Selection Criteria for Software as a Service: An Explorative Analysis of Provider Requirements

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ABSTRACT

Currently, customers can choose among many Cloud providers for enterprise systems. The provider selection involves several challenges to match individual customer requirements and provided service characteristics. Unfortunately, this process is not transparent and characterized by the lack of appropriate selection criteria. Research is mainly concentrated on capabilities and success factors on the customer side. A set of Cloud provider requirements from a customer perspective, especially within the context of an adoption of on-demand enterprise systems, have barely been discussed so far.

In this paper we present a set of selection criteria for Software as a Service (SaaS). These criteria are developed to enable a Cloud provider comparison and match the customer requirements with the provider characteristics. We followed a design science approach and conducted a systematic literature review, an extensive market analysis of 651 providers and an evaluation based on expert interviews to develop the presented selection criteria.

Keywords

Software as a Service, Selection Criteria, Cloud Provider Requirements, Enterprise Systems

INTRODUCTION

Software as a Service is emerging as a viable outsourcing option for customers and is currently enjoying great popularity in research as well as in practice (Benlian and Hess, 2010; Xin and Levina, 2008; Huang and Wang, 2009; Stuckenberg, Fielt and Loser, 2011; Castellina, 2011; Buxmann and Hess, 2008). According to a study by Gartner the enterprise-based spending for Software as a Service (SaaS) applications will grow at a 16.3% compound annual growth rate through 2015 (Mertz et al., 2011). The total software revenue forecast for SaaS delivery for 2012 will be 14 Millions of U.S dollars and is predicted to be important in most enterprise application software markets. This puts companies under increasing pressure in the next years to enhance, modify, or even replace existing enterprise systems while standardizing technology across the enterprise at the same time (Mertz et al., 2011). Currently an increasing number of software providers are changing their solution offerings to a Software as a Service model (Stuckenberg et al., 2011). On-demand enterprise systems are used due to cost savings, time-to-deploy advantages, and the flexibility of customizing standard services to specific requirements (Katzmarzik, 2011; Susarla, Barua and Whinston, 2009; Castellina, 2011). Especially in application markets the functions for customer relationship management, content, communication and collaboration are seen as promising opportunities for the large adoption of the on-demand software delivery model (Mertz et al., 2011). In particular Cloud providers can profit from this market development but must diversify their offers to be attractive for both existing and new customers (Katzmarzik, 2011). They have to understand how costumers perceive and evaluate Cloud based services (Benlian, Koufaris and Hess, 2010). For the customer it is difficult to select a provider due to a nontransparent provider market. In addition, it is often irreversible due to the lack of standards and interoperability (Clemons and Chen, 2011). This difficulty, known as “provider lock-in”, is

discussed extensively and is an important topic for practitioners and for several initiatives, e.g. the *Open Grid Forum* (OGF) or the *Distributed Management Task Force* (DMTF) (Cattedu and Hogben, 2009).

There is only little research on enterprise systems based on the SaaS model so far (Koslowski and Strueker, 2011). Our literature review on selection criteria for SaaS does provide a number of contributions. They can be summarized as the drivers, the types of implementation and the dimension regarding an adoption of Cloud Computing (Luoma and Nyberg, 2011; Nuseibeh, 2011). Unfortunately most of the findings concentrate on customer capabilities and success factors on the customer side. The requirements on the provider side and associated customer selection criteria, within the context of an adoption of enterprise systems as a Service, have barely been discussed so far.

Given this call for papers and the research gap identified above, our paper aims to contribute a set of selection criteria for SaaS. In this context we focus on the research question: *Which selection criteria exist for Software as a Service*?

This article is organized as follows. First, the research methodology and prior research is described. The first section provides an overview of the relevant literature and related work. Next, we present the set of selection criteria for SaaS based on an extensive market analysis and conducted expert interviews. Finally we explain two types of selection criteria and the relevance for enterprise systems.

RESEARCH APPROACH

The presented selection criteria for SaaS underwent several cycles of development. The research method used in this article is based on the design science paradigm in IS research (Nunamaker, Chen and Purdin, 1990; Walls, Widmeyer and Sawy, 1992; March and Smith, 1995; March and Storey, 2008). The design science research is a prescription-driven and problem-solving paradigm that seeks to create viable artifacts in the form of a construct, a model, a method, or an instantiation (design artifacts) which provide solutions for management problems (Hevner, March, Park and Ram, 2004; Gregor and Jones, 2007; van Aken, 2004). Based on the three-cycle (rigor cycle, design cycle, relevance cycle) view of design science research proposed by Hevner et al. (2004) and Hevner (2007) we structured our research methodology (see Figure 1). Following a rigor cycle we started to build on our existing work and conducted a systematic literature review on Cloud Computing characteristics and provider requirements. The results of the rigor cycle were used for the initial design cycle. In this research step, we designed a first draft of provider requirements relevant for a selection of Cloud services based on existing knowledge supported by two workshops (initial set of selection criteria). The relevance cycle was considered through a market analysis with regard to SaaS. An iteration and final evaluation consists of expert interviews to evaluate the developed initial set of criteria.

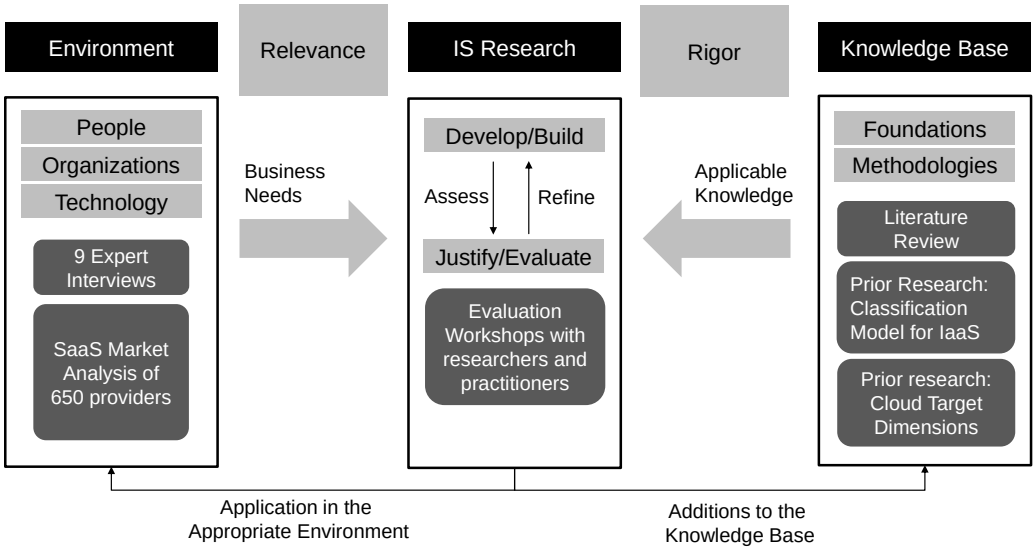

Figure 1. Research approach outline

We started by conducting a rigor cycle and defining our knowledge base of scientific foundations. Following a rigor cycle we started to build on our existing work and conducted a systematic literature review on Cloud Computing characteristics and provider requirements. In order to develop the theoretical foundation of our model we started with a literature review to gather relevant requirements of Cloud provider. We followed the approach of a systematic literature review by Webster and Watson (2002) and limited the search approach to the top 16.8% (21 out of 125) of all journals included in the AIS ranking list (Vom Brocke, Simons, Niehaves, Riemer, Plattfaut and Cleven, 2009). Thus, we started to explore the field from a high quality journal perspective. We focused on the following keywords "enterprise system*", "requirement*", "provider*", "selection*", "criteria*", and combined them with "Cloud Computing", "on-demand" and " Software as a Service". The applied wildcards assured the identification of related, conjugated terms. We searched in databases like AIS Electronic Library, EBSCO, SpringerLink or Science Direct as well. We found several articles regarding Cloud Computing or enterprise systems, but only one paper by Koslowski and Strueker (2011) examined both aspects.

STATE OF THE ART

Enterprise systems are an off-the-shelf package providing an integrated suite of applications and support business processes by means of transaction processing and the use of management information systems (Sedara, 2004). Information and knowledge intensive organizations, using enterprise systems, typically have large data and application infrastructure needs that vary significantly with market conditions and technology changes (Brust and Sarnikar, 2011). In order to fulfill these requirements many enterprises are increasingly discussing Cloud Computing models to efficiently meet such needs (Nuseibeh, 2011; Motahari-Nezhad, Stephenson and Singhal, 2009). Which value is achieved through a SaaS-based application for enterprise customers by means of cost savings and flexibility or elasticity is partially covered (Koslowski and Strueker, 2011). Fuller and Mclaren (2010) analyzed three modes of delivery for enterprise systems: Integrated ERP, Best of Breed (BoB), and Software as a Service (SaaS), and determined how well these delivery modes are aligned with the requirements of small and medium enterprises. Lu and Sun (2009) did a comparative analysis of SaaS benefits from different dimensions and discussed first insights about the characteristics of enterprise information systems fit for SaaS.

To understand Cloud Computing and to exploit its opportunities, companies have to focus on user-related issues, not technology (Iyer and Henderson, 2010; Koehler, Anandasivam and Dan, 2010a). Koehler, Anandasivam, Dan and Weinhardt (2010b) identified consumer preferences for Cloud service attributes to gain insights on the prerequisites of a successful market introduction of Cloud services. That a provider may face the problem of how to price infrastructure services and how this pricing may impact the resource utilization were highlighted by Anandasivam and Weinhardt (2010). Drawing on service quality literature, Benlian et al. (2010) developed a SaaS service quality scale that can be used as a diagnostic tool by SaaS providers and users alike. A study by Nuseibeh (2011) summarized the success factors for a Cloud adoption based on economic theory (Transaction Cost Theory), strategic management theory (Resource Dependency Theory) and Diffusion of Innovation Theory. Especially for companies with purpose to implement Cloud Computing, it is relevant to identify the factors that affect firms' behavioral intention to adopt Cloud Computing (Son and Lee, 2011). Thus, Son and Lee (2011) focus on establishing a theoretical framework specific to Cloud Computing adoption and conceptualizing factors affecting the adoption and evolving measurements. An attempt to capture important influencing factors for the Cloud adoption a maturity model for the quality assessment of Cloud Computing Services is provided by Martens, Teuteberg and Graeuler (2011), where the relationships between Cloud services, Service Level Agreements (SLAs), technical implementation and provider characteristics are described. Benlian, Hess and Buxmann (2009) surveyed relevant drivers of SaaS adoption based on an empirical study of different application types and observed the control of IT function and identified benefits related to the outsourcing of the local control, installation and development of software. Furthermore, Benlian (2009) developed a research model based on the transaction cost theory for assessing SaaS sourcing at the application level. Adoption criteria related to the SaaS model from a government perspective are discussed by Janssen and Joha (2011).

In order to distinguish SaaS solutions with regard to enterprise systems we examined service categories within our market analysis. We preliminary used software categories defined by Benlian et al. (2009). After an initial screening these categories were adapted and re-defined. In Figure 2 the SaaS solutions by category are depicted. It is not excluded that one provider covers several service categories. This can be the case if more than one service is offered or the service has a wide-ranging functionality.

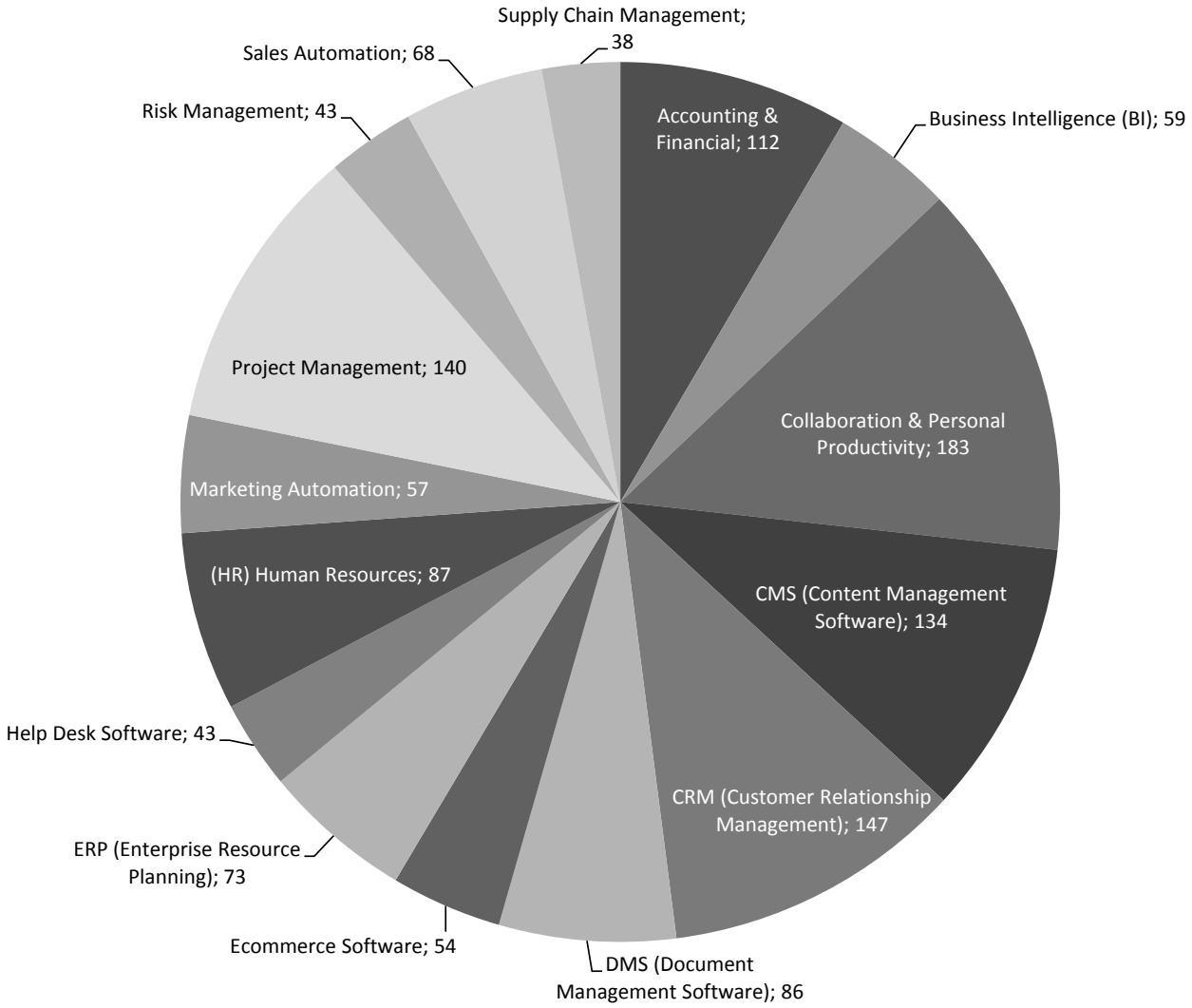

Figure 2. SaaS categories (representation of 651 providers)

DEVELOPMENT OF SELECTION CRITERIA FOR SAAS

First, we developed an initial set of selection criteria. We assured that during this phase the results were revised against the requirements until a satisfactory design was achieved and then conducted three iterations of a relevance cycle to evaluate our requirements and gather information about specific and general selection criteria for SaaS. This distinction is made due to heterogeneous characteristics among the service models (Weinhardt, Anandasivam, Blau, Borissov, Meinl, Michalk and Stoesser, 2009). In the first iteration we discussed a set of selection criteria for SaaS in two separate workshops with four and three experts (see Table 1). In addition, we built on existing classification criteria for IaaS provider from prior research and used already developed Cloud target dimensions to classify the selection criteria (Repschlaeger, Wind, Zarnekow and Turowski, 2011; Wind, Repschlaeger, Turowski and Zarnekow, 2011). In this previous contribution we defined six target dimensions to group and structure the Cloud characteristics (Wind et al., 2011). These dimensions help enterprises and other institutions to get better insights of Cloud Computing objectives and support the decision and implementation process, e.g. by classifying appropriate providers. The relevance of the developed target dimensions was evaluated with an additional international survey conducted among 30 IT managers and CIOs (Repschlaeger and Zarnekow, 2011). By means of the literature review, the prior research and the workshops we derived an initial set of selection criteria, as shown in Figure 3.

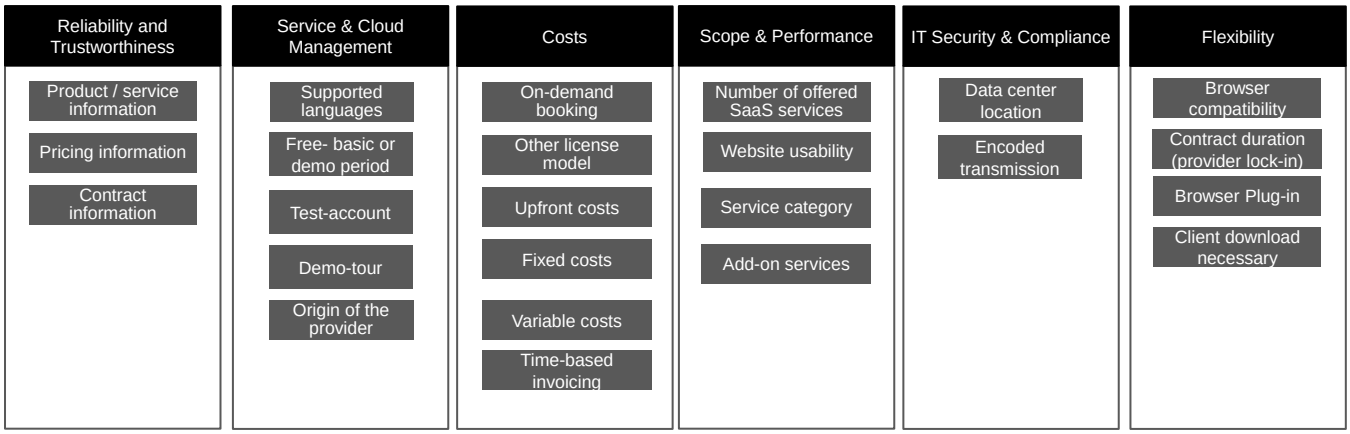

Figure 3. Initial Set of selection factors

The second iteration with regard to the relevance cycle was a market analysis regarding SaaS where we gathered and systematized the criteria. This analysis was based on an extensive internet research where the websites of relevant companies were examined regarding their pricing model, Cloud service offering, company data and customer segment. By means of market studies, business publications on the Cloud market and an extensive internet search we detected over 1000 providers for SaaS. In an iterative evaluation process we examined 651 providers to extract relevant selection criteria and to assess them. The providers where located mostly in the U.S. (44%) followed by Germany (23%) and the UK (13%) (see appendix A).

The third iteration and final evaluation consists of expert interviews to evaluate the developed initial set of criteria. In total nine experts were selected from seven companies, all holding different positions within their companies (see Table 1). Care was taken that those respondents were representing complementary perspectives (provider, customer, integrator, and consultant). The interviews with the experts were structured and conducted referring to Glaeser and Laudel (2010) and addressed the following aspects: evaluation of existing criteria, discover missing criteria, classify the criteria with regard to the target dimensions.

(Expert from) Company type	Company data	Position within company	Cloud experience
IT service provider	170.000 employees Global IT service offerings 10-15% revenue based on Cloud Computing Innovative solutions in IaaS	Senior Vice President of Cloud Business	Deep understanding of Cloud Computing (IaaS, PaaS and SaaS)
IT service provider	SME software company 20 employees Development of standardized components for web-based services	CIO (W1), Software architect (W1)	Expert know-how in IaaS and PaaS
IT service provider	Start up company in the field of SaaS 32 employees Developing of digital record and human resources solutions	CEO (W1), (W2)	Expert know-how in developing, maintenance and distribution of SaaS.
IT service provider	Start up company offering SaaS solution for newsletter delivery	CEO (W1), CIO (W1)	SaaS and IaaS expertise
Consulting company	International consulting company 500 consultants worldwide Cloud Computing as one consultancy topic	Partner	Current consulting focus; Cloud market appreciation
Customer / Client	Automotive sector ca. 95.000 employees	Divisional director IT	Experience in selecting, implementing and operating IaaS and SaaS
Customer / Client	SME software company 11 employees Development of standardized components for web-based services	Software architect (W2)	Expert knowledge in IaaS and PaaS especially in the implementation

W1 = Participant at workshop 1 W2 = Participant at workshop 2

Table 1. Experts interviewed

Based on these interviews we categorized each criterion concerning the target dimensions to a final set of selection criteria. In total, we defined 45 selection criteria and mapped them to the Cloud target dimensions. The set of final selection criteria can be divided into initial criteria, which are evaluated and accepted by practitioners, updated criteria, which need to be changed to be applicable for the provider evaluation, and new selection criteria, which emerged during the market analysis and where requested by the experts (see Figure 4). In the next two sub-sections the selection criteria will be presented (see appendix B). First the selection criteria independent from one specific service model (general selection criteria) and second the criteria specific to SaaS (SaaS selection criteria) are explained. Thereafter, we briefly discussed the relevance for enterprise systems.

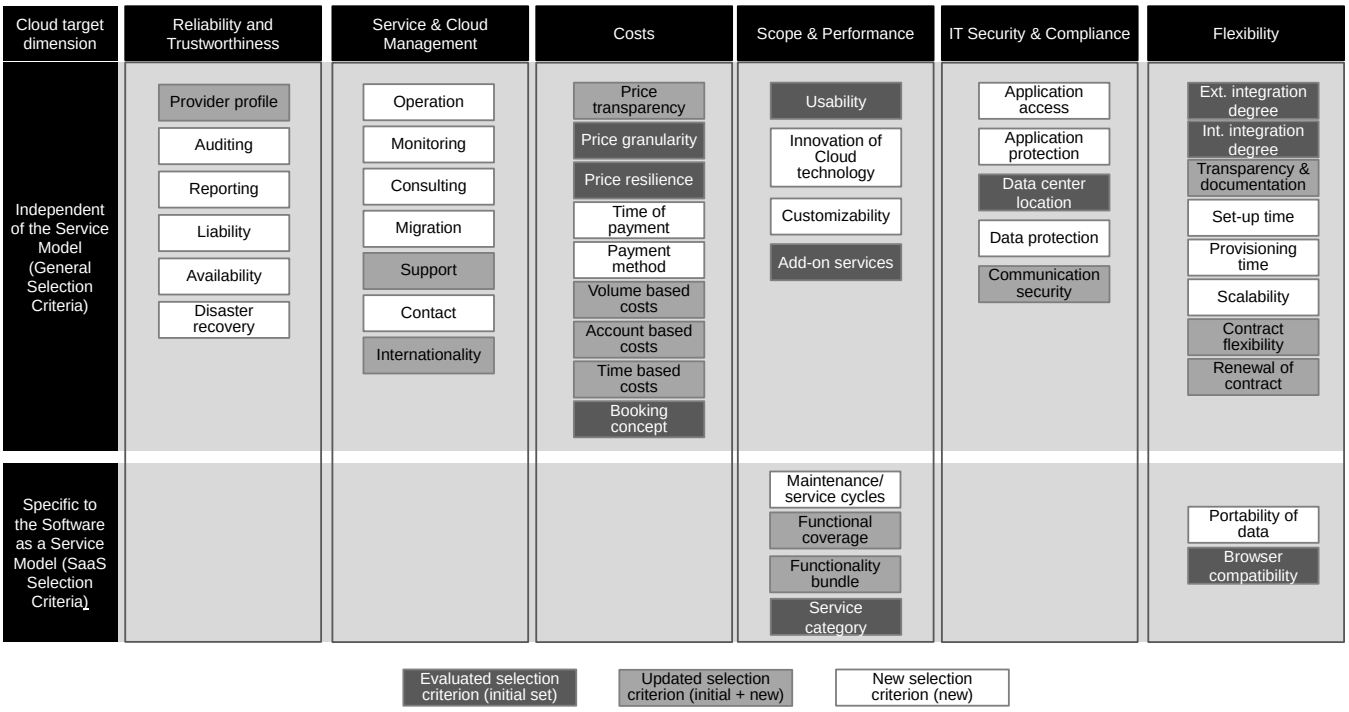

Figure 4: Final set of selection criteria for SaaS

General Selection Criteria

Selection criteria related to the target dimension "Reliability & Trustworthiness" describe the certainty of the customer to get the service from the Cloud in a certain quality. Trustworthiness characterizes the provider, its infrastructure and its business activities, including performance and service transparency (e.g. reports, service description), market experience, the number of customers or the annual revenue. The selection criteria "Auditing" depicts the opportunities and support offered by the provider for auditing activities on customer side. Disaster recovery describes activities related to regularly backups, snapshots and data mirroring in other locations. Availability and liability include the probability that service commitments can be met by the provider.

The "Service & Cloud Management" dimension enables the customer to evaluate the Cloud management and the maintenance of the relationship to the provider. IT can be differentiated according the three abstract requirements: provider management, service management and transformation management. Provider management contains support and contact information of the provider. This criterion considers all aspects regarding support and customer services, e.g. type of support, contact opportunities or the office hours. Furthermore it contains facts about a multilingual support, the existence of local offices and direct contact. Service management includes all activities necessary to control and manage the obtained Cloud services which are subsumed in this selection criterion, e.g. monitoring of services and volume control via application programming interfaces (APIs).

The target dimension "Costs" is characterized through monetary aspects like small capital commitment or low acquisition costs. To achieve a better transparency the presentation of the price information and the clarity of the pricing model is considered within this dimension. The payment opportunities include the possible payment method (e.g. credit card or bank

transfer), the time of payment (pre-paid or post-paid) and the price options. How the services are invoiced (volume based, time based, or account based) and which booking concept is used (e.g. pay per use, subscription fee, or market based prices) is defined as well.

The selection criteria of the target dimension ”Scope & Performance” cover the functionality and performance of Cloud services. The innovation degree of the technology indicates the capability of the provider to survive on a competitive market. The adaptability of the interface, the user interacts with, gives the customer information about the customizability. The Usability in contrast represents the structure and the ease of use, following the self-service concept. By means of individual predefined templates, editable user views and settings the user can customize only the appearance or functionality. Additionally, some provider offers add-on services like storage, database services, communication services (e.g. collaboration or messaging) or security services.

The target dimension “IT Security & Compliance” summarizes aspects related to protection and safety and is composed of selection criteria considering the network protection, the operations protection and the IT compliance. The IT compliance is separated into provider requirements for privacy (e.g. encryption of data) and compliance (e.g. location of data center). Communication security refers to the protection of the data transfer via secure cryptographic protocols (e.g. SSL) and dedicated firewall settings. Manageable Cloud services make it necessary to have an access management or implemented role concept for application access and multi-user operation. Furthermore, a multi-tenancy and firewall protected infrastructure, including virus protection systems (application protection) may be requested by the customer.

The dimension “Flexibility” describes the ability to respond quickly to changing capacity requirements and competitive pressure. It contains selection criteria directly linked to one service from the provider. Provisioning and set-up time are subsumed under the associated flexibility advantage of Cloud Computing. Resources, for instance, can be allocated and de-allocated as required. The provisioning time is shorter compared to traditional outsourcing and the set-up time to get the service running for the first time (e.g. register or set up a new account) is shorter as well. Interoperability and scalability comprise all features regarding the maximal number of available resources (e.g. user accounts, instances, functions, or services) which can be used simultaneously. Additionally, the interoperability describes the integration degree separated into internal communication (between services of the provider) and external communication (between services of different providers). The selection criterion “Transparency and Documentation” describes how well the services are documented, especially the APIs. Unfortunately, Cloud providers often try to bind (lock-in) the customer, so he is only able to switch after a certain contract period. The contract flexibility represents the commitment between the customer and the provider, for instance via contract length or defined contract automatisms (e.g. cancelation period).

SaaS Selection Criteria

SaaS selection criteria describe six customer requirements including the maintenance and service cycle, the functional coverage, service category, the user scaling, the portability of data and the browser compatibility. The maintenance cycles of the provider can be an indicator for a continuous service improvement and future market competitiveness. In addition, increased maintenance cycles can indicate the software stadium based on the frequency and schedule. The software may be faulty and has not reached a market maturity yet if the maintenance is not scheduled and in short cycles. Another selection criterion is the functional coverage and the service category. It describes the coverage of customer needs by the software functionality. In this case it is necessary to check the provided functions against the functionality requirements for each customer individually. A major percentage of the software selection process is based on this criterion which implies much effort on the customer side to evaluate. Service bundles or a wide price range are also important. The service functions are divided into modules which can be booked or assigned to a user-role, for instance SAP offers within *Business ByDesign* user bundles for CRM, financials or professional services. To avoid the provider lock-in the opportunity to extract and export data from the provider is essential. This leads to an increased interoperability and flexibility for the customer. An unrestricted compatibility to internet standards (REST or SOAP) and different browsers is of high interest as well, especially on the SaaS level. Solutions of Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) can be used without major limitations via communication based on APIs while SaaS is highly dependent on the browser and its accurate functionality.

Relevance for Enterprise Systems

SaaS can reduce the initial costs and allows the enterprise to entrust system administration completely to the service provider. Especially for small and medium enterprises it is hard to afford the capital expenditures for an ERP solution with all up-front investment in software licenses, databases, servers, or backup equipment. A company may benefit when changing enterprise systems from on-premise to an on-demand model. Enterprise systems normally involve a lot of different roles and users. To keep the business smoothly running the company has to plan the expected usage and workloads upfront and to buy necessary licenses. With an on-demand model required user accounts can be booked flexible every month in order to avoid unused

licenses and scale up or down the demanded resources. It provides flexibility to scale up or down based on the growth of the company without any interruption to the existing functionality. The company gets the chance to extend their IT strategies, e.g. provide access to remote offices or realize corporate E-Mail for all business units.

The use of enterprise systems contains a lot of crucial data and involves several risks for the company. An enterprise system normally stores information about supplier, customer, products, and personal data about the employees. In order to obtain an enterprise system from the Cloud the company has to consider the laws governing data protection and data security, particularly if personal data is involved. Nevertheless, the on-demand enterprise system is a standardized product which can only be customized to a certain degree. The customer must accept that some functionality can't be tailored around his individual needs. Instead, the business process has to be changed to make use of the Cloud service.

CONCLUSION

In this paper we presented selection criteria for SaaS which help companies to choose the appropriate provider. These assessment criteria are developed to enable a Cloud provider comparison and may provide a first step through a provider benchmarking. When selecting a Cloud provider many different criteria have to be considered by the customer. Most of these selection criteria are valid for all Cloud Computing models (IaaS, PaaS and SaaS). Nevertheless, six criteria exist which represent specific characteristics of a SaaS provider, dealing with performance and flexibility requirements. In addition, Cloud providers can profit from the selection criteria and use them to diversify their offers in order to be attractive for both existing and new customers. A limitation of the presented selection criteria is the lack of prioritization and usage guideline. In this article we do not provide an adoption approach how the selection criteria exactly can be used. The customer has to decide individually in which way he wants to use the criteria, dependent on its purpose.

Through several case studies with existing Cloud customers the selection criteria will be prioritized and used to develop a decision model, within future research. In addition, the final set of selection criteria will be evaluated and checked on applicability. Therefore, a second market study is intended. This study will target the availability of data regarding the final set of selection criteria and will also provide a detailed understanding of the SaaS market. The profits for the customer are a more transparent Cloud market and a set of criteria to select an appropriate provider.

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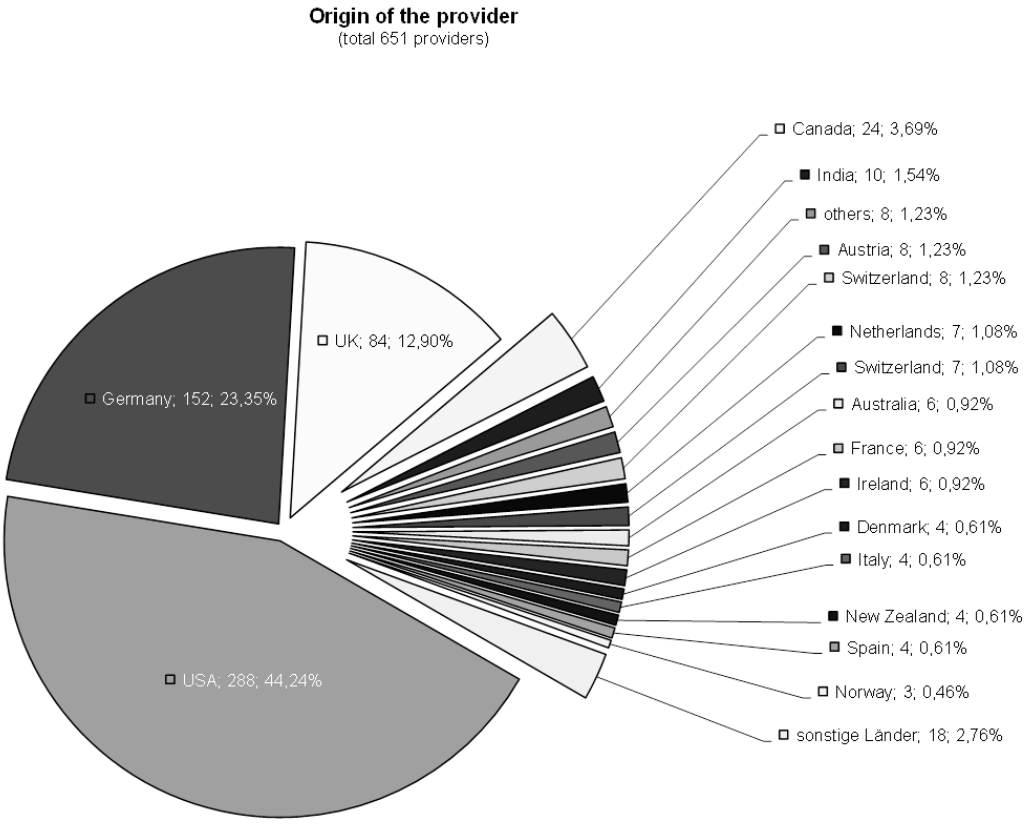
APPENDIX A



If interested, ask the authors for the complete results of the market study. This study was conducted between September 2011 and February 2012.

APPENDIX B

Hirarchy of Selection criteria			Scope		valid for all service models	Specific to SaaS
Target Dimension	**Abstract Requirement**	**Selection criteria**	**Provider**	**Service**		
Flexibility						
	Interoperability					
		external integration degree			x	
		internal integration degree			x	
		compatibility (browser)				x
		transparency and documentation			x	
	Portability					
		portability of data				x
	Delivery Model / Service Dynamics					
		Set-up time			x	
		provisioning time			x	
		scalability			x	
		contract flexibility			x	
	Automatization Degree					
		renewal of contract			x	
Costs						
	Pricing Model					
		price transparency			x	
		price granularity			x	
		price resiliance			x	
	Payment					
		time of payment			x	
		payment method			x	
	Service Invoicing					
		volume based costs			x	
		account based costs			x	
		booking concept			x	
		time based costs			x	
Scope & Performance						
	service characeteristics					
		functional coverage				x
		service category				x
		usability			x	
		functionality bundles				x
		customizability			x	
		add-on services			x	
	service optimzing					
		maintenance/service cycles				x
		innovation of Cloud technology			x	
IT Security & Compliance						
	network protection					
		communication security			x	
	operations protection					
		application access			x	
		application protection			x	
	IT compliance					
		data center location			x	
		data protection			x	
Reliability & Trustworthiness						
	Service Level Agreements					
		Availablity			x	
		Liablity			x	
	Reliability					
		disaster recovery management			x	
	Trustworthiness					
		provider profile			x	
		Reporting			x	
		Auditing			x	
Service & Cloud Management						
	provider management					
		support			x	
		contact			x	
		internationality			x	
	service management					
		monitoring			x	
		operation			x	
	transformation management					
		consulting			x	
		migration			x	

Provider criterion Service criterion **X** Relevant for service model