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The Risks of Sourcing Software as a Service – An Empirical Analysis of Adopters and Non-Adopters

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THE RISKS OF SOURCING SOFTWARE AS A SERVICE – AN EMPIRICAL ANALYSIS OF ADOPTERS AND NON-ADOPTERS

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Abstract

Software-as-a-Service (SaaS) is said to become an important cornerstone of the Internet of Services. However, while some market research and IT provider firms fervently support this point-of-view, others already conjure up the failure of this on-demand sourcing option due to considerable risks associated with SaaS. Although there is a substantial body of research at the intersection of traditional and on-demand IT outsourcing and risk management, existing research is virtually silent on analyzing the risks of SaaS. This study thus seeks to deepen the understanding of a comprehensive set of risk factors affecting the adoption of SaaS and discriminates between SaaS adopters and non-adopters. Grounded in perceived risk theory, we developed a research model that was analyzed with survey data of 379 firms in Germany. Our analysis revealed that security risk was the dominant factor influencing companies' overall risk perceptions on SaaS-based sourcing. Moreover, we found significant differences between adopters' and non-adopters' perceptions of performance and financial risks. Overall, this study provides relevant findings that potential and actual SaaS clients may use to better assess SaaS-based offerings. For SaaS providers, our study gives important factors to emphasize when offering SaaS services to companies in different stages of the technology adoption lifecycle.

Keywords: Software-as-a-service, risk, sourcing, adopters, non-adopters

1 INTRODUCTION

According to a study by Gartner, Software-as-a-Service (SaaS) is predicted to be increasingly important in most of the enterprise application software (EAS) markets in the future. Worldwide software revenues for SaaS delivery are forecast to grow from 2008 to 2013 by 19.4% overall, which is more than triple the total market compound annual growth rate of 5.2% (Mertz et al., 2009). Especially in those application markets where low levels of customization are required (e.g., Office suites), practitioners see promising opportunities for the successful adoption of the on-demand software delivery model (Pettey, 2006). However, there are not only positive voices to be heard about the adoption of SaaS. Some user companies and market researchers are in particular skeptical about its viability and applicability in strong EAS markets such as ERP or SCM (Marks, 2008). Main reasons for these adoption barriers are said to be the risks of reliability (i.e. robust access to the applications services), security (i.e., data privacy), and process dependence (i.e., performance measurement and quality of service) when sourcing EAS via a SaaS interface (Dubey & Wagle, 2007).

First theoretical and empirical research studies examining the drivers of SaaS sourcing confirm that the uncertainty about environmental factors (such as technical, process, economics, or demand-driven risks) play an important role for companies' reluctance to adopt SaaS (Benlian, 2009; Xin & Levina, 2008). However, these findings remain quite abstract in the sense that there is no in-depth and comprehensive empirical analysis of risk factors so far that enables the determination of which risk factors weigh more or less in the perception of companies. More specifically, the relative importance of risk factors has not been captured in a more distinguishing manner to provide an advanced understanding of the nuances of risk perceptions of SaaS-based sourcing. In addition, there are no distinctions made in the existing assessments of risk perceptions yet between SaaS adopters and non-adopters which seems to be especially relevant for SaaS providers' service offerings along different stages of the technology adoption lifecycle. Although there is a substantial body of research at the intersection of traditional and on-demand IT outsourcing and risk management (e.g., Earl, 1996; Bahli & Rivard, 2003; Aubert et al., 2005; Kern et al., 2002b), existing findings have not been transferred and adapted to the context of SaaS-based sourcing. This research gap motivated us to address the following research questions:

(1) What specific risk factors influence the level of SaaS sourcing to what extent?

(2) How do SaaS adopters and non-adopters compare in their respective risk profiles?

To address these research questions, this paper is structured as follows. First, we review the relevant literature on IT-sourcing, SaaS and risk management. Second, we develop a conceptual model hypothesizing on the relationships between risk factors and SaaS sourcing. Third, we present our research methodology which is followed by the results of our empirical analysis. Finally, we present the results of our empirical analysis based on structural equation modeling. The paper concludes with a discussion of the theoretical and practical contributions of our work, its shortcomings, and future research directions.

2 IT-SOURCING, SAAS AND RISK

Since the beginnings of IT outsourcing activities, there has been plenty of evidence that outsourcing entails a significant amount of risk. Many researchers have thus more thoroughly investigated how and what forms of actual or perceived risks influence the outsourcing decision. Earl (1996), for example, identified 11 risks ranging from organizational (e.g., loss of innovative capacity and lack of organizational learning), technical and operational (e.g., the endemic uncertainty of IT operations and development or the indivisibility of IT) to financial (e.g., the 'hidden costs' of outsourcing) and strategic factors (e.g., risks emanating from a change in business strategy or from an excessive dependence and lock-in). Lacity and Willcocks (1998) found several other problems and obstacles in their empirical analyses of IT outsourcing practices including the potential lack of business understanding and vendor skills or the loss of control and deterioration of service levels over time (Lacity & Willcocks, 1998).

Risks and how to cope with risks has remained a recurring and central theme in more recent IT outsourcing studies, which have mainly confirmed existing findings. Gonzalez et al. (2009), for example, were able to show in an empirical analysis of IT outsourcing clients that concerns about provider staff qualification and provider's compliance with the contract ranked highest, while the risks of possible IS staff opposition and the irreversibility of the decision ranked lowest (Gonzalez et al., 2009). Gefen et al. (2008) examined how business familiarity could be used to mitigate risk in software development outsourcing (Gefen et al., 2008), while Gewald and Dibbern (2009) examined specific risk factors in the banking industry and found financial and strategic risks to be the dominant risk factors (Gewald & Dibbern, 2009). With the advent of more service-oriented and on-demand software delivery models, research studies have also examined the risks in adopting e-services (Featherman & Pavlou, 2003) and application service provisioning (ASP) (e.g., Kern et al., 2002b; Susarla et al., 2003). These studies basically found that the sourcing of software services has many of the same risks as traditional IT outsourcing but that the pattern of likely risks differs. While some risks are greater in the case of services, some are as pronounced or less pronounced.

Although first studies have explored drivers of SaaS adoption including uncertainty factors such as technical, process, and economic risks (Benlian, 2009) or demand uncertainties for functionality and service volume (Xin & Levina, 2008), there is still a lack of research on the empirical analysis of a comprehensive set of risk factors for the sourcing of applications via a SaaS interface. Examining risk factors of SaaS is important, however, because its characteristics differ not only from traditional on-premises but also from former on-demand software delivery models such as ASP. While the ASP model allows customers to customize their client-specific instance of an application, which is located at the vendor's data center, on a one-to-one basis, the SaaS model relies on a different architecture. In this new multi-tenant architecture, only a single instance of the common code and data definitions for a given application exists on the vendor's server, and no customization of this code is permitted. SaaS is thus designed to deliver software services to multiple customers (Chou, 2008). Customer-specific configurations can be made at the meta-data layer on top of the common code using interfaces provided by the SaaS vendor. The service can be integrated with other applications or connect with more custom functions through common web services application programming interfaces (APIs) that are defined and maintained by SaaS vendors (Chou, 2008).

The new architecture has four major implications (Xin & Levina, 2008). First, it constrains clients' options for customization of the main functionality and data structures of the software. Second, while in traditional adoption of packaged software, clients can choose how to implement the package and later decide on where to host their instance of the package, clients simultaneously make their implementation and hosting choice in the SaaS case. Third, SaaS model gives more control over future development to the vendor, as clients have no choice but to adopt future upgrades of software if they continue using the service. Fourth, the architecture of SaaS allows for the separation of maintenance responsibilities between the SaaS vendor and the client. In particular, the SaaS vendor is responsible for maintaining the common code base that delivers the standard application services to all customers, while customers are responsible for maintaining their custom-developed code. Thus, this model no longer requires any client-specific investment by the vendor and helps vendors to reap significant economies of scale for they do not need to constantly keep increasing the size of their data centers. This is also the reason why vendors can pass on lower up-front cost to their customers because they do not have to host client-specific instances of an application which enables them to divide up service provisioning cost among all clients. In sum, it is claimed by SaaS proponents that SaaS allows providers to offer customers technologically more mature service packages than the ASP model and, from a total-cost-of-ownership point-of-view, a more inexpensive access to applications via easy-to-use Internet interfaces (Dubey & Wagle, 2007). On the provider side, it supports a multi-tenant and shared IT infrastructure to reap significant economies of scale (Valente & Mitra, 2007).

Given these advanced technological and economic features, we argue that although the risk factors in SaaS sourcing are basically the same as in traditional or ASP-based sourcing models, the perceived importance of individual risk factors will change. Due to the paucity of research in the analysis of risks of SaaS sourcing, the primary goal of this study is thus to provide answers to the question of what risk factors weigh more or less in the perception of potential and actual SaaS customers.

3 HYPOTHESES DEVELOPMENT

We adopted the perceived risk framework developed by Cunningham (1967) to derive a conceptual model on the relationship between perceived risk factors and SaaS-based sourcing (Cunningham, 1967). In this regard, perceived risk (PR) is commonly thought of as felt uncertainty regarding possible negative consequences of using a product or service. It has formally been defined as "the expectation of losses associated with purchase and acts as an inhibitor to purchase behavior" (Peter & Ryan, 1976). PR is relevant in decision-making when circumstances of the decision create feelings of uncertainty, discomfort and/or anxiety or conflict aroused in the decision-maker (Bettman, 1973). Following these definitions, we define perceived risk as 'the potential for loss in the pursuit of a desired outcome of sourcing via a SaaS interface'.

Cunningham (1967) typified perceived risk as having six dimensions: (1) performance, (2) financial, (3) opportunity/time, (4) safety, (5) social and (6) psychological loss. A rich stream of consumer and organizational behavior literature supports the usage of these risk facets to understand product and service evaluations on the individual and organizational levels (e.g., Featherman & Pavlou, 2003). Transferring this framework to the SaaS context, we reduced it to the following five facets – *performance, financial, strategic, security and psychosocial risk facets*. They were the most pertinent risk facets for SaaS-based sourcing in the literature on IT outsourcing, ASP, and SaaS (e.g., Earl, 1996; Kern et al., 2002b; Benlian, 2009).

In line with Ajzen's Theory of Reasoned Action (Ajzen, 1985), we argue that management's intention to change the level of SaaS sourcing depends on its attitude towards SaaS sourcing, which is influenced by salient beliefs about it. More specifically, we suggest that these negative beliefs about SaaS sourcing (i.e., negative beliefs about performance, financial, strategic, security and psychosocial risk facets) result in an overall evaluative appraisal of SaaS sourcing (i.e., an overall level of perceived risk of SaaS sourcing) which in turn (negatively) influences the intention to change the current level of SaaS sourcing (Gewald & Dibbern, 2009). Accordingly, we derive the following hypothesis:

Hypothesis 1: A high level of overall perceived risk of SaaS sourcing negatively influences the intention to increase the level of SaaS sourcing.

The resulting model on the perceived risk of SaaS sourcing, which already foreshadows further hypotheses development in this section, is shown in Figure 1.

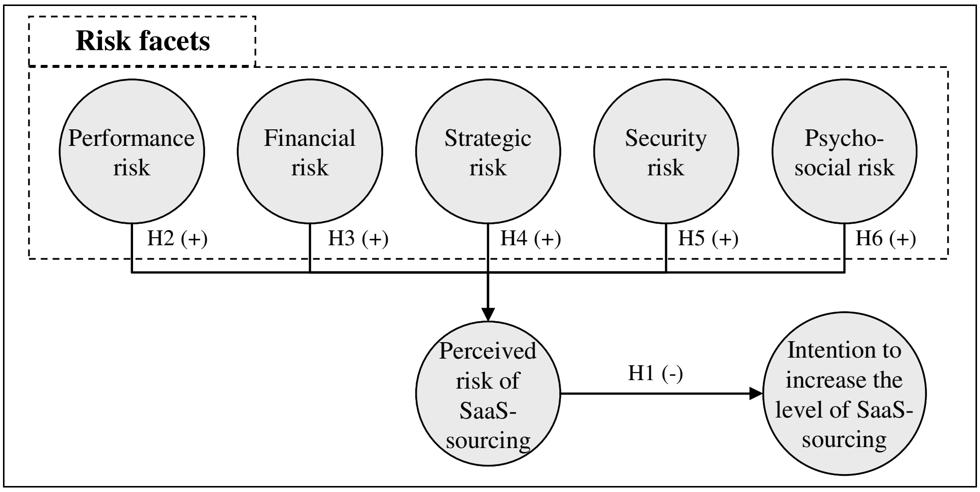

Figure 1. Research Model on Perceived Risks of SaaS Sourcing

Performance risk admits that SaaS sourcing may not deliver the expected level of service by failing to provide application availability and network bandwidth as originally stipulated between the SaaS provider and the client (Benlian, 2009). In addition, performance risk refers to problems with the seamless interoperability between the SaaS application hosted by the vendor and all home-grown applications located on the client side. Potential losses due to these problems can be significant because day-to-day operations would not be supported in an optimal way leading to organizational inefficiencies or even to a severe damage to the organization's reputation if customer-facing processes are affected. Therefore, managers must carefully analyze the ability of the service provider. Potential sources of failure are the inability to provide the resources, a lack of vendor capabilities or poor SLA management (Quélin & Duhamel, 2003). We thus formulate:

Hypothesis 2: *The higher the perceived performance risks of SaaS sourcing, the higher the overall perceived risk of SaaS sourcing.*

Financial risk assumes that a SaaS client has to pay more to reach the expected level of service than initially anticipated. The architectural approach of SaaS shifts specific investments to the client: the vendor does not customize the code or data definitions on its servers, and the client is responsible for maintaining all the customized components. Thus, if the client wants to customize the core of the application, he needs to own it. Even if the client is able to use the standard core, he may want to build components on top of the core functionality (using APIs) to suit his needs. Higher-than-expected costs may thus occur due to changing requirements (i.e., the usually high level of standardization of SaaS applications may not suffice to completely match the needs of the client company) or increasing costs due to hold-up, as a vendor's ownership of the core of the application gives him more bargaining power to raise prices or he refuses to invest in maintaining backward-compatible interfaces for the customized code of the client (Xin & Levina, 2008). Thus, we formulate:

Hypothesis 3: *The higher the perceived financial risks of SaaS sourcing, the higher the overall perceived risk of SaaS sourcing.*

Strategic risk admits that a company can lose critical resources and capabilities when sourcing applications via SaaS. This is especially the case if business-critical applications are outsourced that support a broad spectrum of key functional areas of an organization such as ERP, SCM, or CRM systems (Xin & Levina, 2008). Essential resources and capabilities may include cross-functional skills as well as the technological know-how necessary to facilitate innovation. In the same vein, the sourcing of applications via SaaS may reduce a company's flexibility to react swiftly to new internal and external forces because full control over application development and maintenance is given to the SaaS provider (Kern et al., 2002a). Accordingly, we formulate:

Hypothesis 4: The higher the perceived strategic risks of SaaS sourcing, the higher the overall perceived risk of SaaS sourcing.

When using SaaS, some if not all of the data of a SaaS client will be stored at the SaaS provider's data center. SaaS clients thus give the direct control of their data to a provider without knowing how this provider will secure the data and what backup and disaster recovery procedures the provider will have in place. Although service-level agreements can be used to write down exactly what security levels should be maintained, clients' experience in IT outsourcing is often so little that they are unaware of the current legislation in case of any damage or of the risk of signing an incomplete contract (so-called legal security risk). Also, the nature of Internet-based technologies and environmental uncertainties are still unpredictable (Pavlou, 2002), so that potential security breaches, such as data theft or corruption, may cause feelings of anxiety and discomfort on the side of potential and actual SaaS customers (Kern et al., 2002b). Thus:

Hypothesis 5: The higher the perceived security risks of SaaS sourcing, the higher the overall perceived risk of SaaS sourcing.

In addition to these risks at the firm level, outsourcing may also affect the personal affairs of the managers responsible for the application being outsourced. Psychosocial risk involves the possibility that the personal reputation and career of these managers will be harmed due to SaaS sourcing. Outsourcing ventures are often associated with negative assertions in the daily press about loss of jobs. This may affect the personal reputation of managers amongst peers, clients, and staff, as well as lead to a loss of power due to loss of control over resources (Gonzalez et al., 2009). Thus:

Hypothesis 6: The higher the perceived psychosocial risks of SaaS sourcing, the higher the overall perceived risk of SaaS sourcing.

4 EMPIRICAL METHOD

4.1 Survey Administration and Sample Characteristics

To test the research model in Figure 1, we designed a questionnaire and conducted a survey based on a random sample of 2,000 German companies drawn from the Hoppenstedt database. To support the external validity of our study, we did not constrain the sample to specific industries or to firms of a specific organizational size. The survey questionnaire was designed based on a comprehensive literature review of the IT outsourcing literature and on interviews with two IT executives. After several rounds of pretests and revisions, the survey was sent by mail and e-mail to the companies in the sample in May 2009. The questionnaire was addressed to top or senior IT executives who were deemed most qualified to answer the survey questions. After 34 responses were dropped due to missing data, a total of 379 usable responses coming from 155 SaaS adopter and 224 non-adopter companies could be used for analyzing our model. The random sample included firms with the following industry breakdown: manufacturing (31%), wholesale and retail trade (23%), financial intermediation (14%), TIME industries (12%), construction and real estate (8%), logistics (6%), public and healthcare (3%), and electricity/gas/water supply (3%). Further sample characteristics are shown in Table 1.

Category	Percent	Category	Percent
Number of Employees		*Annual Revenue (Euro million)*	
< 10	22.9	< 1	23.3
10 – 49	21.2	1 – 9	28.3
50 – 99	18.2	10 – 99	23.0
> 99	37.7	> 99	25.4
Usage of SaaS-based applications (years)		*Respondent Title*	
0 (non-adopters)	59.1	CEO, CIO/VTO	35.0

>0 (adopters)	40.9	IT manager (business applications)	50.3
Familiarity with SaaS since … years		Business operations manager, COO	11.5
< 2	15.0	Other managers and n/a	3.2
> 2	85.0		

Table 1. Sample Characteristics (n=379)

4.2 Measures

Table 2 provides our conceptual definition of the constructs and a summary of the sources from which the items for the scales were drawn. All questions were asked from a Likert-scale ranging from 1 to 5, where 1 refers to the lowest score and 5 the highest score in the item scale.

Constructs	Indicators Likert scales from 1=lowest score to 5=highest score except	Source
To what extent do you agree with the following statements:		
Intention to increase level of SaaS sourcing	If there is a superior offer, a SaaS-solution should be used for the application domain I am in charge of	Based on Dibbern, 2004
	Our company should increase the existing level of sourcing of SaaS-based applications	
	I support further adoption of SaaS-based applications	
Perceived risks	SaaS-based sourcing of applications is associated with a high level of risk	Based on Featherman & Pavlou, 2003
	There is a high level of risk that the expected benefits of SaaS-based sourcing of applications will not materialize	
	Overall, I consider SaaS-based sourcing of applications to be risky	
How do you perceive the risk that …		
Performance risk	… the SaaS provider will not provide the promised service?	Based on Quélin & Duhamel, 2003
	… the SaaS provider will not perform the process to the desired quality (speed and reliability of network) and quantity?	
	... the service provider will not be able to ensure seamless interoperability with your home-grown applications?	
Financial risk	... the originally calculated business case will not include all the actual costs?	Based on Gewald & Dibbern, 2009
	... unanticipated costs that reduce the calculated cost savings will emerge?	
	... the anticipated cost savings will not be achieved?	
Strategic risk	... through SaaS-based sourcing of applications our company will lose its ability to react flexibly to changes in the market?	Based on Earl, 1996
	… through SaaS-based sourcing of applications our company will lose its ability to improve its position in the market by means of internal optimization procedures?	
	… through SaaS-based sourcing of applications our company will lose know-how that will be required to remain competitive in future markets?	
Security risk	… the confidentiality and security of your business data is not guaranteed when sourcing applications via SaaS solutions?	Based on Bahli & Rivard, 2003; Featherman & Pavlou, 2003
	… in case of damage, present liability law is still unclear about who will bear the damage?	
	… the SaaS provider will exploit contractual loopholes (i.e., incomplete contracting) to the detriment of your company?	
Psychosocial risk	... through SaaS-based sourcing of applications for which you are responsible will damage your standing among colleagues and business partners?	Based on Gewald & Dibbern, 2009
	… through SaaS-based sourcing of applications for which you are responsible will negatively affect your standing within and outside the company?	
	... through SaaS-based sourcing of applications for which you are responsible will decrease the respect of colleagues and business partners?	

Table 2. Measurement models of variables (n=379)

5 STATISTICAL ANALYSES AND RESULTS

5.1 Assessing the Measurement Models

Content validity was established through the adoption of constructs that already had been used in former studies, as well as through pilot tests with IS practitioners of different industries. The measurement models were validated using the standard procedures of current literature (Straub, 1989) (see Tables 3). Items of scales in a related domain were pooled and factor-analyzed to assess their convergent and discriminant validity. While convergent validity was determined both at the individual indicator level and at the specified construct level, discriminant validity was assessed by analyzing the average variance extracted and inter-construct correlations.

Constructs	Number of items	Range of Stand. Factor Loadings*	Composite Reliability	Average variance extracted (AVE)	Cronbach's Alpha
Intent. to increase SaaS	3	0.940 – 0.962	0.965	0.901	0.945
(Overall) Perceived risk	3	0.890 – 0.946	0.945	0.851	0.912
Performance risk	3	0.918 – 0.921	0.942	0.845	0.908
Financial risk	3	0.936 – 0.958	0.962	0.895	0.941
Strategic risk	3	0.889 – 0.922	0.932	0.821	0.891
Security risk	3	0.838 – 0.930	0.928	0.812	0.883
Psychosocial risk	3	0.950 – 0.962	0.973	0.925	0.959

* All factor loadings are significant at least at the $p<0.001$ level ($n=379$)

Table 3. Assessment of Measurement Models: Factor Loadings and Reliability

All standardized factor loadings are significant, thus suggesting convergent validity. To evaluate construct reliability, we calculated composite reliability for each construct. All constructs have a composite reliability significantly above the cutoff value of 0.70 (Straub, 1989). All reflective constructs also met the threshold value for the average variance extracted (AVE>0.50). For discriminant validity of latent variables, the square roots of AVEs exceeded the inter-construct correlations that were negligibly low between the independent constructs. The same procedures were also conducted for the sub-models of adopters and non-adopters examined in this study. All constructs in these measurement models also satisfied the reliability and validity criteria mentioned above; as a result, they could be used to test the structural models and the associated hypotheses proposed earlier.

5.2 Structural Model Test for the Aggregate Data Set

For data analysis, we tested our research hypotheses using PLS-based structural equation modeling (Chin, 1998) based on SmartPLS. In contrast to parameter-oriented and covariance-based structural equation modeling, the component-based PLS method is prediction oriented (Chin, 1998, p. 352) and places minimal restrictions on sample size and residual distributions. Tests using SPSS revealed that our data set contains a number of abnormally distributed variables. Consequently, PLS was the method of choice because it does not rely on normally distributed indicator data (Chin, 1998). To provide an aggregate view on the assessment of PLS-based models, the structural model is evaluated by looking at the percentage of the variance explained (R^2) of all dependent latent variables. By examining the size and stability of the coefficients associated with the paths between latent variables, hypotheses are finally analyzed for their significance. The results in Figure 2 indicate that 72 percent of the variance in the perceived risk of SaaS sourcing and 66 percent in the intention to increase the level of SaaS sourcing were explained by the research model. The results also show that all coefficients of paths leading from the risk facets to perceived risk of SaaS sourcing are positive and statistically significant except for psychosocial risk. Finally, the overall construct 'perceived risk of SaaS sourcing' negatively and significantly influenced the intention to increase the level of SaaS sourcing.

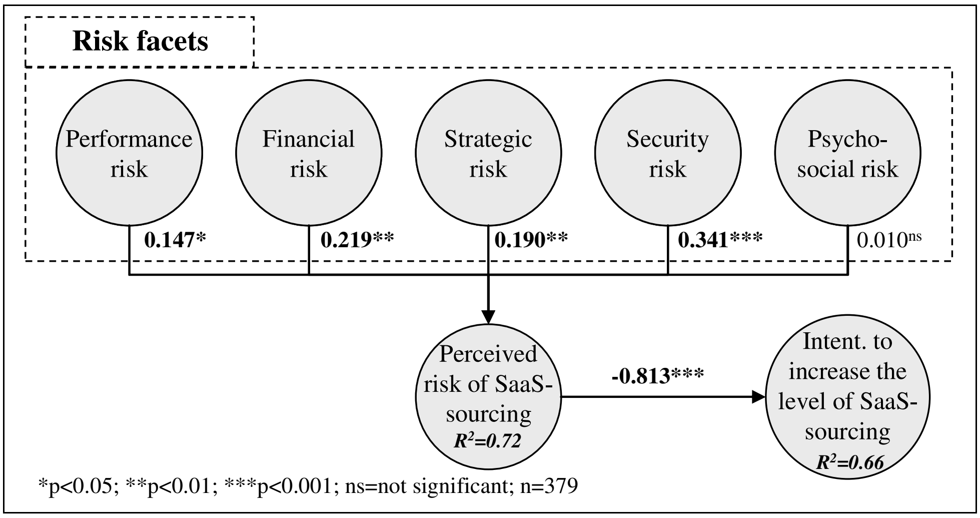

Figure 2. PLS Test of Structural Model based on Aggregate Data Set (n=379)

5.3 Comparing Adopters and Non-Adopters

Based on sub-samples of 155 adopters and 224 non-adopters, structural equation models were calculated. Analogous to the assessment of the full sample, standardized path coefficients and the share of explained variance (R^2) were analyzed and compared (see Figure 3). In the non-adopter sample, financial, strategic, and security risk facets have strongly positive and significant paths leading to perceived risk of SaaS sourcing that in turn has a strong negative effect on the intention to increase the level of SaaS sourcing. Both performance and psychosocial risk facets are not significantly associated with the perceived risk of SaaS sourcing. A total of around 55 percent of the variance of perceived risk of SaaS sourcing could be explained by the risk facets, while 54 percent of the variance of the intention to increase the level of SaaS sourcing could be explained. In the adopter sample, by contrast, 71 percent of total variance of perceived risk of SaaS sourcing could be explained by the risk facets, while 49 percent of the variance of the intention to increase the level of SaaS sourcing could be explained. Paths from performance, strategic and security risks to the perceived risk of SaaS sourcing are highly significant, while there is no significant association between financial and psychosocial risk factors and perceived risk of SaaS sourcing.

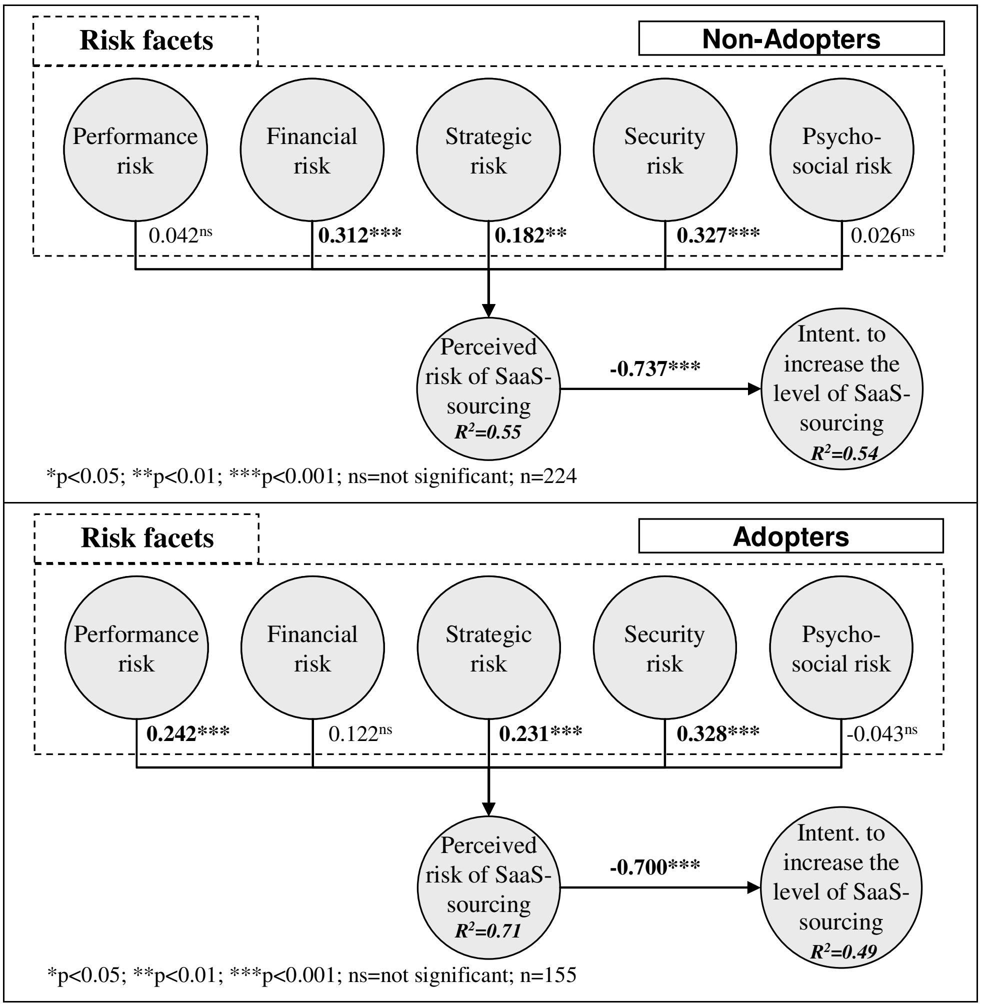

Figure 3. Between-Group Comparison: Adopters vs. Non-Adopters

As can be seen from the results in the sub-samples, the significance of risk facets varies for adopters and non-adopters. To test whether these differences are significant or not, we conducted a multi-group comparison with PLS (Qureshi & Compeau, 2009).

Group comparison		*β-coefficients*			*t-test for mean equality*			
Relationship	*Groups*	*Mean*	*SD*	*SE*	*t*	*Sig.*	*ΔMean*	*ΔSE*
Performance risk → Perceived risk	ADOPT	0.248	0.083	0.006	22.301	0.000	0.190	0.000
	NONADOPT	0.057	0.088	0.006				
Financial risk → Perceived risk	ADOPT	0.122	0.072	0.005	-23.699	0.000	-0.190	-0.001
	NONADOPT	0.312	0.087	0.006				
Strategic risk → Perceived risk	ADOPT	0.232	0.062	0.004	7.009	0.000	0.050	-0.002
	NONADOPT	0.182	0.079	0.006				
Security risk → Perceived risk	ADOPT	0.319	0.078	0.006	0.361	0.719	0.003	0.001
	NONADOPT	0.316	0.070	0.005				
Psychosocial risk → Perceived risk	ADOPT	-0.044	0.061	0.004	-13.994	0.000	-0.076	0.001
	NONADOPT	0.031	0.047	0.003				

Table 4. Descriptives of β-coefficients and t-test results of multi-group comparison

For every sub-sample, 200 β-coefficients for the paths between the risk facets and the perceived risk of SaaS sourcing were generated with the bootstrapping routine of PLS. Table 4 summarizes the descriptive statistics of the β-coefficients generated with PLS for both adopters and non-adopters. Based on these values, a t-test was conducted to test for the significance of difference between adopters and non-adopters. A Levene test for equality of variances indicated that the variance is equal between adopters and non-adopters for both sub-samples across all investigated relationships between risk facets and perceived risk of SaaS sourcing. From the results of the t-test, one can conclude that on a $p<0.001$ level, there are significance differences between non-adopters and adopters for all relationships except for the relationship between security risk and (total) perceived risk.

6 DISCUSSION

6.1 Research and Practical Implications

To the best of our knowledge, this is the first study examining a comprehensive set of risk factors of SaaS-based sourcing discriminating between SaaS adopters and non-adopters. Several interesting research implications can be drawn from our results.

Security risk was the dominant factor affecting company's perceived risk of SaaS sourcing followed by strategic risk. Obviously, irrespective of the adoption status, IT executives are mainly concerned about data security issues and potential contractual loopholes that are exploited to the detriment of the customer. Also, companies do have concerns about the loss of innovative capacity prior to and within a SaaS-based relationship. In contrast to security risk, psychosocial risk did not play a significant role in forming perceived risk. IT executives thus do not fear any loss of face or loss of control over resources when weighing the option of SaaS sourcing. Performance and financial risk were also significant factors affecting perceived risk in the aggregate research model. However, we found interesting differences between adopters and non-adopters. While financial risk was a considerable risk factor of non-adopters, it did not play a significant role for SaaS adopters. Apparently, non-adopters are still skeptical of SaaS vendors' promises that customers will have a lower total cost of ownership when sourcing applications via SaaS compared to traditional on-premise installations. On the contrary, SaaS adopters actually no longer consider financial risk to be crucial, from which it may be inferred that they are satisfied with the basic economics of SaaS. This would also support the proposition that the distribution of power in this market is shifting towards customers in the sense that they can realize lower cost structures compared to traditional on-premise installations while vendors earn less profits (Chou, 2008). Conversely, non-adopters obviously have the naive assumption that performance issues do not matter in SaaS sourcing. However, as evidenced by our results on SaaS adopters, providing a pre-specified service quality level is indeed a major challenge for SaaS vendors.

Our findings are in line with previous research on traditional IT outsourcing. They, for example, support that performance, financial and strategic risks are significant factors affecting the intention to increase the level of SaaS sourcing, while psychosocial risks are not (Gewald & Dibbern, 2009). Furthermore, our results also corroborate previous findings in ASP research that security risk including data breaches and incomplete contracting as well as strategic risks such as the loss of innovative capacity are crucial factors in explaining potential and actual risk concerns (Jayatilaka et al., 2003). However, as argued in the beginning of our paper, the relative weights of the different risk facets have changed in SaaS sourcing compared to traditional and ASP-based outsourcing. While, for example, in classical IT-outsourcing, researchers have found that financial risks in most cases outweigh other risk factors (e.g., Bahli & Rivard, 2003), security risks are much more prevalent in SaaS sourcing. Likewise, while performance risks (such as application availability) have been considered as one of the most crucial risks in the ASP model (e.g., Kern et al., 2002b), they are still considerable but not the dominant risk concerns of IT executives in the SaaS model.

Besides research implications, there are also several relevant implications for practitioners. Our study produced a comprehensive set of risks to be considered in the SaaS sourcing decision and revealed interesting divergences in the perception of SaaS adopters and non-adopters. Non-adopters of SaaS can learn from our results that they should reassess their financial and performance evaluations of SaaS-based application services, as they seemingly overestimate SaaS' total-cost-of-ownership on the one hand and underestimate performance issues on the other. Before adopting or rejecting SaaS, non-adopters should therefore compare their individual situation with those of a meaningful set SaaS-adopting peers. According to our findings, SaaS adopters should primarily seek to get a grip on security and performance risks. Possible risk-mitigation strategies may be to detail contracts with the SaaS provider by including mandatory security standards (e.g., data encryption technologies, virtual private networks etc.), penalties for data breaches or non-performance (for supplier-caused failures) or by introducing a 3rd party that guarantees the availability and integrity of data ("escrow services").

For SaaS providers, our study gives important factors to emphasize when offering SaaS services to companies. The assessment of perceived risks showed that potential clients appear to overestimate the total cost of ownership of SaaS, while actual clients have significant performance risk concerns. Furthermore, both SaaS adopters and non-adopters consider security risk as the most crucial risk factor nurturing their reluctance to adopt SaaS. SaaS providers can learn that they should address potential and actual SaaS clients' risk concerns differently. In particular, lowering non-adopters' security and financial risk seems important for gaining SaaS accounts. In this regard, SaaS providers may use reference cases to convince potential clients from the superior economics of SaaS services compared to on-premises solutions and to show their track record in providing secure services. Concerning performance issues perceived by actual SaaS clients, SaaS providers should not only address their own shortcomings ("supplier-caused failures") but should also help their customers to overcome Internet-related problems (e.g., that a client's Internet service provider provides them with a redundant, high quality or even dedicated Internet connection) in order to offer ways of risk mitigation and sharing.

6.2 Limitations and Future Research

As with any research, this study has some limitations. First, our research model was tested using cross-sectional data. Since the data represents a snapshot in time, the imputation of cause-effect relationships between the constructs in the model must be made with caution. Future research in this area may thus examine the associations between risk facets and SaaS adoption decisions in a longitudinal setting to address the question of causality. Second, our empirical analysis focused on comparisons between adopters and non-adopters neglecting other interesting inter-group effects. Further research may thus investigate how the relative importance of risk facets differs across industries, company size, and application types. Last but not least, future research may also investigate *opportunities* of SaaS services from a user perspective to provide a complete picture of a SaaS opportunity-risk analysis.

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