Cloudy with a Chance of Usage? – Towards a Model of Cloud Computing Adoption in German SME

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Abstract. While Cloud Computing has become an important topic in research and practice in recent years and widely adopted by consumers and companies around the globe, especially German small and medium-sized enterprises (SME) are reluctant with the respect to using cloud services. Scientific literature on cloud adoption in German SMEs is still scarce, in particular with respect to the use of PaaS solutions. Therefore, in this paper a research model for the organizational adoption of Cloud Computing and especially PaaS solutions is proposed, which is based on the Diffusion of Innovation (DOI) and Technology, Organization and Environment (TOE) theories. The proposed model is derived from an explorative qualitative empirical study among German SMEs. Within this model, security and privacy concerns and fast broadband internet access have been identified as the most important technological influencing factors for cloud adoption.

Keywords: Cloud Computing, PaaS, Adoption, Organizations, SME

1 Introduction

In recent years, Cloud Computing has become an important topic in research as well as in practice [11]. It refers to providing computing infrastructure or software services in a flexible way via the internet [14]. Three main service models could be distinguished: Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS) [14]. From these, in particular PaaS is getting increasingly important [1].

Furthermore, there is a need to focus especially on small and medium-sized enterprises (SME). E.g., in 2014 an official study showed the importance of SMEs for the German economy [2]. Nevertheless, so far few scientific studies exist on the adoption of Cloud Computing and in particular PaaS by German SMEs. Therefore, in this paper a research model for describing the influencing factors on organizational adoption of Cloud Computing with special consideration of PaaS is derived from an explorative qualitative study among German SMEs.

The rest of this paper is organized as follows: In Section 2 the related literature is analyzed in detail, Section 3 describes the research model used for the empirical study and Section 4 the respective data collection and analysis. The results of the empirical study are presented in Section 5. We conclude with a summary of our findings.

2 Related Work

For evaluating the adoption of information Technology (IT) trends, in information systems research (ISR) various adoption theories are commonly used. These can be categorized into two groups: On the one hand theories with a psychological focus, like the Technology Acceptance Model (TAM) [7] or the Theory of Planned Behavior (TPB) [3] and their various descendants, on the other hand approaches taking an organizational perspective like the Diffusion of Innovation (DOI) [19] or Technology, Organization and Environment (TOE) frameworks [21, 16, 17].

By such frameworks, the organizational adoption of Cloud Computing has been studied in recent years by various authors for different contexts and countries, but only partially for SMEs [5, 18, 20, 22, 9, 17, 15, 11, 23, 10].

While the importance of analyzing Cloud Computing adoption in SMEs has been emphasized by various authors [18, 22, 9, 15, 11, 23, 10], only few studies on the topic have been published (the term SME here is used according to the definition of the European Commission [8]). In particular, only a limited number of studies on SMEs in Germany exist [11]. Due to the big importance of SMEs for the German economy [2], more research is required here. Despite its rising importance [1], literature on the organizational adoption of PaaS is also scarce [23], and in particular no scientific studies have been found focusing on the organizational adoption of PaaS by SMEs in Germany.

Therefore, in this paper an organizational adoption model for Cloud Computing in SMEs in Germany with a special focus on PaaS is derived from an explorative qualitative empirical study.

3 Research Model

For the present qualitative study the TOE framework is combined with elements of DOI model [19, 21]. The innovation characteristics of the DOI model have been integrated in the technological context of the TOE model, as both aspects cannot be clearly separated from each other. This approach represents an extension of the work by Oliveira et al. [17], while adding some constructs based on further authors' results [20, 5].

Figure 1 shows the resulting initial research framework with its respective hypotheses (HB1 – HB10) regarding the positive (+) or negative (-) influences on the adoption. The influences on the adoption according to the TOE framework are grouped into three major contexts:
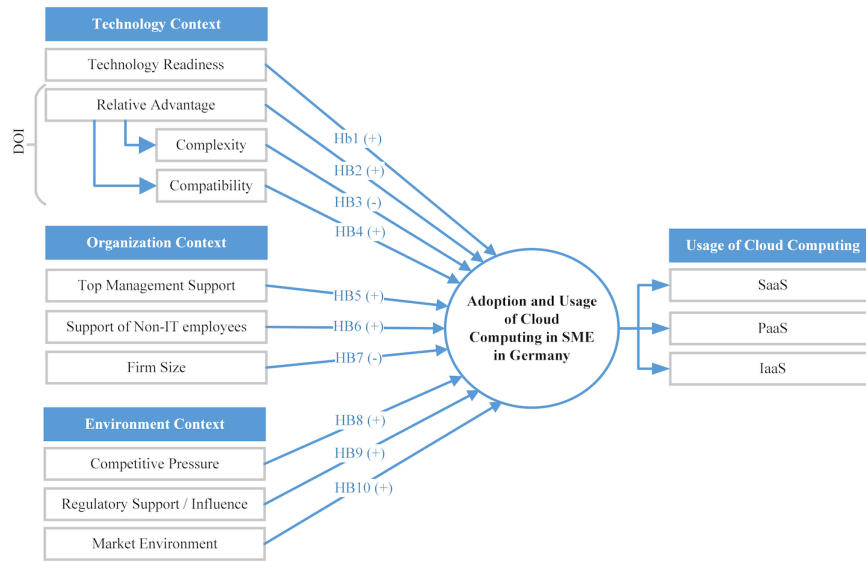
Fig. 1. Research Framework for the qualitative study with its hypotheses (HB1–HB10) (negative (-) or positive (+) direction of influence).

Technology Context. Contains the factors technological readiness and relative advantage. Together with its sub-factors complexity and compatibility it has been taken from the DOI model [19, 17].

Organizational Context. Consists of the factors top management support, support of Non-IT employees and firm size. Support of Non-IT employees has been suggested to influence the adoption of Cloud Computing [5]. Firm size has been recognized as an important factor when adopting new technology [5, 20, 17].

Environment Context. Describes the setting in which a company pursues its business, consisting of the factors competitive pressure [18], regulatory support or influence [5, 20, 17] and market environment [4].

In addition, the adoption is considered to be influenced by the actual *Usage of Cloud Computing*, considered separately for the three service models (SaaS, PaaS and IaaS).

4 Data Collection and Analysis

To evaluate and refine the described research model, a qualitative study among SMEs in southern Germany was conducted. A convenience sample of 16 representatives of SMEs was interviewed in November 2014 using semi-structured interviews with a paper-based questionnaire. 10 interviews were performed face-to-face, 5 by telephone and 1 via e-mail. 9 interviewees were CEO of a SME, while the remaining participants were working in other positions (e.g. software

developers). In addition, public information about the enterprises of the interviewees was collected and analyzed.

13 participants worked for actual SME according to the EU definition. The majority of the participants were from the IT industry (13), but also from business consulting (1), retail industry (1) or even indoor car racing (1). 10 of these companies are mainly active on the German or regional markets, but also in Europe (5) and even worldwide (1).

The interviews were audio recorded and transcribed. They were performed in German language, with the resuls being translated for publication. The subsequent coding and further analysis was performed using the MAXQDA 11Plus software tool[1] using a grounded theory approach [6] in combination with a qualitative content analysis [13].

5 Results

The combination of the codes/categories resulting from the qualitative analysis with the predefined model structure is illustrated in figure 2.
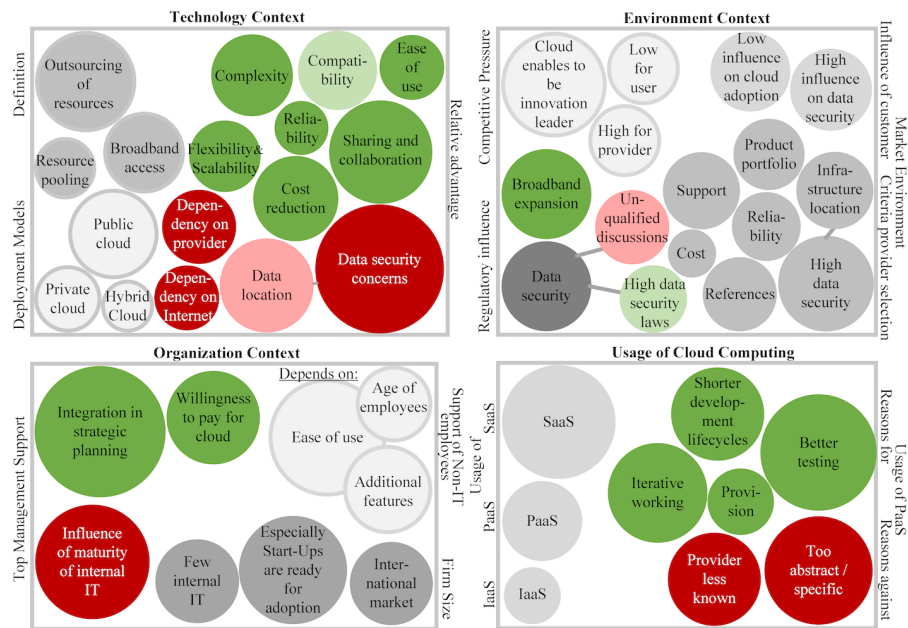

Fig. 2. Results obtained from the qualitative study (circle size = Importance of code / category, green circle = Advantage / positive influence, red circle = Disadvantage / negative influence, grey circle = Fact mentioned)
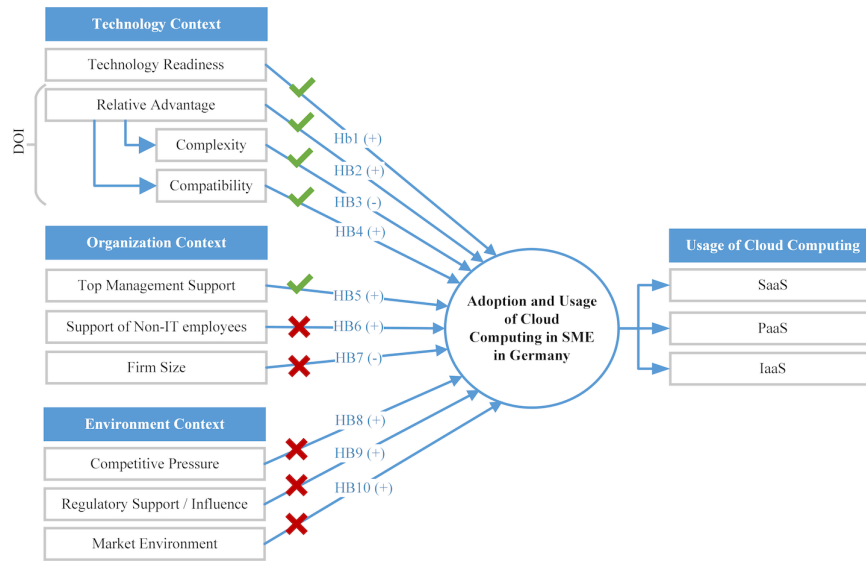
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[1] http://www.maxqda.com

Fig. 3. Research Framework of qualitative Study with hypotheses status (negative (-) or positive (+) direction of influence, green check mark = confirmation of the hypothesis, red cross = rejection of the hypothesis).

Technology Context. Deeper technical knowledge of Cloud Computing (in agreeement with [17] but contradicting [12]) as well as its perception as being beneficial for collaboration (contradicting [9]) while being rather uncomplicated to use (contradicting [17]) have a positive impact on its adoption.

Data security concerns were considered the most important negative impact on adoption of Cloud Computing. Topics as the NSA affair, and the necessity to meet complicated legal requirements were mentioned in this context. This aspect has not been found in previous studies so far. However, concerns about the dependency on the provider and problems with internal IT or API played a minor role.

Organization Context. In agreement with the literature [12, 5, 17], top management support was considered as rather important for the adoption. With respect to the role of Non-IT employees and firm size the results remain inconclusive. Regarding firm size, this is in line with [5] but not [12, 17].

Environment Context. Competitive pressure played a minor role for the participants. In contrast, the participants stated that Cloud Computing could enable firms to become innovation leaders and as a result influence their cloud or software providers. This is in line with [17], but not [12, 5].

The regulatory influence is considered ambivalent. While the ongoing expansion of the broadband network infrastructure is perceived positive by the participants, the privacy and data protection regulations as well as unqualified statements by German politicians are considered to have negative impact on
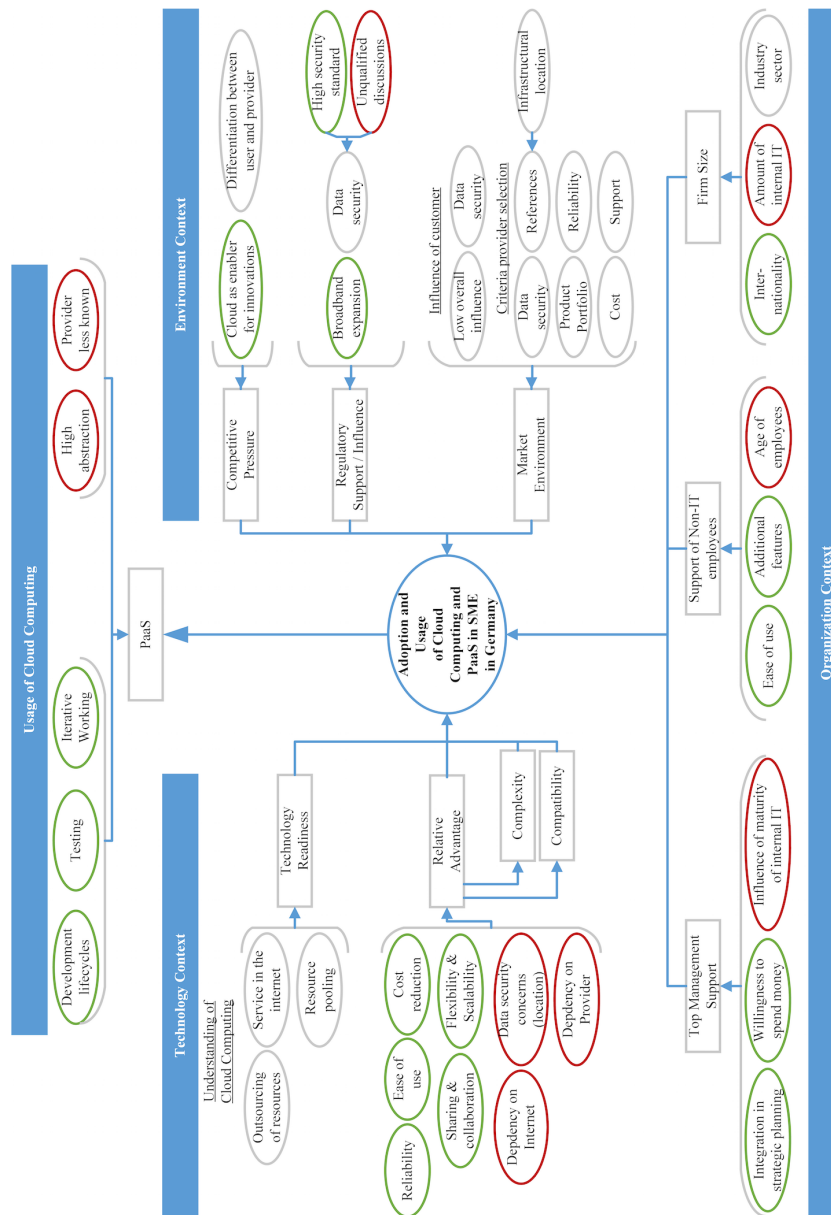
Fig. 4. Adjusted research framework according to the results of the study (Additional elements have been added with ellipses as subordinated points. Color green = possible positive influence, red = possible negative one, grey = neutral but still important one on the adoption).

the adoption. This is probably specific to Germany and in contrast to previous studies [5, 17].

Usage of Cloud Computing. Regarding the cloud service models, SaaS was frequently mentioned, but PaaS and IaaS only by participants from the IT industry. PaaS is well-known to software developers, but only about half of them are using it. In line with the literature [9], simplified provisioning, improved testing possibilities and shorter development cycles are considered as positive, the higher abstraction level as negative. PaaS is only used in development but not in production environments.

Figure 3 summarizes these findings with respect to the original hypotheses in the TOE research framework. Based on these results, the initial research framework was refined as illustrated in figure 4. Compared to the initial model in figure 1, cloud usage now was focused on PaaS.

6   Conclusion

In conclusion, in this paper a research model for analyzing the organizational adoption of PaaS Cloud Computing in German SMEs has been presented. The model was derived from an explorative, qualitative empirical study among SMEs in southern Germany.

Technological factors have been identified to have a major influence on the adoption in SMEs, in particular the availability of broadband internet access and data security and privacy concerns. With respect to PaaS, the key reasons for usage are better testing possibilities and shorter product development lifecycles.

The main limitation of the study lies in its qualitative nature. In addition, mainly companies from the IT sector were interviewed so far, which may lead to a bias in the results. So the study should be extended to other industrial sectors as well. The obtained model now should be tested further by means of a quantitative empirical study to obtain a more comprehensive picture of Cloud Computing adoption by SMEs in Germany.

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