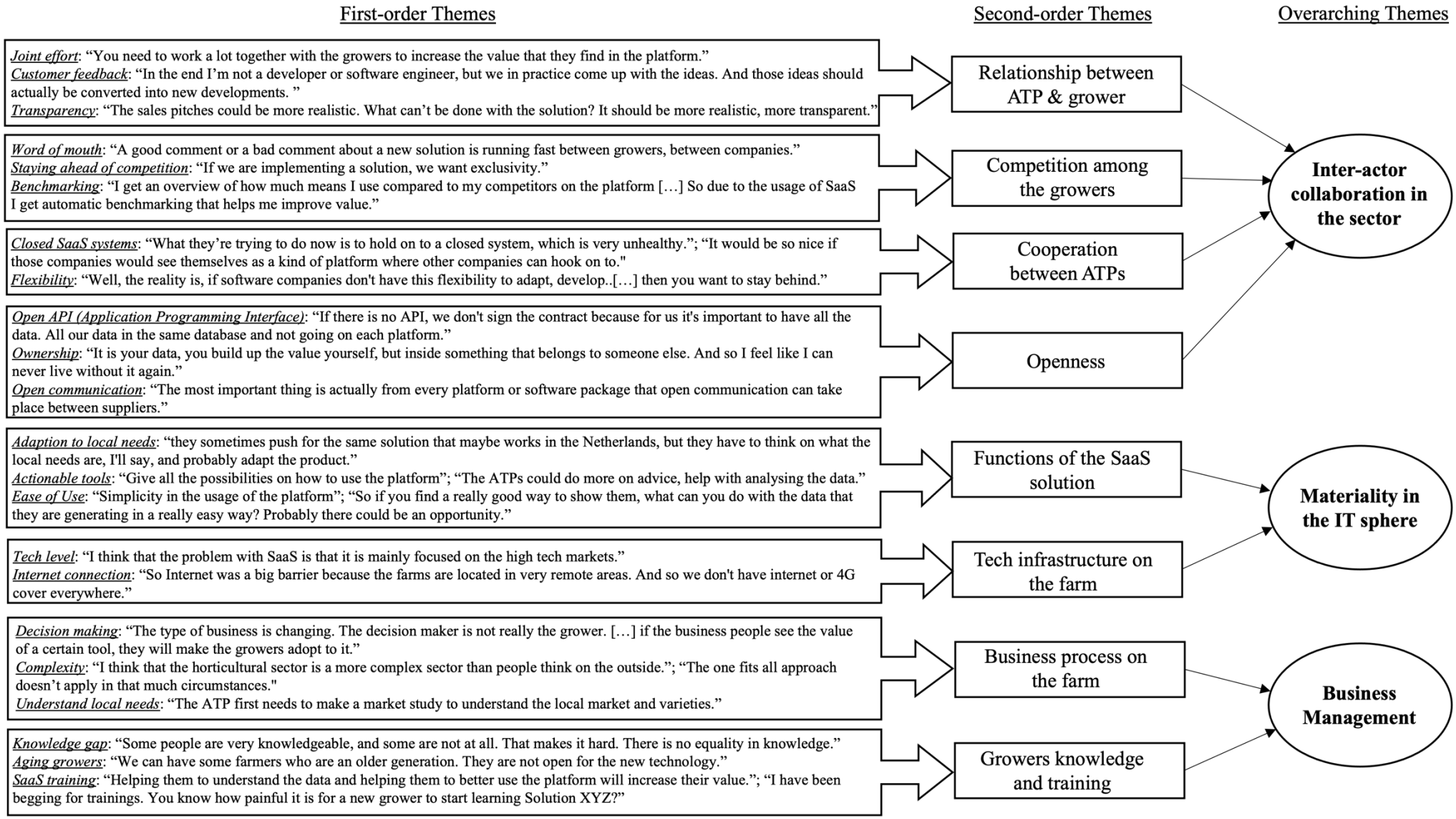

Figure 3 Thematic Analysis

> *a completely different type of management and thinking*." – *Interviewee 6*

The interviewees portray a need for the nature of the relationship to be transparent, flexible and should include more listening to facilitate an optimal environment for value co-creation. The citations show the frustration that is present at the growers on the current way of relationship building. More transparent communication and an improved customer feedback loop is needed to enable a more stimulating environment for value-in-use creation.

The competing growers operating in the same market are part of the growers environment. The competition among the growers can both enable and constrain their value-in-use creation. Growers can discuss and compare their experiences on SaaS and technology through the use of study groups, corporations and networking events. However, due to rivalry among the growers and the need to stay ahead of the competition, the growers often demand exclusivity from their suppliers and are hesitant on sharing information. The up- and downsides of the *competition among the growers* is also visible in the following quotes:

> *"The more growers use the same platform, the easier for them […] They are taught in the same languages and the same topics about the greenhouses because they use the same system, they have the same problems. And if some of them have a problem, another one has solved the problem. They help each other."- Interviewee 1*

> *"In the low tech in general if we are implementing a solution, we want exclusivity. For example, for predicting shelf life of tomatoes, that's something huge. And if we create a model for tomatoes growing in Morocco, the neighbors can take the same model. Exactly the same. Because we have the same growing conditions. So the neighbor, the competitor will benefit from that. And our company doesn't want that."- Interviewee 7*

Furthermore, the following extract of the interview illustrates that ATPs can facilitate the creation of value-in-use better by cooperating more among themselves and provide more flexible SaaS solutions that create the opportunity for the growers to combine data sources.

> *"Ultimately, what would be better if those companies see themselves as Apple and their product, the iPhone is their climate computer, and the consumer can put apps on it themselves and one consumer puts weather app A on it and the other consumer puts weather app B on it."- Interviewee 4*

The growers feel a need for the *ATPs to cooperate* on a versatile system that stimulates adaptability and value-in-use creation. The current level of cooperation among ATPs is identified as a constraint for the creation of value-in-use by all 8 interviewees. All the interviewees see the need for the current ATPs to listen better to the growers needs by providing open API and solutions that facilitate the exchange of information between the platforms. To create the optimal value-in-use of SaaS solutions, the hardware providers (i.e., climate computers) must disclose their platforms and share the collected data with other ATPs. The growers feel like if the ATPs do not facilitate this type of value creation, growers will take the development into their own hands. As also described by the following quote:

> *"Because if they don't, then the big boys just go develop something on their own. Because once the frustration is so high that a group of growers stands up and says: we will develop something ourselves."- Interviewee 4*

Part of the *openness* is also the ownership of the data, which the growers currently do not feel they have:

> *"Yes, I would like to feel more ownership of my own data. And now I feel more like I'm buying a tool that I just put everything into."- Interviewee 5*

To ensure the growers feeling of safety, ATPs must communicate clearly on the growers having

full data ownership by utilizing a data protocol. Furthermore, Open API is requested to make the collected data interchangeable between different systems, which is currently still lacking:

> *"We have some problems. Like, for example, in irrigation we have some problem to collect some data from a company to have it in another system. […] If we have a common system it will be better. […] We will not need more training and more information for our technicians and workers."- Interviewee 8*

The findings within this theme thus highlight the importance of inter-actor collaboration to create a more fertile environment for value-in-use creation. And how an unsatisfactory relationship can have a substantial influence on the (perceived) value-in-use by the growers.

4.1.2 Materiality in the IT Sphere

The theme materiality in the IT sphere revolves around the material IT concepts, either on the farm or in the SaaS solution. These materials are important for the functioning of the SaaS solutions.

As a means to the growers to have an optimal experience with their SaaS solutions, it is important for the functions to suit their needs and that the infrastructure on the farm facilitates the data collection. To provide the growers with a platform that fits their needs, it is important to *adapt the platform to the local needs* of the market, as illustrated by the following quote:

> *"In Kenya they have different units of measurement than in Ethiopia. So, you have to take a good look at that, because in the end everything comes together at holding level."- Interviewee 3*

As growers can have different farms in different markets, the data collection can become challenging. Facilitating different units of measurement in the data collection would fit the local needs better and stimulate the creation of value-in-use by simplifying the multi-market data collection. Data collection and turning the data into valuable cultivation insights can be identified as the main function of SaaS solutions for growers. And even though the SaaS solutions seem to provide enough data models, it is often seen as too complicated, as described by interviewee 1:

> *"The systems that today are common in the mid to high-tech greenhouses are complete because they have innovation models and creation models, lightning, heating, climate control. They have all the models that you need. Sometimes I think that they are complex because they have more models."- Interviewee 1*

A constraint identified by most of the interviewees is that whilst the data is there, and the models are there, the *tools are not actionable* enough:

> *"What could be improved in those packages I think is just a kind of graphical interface, so it should be more intuitive [...] When I look at the farm it is still very classic, you just register and you can analyze much less and get hardly any information back. So if I put it differently, I have a lot of data but relatively little information."- Interviewee 3*

The next extract of interview 8 illustrates the need for increasing the *ease of use* of the SaaS solutions:

> *"*We need a simple platform. Simplicity of the usage of the platform. It's not easy enough. And the majority of Morocco's farmers are illiterates*."- Interviewee 8*

An increased simplicity would enable a higher creation of value-in-use and would make it possible for the growers to spend less time on analyzing the data while getting more insights.

Additionally, the high-tech growers that do have a lot of knowledge in house, also experience a need for an easier to use SaaS solution to enable their value-in-use creation:

> *"And precisely because it is so high tech, I don't think it is lagging behind, it is really all very well developed and also has a lot*

> *of possibilities, but it is sometimes difficult for companies to keep up with it."- Interviewee 5*

Part of adapting to the local needs and increasing the ease of use, is also looking at the needs of the different *tech levels* of the markets. As described by the two quotes below, there are different needs for low, mid, and high-tech growers:

> *"If you are talking about low and mid-tech, you need to understand the plant physiology. Maybe just getting the main sensors, for instance, to track main parameters."- Interviewee 2*

> *"But what I want to tell you that we are in the mid and high-tech greenhouses, but in the low tech they don't use these kind of systems, they don't use it and it is like 90% of the greenhouses in Mexico, probably 80%."- Interviewee 1*

Nonetheless, the different farm locations all seem to have one problem in common, the dependency on a stable *internet connection*:

> *"In some places we have good internet, but in others we don't have good connection. So I have seen software that need internet and if you have a place that is really away from the internet connections or things like that, then it is not useful."- Interviewee 1*

> *"Saturday we just had no internet for a whole day. Two weeks before that, on Friday, for two or three hours there was nothing, and then you really get stuck [...] And if the internet is down, you really can't do anything at all."- Interviewee 5*

The internet stability, however, is not something that the ATPs can influence. Be that as it may, their SaaS solutions would enable a higher value-in-use creation when their offering is less dependent on internet connection.

4.1.3 Business Management

Besides the inter-actor collaboration, and the IT materiality influencing the value-in-use creation, the management of the business in both the growers organizations and the ATPs influences the value-in-use creation. By coordinating and organizing the business activities in the right way, the ATPs and growers can facilitate a fruitful environment for value creation. This is both on an organizational level, leadership and the markets they operate in, as well as the individual level, with for example the aging workforce of the sector and not enough education (knowledge and SaaS training).

As identified by multiple interviewees, the business process on farms is rather complex and strongly influences the value creation. It is a constantly changing construct and it thus requires different value-in-use facilitating activities. The decision makers within the organization are different between the markets. Whereas the Dutch farms are often family owned, the Mexican and Moroccan farms are more corporate organizations. The owners of the Dutch farms are often also growers themselves and thus have knowledge about cultivation. The corporate business leaders on the contrary do not possess this knowledge, as pointed out below:

> *"The owner is not the grower here. We sometimes have the grower and the boss. And the boss in some cases is not related with this industry. These people are people that have money, but they are doing businesses in other industries. You need to take that into account."- Interviewee 1*

When the grower is also the owner and decision maker, the *decision-making* process follows another path and there are different measurements on value-in-use creation. The different businesses owners and company structures increase the complexity of relationship building and all require another approach.

As mentioned by different interviewees, the horticulture sector is a *complex* sector where one size does not fit all:

> *"And I think that the horticultural sector is sometimes a more complex sector than people think on the outside. [...] systems of which you might think in other sectors oh, I can copy paste them to horticulture, I think*

> *that is sometimes too easy to think that."- Interviewee 5*

The solutions must be adapted to the horticulture sector to be able to enable value-in-use creation. Additionally, for the ATPs and its employees to understand the needs of the growers, it is important for them to know what is going on at farms. Engineers that have visited farms and have knowledge of cultivation matters are better enablers of facilitating value-in-use creation. As described by interviewee 4, there is ATPs already following this approach and the interviewees identify it as a value creation enabling activity:

> *"For example, a friend of mine works at ATP X and everyone who comes to work at ATP X in the office will really have to go to a farm to experience what it is like."- Interviewee 4*

As visualized by the following interview citations, the distinctive business process on the farm between different markets and tech levels, entail different needs for different farms – one size does not fit all when it comes to solutions for different farms:

> *"I've seen it like they sometimes push for the same solution that maybe works in the Netherlands, but they have to think on what the local needs are, and probably adapt the product. Because it's a service, right, at the end. And the one fits all approach doesn't apply."- Interviewee 2*

> *"Varieties of the Moroccan farms is so different from Europe. They can't propose or offer some solution which is not interested in Morocco. We don't have green houses like the Netherlands. We have some traditional things and the irrigation, also for that we need market studies."- Interviewee 8*

To be able to understand the constraints and enablers of the value-in-use creation per market or tech-level, the ATPs must thus *understand the local needs*. The differences between the markets and tech levels are also reflected in the knowledge of the growers and the required training. In Morocco, a low-tech market, there is a big *gap between the knowledge* among top management and the growers. But also the access to external knowledge is limited and thus restrains the value creation, as mentioned in the quote below:

> *"There is the access to knowledge and how knowledgeable Moroccans are on this new technology is very low compared to France. And there is, like I said, some people that are very knowledgeable and some people that are not at all. And that's what makes it hard."- Interviewee 7*

The available knowledge can also be influenced by the *age of the growers* within the organization:

> *"Yes, you always have different people and different ages within your team, and I really see a huge difference [...] those young people who are skilled with everything about technology and they are used to working with all the digital solutions and often I notice that one of the young people, when something new comes along, picks it up, fills it with data, actually takes the lead."- Interviewee 5*

When there are different generations working on the same farm, younger generations take the lead in the SaaS adoption. Likewise, Interviewee 8 mentioned that the older generation is harder to convince and thus needs a more excessive explanation on the enablers of value-in-use creation of SaaS solutions before they will adopt it on their farm.

To stimulate the growers knowledge and facilitate an optimal value-in-use creation, it is important to explain the SaaS solutions with relevant training. The approach to this however differs between the markets and the functions of the SaaS solutions. The more involved the platform is in the company's main activities, the bigger the need for training. As described by the following quote, it can be very hurting for customers to keep asking for trainings:

> *"I mean, the climate computer is the main technology, right? And what I experienced with Solution XYZ [...] It's an old system. They are now really focusing a lot on helping the grower maybe in some cases, but I see that they just drop the customer at some point. Right now, I have been begging for trainings. You know, how painful for a new grower it is to start learning Solution XYZ? Because you don't get trainings. It's a really difficult system because it's not user friendly at all."- Interviewee 2*

The low and mid-tech companies require the ATPs to take the lead when it comes to *trainings*. Once again, these trainings must be adopted to the local needs and the knowledge of the customer, as described by interviewee 7:

> *"To implement technology, implement the software, but to do the whole thing, I think it's better that the supplier does the training. Yes, but then the training needs to be with someone local because the growers, they speak French, not all of them, but mostly Arabic."- Interviewee 7*

The high-tech growers, however, already provide in-house trainings for their employees and need the ATPs to take a more supportive role in this process. By doing so, both companies can learn from each other and co-create the value-in-use of the growers. As described by the following quote:

> *"If we provide in-house training to our cultivation people, it may very well be that we invite Company XYZ. And that's because Company XYZ can transmit, but Company XYZ can also receive, because ultimately there are users there and that interaction should be much better, because that is not happening enough."- Interviewee 4*

The business management thus has an extensive influence on enabling or constraining the value-in-use creation of the growers. By understanding the customer, their company structure, knowledge level and business processes, the ATP can adapt their practices to enable a fruitful environment for value-in-use creation.

4.2 INTERPRETATING THE THEMES THAT INFLUENCE VALUE-IN-USE CREATION

Within this chapter, the previously discovered themes that influence the creation of value-in-use will be discussed. The role of the ATP on the creation of value-in-use is determined and how their practices can constrain and enable the value-in-use creation. An empirically grounded framework (Figure 4), as based on the previously developed theoretical framework, is presented. The framework shows the interpretation of the empirical findings of the study and differentiates between the provider, joint and customer sphere on what the enablers and constraints of the value creation are. Below all three spheres will be discussed on how their practices influence the value-in-use creation.

4.2.1 Facilitating and Minimizing Practices Affecting the Potential Value-in-Use Creation

The ATP is responsible for creating potential value-in-use that the grower can convert into real value-in-use. There are three value facilitating practices identified within the provider sphere. By adapting the solution to the local needs, creating an open API, and increasing the ease of use and actionability of the offering the ATPs will create potential value-in-use for the growers and better facilitate their value creation. The need for the solutions to be easy to use and actionable confirms the findings of Wu (2011a), that states that providers should focus on the perceived usefulness and perceived ease of use of the solutions. All tech levels (low, mid and high) have identified an easy-to-use solution as a contribution to their value creation. For the open API it is extremely important that the ATPs reciprocally collaborate on the development of their open API and to discuss how the different SaaS solutions together can create more value-in-use for the growers.

On the contrary, the results show that if the ATPs would keep a closed system that prevents open communication between different SaaS solutions and will not have a flexible offering, their practices will constrain the creation of value-in-use and thus minimize the potential value-in-use. The closed system is especially identified as a

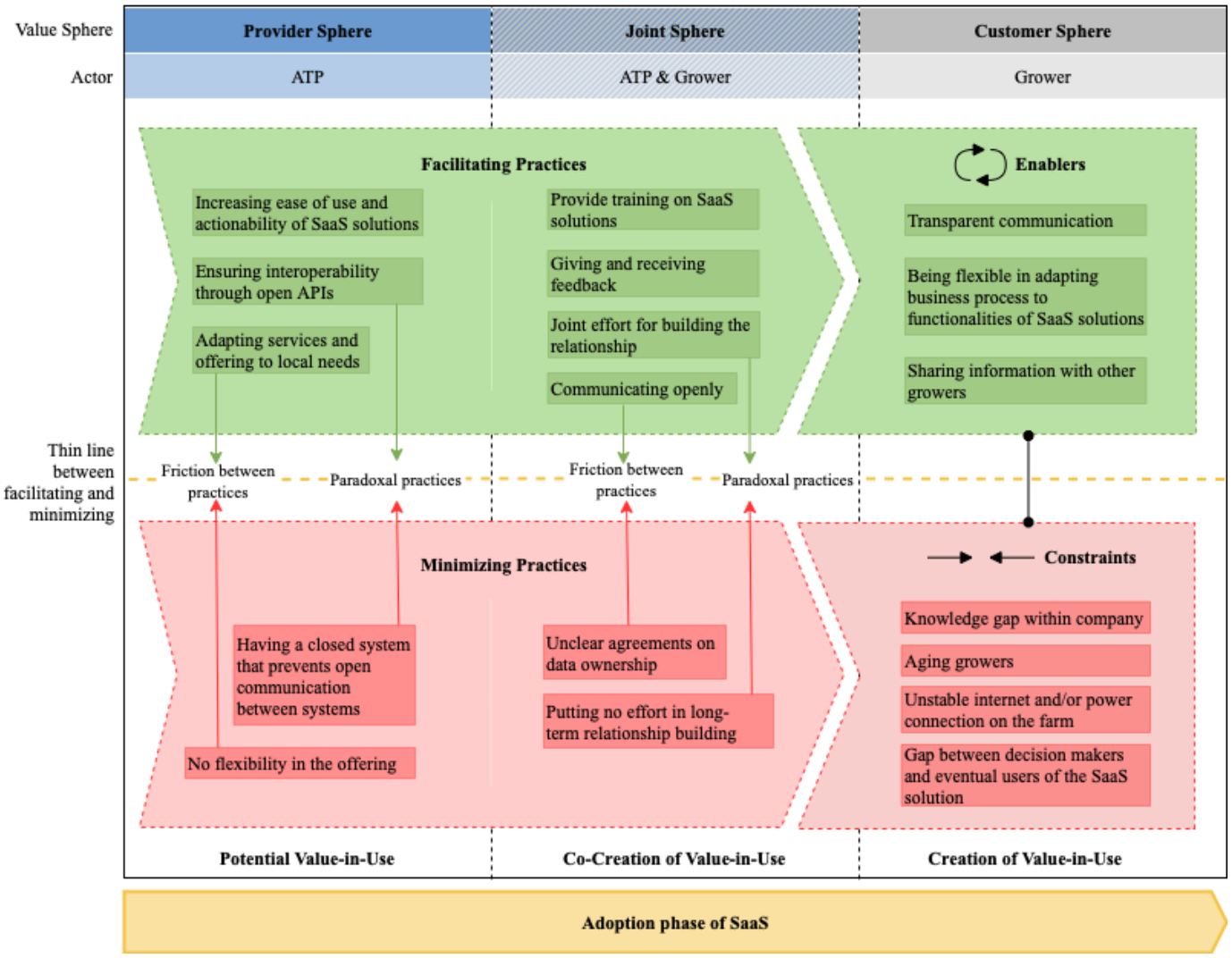

Figure 4 The process of value-in-use creation during the adoption phase of SaaS solutions

substantial constraint by the growers for their value creation. Consequently, ATPs should open op their system to become a better value facilitator.

4.2.2 Facilitating and Minimizing Practices Affecting the Value Co-Creation

Within the joint sphere, both the ATP and grower are responsible for the co-creation of value-in-use. Consequently, the facilitating and minimizing practices within this sphere revolve mostly around the interaction and relationship between ATP and grower. To facilitate the co-creation of value-in-use, both ATP and the growers must communicate openly, put in a joint effort for relationship building, collaborate on user trainings and create an open atmosphere for giving and receiving feedback. Technology needs can differ between company, market, and cultural background. Notably, the low and mid-tech cherish the importance of a good relationship and collaboration. This is because the low and mid-tech have less knowledge within the company and are therefore more dependent on the knowledge of the ATP. When it comes to training the SaaS users, it is also the low and mid-tech growers who need more support from the ATPs. High-tech growers often have their own training programs, and they require less support and thus less co-creation.

On the opposite side are the value-in-use minimizing practices of putting no effort in a long-term relationship and having unclear agreements on the ownership of the data. The ATP and grower should therefore work together on a healthy relationship that creates a fruitful environment for co-creating value-in-use. Unclear communication and agreements about the ownership of data, will harm the relationship and lower the trust that growers have in their ATP. The minimizing practices apply to all tech

levels (low, mid, and high-tech) and are important for all growers.

In general, the joint sphere is of greater importance for the low and mid-tech growers, as they rely more on the ATP to guide their value-in-use creation process.

4.2.3 The Constraints and Enablers of Value-in-Use Creation

The actual creation of value-in-use takes place within the customer sphere. The growers themselves are responsible for the value-in-use creation and they can also hinder this process. The identified enablers of value-in-use creation are transparent communication, sharing information between growers and being flexible with adjusting parts of the business process to the functionalities of the SaaS solutions. All growers have the same goal of growing the perfect crop to feed the growing population. By sharing information and knowledge between growers, markets and tech-levels, the growers will work together on reaching that shared goal. This also involves growers to be more transparent towards ATPs on their business processes, as ATPs can then better support the growers with the implementation. Due to the complexity and differences between farms, it becomes impossible for ATPs to customize their offerings for all growers. Growers should thus also critically look at their business process and identify the possible changes to create a better match between SaaS solution and business process.

The growers can also be their own burden when it comes to the value-in-use creation. There is often a knowledge gap present within the company and between markets - the growers population is aging, some markets struggle with a gap between the decision-makers and eventual users of SaaS and the farms can be on locations with unstable internet and power connection. These findings are in line with Pierpaoli et al. (2013). To optimize value-in-use creation, the growers should invest more in education and attracting new young talent into the sector. As long as the technology infrastructure is not stable enough, the value-in-use creation will always be limited and reliant on connectivity issues. With the low and mid-tech markets often being run by corporations without much knowledge of the sector and growing, the decision-making often does not involve cultivation knowledge but is merely based on (potential) monetary benefits. However, the corporate decision-makers are eventually not the users, and it thus relies on the eventual users to create the value-in-use.

4.2.4 Synthesizing the Practices, Constraints and Enablers

The presented practices, constraints, and enablers in Figure 4 are not isolated aspects but are interdependent and influence each other. The interdependence takes place horizontal and vertical. There is a thin line between minimizing versus facilitating practices and constraints versus enablers. The thin line symbolizes how each aspect can be a facilitator and minimizer at the same time.

Between the spheres (horizontal), all practices, enablers, and constraints are interlinked and influence each other. Combining the facilitating practices and enablers together will eventually create the strongest value-in-use. Whereas any minimizing practice or constraint, will reduce the value-in-use creation. The value creation is taking place during the adoption phase of a SaaS solution. The facilitating practices and enablers will ease the adoption process of SaaS solutions for growers. The adoption starts at the provider, and gradually move in a linearly matter to eventually move the value creation towards the next phase of usage.

Among the minimizing and facilitating practices (vertical), there are specific practices that influence each other. There is a paradox present between ensuring interoperability through open API and having a closed system. The practices cannot fully exist simultaneously, as the ATP is either ensuring or preventing interoperability. Furthermore, there is friction between '*adapting services and offerings to local needs*' versus '*no flexibility in the offering*'. Either one of them is existing, as the ATP cannot have no flexibility while adapting their offering to local needs at the

same time. For the provider sphere, it is thus the case that the same activities can hurt or stimulate the value facilitation.

The joint sphere also has two practices that interfere with each other. There is a friction between open communication while having unclear agreements on data ownership. In the ideal situation of open communication between ATP and grower, the minimizing practice of unclear agreements of data ownership cannot be present. In addition, the effort put in the long-term relationship, by the ATP and grower, can either facilitate or minimize the value creation. This practice can thus either be facilitating value when done correctly or minimizing value when not done at all.

The customer sphere contains the constraints and enablers. All of them are independent, however, they do influence each other and together influence the value-in-use creation. It is dependent per grower which constraint is the most urgent to solve for an increase in value creation. The enablers described are important for all growers in all markets and tech-levels.

5. DISCUSSION & CONCLUSION

This study explored the constraints and enablers for facilitating the value-in-use of growers during the adoption phase of SaaS solutions. By analyzing the constraints and enablers of value-in-use creation, the study exposes the micro-foundational actions that are taken by the growers. Furthermore, it acknowledges the dyadic relationship that is taking place between the ATP and the grower on a micro level (Felin, Foss & Ployhart 2015). Through conducting eight interviews and by performing a thematic analysis via inductive coding, the study was able to identify three overarching themes: (1) *the inter-actor collaboration in the sector*, (2) *the materiality in the IT sphere*, and (3) *the business management*. By combining the three themes, a value-in-use creation process model was created to visualize the practices, enablers and constraints that influence value-in-use creation during the adoption process. The study's findings show the importance for both ATPs and growers to find balance between collaboration and competition, where building long-term relationships improves the value created over time. These findings are important for both the technology adoption and the service marketing literature. The contributions of the research to both theory and practice are discussed in more detail below.

5.1 THEORETICAL CONTRIBUTION

Despite the adoption process of technologies being studied by many scholars before (Pierpaoli et al. 2013), the adoption phase of SaaS solutions contains extra challenges due to it being intangible – digitalization and data bringing the value of the innovation. By focusing the current research on value-in-use creation within the SaaS adoption phase, the study contributed to fill this gap in the technology adoption literature. The empirical findings and developed framework offer a solid foundation for a deeper – micro foundational – understanding of the constraints and enablers for value-in-use creation specifically for SaaS solutions.

Moreover, the current research studied three different market, all with different cultural backgrounds, geographical locations, and tech development levels. Doing so, fulfilled the need for comparison and deepening the understanding of how the SaaS adoption phase differs between different markets (I.e., Yang et al. 2015; Oliveira et al. 2019; Palos-Sanchez et al. 2017). This study showed that growers have different constraints and enablers based on their location and tech-level. In this respect, the lower the tech-level of the grower, the more the ATP must be involved during the adoption of the SaaS solution.

Furthermore, this study contributes to the theory by adding a new dimension on the constraints and enablers of adopting to SaaS solution. This study's most interesting finding elucidates the importance of inter-actor collaboration inside the sector. This is new to the technology adoption literature (Pierpaoli et al. 2013; Taherdoost 2018; Jackson, Allen, Michelson & Munir 2022). Within innovation literature, the

importance of inter-actor collaboration has been identified before as a catalyst for growth and development in low-tech industries (Maninggar, Hudalah, Sutriadi, & Firman 2018). This perspective reveals the conflict between cooperation and competition for both ATPs and growers. The results show that for optimal value creation, the ATPs and growers must find the right balance between competition and cooperation. In this way, the research shows the importance of involving the relational aspects in research into service-based technologies.

Next to the study's contribution to technology adoption literature, the findings of this study also contribute to the service marketing literature. Aarikka-Stenroos & Jaakkola (2012, p. 17) have defined a gap in the service marketing literature on the value-in-use as experienced by the actors within the knowledge intensive service contexts. In the SaaS knowledge sector in agriculture, the growers (as actors) experience that there is a lack of focus on long-term relationship building and that ATPs have to invest more in supporting the adoption process. in this regard, the study expanded the available literature on a substantial empirical basis (Benlian et al. 2009) that departs from the individual perspective.

5.2 MANAGERIAL IMPLICATIONS

Besides the study's contribution to theory, the findings also make several contributions to practice. The managerial implications are aimed at industry organizations and growers. The study results provide ATPs with opportunities to strengthen their position and increase the value creation for their customers. The growers can learn more about what their current constraints and enablers are, and how they can utilize SaaS to create value on their farm. There are three managerial implications defined.

First, the identified minimizing and facilitating practices provide ATPs with important insights and tools in how to become better value facilitators. It is important for the ATP to recognize their role as value facilitator, and that it is thus the customer who creates the eventual value-in-use. The results show seven facilitating practices that the ATP must carry out to become value facilitators and fulfil their customer needs, namely: (1) increase ease of use and actionability of SaaS solution, (2) ensure interoperability through open API, (3) adapt offering to local needs, (4) provide training material on SaaS solution, (5) accept customer feedback, (6) focus on long-term relationship building, and (7) open communication. These 7 practices are in line with previous research, that found the importance of technological, organizational, and environmental aspects on the growers willingness to adopt (cf. Pierpaoli et al. 2013; Benlian & Hess 2011; Oliveira et al. 2019). The impact on the value creation by the practices differs per market and customer, but all practices together will help ATPs to become better value facilitators. Additionally, part of ensuring interoperability involves the ATPs to start collaborating more. This demands open APIs in their SaaS solutions, making sure the data is exchangeable between platforms, and communicating with other ATPs on how they can work together to increase the value creation. However, growers also must take their part by allowing ATPs to use the data for development purposes and by allowing a more open environment for knowledge sharing. Furthermore, the facilitating practice of 'adapting to the local needs' also involves the ATPs adjusting their services for the low and mid-tech growers. The 'one size fits all' approach does not apply, and all growers have different needs. The low and mid-tech growers are facing more constraints - i.e., instable internet/power connection and lower level of knowledge – that makes the adoption phase of SaaS more complicated. These findings support earlier findings (i.e., Pierpaoli et al. 2013), that stated the impact education and the access to knowledge as a constraint on adoption SaaS solutions. Nevertheless, the low and mid-tech markets have a lot of growth potential and there is a great efficiency gain to be made.

Additionally, the research findings can be used as growers testimonials on SaaS solutions. Previous research has shown that growers value their neighbors and fellow growers opinions

when exploring new technologies for their farm (Moons et al. 2022). The interview results can be applied as a guideline for growers on what the benefits and constraints are for the adoption of SaaS solutions on the farm.

Lastly, the study contributes to the understanding of the horticulture sector as a whole. The horticulture sector is defined as a demanding, dynamic, and complex sector (Ayaz et al. 2019; Pierpaoli et al. 2013). By positioning this research in the sector, and by exploring the thinking and behavior of the growers, the study contributes to understanding the needs of the sector. Likewise, it shows the need for tech providers to understand their audience and to comprehend where their technologies are applied.

5.3 LIMITATIONS & FUTURE RESEARCH

As with any research, this study has several limitations that indicate future research directions. Firstly, the study focused on three specific sample markets, Morocco, Mexico, and the Netherlands. These markets were selected because of their high potential (Morocco and Mexico) or because they are a forerunner in the sector (Netherlands). Although the practices, constraints, and enablers could also be present in other markets, it remains unclear if these results can be generalized for other markets. It could just as well be that other markets show different results. Rather, the three markets symbolize the distinction between low, mid, and high-tech markets and can be applied as example markets for the different tech development levels. It is suggested for future research to investigate whether other markets - representing low, mid, and high-tech levels – have similar results or rather display that there are idiosyncrasies per market. This allows the needs and segmentation of the markets to be better understood. Furthermore, the research took place in the horticulture sector, a complex and demanding sector that involves a lot of hurdles to get the growers to adopt new technologies (Ayaz et al. 2019; Pierpaoli et al. 2013). Hence, the importance of positioning the research in horticulture. It is unclear if, and to what extent, the sector had impact on the findings. The adoption phase of SaaS solutions can involve different practices, constraints, and enablers in other sectors. Therefore, it is recommended for future research to reproduce the study within other sectors.

Eight interviews were conducted for the study, divided over the three sample markets. By following thematic analysis and inductive coding, different themes were defined, and the value-in-use creation process model was formed. The findings are mainly based on the growers interpretation of value, and their personal views. By doing so, it generated inside views and an individual perspective. However, it would be valuable to verify the results with a bigger sample, to be able to show that the interviewed growers' perspectives reflect the whole market. If future research is to conduct a survey on the matter, numerical data can be added to support the findings of this study. The added data can contribute to minimize the thematic analysis disadvantage of the high level of freedom in the results interpretation (Nowell et al. 2017).

Lastly, this study has broadened our understanding of the practices influencing value-in-use creation and the enablers and constraints as identified by growers. Part of the findings are the inter-actor collaboration within the sector, and the importance of finding the right balance between collaboration and competition. It would be interesting for other researchers to elaborate further on these findings. Future researchers can focus on exploring how ATPs and growers can find the right balance between collaboration and competition to together achieve the main goal of an improved food production. These results can then be applied by ATPs and growers to work towards optimal value co-creation with SaaS solutions.

5.4 CONCLUDING REMARKS

This article contributes to technology adoption and service marketing literature by studying the practices, constraints, and enablers influencing the value-in-use creation during the adoption phase of SaaS solutions in horticulture. The

study's results can be applied in practice by both ATPs and growers, to create a more fruitful environment for value creation.

To conclude, the study's result suggest that ATPs and growers must increase their collaboration and effort put into long-term relationship building. ATPs must open their platforms and join forces with other ATPs, while growers must increase transparency in knowledge sharing. By doing so, it creates an ideal situation for the creation of value-in-use during the adoption phase of SaaS solutions.

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8. APPENDICES

APPENDIX A: INTERVIEW GUIDE

Introduction

Hello and thank you for participating in this research and making time for the interview. First, I would like to ask you if I have the permission to record the interview?

I will start with some more background information. I'm Annelot Schmeitz and I study MSc Business Administration at the University of Twente and MSc International Marketing Management at Lappeenranta University of Technology. For my master thesis I'm researching the barriers and accommodators to adopting Software-as-a-Service (SaaS) solutions for growers. The goal of the study is to assess the constraints and enablers for value-in-use creation during the adoption process of SaaS as experienced by growers and to determine how ATPs (agricultural technology providers) can facilitate the growers in this process. Two research questions have been formed to fulfill the research purpose:

RQ1 What constraints withstand and what enablers facilitate the creation of value-in-use for growers during the adoption of SaaS solutions?

RQ2 How can an Agricultural Technology Provider (ATP) facilitate the growers value-in-use during adoption of SaaS solutions?

The study is taking place in three different markets: Morocco (low-tech), Mexico (mid-tech), and the Netherlands (high-tech). By doing so, the results between the different markets and technology levels can be compared and the needs of low-, mid-, and high-tech growers can be differentiated.

The goal of this interview is to get better insights in your decision-making process around subscription-based software(/SaaS) that is utilized on farms, and to understand the value that is created during the usage of the software.

The interview is going to be semi-structured, open questions. The questions are related to SaaS and the use of it by farmers. I will start with some background questions and then divide the questions based on technology, the organization, and the environment.

Background Information & Definitions

Definition of SaaS: a software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted. The user will access it over the internet and must keep paying a fee to be able to use the software. The most common (customer) example is Netflix, which you access online, the movies/series stay in the ownership by Netflix, and you must keep paying your subscription to keep using it.

Definition of Value-in-Use: The value for customers, created by them during their usage of resources. Hence, the value is thus created and determined by the customers themselves. The opposite of value-in-exchange. A good example would be a bottle of water, which has a low value-in-exchange (cheap to buy), but high value-in-use as you need water to stay alive. On the contrary, a diamond would have a high value-in-exchange (expensive to buy, good to resell after), but a low value-in-use.

Questions

Background

- Can you tell me a bit more about what your job is?
- What is your expertise?
- On which markets do you operate?
- Would you position your organization as low-, mid-, or high-tech?
- Are you currently using software on the farm? Is it subscription based?
    - If answer is *Yes*,
        - Did you face any barriers during the adoption process of the software?
        - What were the reasons you choose for subscription based?
    - If answer is *No*,
        - Did you ever consider getting a subscription-based software?
        - What stopped you from getting the software?

Technology

- On a technology level, what barriers do you face with the currently available software?
- On a technology level, wat accommodates you to use the currently available software?
- On a technology level, how can the ATPs facilitate your value creation?
- What value does decision-support software bring you?
- *If the grower is currently not using SaaS*
    - What needs to change in the software before you will start using it?
- *If the grower is currently using SaaS*
    - What is the biggest reason that you are using SaaS at your farm?

Organizational

- On an organizational level, what barriers do you face with the currently available software?
- On an organizational level, wat accommodates you to use the currently available software?
- On an organizational level, how can the ATPs facilitate your value creation?
- *If the grower is currently not using SaaS*
    - Within the organization, who would decide to start using SaaS?
- *If the grower is currently using SaaS*
    - Who decided in your organization that SaaS would be a good fit?

Environmental

- On an environmental level, what barriers do you face with the currently available software?
- On an environmental level, wat accommodates you to use the currently available software?
- On an environmental level, how can the ATPs facilitate your value creation?
- How does the opinion of other growers on software impact your decision-making?

General

- How can an ATP facilitate your value-in-use better?
- Is there anything else you would like to say about SaaS?

Thank you for the participation!