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Requirements Engineering in the Planning Phase of a Software Ecosystem

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Abstract. **[Motivation]** Companies are building software ecosystems to gain competitive advantage by developing digital services together for customers. The planning phase of the software ecosystem can, however, be challenging. **[Question]** The goal of this study was to analyze what the role of requirements engineering (RE) was in the planning phase of a small-sized software ecosystem. The case study was conducted by interviewing representatives of all six actors of the ecosystem and analyzing material from the 12 planning workshops. **[Results]** The paper describes the conceptualization process of digital services the actors used during the planning phase. This process contained a flow of tasks from a vision and objectives of the software ecosystem to a go/no-go decision on the development of a Minimum Viable Product (MVP). One key characteristic of the conceptualization process was to have traceability from the prioritized functionalities of the MVP to a value proposition, target customer groups and customer paths of digital services and further to the vision and objectives of the software ecosystem. **[Contribution]** The paper provides knowledge on how actors can start building a software ecosystem together from a business perspective. In addition, it addresses the importance of RE to link the business view to the development of the MVP of digital services in the software ecosystem.

Keywords: Software Ecosystem, Requirements Engineering, Business View, Conceptualization Process, Planning

1 Introduction

Companies are building business ecosystems together to reach competitive advantage in the markets. The business ecosystem concept was proposed by Moore [18] in the 1990s. The business ecosystem where digital services are developed and provided can be considered as a software ecosystem (SECO) [11]. It can be defined thus: *"a set of actors interact with a shared market, develop software and services together and operate through the exchange of information, resources and artifacts"* [11]. The creation of the ecosystem starts from a planning phase, where a basic paradigm of the ecosystem and how value will be created and shared need to be determined [18]. The software ecosystem enables the actors to build a broader set of services than one actor can do by its own [10]. In addition, it allows the actors to better address customer needs, as it can bring a diverse set of capabilities and innovation to the solution quickly [5]. It is also possible to tolerate risk through cost-sharing [10].

Manikas and Hansen [15] point out the importance of studying existing and real software ecosystems. Understanding different perspectives of specific types of software ecosystems can provide results which can then be applied to other software ecosystems [16]. This will enable repeatability and theory confirmation [16].

Earlier studies have examined requirements engineering (RE) in software ecosystems [e.g. 16, 24, 25]. The focus of these studies has varied across RE activities [24] or ecosystem lifecycles in small- to large-sized software ecosystems [16, 24]. RE-related research concentrating on the planning phase of small- and medium-sized software ecosystems has had only little attention in recent studies [16, 24].

In our previous paper, we identified the main activities and challenges in the planning phase of a software ecosystem [21]. However, we are interested in gaining a deep understanding of RE when actors are building digital services together in the planning phase of the software ecosystem. Therefore, we extended the quality analysis of the collected data to answer *the following research question: What is the role of RE in the planning phase of a software ecosystem?* The main contribution of this study is that it provides information for practitioners on how they can start building a software ecosystem. In addition, the paper addresses the importance of RE in linking the business view to the development of the MVP of the digital services in the software ecosystem.

The rest of the paper is organized as follows. Section 2 summarizes the main concepts of software ecosystems and gives an overview of existing RE research on software ecosystems. The qualitative research method of the study is described in Section 3. The conceptualization process of digital services is described in detail in Section 4. The results are discussed and the answer to the research question presented in Section 5. Finally, the paper concludes and points to future research.

2 Related Work

2.1 Overview of Software Ecosystems

In the 1990s, Moore [18] proposed the concept of the business ecosystem, concentrating on how the economic community worked and the interactions between companies, their business environments and business opportunities. A software ecosystem is a subset of a business ecosystem and the literature contains many definitions of the SECO [e.g. 1, 9, 11, 12]. The main common characteristic of all these definitions of the SECO is the use of software, which differentiates SECOs from other ecosystem types. In this paper, we use the definition by Jansen et al. [11] of a SECO: *"a set of actors functioning as a unit and interacting with a shared market for software and services, together with the relationships among them. These relationships are frequently underpinned by a common technological platform or market and operate through the exchange of information, resources and artifacts."*

Software ecosystems can be classified through four factors: base technology, coordinators, market extensions and accessibility [12]. This means that a software ecosystem is always underpinned by a software platform, a software service platform, or a software standard, and it can be a privately owned or owned by a community [12]. In addition, there are several scenarios for how the software ecosystems can be available

in the markets e.g. commercial market extensions mean the owner(s) will take all profits [12]. The accessibility possibilities can be open source, screened but free, and paid [12].

Participants in software ecosystems can be called actors and can have different roles e.g. keystone actors, dominators, hub landlords and niche players [10]. The software ecosystem is usually governed [12] and the digital service development is often led by one or more keystone actors [10]. An actor may have one or more roles in the software ecosystem [13], and their role may also change during the ecosystem's life cycle [17]. The lifecycle of an ecosystem consists of phases [10, 18], where an early phase of the ecosystem is for example referred to as its birth [18] or emerging [10] phase. We call the first phase of building software ecosystems the planning phase [21].

Software ecosystems can be characterized in several ways, for example information about the owning companies, number of participants, main customers as well as how much business has been created through the software ecosystem [11]. Campbell and Ahmed [4] proposed a three-dimensional view of the development of software ecosystems, consisting of the business, architecture and social views. The business view includes activities where customer expectations and competitive advantage are reached by a business vision, innovation and strategic planning [4]. The architecture view focuses, for example, on software architecture solutions for software ecosystems [1] whereas the social view looks at, for example, how the actors negotiate during the planning of the digital services development to achieve the goals [8].

In addition, we have identified in our previous study five activities in the planning phase of the software ecosystem: 1) definition of a vision and objectives, 2) selection of actors, 3) definition of a governance model, 4) conceptualization of digital services, and 5) definition of a business model [21]. Other studies also pointed out that definition of a vision and objectives [10, 18, 20] and definition of the roles of actors [7, 10] are important activities in the planning phase.

2.2 Requirements Engineering in Software Ecosystems

Earlier studies have considered requirements engineering (RE) from different perspectives in software ecosystems [e.g. 8,16, 23-25]. Vegendla et al. [24] map previous studies to RE activities. The previous studies have also been directed toward different phases during the lifecycle of a software ecosystem [16, 24]. In addition, the size of the software ecosystems varied from small- and medium-sized [e.g. 23] to large-scale ecosystems [e.g. 8, 27].

Goal modeling [27] and a definition of a common value proposition [19] as well as requirement negotiation [8] and prioritization [23] are activities which occur in the planning phase of a software ecosystem. Yu and Deng [27] proposed a modeling approach for achieving the strategic goals of each actor in a large-scale software ecosystem. Pichlis et al. [19] studied small software ecosystems and emphasized a need for a common value proposition. Fricker [8] proposed a model based on negotiation and network theory for analyzing and designing the flow of requirements through a large-scale software ecosystem. Valenca et al. [23] studied small- to medium-sized companies during the planning of a software ecosystem. They identified a need for strong strategic alignment and difficulties in prioritizing the most valuable features.

Villeda et al. [25] identified an iterative process to achieve a first version of the digital services in the software ecosystem. The first step in this process is the definition of a preliminary software ecosystem concept. End-user roles, business strategy and needed software services from actors to accomplish the strategy are included to the concept [25].

Bosch and Sijtsema [1] reported a lack of connection between business and engineering process in a large-scale software ecosystem. Schultis et al. [22] reported challenges where the actors have different requirements based on their business objectives, and if all the actors are involved in the architectural decision-making, it takes time to reach a common agreement on the architecture. These results have occurred more in the development phase, but relationships to the planning phase exist.

3 Research Methods

3.1 Research Question

The goal of this study was to understand the role of the requirements engineering when the actors were building digital services together in the planning phase of a software ecosystem. The research question of the study is defined as follows: **What is the role of requirements engineering in the planning phase of a software ecosystem?**

3.2 Description of Case SECO

The role of requirements engineering in the planning phase of one Finnish software ecosystem (called Case SECO in this paper) was investigated in this study. The aim of Case SECO was to provide digital services for new entrepreneurs. Before the actual planning phase of Case SECO, three cooperating actors had recognized that there was a need in the market for comprehensive digital services. Therefore, they were interested in co-creating a targeted offering for them. They recognized that creating this kind of digital service offering requires a set of companies developing it together. A software ecosystem was recognized as a suitable model for this kind of cooperation. The actors started to gather appropriate companies. Based on the preliminary discussions with them, potential companies were selected.

The planning of the software ecosystem took place from February to June 2018 and was performed through 12 workshops. In the beginning, there were five actors, and the sixth actor joined the planning phase in the eighth workshop. The actors represented five different business sectors: two actors were categorized as small- and medium-sized companies and four were large companies. One to three people from each actor attended the workshops and all members actively participated in defining the vision and objectives of the software ecosystem and a set of digital services to be developed during the workshops. One actor took the role of facilitating the planning phase because it had previous experience of ecosystem creation and knowledge of digital services development. The planning was done in an iterative manner.

During the planning phase, the actors agreed that all of them had a keystone player's role and were in an equal position with each other in decision-making. An advisory board was set up consisting of one member of each of the actors of this planning phase. The advisory board in the was the highest decision-making governance body, to enable the planning of the ecosystem and steer the planning of the digital services. The roles and responsibilities, limitations, cost-sharing principles, rules for co-operation and business model were described in the rule book, which was the main guiding document for the governance of Case SECO.

Case SECO can be classified to be a closed and privately-owned software ecosystem. All six actors owned equal parts of the software ecosystem. In addition, they decided to share the costs of the planning and development of the software ecosystem equally. They also agreed that each actor would get the profit that came from their own offering through the digital services. The actors decided to keep Case SECO closed during the planning phase and not to take on new members. However, they agreed that new members would be welcome later if their offering is suitable for the end-users of the digital services. The actors included rules for joining and possible roles for new actors in the rule book. The digital services fulfilled the vision and objectives of Case SECO, which the actors defined together. The digital services were executed through one software platform, which was developed by a one external development team. Each actor's offering showed up as solid digital services for the end-users.

The development phase of the digital services started in July 2018 and the first version was launched in July 2019. Currently the digital services are in the continuous development phase.

3.3 Research Process

This qualitative research was performed using a case study research method [26]. A descriptive approach for the case study was used to describe a single case in depth. We applied the coding and code comparison guidelines of grounded theory to analyze the data [6]. The grounded theory method was selected for the analysis because it offers systematic and flexible guidelines for analyzing qualitative data [6]. The research process was first presented in our publication [21], where open coding was used to analyze the data. In this paper, we further analyzed the data by applying axial coding [6]. Figure 1 shows a timeline of the phases of Case SECO and the main research activities of this study.

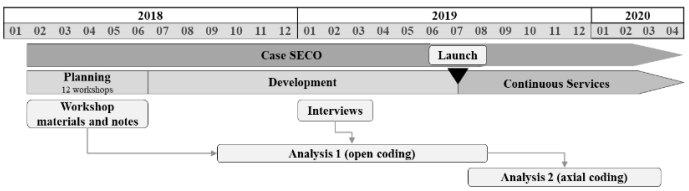

Fig. 1. Timeline of the phases of Case SECO and the main research activities.

The answers to the research question of this study were based on the workshop materials from the planning phase and the results of semi-structured interviews performed in January and March 2019. The workshops had a predefined agenda, but other topics were also covered. The length of the workshops varied from 1 to 4.5 hours. The workshop materials included presentations, notes and all additional material which was delivered to the actors during the planning. The actors prepared the workshops together with pre-agreed responsibilities. The facilitator took care of the notes, which included decisions and work items with responsibilities in each workshop.

The interviews were designed following the guidelines from Boyce and Neale [2]. The themes of the interviews covered main topics related to software ecosystem creation. All the six actors, that had a keystone role in Case SECO and were participants on the advisory board in the planning phase, were interviewed. All the interviewees had over 15 years of work experience and had extensive knowledge of their company's business and its development. Only one had previous experience of planning ecosystems together with other actors. Table 1 summarizes the interviewed actors.

Table 1. Summary of the interviewees.

Business sector	**Company size**	**Role in the company**	**Ecosystem experience**
Insurance	Large	Business development director	No
Pension insurance	Large	Business development director	No
Telecommunication	Large	Business director	No
Financial and accounting	Medium	Chief executive officer	No
Financial and accounting	Medium	Business development director	No
Information and communication	Large	Principal consultant	Yes

The interviews were conducted in Finnish, because Finnish was the mother tongue of all the interviewees, and we wanted to collect as rich data as possible. The length of each interview varied from 25 min to 55 min. The interviews were recorded and transcribed by a professional external organization.

Open coding [6] was used to analyze the data and define the main activities and challenges in the planning phase of a software ecosystem. The results of this analysis are reported in our already published paper [21]. In this paper, we further analyzed the tasks and challenges of the conceptualization activity of digital services by applying axial coding from the grounded theory method [6]. Axial coding was used to identify the relationships between the tasks of the conceptualization activity. The outcome of this analysis is the visualization and description of the conceptualization process that was used in Case SECO. This process was further analyzed from the RE perspective. First, we identified important RE activities the actors applied during the conceptualization process of the digital services. After this, we analyzed the benefits and relationships of the identified RE activities. Finally, we categorized the important RE activities of the conceptualization process according to requirements elicitation, analysis, representation and validation. This led us to understand the role of RE in the planning phase of a software ecosystem.

4 Results

4.1 Overview of the Conceptualization Process of Digital Services

Figure 2 summarizes **the conceptualization process of digital services in the planning phase** of Case SECO. The six actors of the software ecosystem defined a shared vision and main objectives of Case SECO in the first planning workshop before the conceptualization process started. The shared vision and main objectives provided important information for the conceptualization process and they were also adjusted during the conceptualization. The process consisted of two sub-processes: **a high-level conceptualization** and **a detailed conceptualization.**

The first sub-process, the high-level conceptualization of digital services, included three tasks: benchmarking existing similar digital services, definition of a value proposition and definition of target customer groups and customer paths. The actors of the software ecosystem did these three tasks in parallel and in an iterative manner in the first three workshops.

The second sub-process, the detailed conceptualization of digital services, consisted of four tasks: definition and prioritization of functionalities, creation of a Proof-of-Concept, determination of a Minimum Viable Product (MVP) and determination of the costs and schedule of the MVP. The actors executed the first three tasks in an iterative manner and in parallel in the third to seventh workshops. In addition, minor iterations were also done in the ninth and eleventh workshops. These three tasks provided enough information to define the costs and schedule for the MVP.

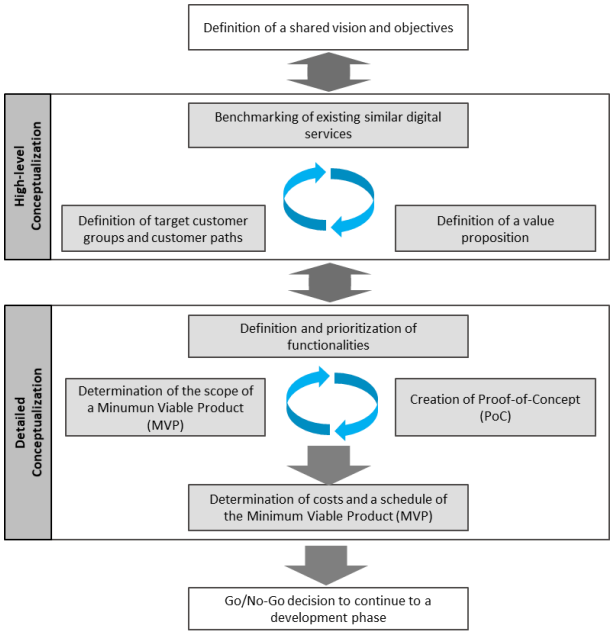

Fig. 2. The conceptualization process of digital services in the planning phase.

After the conceptualization process, the actors saw that they had enough information to make a go/no-go decision on continuing to the development phase. Although the actors understood that the estimated costs and the schedule might change after the requirements had been defined in more detail, the actors decided to continue to the development phase.

4.2 High-Level Conceptualization of Digital Services

The high-level conceptualization contained three very closely related tasks: benchmarking existing similar digital services, definition of a value proposition and definition of target customer groups and customer paths.

The **benchmarking of existing digital services** included a market review and reviewing five existing similar digital services. The market review included statistics about companies already established in Finland, for example, quantity, sizes, forms, industry and business areas. In addition, the gender, age and geographical location of new entrepreneurs were analyzed. This information was gathered from different statistics services. The market review provided information about the market potential, and it helped to understand potential target customer groups and customer paths.

The three main findings from the review of existing similar digital services were: 1) there was not much automation on processes, 2) a lot of information about establishing a company and entrepreneurship was available, but the language was quite bureaucratic and difficult to understand, and 3) the existing digital services were quite expensive. In addition, the actors realized that each existing digital service provided services at some specific point of the entrepreneur's lifecycle and solutions that support the whole lifecycle from the beginning seemed to be missing. The benchmarking of existing digital services provided important information for the definition of a value proposition, target customer groups and customer paths.

When the actors were proceeding with the tasks of the high-level conceptualization, they were also expanding the benchmarking to gain more information. For example, they studied the functionalities of the existing digital services to see if they provided learning materials for entrepreneurs or templates for the most-used business contracts.

Twenty potential end-users were interviewed to understand customer behavior and discover the main pain points they face when establishing a company and starting to be an entrepreneur. The results of the interviews were visualized. An example of the visualization is given in Figure 3. The results of the interviews impacted on the definition of the value proposition and the definition of the customer paths.

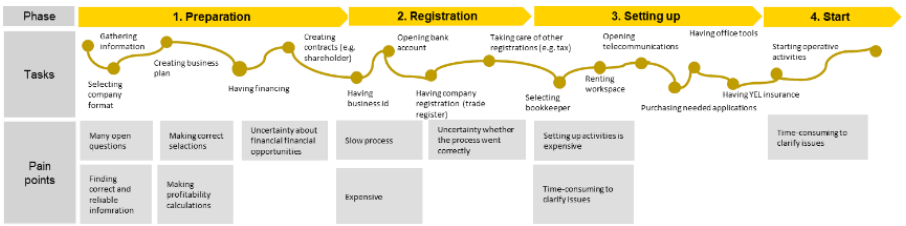

Fig. 3. Visualization of customer behavior and the main pain points of end-users.

The analysis of existing digital services and, especially, the main pain points of potential end-users provided valuable information for the definition of a **value proposition**. The value proposition of Case SECO was defined to be *"providing believable digital services for end-users, removing uncertainty and enabling carefreeness of end-users through the entrepreneur's lifecycle."* The value proposition was meant for both defined target customer groups. In addition, the actors saw that it is important that the defined value proposition does not conflict with their company's own values so that they can all stand behind it. The value proposition also had an important effect on how the digital services were communicated and marketed to stakeholders.

The benchmarking of existing similar digital services and end-user interviews addressed the need to provide digital services for people who are aiming to be entrepreneurs and those who have recently set up a company and are already entrepreneurs. These two groups were selected to be the **target customer groups** of the digital services. The two target customer groups already represented important customers for each participating actor, and they had good experience of the behavior and needs of these customers.

The main idea when defining the **customer paths** was to support the recognized behavior and remove the main pain points the end-users are currently facing. These were gathered in the potential end-user interviews. The visualization of end-user behaviors was analyzed and further refined to form the customer paths. All of the actors needed to recognize their interests in the defined customer paths even though the actors' specific offering was pointing to only one specific customer path.

Figure 4 shows the relationship between the defined target customer groups and customer paths. The first two customer paths were addressed to persons who are planning to be entrepreneurs: the digital services provide information about available company formats and recommend the most appropriate for the new entrepreneur. They can also set up a company by selecting the company format and receive the needed information during the setting-up process. In addition, the end-users can clearly see where to commit and what the upcoming costs will be. The third customer path serves both target customer groups. The entrepreneur can order tools, services and insurances for operating the company. The ordering process is smooth, and the status and costs are visible to the end-user.

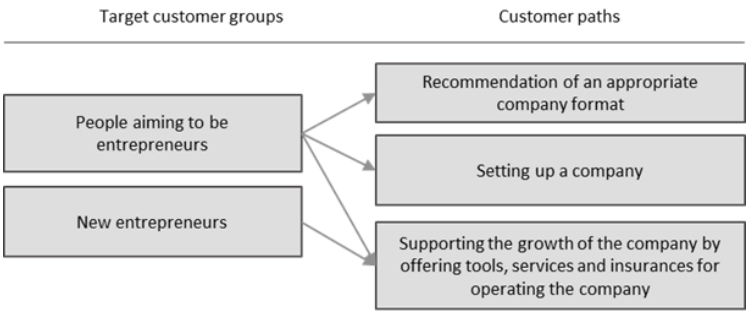

Fig. 4. Relationships between target customer groups and customer paths.

4.3 Detailed Conceptualization of Digital Services

The starting point for the detailed conceptualization of digital services was the defined value proposition, target customer groups and customer paths, which the actors of the software ecosystem did together during the first sub-process. The second sub-process consisted of defining and prioritizing functionalities, creating the Proof-of-Concept (PoC), determining the Minimum Viable Product (MVP) and determining the costs and schedule of the MVP. The actors also had a possibility to shape the results of the high-level conceptualization during the detailed conceptualization process.

The main customer paths were further refined by defining main **functionalities** of the digital services, which can be seen in Figure 5. In addition, the first **prioritization** for the main functionalities was also done. The defined value proposition guided the definition and prioritization of the main functionalities.

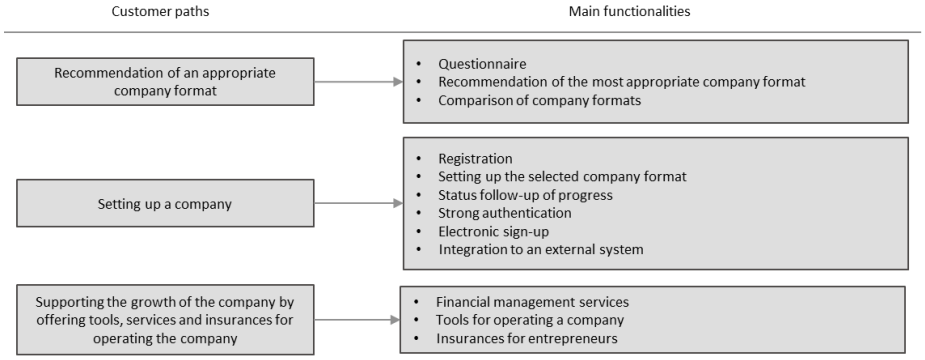

Fig. 5. Relationships between the customer paths and the main functionalities.

The **Proof-of-Concept** was a user interface prototype where the top prioritized functionalities for the main customer paths were drafted and the layout and main interactions defined. The PoC enabled the concrete look and feel of the planned digital services. Potential end-users and the actors tested the PoC and feedback was gathered and discussed in the workshops. The PoC helped the actors to consider the prioritized functionalities, define them in more detail and determine the MVP. During the second sub-process, the PoC was further modified to correspond to the desired set of functionalities and the MVP.

The **Minimum Viable Product** was defined based on the information the PoC provided. The actors agreed that a winning end-user experience should be already in place in the MVP. This meant that everything the end-user sees and how the functionalities work for them should be in place already at the first launch and should not change during the next versions. In this Case SECO, the definition of the MVP on that level was done without disagreements.

After the scope of the MVP was defined, the functionalities were further divided into more detailed requirements. In addition, the main quality requirements were also determined. The first version of a high-level product backlog of the MVP was composed, where all the detailed functional and quality requirements were listed. The actors went

through the backlog and considered it against the defined value proposition, target customer groups and customer paths and made some further changes to the prioritization. The result was a prioritized high-level product backlog.

After the MVP had been defined, an overall view of **costs** and a development **schedule** of the MVP were preliminarily determined. The costs included costs for the work needed during the development as well as costs for the technologies and services used. In addition, preliminary costs for continuous services were also estimated. The schedule was based on the estimated work effort for the development and a full time equivalent (FTE) development team. The overall estimation of the costs and the schedule at this point worked as information for decision-making on proceeding. The actors understood that it was an estimation and might change after the definitions of the requirements had become more accurate and the actual development work had started.

4.4 RE Activities of the Conceptualization Process of Digital Services

Table 2 summarizes the set of RE activities that we recommend based on the analysis of the conceptualization process of Case SECO. These RE activities had an important role in the iterative conceptualization process. We categorize the first four (1-4) RE activities to be important requirements elicitation and analysis practices that provide valuable information about the market potential, existing digital services, and especially needs of potential end-users.

The following four RE activities (5-8) can be categorized to be modelling and documentation practices. Before the definition of functionalities of digital services, it was important to define clearly the most relevant target customer groups for whom the digital services will be developed and their customer paths the digital services will support. The starting point for all these modelling practices was to define a value proposition that sets the most important objectives of digital services from the perspective of end-users.

The traceability activity (Activity 9) can be classified to be a very important requirements management practice. Its purpose is to ensure the traceability from the defined functionalities to the value proposition, target customer groups and customer paths of digital services and further to the vision and objectives of the software ecosystem. This traceability activity helped the actors of Case SECO to prioritize functionalities as a team (Activity 10) and define the scope of the MVP (Activity 12).

Prototyping (Activity 11) was one important activity that was used to validate the prioritized functionalities and the definition of the MVP. Organizing workshops throughout the conceptualization process and conducting the RE activities iteratively also supported the validation of the important outcomes of the conceptualization.

Table 2. Important RE activities of the conceptualization process of Case SECO.

ID	RE activity	Benefits
1	Conducting a market review	Getting information about the market potential
2	Benchmarking existing services	Understanding the functionalities and weaknesses of the existing digital services
3	Interviewing potential end-users	Gaining a deep understanding of user needs such as their current processes, behavior, and pain points.
4	Visualizing customer behavior	Clarifying the current tasks and pain points of potential end-users
5	Defining a value proposition	Deciding the most important objectives of digital services from the perspective of end-users
6	Defining target customer groups	Selecting the most relevant customer groups for whom the digital services will be developed
7	Defining customer paths	Determining targeted customer paths for the defined target customer groups
8	Defining main functionalities	Describing the digital services in more detail and enabling a definition of costs and a schedule for the development of the digital services
9	Ensuring traceability from the vision to functionalities	Helping actors to make compromises and prioritize functionalities and commit to the digital services
10	Prioritizing functionalities as a team	Ensuring that digital services fulfill the defined vision and objectives of the software ecosystem
11	Building a user-interface prototype	Validating the prioritized functionalities and the definition of the MVP
12	Defining the Minimum Viable Product (MVP)	Enabling the launch of a first useful version of the digital service as soon as possible
13	Organizing workshops with all actors	Building trust between all actors and commitment to the created software ecosystem
14	Conducting RE practices iteratively	Enabling enhancements to the outcomes of the conceptualization process

4.5 Challenges in the Conceptualization Process

The actors did not face any remarkable challenges during the high-level conceptualization. The main reasons were that the tasks in the high-level conceptualization were executed based on the shared vision and objectives, which the actors had defined together, and the participating actors were very familiar with the substance of the tasks. In addition, the actors did not need to think about costs and schedules yet during the high-level conceptualization.

During the detailed conceptualization, the actors faced three main challenges: 1) it was difficult to define the MVP and prioritize functionalities, 2) they had difficulties understanding the needed definition level of the digital services, and 3) they did not have enough substantive knowledge to define common functionalities of the digital services.

The definition of the MVP and prioritization of functionalities was challenging because it required some compromises from the actors. The actors accepted this and understood that the prioritization and thereby the MVP was based on the tasks that they defined very carefully together in the high-level conceptualization and which were strongly based on the shared vision and objectives.

The actors were not sure how detailed the definitions of the requirements should be to gain enough information about the costs and schedule in order to ensure that their go/no-go decision for the proceeding was correct. In addition, the actors considered that they did not have enough substantive knowledge to define the common functionalities (e.g. registering, interactions, security and layout) of the digital services. The detailed conceptualization was an important sub-process and ensured the needed information for the decision-making. Thus, the second sub-process should have included participants who were experts in detailed conceptualization.

5 Discussion

5.1 Requirement Engineering in the Planning Phase of a Software Ecosystem

In this study, we identified the conceptualization process of digital services that was used by the actors in the planning phase of the software ecosystem. One important characteristic of the conceptualization process was that the actors defined the value proposition, the target customer groups and the customer paths of digital services together. It was also important that the value proposition, target customer groups and customer paths were defined based on the vision and objectives of the software ecosystem. This high-level conceptualization ensured that the business view was considered systematically during the planning of the digital services.

Previous research has also highlighted the importance of a business perspective in software ecosystem creation. For example, Yu and Deng [27] stressed the importance of strategic goal definition and Valenca et al. [23] also reported the need for strategic alliances in small- and medium-sized software ecosystems. In addition, Villeda et al. [25] recognized the need for the software ecosystem concept, which included a definition of the business strategy and needed software services from actors to accomplish the strategy.

Our findings support the results of Pichlis et al. [19]. They have reported the need of the common value proposition when developing a software ecosystem. Defining value propositions, target customer groups and customer processes of digital services can also be considered an important part of RE especially when connecting RE to business planning [14].

The analysis of the current pain points of customer processes was one of the critical tasks of the conceptualization process. The purpose of the software ecosystem was to remove these pain points. Gaining a deep understanding of customers' current processes and their problems is also an essential part of requirements elicitation.

During the detailed conceptualization, the actors felt it was challenging to define the MVP and prioritize functionalities. Valenca et al. [23] have also pointed out the

challenges in prioritizing product features in a software ecosystem. Requirements prioritization is a challenging RE activity that has been investigated for decades, and researchers have proposed a large number of prioritization methods [3].

The actors needed to make compromises when they prioritized functionalities and defined the MVP during the planning phase of the software ecosystem. Even though the actors found requirements prioritization challenging, they accepted the compromises, because it was very transparent how the MVP was derived from the together defined value proposition, target customer groups and customer paths. Therefore, the actors knew that the MVP fulfilled the vision and objectives of their software ecosystem. This is an example how the actors of the software ecosystem were able to prioritize the requirements of the MVP together without using requirements prioritization methods.

The social view and collaboration were emphasized in the planning phase of this software ecosystem. It was essential that the actors worked coequally and iteratively together during the planning phase. They made decisions together and committed to the results of the conceptualization process. Previous studies have also pointed out the social view of software ecosystems [e.g. 8]. Fricker [8] highlighted negotiation issues. Our case study indicates that negotiation issues are easier to avoid if the conceptualization process is done carefully together and the dependencies between tasks in the conceptualization process are clear and visible. The small number of actors also impacted on the ease of negotiation compared to large-scale software ecosystems with a correspondingly large number of actors.

Our paper presents how the business and social views were considered during the planning of the real-life software ecosystem. For practitioners, the paper provides knowledge on how actors can start building a software ecosystem together from a business perspective. In addition, our study points out the important role of RE activities to link the business view to the development of the MVP of digital services in the software ecosystem.

5.2 Threats to Validity

Here, we discuss four potential threats to the validity of the results. First, the interviews were conducted six months after the planning phase had ended. This might lead to deviations in the answers of the interviewees. This threat was mitigated by the researcher encouraging the interviewees to try to answer as they felt during the planning phase. In addition, the objectives of the study and the interviewee's rights and responsibilities were presented to them. The interviewees knew that the interviews were anonymous, and the material would be kept confidential. Therefore, it could be assumed that the interviewees gave honest answers.

Secondly, one of the limitations of this study is that only one representative from each actor was interviewed. Triangulation of the data sources was used to reduce this validity threat. The detailed material from the workshops was another source of data.

The third validity issue concerns investigator triangulation, which we were able to use in a restricted way. The first author of the paper was responsible for the design, execution, analysis and reporting of the study, and the second author reviewed the

results of the study. The first author started to work at Case SECO after the planning phase, which enabled them to consider the planning phase neutrally. In addition, participation in Case SECO after the planning phase enabled her to understand the context and actors in detail.

The fourth limitation is that the findings of this study are derived from a single case study, where the case software ecosystem was quite small. It could be assumed that similar findings are achievable by conducting the same research, investigating the planning phase of another software ecosystem or repeating the same research for this case software ecosystem.

6 Conclusions

The results of this study give detailed information for practitioners on how to conceptualize digital services in the planning phase of a software ecosystem. The results show how the business view can be incorporated systematically into the conceptualization of digital services and how actors can work together during the planning phase. If actors create the vision and objectives of the software ecosystem carefully together, it supports them in defining the MVP and prioritizing the functionalities of digital services. The results of the study also show that RE has a critical role in the planning phase of the software ecosystem. RE ensures traceability from the prioritized functionalities of the MVP to a value proposition, target customer groups and customer paths of digital services and further to the vision and objectives of the software ecosystem.

Our future research goal is to gain more detailed knowledge of how actors can conceptualize and develop digital services together in a software ecosystem. We also plan to conduct case studies and gather data from other software ecosystems in order to validate the findings of this study especially from the perspective of RE.

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