Adoption of Open Source Software and Software-as-a-Service models in the Telecommunication Industry

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Abstract. A case research is carried out on adoption of open source software (OSS) and software-as-a-service (SaaS) in the telecommunication industry. The study was conducted to examine the types of software deployed as OSS and SaaS and the conditions of adopting OSS and SaaS. Findings of the case study indicate that industry-specific software is not developed as OSS or deployed in SaaS mode. Based on the findings, we also arrive at conclusion: Adoption is hindered by specificity of processes and technology interfaces.

Keywords: Open source software, Software-as-a-Service, Telecommunication, Vertical Software Industries.

1 Introduction

Examining software business from the perspective of information systems (IS) science, software business is all about outsourcing the IS function. In the context of vertical software industry[1], software business takes place in dyadic relationship between a vertical industry enterprise and a vendor providing software products or services [1]. The vertical industry enterprise usually has its own unit or employees to produce certain parts of the IS function itself [2]. Alternatively, the enterprise may find it more efficient to outsource software development, deployment and operating to an external vendor. Nelson et al. [3] have provided an examination on which types of information systems are being outsourced. They found that common applications based on common technology are more likely to be acquired as packaged software, whereas specialized and unique applications require custom software development.

[1] *Vertical software industry* comprises of vertical industry enterprises (secondary software companies and software vendors (primary software companies), producing software products and services for the specific needs of the vertical industry. Vertical industry (e.g. telecommunication) has a clear specialization and limited transferability of skills and knowledge outside its own domain. Later, the term *industry-specific software* is used to describe software, which cannot be easily redeployed in other vertical industries than its original domain, as opposed to producing horizontal (general-purpose) software.

Further, unique applications based on common technology are more likely to be insourced and common application based on advanced technology are rather outsourced. The common development in the vertical software industries is that once unique and differentiating software depreciate into commodity [1, 4].

The software business setting in vertical software industries is also relevant when investigating the adoption of open source software and software-as-a-service. To facilitate such examination below, we define the concept based on contemporary literature as follows. *Open source software* (OSS) refers to product software, which is produced in collaborative manner and made available royalty free and with relaxed license terms. The terms allow to running, distributing and modifying the source code, for both commercial and non-commercial use. [5–8]. *Software-as-a-Service* (SaaS) is a type of software-based service where a service provided offers access to the functionalities of a commodity software over the Internet to several end-users, running a single instance of the particular software on top of multi-tenant infrastructure [9–11]. These definitions imply that OSS is a model for organizing software development and maintenance and, in turn, SaaS is a model for orchestrating software deployment and operating. Further, both OSS and SaaS can be treated as means to outsource software-related activities from vertical industry enterprise to external vendor.

The utilization of OSS has increased remarkably in the last decade. In the development of software programs and even large software systems, open source has become a serious alternative for the utilization of proprietary software [5, 6]. As one of the manifestations of cloud computing, even higher expectations are set to SaaS offerings. Primarily for established software vendors, SaaS presents an opportunity to add value in form of service offering, even as the product business declines [12]. Customers are also offered economic, flexibility and strategic benefits [11]. Against this background, it is interesting to examine why OSS and SaaS have not become widespread in industry-specific software. Conducted literature review reveals that this question has not been addressed before with regard to the two models.

Consequently, the following questions are of particular interest in this study: 1) Which types of software do the vertical industry enterprises deploy using OSS and SaaS models? 2) Do the vertical industry enterprises perceive value of OSS and SaaS differently? 3) Which factors drive and inhibit adoption of OSS and SaaS offering in vertical industry enterprises? These questions are set with the intention to generate an overview to the adoption of OSS and SaaS models and to compare these models to other business models in software business (e.g. with bespoke software) through their benefits and problems. We seek answers to the questions by adopting an exploratory approach and, therefore, the aim of our study was to arrive at a hypothesis on the factors affecting the OSS and SaaS adoption.

Our empirical investigation is conducted in the context of telecommunication software, where communication service providers (CSP) and software vendors serving them form the vertical software industry. Software specific to this industry supports CSP's day-to-day processes for service fulfillment, service assurance and billing as well as infrastructure development processes. Specifically, two types of software are considered to fall under this definition. First, operations support systems are software systems supporting telecommunication network management processes such as maintaining network inventory, provisioning services, configuring network

components, collecting and mediating usage information and managing faults [13]. Second, business support systems are software systems supporting customer management processes including taking orders, providing customer service, processing bills and collecting payments [13]. This definition of telecommunication software excludes e.g. software used in mobile terminals, where OSS is used in different forms and to a different extent. Telecommunication software industry was chosen as the context for investigation for its plurality: operation support systems were assumed to incorporate specific knowledge that cannot be redeployed in other industries, whereas business support systems support processes common to many vertical industries.

The article has four further sections. Next section gives an overview on relevant literature concerning the OSS and SaaS adoption. Section three introduces the case study methodology applied. In section four, we present the findings made in the empirical study about the context of the particular vertical software industry, and about the current OSS and SaaS adoption in the industry. In the concluding section, we discuss the findings against the research questions and present two hypothesis for further studies.

2 Literature Review

2.1 Open Source Software Adoption

The research on OSS has progressed in the last decade. Most of the earlier literature focused on the motivations of individuals to contribute to the communities, open source project management issues and on general descriptions of the model [5]. More recent studies have additionally aimed at observing the adoption of OSS in organizations, through clarifying the benefits and problems of OSS adoption [5, 14–21] through examining which kind of OSS are deployed [5, 17, 18] and through studying the antecedents of adoption [5, 22, 23].

Ajila and Wu [14] suggest that the benefits of OSS are associated with reuse: customers receive added value from reduced time to market, reduced product development costs, improved process predictability and increased product quality. Their study also indicates that when organizations perform OSS component reuse in a systematic manner, organizations can attain economic benefits, increased productivity and increased quality. These observations are in line with many other similar research results, which often state lower costs, higher quality, adaptability and reduced dependency on vendor as the main benefits of OSS [14, 16, 18, 19]. The papers reporting on OSS adoption [21, 22] analogously ascertain that the decision making in organizations culminates on assessing potential cost benefits, on opportunities to exploit communities' resources and knowledge, and on functionalities and maturity of the software under consideration. Maturity is stressed by [20, 21] stating that both the customers and the vendors may hold their actions until dominant design emerges, and act only when peers are deploying OSS. To conclude, important determinants for

adoption are, uniformly to general IS outsourcing, economics of the offering, capabilities and commodification.

There are fewer studies questioning the claimed benefits [5, 19, 22]. Ven et al. [19] raise several arguments, for instance OSS itself may be for free, but the switching costs as well as total costs are unclear. Performing customization and modifications to the source code may also turn out impractical in case the organization is missing required skills [5, 16]. Finally, whereas using OSS reduces vendor lock-in in software development, dependency on the vendor providing supporting services may increase [5, 19].

The advantages of OSS are examined in the literature mainly from the viewpoint of software intensive enterprise. To our knowledge, there are also studies targeting vertical industry enterprises [16, 22, 23] and a single study with focus solely on secondary software enterprises [15], in which the authors interviewed representatives of 13 companies from different vertical industries. They found that incentive to innovate and collaborate (by virtue of access to source code) reduced vendor lock-in and diminished costs were the most important business-related benefits. Technical benefits included various elements of software quality such as performance, security, flexibility and interoperability, and the respondents of the study indicated that these outweigh the drawbacks (lack of OSS expertise and poor documentation). As business-related problems, the study lists e.g. lack of ownership and support, which denotes that the vertical industry enterprises may find it difficult to find a service provider taking responsibility over support. While [5, 16, 22, 23] lists several other qualities in favor of and against OSS, and also some which do not usually appear in OSS literature, none of authors did explicitly compare motivations of secondary software enterprises to general findings across OSS literature. Overall, there appears to be a paucity of published empirical research on how motivations to deploy OSS differ in vertical industry enterprises.

Studies on industry-specific software developed in open source communities further seem non-existent. Current academic literature concerns horizontal infrastructure software [5, 17, 18, 23] almost exclusively and the industry-specific OSS may perhaps come forth in next wave of publications [8]. It seems that proper business models are missing in provisioning of OSS for vertical industries [16].

2.2 Software-as-a-Service Adoption

Contemporary academic literature is mostly limited to describing the architectural and technical properties of the SaaS offering and, in terms of adoption, suggesting advantages and downsides of the model. [11] and [24] were among the first to introduce claimed value propositions: less need for internal IT resources, and lower initial and total costs. These economic benefits are associated with the deployment and distribution model of SaaS, enabling service provider to achieve economies of scale [11, 25]. In addition to the economic value, customers may gain flexibility advantages such as prompt deployment, scalability, easily accessible updates and patches and, additionally, strategic benefits like increased bargaining power over vendors [11, 24–28]. Offering and using SaaS may also create problems compared to traditional means of deploying software systems. Using SaaS, customer is exposed to

risks of losing control of business-critical data [24, 25, 29], thus not being able to access the service or experience inferior performance owing to the distribution of the service over the Internet [24, 27, 29]. Extensive integration and need for customizations may also reduce the attainable benefits compared to other business models in software business [30].

Similarly to OSS, well-known examples of SaaS are horizontal and employed in multiple industries [25, 29]. Excluding infrastructure software (which are rather part of platform-as-a-service offering), in services to business customers, SaaS model is mostly applied to email, customer relationship management, human resources management and financial management applications. In services to individual consumers, SaaS is applied to social media applications (e.g. Blogger, Facebook) and to storage and office applications (e.g. Dropbox, Google Apps).

Despite the enthusiasm towards SaaS model, relatively limited amount of research on the actual volume, reasons and experiences of adoption is available. However, few insightful studies can be found. Xin and Levina [31], reporting a research in progress, hypothesize that customization and need for client-specific functionalities, required service volume, internal IT capabilities among few other factors derived from IS outsourcing literature would be determinants for SaaS adoption. Benlian et al. [32] examined adoption of different types of applications using SaaS model. Applying transaction cost theory, resource-based view of firm, and theory of planned behavior, the authors found that in office applications attitude towards SaaS adoption and SaaS adoption can be explained by subjective norm, by low level of specificity and low level of adoption uncertainty. Correspondingly, when analyzing ERP systems, SaaS adoption is explained by higher adoption uncertainty, higher strategic value of application and higher application inimitability. This result can be interpreted in a way that standard applications and applications which are not supporting core processes of the enterprise may be offered and adopted using SaaS model.

3 Research Method

Using empirical data, this study examines the adoption of OSS and SaaS model in the telecommunication industry. Specifically, present study analyzes why adoption takes place, which factors drive and which inhibit adoption of OSS and SaaS. Moreover, we examine how adoption occurs in the companies of the specific industry, both on the client-side and on the vendor-side. This study applies exploratory approach [33] and case research [34] including a total of eight companies. Out of the total, six are communication service providers (CSP) and two are companies producing software products and services. The case study approach was chosen because of the lack of previous research and explanations on limited adoption of OSS and SaaS in industry-specific software. Therefore, motivation to conduct case research was to increase understanding on the specific context of vertical software industries [35]. Furthermore, case research has been argued to apply for initial identification of cause-effect relationships and forming hypothesis for further studies [34].

Telecommunication industry was selected as the target domain, since it clearly exhibits characteristics of a vertical industry that were thought also to affect the

software business setting. First, software systems in this domain are required to interface with telecommunication networks. In addition, software systems are required to support processes specific to the industry. Furthermore, analyzing the properties of operations support systems and business support systems used in the domain, it was assumed that the domain would have both industry-specific and horizontal software systems, facilitating more insightful analysis on adoption of OSS and SaaS. The set of companies was selected to the case study through both purposive and convenience sampling [36]. For the former part, the sampling frame consisted of finding case companies of different sizes and breadth of operations and finding markets within telecommunication industry with different phases of maturity. Consequently, European and Chinese communication service providers were first selected as the target group of this study. Secondly, we also wanted to incorporate the software vendor's viewpoint into the study and, therefore, the inquiry was targeted to software vendors serving the communication service providers. These vendors are typically well aware of the customer needs and trends, and often push the adoption of new technologies and models.

The present study was executed in 2010, using two main sources of information: public documents and interviews. We initiated the study by gathering general background information on the case companies from their own and other public web pages. Case company details are summarized in Table 1, including company type, geographical area, and company size measured by revenue in the year 2009. With regards to the company type and revenue, it is noteworthy that they are defined based on the primary source of information, namely the respondents organizational unit.

The interviews were conducted as semi-structure interviews consisting of both fixed and open-ended questions. The questions covered operational environment, software acquisition strategies and adoption of OSS and SaaS in particular. Questions concerning operational environment attempted to prioritize between certain focus areas and capabilities: increasing customer base, network technologies and their development, operational efficiency and new services making possible new sources of revenue. It was hypothesized that business focus would affect software acquisitions strategies, i.e. whether software-related activities are insourced or outsourced, or whether CSP would prefer to acquire bespoke software or software product. These aspects were asked from CSPs through ratio of spending between internal versus outsourced development and bespoke versus product software, respectively. Additionally, the reasons for the selected strategy were asked. Further, both business focus and software acquisition strategy were seen as associated with OSS and SaaS adoption. Both the OSS mode of development and the SaaS mode of deployment assume outsourcing and relatively high level of commodification. Therefore, the more CSPs outsource there is function and utilize product software, the more OSS and SaaS should become a viable alternative. The questions on OSS and SaaS adoption simply comprised of open-ended questions on whether, how and why the models were adopted in the CSP software systems. All the respondents were asked essentially the same questions.

The interviews were mostly accomplished by the authors. The interviews were digitally recorded and transcribed. A Chinese scholar interviewed the service providers E and F. For these interviews, the questions were first translated into local language and Chinese scholar was instructed in performing the interviews. Later,

responses were later translated to English. Due to confidentiality reasons, these interviews were not recorded, but the interviewer made notes on the questionnaire form.

As presented in the Table 1, the interviewees represented different positions in their organization. The main criterion for interviewed persons among the CSPs was that they were actively involved in their firm's decision-making regarding acquisition and deployment of software systems. In the software companies, we selected respondents who were frequently in contact with their customers and were consequently acquainted with their customers' needs, decision-making criteria and actions. Also, we interviewed those employees responsible of development of software products.

Table 1. Details of the case companies.

	Company type	**Area**	**Revenue in 2009 (Euros)**	**Respondent**	**Mode**
Service provider A	Group of 28 regional operators	Europe	consolidated, 450 million	CEO	In-depth interview
Service provider B	Affiliate of global CSP	Europe	close to 1 billion	IT manager	Focused interview
Service provider C	National, incumbent CSP	Europe	over 12 billion	IT manager	Focused interview
Service provider D	Affiliate of global CSP	Europe	over 1,5 billion	Director, R&D	In-depth interview
Service provider E	Provincial branch of national CSP	China	estimated 450 million	IT manager	Focused interview
Service provider F	Provincial branch of national CSP	China	estimated 750 million	Business manager	Focused interview
Software vendor A	Global telecom software vendor	Europe	consolidated sales over 12 billion	R&D managers	Two focused interviews
Software vendor B	Global telecom software vendor	China	consolidated sales over 12 billion	Account and R&D manager	Two focused interviews
Software vendor C	Global system integrator	Europe	consolidated, close to 75 billion	Account manager	Focused interview

With the software vendor producing software especially for telecommunication, we had the possibility to carry out two interviews in both Europe and China. In China,

these interviews complemented the answers by the CSPs and enabled verifying certain aspects regarding the operational environment. While most of the interviews were so called focused interviews, we also conducted two in-depth interviews with informants. By *focused interviews*, we refer to a single interview [34], which in the present study usually took approximately two hours. By *in-depth interview*, we refer to an interaction with the informant over longer period of time involving at least two interview sessions [34]. This enabled asking more detailed questions and confirming initial observations.

Data analysis followed the principles of qualitative research on parallel data reduction, data display and drawing conclusions [36]. First, the data was organized by identifying unique patterns in each case on the basis of interview themes and research questions. These themes were operating environment, software acquisition, and adoption of OSS and SaaS. Pattern matching [34, p. 136] enabled analyzing factors within the cases. Next cross-case synthesis technique was employed, enabling comparing the cases and aggregating the data [34, p. 156]. Overall, particular emphasis was on aspects explaining adoption of OSS and SaaS across the cases, on comparing customers and vendors viewpoints and on potential connections between the context (operating environment and software procurement) and adoption of OSS and SaaS.

4 Research Findings

In the following, the observations made in the empirical study are presented by categorizing them according to the interview themes. The operational environment and general alignments in developing, deploying and operating software should be treated as the context, where the contemporary models of software business may be examined.

Properties of the operational environment were realized through examination of communication service providers' business focus and required organizational capabilities. Surprisingly, there was much variety among European CSPs. Service providers A and B saw increasing customer base as most important focus area. In contrary, service providers C and D perceived operational efficiency and new service development as most critical. While this may be due to the positions of the companies in their market (market leaders and challengers), respondent in CSP C highlighted that the telecommunication market is already saturated and that developing new services is possible only through understanding customer needs. In China, the market is still growing and service providers focus on customer acquisition and improving quality of their network services.

Both the European and Chinese service providers suggested that the capability of being able to customize standard technologies to match the customer needs will be critical in the future. Overall, CSPs seem to be transforming from technology-orientated to customer-orientated companies. One of the interviewees from service provider C described this change:

"We started out as a true technicians' company. We had an advantage because we were the only operator so selling your services was easy. That changed with the competition from cable companies around two years ago. We said ok, the customer is the central of our world and technology is a way to attract the customer."

Software procurement activity in the service provider firms was investigated through outsourcing viewpoint. Questions on this topic focused on reasons to outsource and spending on software related activities. Currently, majority of software development and deployment is outsourced. Chinese CSPs estimated the ratio of expenditures between internal work and outsourcing expenses to be around one to nine. In European CSPs, the ratio varies. For example, CSP B told that these activities are solely in the hands of the vendors, whereas firms C and D estimated the outsourcing ratio to be between 60 to 70 percent.

The European interviewees stated cost-efficiency to be the most important reason for outsourcing. In China, outsourcing may additionally be explained by a lack of high-end capability. One informant from software vendor B explained this as follows:

"Chinese operators do not have capabilities to develop software themselves. CSPs and ISVs co-operate in developing and deploying their operations support systems and business support systems, making it almost all tailor-made... Operating is mostly organized by the CSP."

We also asked the ratio of spending between bespoke systems and software products. Chinese CSPs reported that their software systems, specifically used in producing telecommunication services, are fully bespoke. European CSPs (B, C, D) in turn attempt to employ software products as much as possible. However, the reality with all the CSPs is that company-specific legacy systems cannot be replaced. Reasons for this include complex network interfaces, company-specific procedures and sunk costs. The situation is different between business support systems (for customer management and billing) and in operation support systems (for provisioning, ticketing and mediation). Replacing business support systems with standard solutions is more straightforward; standards for processes of customer management and billing exist and deploying standard software products have become possible.

4.1 Open Source Software Adoption

In the telecommunication industry, OSS is mainly deployed in infrastructure software. Mentioned software included Linux, Apache and MySQL. The software vendor C informed that there are many initiatives, which drive open source adoption and CSPs are increasing use of OSS components in the future. However, it was found that open source is not in use in industry-specific software. The software vendor C expressed his opinion that OSS "does not fit" to software specific to the telecommunication industry and there are no communities to develop them. With regards to infrastructure software, open source is nowadays a common practice and

OSS is used as part of the software system deliveries. Respondent from software vendor B described the use of OSS as follows:

"Operators are using open source, mainly in applications provided for customers. There is no preference in using either open source or proprietary solution, rather they want functioning and secure (and cheap) solution. OSS is more common in infrastructure software than in application software."

In contrary, one of the informants (in CSP D) underlined that the use of open source is avoided in business-critical systems and in services visible to their customers. He suggested that open source can be applied to systems supporting internal processes and to "enterprise-grade" systems, but in "carrier-grade" systems proprietary solutions are preferred.

OSS is mainly adopted because of the cost factors (CSPs B, C, D, F), although CSP D commented that OSS is not cheaper by an order of magnitude when looking at overall costs. Use of OSS is also motivated by the capabilities and resources available through the communities. With CSPs A and C, this is related to the lack of internal capabilities and to the efforts to generate new sources of revenue. Many service providers believe that flexibility is also an important benefit for OSS, including fast time-to-market. Service provider B sees flexibility in form of future capabilities allowing customization of standard building blocks.

Barriers for adopting OSS in telecommunication industry include lack of internal capabilities (CSPs B, C, D), fear of liabilities (CSPs A, C, Vendor A), associated control risks and uncertainties in business continuation (CSP A, B, C, D). According to the respondents, lack of internal expertise leads to situations where obtaining commercial supporting service becomes necessary and as a result cost advantages are diminished. Uncertainties and fear of liabilities are linked to the complexity of different open source licenses. In addition, service providers A and D mentioned that they are not using open source, as no viable offering is available.

4.2 Software-as-a-Service Adoption

Similarly to OSS, SaaS adoption is connected to the cost benefits (CSPs B, F) and principally to the flexibility of SaaS offering. The service providers A, B, C and D presented ease of procurement, ease of maintenance and swift time-to-market as components of flexibility. However, respondents were concerned with the total costs and for instance CSP C disclosed such uncertainty as inhibiting factor to SaaS adoption. The Chinese service providers are not applying SaaS, because their suppliers are not providing it. This was explained by the software vendors A and B; in software vendors currently have a strong customer lock-in (no incentives to offer SaaS) and systems are acquired as custom deployments (transformation to SaaS would be difficult). Service provider B called for industry standards in speeding up the development.

Common concerns related to SaaS mode included integration and security issues (CSPs B,C,D,E). For instance, CSPs are obliged by law to apply high data security measures on call data records, which SaaS vendors are not able to comply with.

Problems with integration are related to the properties of SaaS offering. The mode of deployment assumes standard processes and interfaces, which does not match the attributes of industry-specific software. Informant in CSP C described the issues related to company-specific processes and network technologies:

"It is a combination of the two things. We've got a variety of network technologies in our network, for historical reasons. And that doesn't help in making it easier to outsource it because both of them are completely different. So try to outsource that to one and same company in itself it's a challenge. Try to rationalize and simplify the processes around it is also a challenge... Yeah, I would be inclined to say that it is more challenging to outsource in the OSS side of fence than BSS of fence."

However, the SaaS mode of deployment has already been adopted in several companies in the telecommunication industry (CSP A, B, C, D, F). Deployed software are horizontal, e.g. for financial management and customer relationship management. SaaS is also in use in the business support systems. However, in the companies interviewed, SaaS mode of deployment is not applied for industry-specific software. Service provider D described the adoption of SaaS in their organization:

"SaaS deployments have progressed and CRM system is in production in one business unit. New projects to deploy SaaS have been initiated in the area of business support systems... Attitude towards SaaS is more and more positive."

With regards to third-party software, the most of the operators (CSP B, C, D, F) see their role in the value chain as reseller and operator of the services, and have already taken such role. The CSP A's strategy in providing third-party software is to increase customer lock-in, by providing a combination of IT and communication services, and envisions operating in both intermediating and aggregating roles, and has already launched product concept to do so. The service provider D is aiming for an aggregator role, where CSP offers multiple SaaS products for end-users. Such role is seen natural, and CSPs are expected to take such role in its ecosystem.

5 Conclusions and Further Research

This study has focused on different aspects of OSS and SaaS adoption in the context of vertical software industry. This is a perspective, which has received limited attention in the contemporary literature, although a significant share of software business takes place in this context. Examination of the facets of the vertical industries may to bring into focus certain factors explaining the adoption or non-adoption, which do not manifest in the procurement of more generic software. In this study, the dynamics of software business in the telecommunication industry were examined. It was regarded as suitable target domain for analysis as it demonstrates characteristics of vertical industry enterprises that are both generic (like selling and using CRM) and industry-specific (like provisioning mobile subscriptions and managing network elements). Conducting a multicase study involving both

communication service providers and software vendors serving them therefore facilitated insightful examination on software business in vertical software industry.

The interview data uncovers that OSS mode of development and SaaS mode of deployment are currently utilized by the communication service providers in horizontal software: OSS in infrastructure software and SaaS in customer relationship management and financial management software systems, which can all be used similarly in many vertical industries. Industry-specific software (i.e. operation support systems) is not developed as open source or deployed as a service. This observation addressing the first research question has two further consequences.

First, it signifies that the perceptions and experiences of interviewees on OSS and SaaS can only be associated with horizontal software. However, this allows us to position the empirical findings more easily against the prior literature. The respondents mentioned mostly similar benefits and disadvantages of OSS and SaaS as in earlier studies:

- The benefits of OSS include cost efficiency [15, 21, 22], resources and knowledge of the communities [21, 22], reduced time-to-market [14] and adaptability [14] of source code. Lack of internal capabilities to maintain OSS [5, 15, 16] and resulting increased dependency on support services [5, 15, 19] were considered as problems of OSS.
- SaaS model was regarded as beneficial in terms of flexibility [11, 24–28] in procuring, deploying and maintaining the software. Cost benefits [11, 24] were also mentioned, but the respondents also raised a question whether the total costs of utilizing SaaS would actually be lower over longer period of time compared to other deployment models. The problems with the model to be solved include issues related to security [24, 27, 29] and integration [30].

In this research, the value of OSS and SaaS was examined primarily through advantages and disadvantages of the models compared to more traditional business models incorporating bespoke software or software products. Taking into account that the specific attributes of industry-specific software most probably did not affect respondents assessment of OSS and SaaS, a partial answer to the second research question may be given: conducted case research indicates that the communication service providers see the value of OSS and SaaS consistently with companies in other domains.

The adoption of OSS and SaaS in only certain types of software, and non-adoption in certain others, moreover indicates that there are factors in the operating environment and in the software business setting, which simultaneously drive and inhibit adoption of OSS and SaaS models. As revealed by the case research, the decision-making on software procurement in communication service provider firms is presently business-driven. There are concurrent pressures to reduce expenditures on software and to deliver compelling services of highest quality. Such pressures drive e.g. acting as sales channel for third-party SaaS offering. This also informs us that certain technology, specifically horizontal business support systems, does not to any further extent provide significant competitive advantage to the firms. Instead, focus is on new technologies and services that further makes commoditized software subject to outsourcing and cost considerations. This observation is in line with previous studies, in which productization [1] and commodification [4] are seen as leading to increase in adoption of OSS and SaaS models.

On the other hand, it can be stated that SaaS mode of deployment is not harnessed in industry-specific software, i.e. operations support systems. This observation is somewhat contradicting to the models describing commodification development, since operation support systems (for provisioning, ticketing and mediation) are unlikely to act as source of differentiation in telecommunication either. Some of the case companies addressed the issue. Representatives of software vendors disclosed that there may not be incentives to offer SaaS or developing SaaS offering may turn out infeasible. Reasons mentioned by the CSPs for using the existing systems, instead of opting for SaaS mode, included specificity of processes and technology interfaces. These factors also appear in previous studies as determinants for vertical software industry evolution [1], but in the present study, company-specific processes and interfaces emerged as factors disallowing use of highly commoditized SaaS offering.

When software business is examined as outsourcing of the IS function, transaction cost economics may be employed to explain market failure, i.e. non-adoption of SaaS mode of deployment. Transaction cost theory [37] holds that transactions with high asset specificity are managed more efficiently within the boundaries of the firm. In the software business setting, this means that the more specific the requirements of software are, the more likely shall the clients choose to develop the software internally or as bespoke software. Further, in case of high asset specificity, software is less likely to be acquired as software product or as a service. In a prior study, Benlian et al. [32] analyzed the association of asset specificity as explaining factor for SaaS adoption. However, their focus was on more generic software systems and their operationalization of asset specificity constructs was therefore missing dimensions, which might be relevant to vertical software industries. Based on the case research, and in line with the transaction cost theory, the following hypotheses are put forth for further studies:

H1: Specificity of processes in client organization is negatively associated with SaaS adoption.

H2: Specificity of technology interfaces in client organization is negatively associated with SaaS adoption.

This paper has examined the adoption of OSS and SaaS models in telecommunication industry. Therefore, it contributes to the software business literature by recognizing the similarities and differences in adoption in vertical software industries. Conducting a case research, it was found that managers in communication service providers find similar benefits and problems in OSS and SaaS as suggested by the current literature. A conclusion can also be made on the types of deployed software: communication service providers use OSS and SaaS mode of deployment in software provided and used across industries. In this case research, no examples of industry-specific software developed as OSS or deployed as a service could be found. For theory development in the field of software business, the findings indicate different patterns of adoption on different types of systems. This study arrived at two hypotheses, which are subject to further research.

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