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# EXPLORING THE ROLE OF INTEGRATION IN SOFTWARE-AS-A-SERVICE FAILURE

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## Abstract

*This dissertation project aims at developing a theory-based model that explains the influence of software product and service characteristics of Software-as-a-Service on the relation between organizational integration and the extent of a solution failure. The model is grounded on a thorough literature review of IS and non IS literature and exploratory case studies with different Software-as-a-Service vendors. Typical software service characteristics like simultaneity as well as typical software product characteristics like a multi-tenancy architecture have been identified within existing Software-as-a-Service solutions. The preliminary results propose that software product and service characteristics of Software-as-a-Service increase the importance of internal and external integration to prevent a Software-as-a-Service solution to fail. Software-as-a-Service solutions are argued to require software vendors to integrate internal activities like development and operations and external entities like customers much tighter in order to be successful.*

Keywords: Software-as-a-Service, Solution Failure, Organizational Integration

# 1 PROBLEM STATEMENT

Offering successful software solutions is key to the business model of software vendors. Only if a vendor can sell its solution to customers and at the same time covers the costs that incur during the production of the solution, it is able to survive in the long term. With the emergence of Cloud-Computing and especially its software-related Software-as-a-Service concept, the business model of software vendors is altered (Stuckenberg et al. 2011) and internal processes and structures are challenged (Choudhary 2007; Fan et al. 2009; Heart et al. 2010; Stuckenberg and Heinzl 2010). This situation likely affects the determinants of offering successful solutions.

Software-as-a-Service describes a software distribution and payment concept that is characterized by a responsibility shift of operations and maintenance activities of software solutions from the customer to the software vendor, together with the introduction of a continuous usage-based pricing scheme (Choudhary 2007; Ma 2007; Xin and Levina 2008). Customers access the vendor-managed solutions via the internet by using web-browsers (Sääksjärvi et al. 2005). In addition to these concept defining characteristics come along various other features and technologies that enable and support the concept. Examples are web technologies, or multi-tenancy architectures (Mäkilä et al. 2010; Manford 2008). Together, they represent the common understanding of what is termed ‘Software-as-a-Service’. It can be classified as the software layer of the overarching Cloud-Computing stack model above the related models of Platform-as-a-Service and Infrastructure-as-a-Service (Weinhardt et al. 2009).

The adoption of Software-as-a-Service solutions by the customer, as well as the number of software vendors offering their solutions in a service mode, has gained significant growth rates over the last years (Merz et al. 2011). Although certain aspects of the concept are not entirely new and have already surfaced in preceding concepts like Application Software Provisioning (ASP), the recent technological and infrastructure advances have fuelled the dissemination of solutions and helped to overcome the pitfalls of previous concepts (Mäkilä et al. 2010). This positive trend is expected to last (West et al. 2010) and the concept to sustain high relevance for research and practise.

Despite this promising development, major challenges for software vendors are still linked to the Software-as-a-Service concept. Software-as-a-Service providers, for instance, do not only need to develop solutions that satisfy customer requirements but also need to operate the solution reliably for the customer and at a moderate cost level. Only that allows them to stay profitable despite the smaller but recurring monthly subscription revenues (Choudhary 2007). Vendors are challenged by an additional success dimension, as they not only need to compete with traditional on-premises offerings from a quality perspective in terms of functional quality but also in terms of operational quality (Fan et al. 2009). The operation-responsibility shifts the development priorities from aiming at enhanced functions and software capabilities to internal (operations) costs optimization (Aulbach et al. 2008). This, however, requires developers to maintain a profound knowledge of operation-related aspects and a close relation with operations departments (Stuckenberg et al. 2011). Such communication and coordination links between different departments are commonly referred to as organizational integration (Barki and Pinsonneault 2005). As for on-premises solutions, developing and operating software is a quite separated task, in general carried out by distinct organizations, integration is minimal and of low priority. With the move of a software vendor towards offering Software-as-a-Service solutions, the question arises, how the service character as well as software product characteristics of Software-as-a-Service solutions influences internal integration of vendors and what integration approaches are required to provide Software-as-a-Service successfully.

Similar to the internal integration requirements, the Software-as-a-Service concept also alters the relationship to the customer. End-users are interacting directly with the solution on the servers and within the control of the vendor, enabling a closer observation and analysis of the customer (Saeed and Jaffar-Ur-Rehmann 2005). Quality characteristics like customer satisfaction, at the same time, gain further weight in the assessment of the solutions’ overall quality. The continuous service model requires vendors to convince the customer repeatedly of the value of the solution and, thereby, decrease retraction rates (Choudhary 2007).

In face of these challenges, this dissertation project aims at investigating the relation between internal and external integration within organizational structures and processes and the success or failure of complex software solutions under the influence of the emerging service concept Software-as-a-Service. This leads to the central research question:

*How do software product and service characteristics of Software-as-a-Service influence the relation between organizational integration and the extent of software solution failure?*

The existing literature widely neglects this aspect and is focusing either on the adoption of Software-as-a-Service solutions by customers (e.g. Benlian and Hess 2010; Xin and Levina 2008) or addressing rather technical aspects (e.g. Aulbach et al. 2008; Bennett et al. 2000; Brereton et al. 1999; Turner et al. 2003). A limited number of authors has analysed the potential impact of the concept on the development organizations and processes (e.g. Heart et al. 2010; Manford 2008; Olsen 2006; Saeed and Jaffar-Ur-Rehmann 2005; Stuckenberg et al. 2011; Stuckenberg and Heinzl 2010). Proposed methodologies that define the processes to develop and operate Software-as-a-Service solutions (e.g. Agarwal 2011; Benefield 2009; Espadas et al. 2008; Guo and Wang 2009; La and Kim 2009; Singh 2008) fall short of addressing integration aspects. These studies very often apply a rather traditional developer perspective without extending the process responsibility to operations or oversimplifying aspect within a maintenance phase.

## **2 RESEARCH DESIGN**

The objects of analysis are complex business software solutions. The level of analysis as well as the level of theory are set on the organization. The dissertation project follows a qualitative research design, which is deemed particularly suitable for answering the question of how the Software-as-a-Service concept influences organizational units involved in the solutions' value chain. Case study research has proven to yield promising results within Information Systems Research and is especially suitable to investigate issues that are hard to replicated in an experimental setting and refuse control of its behavioural events by researchers (Stone 1978; Yin 2009).

The dissertation project's research design comprises three sequential stages. The first and already completed phase was exploratory in nature and included a thorough review of IS and non-IS literature on related topics as well as 6 exploratory case studies (Eisenhardt 1989) of software vendors offering at least one Software-as-a-Service solution. The focus was set on organizations offering complex business applications, to allow comparability among the cases and to account for the characteristics of software as a knowledge intensive good that drives process complexity with increasing solution scope (Ivari et al. 2001; Walz et al. 1993). Table 1 provides an overview of the case studies conducted within the exploratory phase. Seventeen semi-structured expert interviews with knowledgeable members of the organizations formed the major information source. Semi-structured interviews offer the advantage of structure but still allow open answers and the flexibility to respond to interesting aspects emerging within the interviews and were therefore considered appropriate within the exploratory stage (Stone 1978; Yin 2009). The interviews were recorded, transcribed and later analyzed in-depth through coding relevant text passages and emerging patterns within the data (Miles and Hubermann 1994).

In the second and current phase of the dissertation project, a theoretical framework (Figure 1) is being developed based on the insights from the exploratory case studies and existing literature. The theoretical framework aims at explaining the relation between organizational structures and processes and the resulting solution performance under the influence of product and service characteristics inherent in Software-as-a-Service solutions. In line with the theory building process of Eisenhardt (1989), the identified characteristics as well as constructs, patterns and connections are defined and iteratively sharpened to form a comprehensive and parsimonious explanatory model. Currently, the so far identified software product and service characteristics are further refined and evaluated in order to be added as second level constructs to the initial research model.

The third and last phase of the dissertation project will substantiate the evolved model with further empirical investigations. The theoretical framework will be refined. Furthermore, the implementation

of internal and external integration that fit in the Software-as-a-Service context will be specified and will enrich the construct's definition and measurement in the software developing context. Due to the still novel context, the project will continue applying a qualitative approach.

### 3 THEORETICAL FOUNDATION

#### 3.1 Exploring software solution failure

In the Information Systems discipline, the success of an information system is very often assessed by using the original and refined success model of Delone and McLean (1992; 2003). The direct application of the model in the Software-as-a-Service context to assess a solution's success may be problematic. The service quality is conceptualized around support related aspects and therefore only covers a small fraction of aspects that a service model would expect. Service operations-related quality aspects are only rudimentary reflected in the systems quality in aspects like systems availability. The model's underlying process view furthermore assumes the existence of distinguished consecutive steps of system development, system use and resulting benefits. With the continuous and iterative evolution character of Software-as-a-Service solutions this separation seems inappropriate.

In the product and service development literature the dependent variable is mostly conceptualized as new product/service success or failure and measured in terms of different performance measures like profitability or financial indicators (Brentani 1989; Ernst 2002; Montoya-Weiss and Calantone 1994). Various studies that examine the determinants for success or failure exist (Brentani 1989; Brentani 1995; Cooper 1979; Cooper and Kleinschmidt 1995; de Brentani and Ragot 1996; Edgett 1994; Ernst 2002; Froehle et al. 2000; Jin et al. 2010; Oldenboom and Abratt 2000). Montoya-Weiss (1994), for instance, list strategic factors, development process factors, market environment factors, or organizational factors as reasons why certain products or service succeed or fail. Aspects like cross-functional teams, internal/external relations, high inter-functional cooperation, or customer participation are frequently associated with success of services and products. As Software-as-a-Service challenges vendors to combine the previously separated activities of developing and operating software, integration is expected to have a major impact in this new context as well. Development process related aspects, like process proficiency, that are likewise often seen as drivers of positive outcomes and preventers of failure, especially in the service industry, are considered less influential due to the common use of development methodologies in the software context. Though authors like Cooper (1979) or de Brentani (1989) give market environment factors a high weight as determinants for success or failure, they are neglected at the current stage of research. The studied companies act in similar market conditions but more importantly, the adoption of Software-as-a-Service is still in an early innovation stage and environmental factors considered less critical in the early diffusion phase. The focus is set on solution failure, as failure studies, have especially in the service concept proven to yield promising results in investigating improvement potentials (Tax and Brown 1998).

#### 3.2 Organizational integration

Organizational integration or inter/cross-functional integration or cooperation is a central constructs within different fields of research in the literature (Barki and Pinsonneault 2005; García et al. 2008; Pinto and Pinto 1990; Song et al. 1997; Song et al. 2000). It is defined as interconnectivity and coordination between different departments involved in the innovation process (Barki and Pinsonneault 2005). It is set on an organizational level compared to the predominantly rather technical perspective discussed in the Information Systems discipline, that analyses the integration of systems or integration of standardized IT-supported processes. Organizational integration acts as a measurement for the extent of communication and coordination links between two distinct and independent organizational subunits (Barki and Pinsonneault 2005; Ettlie and Reza 1992; Millson and Wilemon 2002). Organizational integration is subdivided into internal and external organizational integration. While *internal organizational integration* involves communication and coordination between firm-internal units like development and operations, *external organizational integration*

comprises the communication and coordination of the internal unit with entities external to the firm, like customers and suppliers (Millson and Wilemon 2002). Both, internal and external integration have been heavily discussed in the literature. Although organizational integration has been researched especially in the context of new product or service development, the research results are deemed transferable and applicable in the context of software development (Nambisan and Wilemon 2000).

In this dissertation project's context, potential departments that may require integration can be derived from the main activities of a classical software vendor, whose core competency is centred around the development of software. Based on software development methodologies and software lifecycle models (Messerschmitt and Szyperski 2003; Sommerville 2011), different activities can be identified. Applying a value chain perspective (Porter 1985) yields further activities and organizational functions that are participating in the value creation of a vendor and somehow involved in the creation of one complex software solution (Pussep et al. 2011). Aggregating these identified activities results in the major functions marketing & sales, training & support, development as well as operations & maintenance. Together with the customer, they form the initial entities studied within this project.

### **3.3 Software product and service characteristics of Software-as-a-Service**

Software-as-a-Service combines software with a service model. An evaluation of the potential impact of the concept on software vendors may therefore be divided into the impact of the concept's software product characteristics and characteristics of service models. Typical software product attributes discussed in conjunction with Software-as-a-Service are standardization, fine granularity, the use of web technologies and a multi-tenancy architecture (Olsen 2006; Stuckenberg and Heinzl 2010). While the first three characteristics are not exclusive to the Software-as-a-Service model and also present in the traditional on-premises world, the service model emphasise their relevance. Standardization, for instance, may also decrease software operations costs of vendors (Stuckenberg and Beiermeister 2012). A multi-tenancy architecture is more unique to the concept. As a one-to-many approach, it not only increases the complexity but also the reach of potential development mistakes and operation outages (Aulbach et al. 2008; Bezemer and Zaidman 2010).

With regard to the software service characteristic, services are commonly defined using constitutive criteria like intangibility, the inseparability of production and consumption (simultaneity) or the existence of an external factor in the fulfilment phase. Derived from these, the literature discusses further aspects like an uncertain outcome in terms of quality or value before consumption, the often longer and more continuous relationship of providers and customers, the heterogeneity of services as they often require human interaction, or their perishability (Jaw et al. 2010; Zeithaml et al. 1985). Due to these aspects, the development of services is considered to differ from the development of products (Alam 2002; Dolfsma 2004; Ramaswamy 1994; Stevens and Dimitriadis 2004).

The outcome of combining a software product and a service model is summarized in an altered deployment and payment model that shifts the operation of the software solutions to the vendor and charges continuous subscription fees for the usage of the solutions. The actual service of Software-as-a-Service vendors is the direct provision of software capabilities to the end-user. This is combined with the promise to continuously enhance and extend the functions as well as the take-over of activities previously required to generate such software capabilities in-house by the customer or via alternative service models out of the formerly provided program-code. The typical service characteristics and corresponding problems can be found in the concept.

## **4 DEVELOPMENT OF A THEORETICAL FRAMEWORK**

Based on the findings of the exploratory phase and the literature review, a theoretical framework is being developed that aims at explaining the influence of software product and service characteristics inherent in Software-as-a-Service solutions on the requirement to integrate organizational units and activities in order to provide successful software solutions. The preliminary framework is illustrated in Figure 1 and discussed subsequently. Table 2 provides the definitions of the key constructs.

#### **4.1 Organizational integration to prevent solution failure**

The link between organizational integration and success or failure of a product or service is well researched in the new product and new service development literature (Troy et al. 2008). A positive link of collaboration and communication between organizational units involved in the development on a resulting success or performance of a product or service has been proven by various studies (Adler 1995; Atuahene-Gima and Evangelista 2000; Cordon-Pozo et al. 2006; Ettlie and Reza 1992; Froehle et al. 2000; García et al. 2008; Gupta et al. 1986; Kahn 1996; Millson and Wilemon 2002; Pinto and Pinto 1990; Song and Montoya-Weiss 2001; Song et al. 1996; Song et al. 2000). Departments in focus of these studies are Marketing, Research & Development and Manufacturing. It can be distinguished between internal integration of value creating activities or market-directed integration in form of a customer orientation and integration (Barki and Pinsonneault 2005; Ettlie and Reza 1992). Reasons for the positive effect of internal integration are, for instance, explained by the amount and variety of information available during the process and the resulting broadened team's understanding of problems that is supported by functional divers members of integrated teams (Froehle et al. 2000; Milliken and Martins 1996; Schilling and Hill 1998). In software development, research on the integration of different departments and activities is scarce. However, a link between the integration of focused activities or functions of software development and a solutions success has been shown (Botzenhardt et al. 2011; Tiwana 2004). Evidence also exists for the positive effect of customer-orientation and customer integration in software development, conceptualized within this study as external organizational integration (Keil and Carmel 1995; Kujala 2003). Methodologies like agile development specifically include approaches to foster a tighter integration of the customer into development activities (Kautz 2009). The primary objectives of external integration include the development of products or services that match customer needs and requirements or the identification of new ideas and innovations (Alam 2002; Lundkvist and Yakhlef 2004; Magnusson 2003).

Based on this broad support within the literature, the discussed links are also postulated in the context of developing and operating software-centric service solutions. A separate investigation of internal and external integration is necessary as the primary goals of integration vary between the two perspectives. The priorities of internal integration are, for instance, to improve the efficiency of activities and optimised usage of resources. External integration is focused on the development outcome and its match with the expectations of the customer. A discrete analysis is therefore expected to deliver different insights into the determinants of success. The dependent variable is set to describe solution failure, as the effects of service-based software are increasing the problems of a missing integration but do not render integration to be more effective in a service model.

*Proposition 1a, 2a: The stronger internal and external organizational integration respectively, the lower the extent of a resulting solution failure.*

#### **4.2 The impact of service characteristics**

Studies discussing the influences of service characteristics frequently follow a comparative approach, differentiating services from products and relying on the existing knowledge of the product literature (Gustafsson and Johnson 2003; Young 2008). On the level of characteristics, de Brentani (1989) has identified a mediating effect of intangibility on the relation between new service development processes and performance. As internal communication gaps between departments are seen as a major barrier, which holds back development efforts, the effect may also be valid for integration. Additionally, her results reveal an influence of simultaneity on the relevance of the customer interface and the importance to integrate personnel that is involved in the service delivery, as customers purchase a combination of the end result and the service experience (Brentani 1989). Though software service models normally do not include a personal interaction in the fulfilment phase, the results may also be valid for the back-office. Simultaneity is also said to disclose a lack of collaboration between producing functions much easier for services than for products (Troy et al. 2008).

In the Software-as-a-Service context, the combined service characteristics, which are condensed in the altered delivery and pricing model, result in an increased cost as well as innovation pressure.

Vendors' responsibilities extend as additional activities are added, while at the same time the revenue stream is reduced or delayed. The exploratory cases indicate that this situation pushes vendors to optimize and streamline existing practices to reduce internal costs. Increased automation of processes and the reduction of unnecessary software functions or handling activities are examples in this area. The simultaneity and the perishability of services, in addition, result in the potential waste of excess delivery capacity, further underlining the importance of integrated processes.

Furthermore, the business model of subscription customers is pushing vendors to innovate quicker and to continuously convince the customer of their solutions. Customers have increased expectations on receiving more frequent updates and prompt responses to arising problems. The cases reveal that vendors are analysing the potential to take advantage of the simultaneity of services and direct customer interaction, and use the resulting information to actively adapt solutions to fit the customers' expectations.

The demand and supply pressure, asks for an increased integration of internal activities like development and operations, as well as an increased customer-orientation and integration.

*Proposition 1b,2b: The degree the offered solution fulfils certain service characteristic, the greater the influence of internal and external organizational integration on the likelihood of a solution failure.*

### **4.3 The impact of software product characteristics**

The previously described Software-as-a-Service product characteristics influence the development and operation processes. Standardization and automation of activities and functions, for instance, are required to ease the increased cost and innovation pressure. New product features need to be developed, tested and deployed in a consistent and frequent manner, requiring a close collaboration between developers and operating personnel to assure a continuous flow without bottlenecks. The multi-tenancy nature makes for an immediate availability of development outputs to the entire customer base (Aulbach et al. 2008; Bezemer and Zaidman 2010). Likewise, failures or defected product functions result in a complete outage of the entire solution, requiring prevention methods and rapid solution approaches. Both are supported by a close collaboration and integration of developing and operating units. In summary, the aforementioned software product characteristics underline the importance of a tight integration of involved units, rendering it even more important to provide successful solutions than in traditional settings. A proper integration reduces the likelihood of solution failures even more when the solution features certain product characteristics. However, a direct relationship between certain software product characteristics and integration cannot be entirely ruled out at this point, therefore direct links as well as relations between product and service characteristics will also be considered during further studies.

*Proposition 1c, 2c: The existence of typical Software-as-a-Service software product characteristics positively effects the influence of internal and external organizational integration on solution failure.*

## **5 EXPECTED CONTRIBUTION**

Pursuing the outlined research agenda is expected to contribute to theory and practise. Investigating a dominant success factor of Software-as-a-Service solutions will benefit not only the body of knowledge on service-based business models but also on software development in general. Researching the interrelation of aspects like integration and solution failure will further improve the understanding of the determinants of organizational structures and processes of software vendors and the resulting quality of offered solutions. The analysis will provide additional explanation why especially traditional vendors are often struggling with Software-as-a-Service and will present empirical observations. This study will furthermore explore the influence of Software-as-a-Service on the value creation of software vendors. It will evaluate the inherent characteristics and causes that account for potential change. Software product and service characteristics will be modelled to the specific context and allow a thorough study of the phenomenon. Since this study draws on knowledge that originates in neighbouring disciplines, like Marketing and product development, and applies it



within the software development context, its findings also have implications for the theoretical developments of their original context. The study will substantiate the concrete implementation of the integration construct in the software development and operation context. It will help to clarify the instantiations of organizational integration in this context and thus allow to generate a sustainable advantage by applying the existing knowledge of the relation of integration and a solution's success or failure. In addition it offers the potential to extend and complement organizational integration by technical integration aspects well studied in the field of Information Systems. Finally, answering the raised research question will not only benefit the academic discussion, but also provide companies in the field clear guidelines for offering solutions as Software-as-a-Service. The results will help software vendors to establish appropriate structures and processes to respond to arising challenges and capitalize on the given opportunities that come with the concept. Studying the outlined topic is expected to be especially fruitful for vendors that switch or complement their business model with Software-as-a-Service.

Case Company	Company Size	Solution Scope	Business Model	# of Interviews
A	Large	Large	Mixed	5
B	Large	Large	Mixed	4
C	Large	Small	Mixed	3
D	Large	Large	Pure SaaS	3
E	Small	Small	Pure SaaS	1
F	Small	Small	Pure SaaS	1

Table 1: Exploratory Case Studies

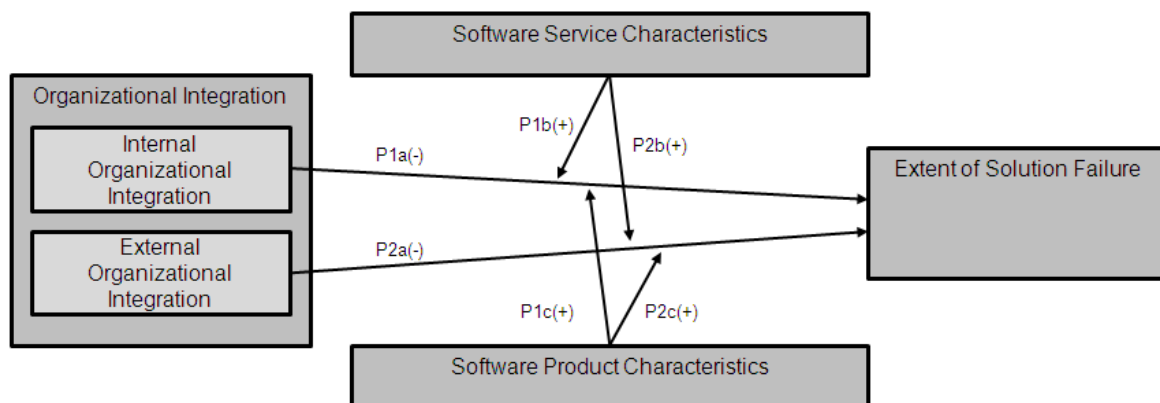


Figure 1 Preliminary theoretical framework

Construct	Definition	Sources
Internal Organizational Integration	Magnitude of interaction and communication, level of information sharing, degree of coordination, degree of joint involvement between different departments involved in the development and delivery process	(Kahn 1996; Song and Montoya-Weiss 2001; Song et al. 2000)
External Organizational Integration	Magnitude/intensity of customer interaction; degree of customer orientation	(Ettlie and Reza 1992; Gruner and Homburg 2000; Song and Montoya-Weiss 2001)
Software Service Characteristics	Degree of service characteristics like continuousness, simultaneity, intangibility, or perishability of solution.	(Brentani 1989; Zeithaml et al. 1985)
Software Product Characteristics	Extent the solution implements Software-as-a-Service typical product characteristics like multi-tenancy, standardization, modularity, or web technology; e.g. # of simultaneous versions	(Stuckenberg and Beiermeister 2012)
Extent of Solution Failure	Degree to which the perception of a solution fell short of the minimum acceptable profitability, performance, market expectations	(Montoya-Weiss and Calantone 1994; Song et al. 1997)

Table 2: Definition of key constructs

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