

Behind the Surveys: Cloud Adoption at Second Glance

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Abstract: Cloud Computing has evolved from a trend technology to a well established part of the international market and still has growing relevance. For strategic decisions especially of information technology providers as well as governments, surveys can provide relevant information, but as usual in surveys, there are noteworthy differences even for the simplest questions. In this paper we give an overview of several existing cloud surveys and compare some of the questions, particularly related to cloud adoption and scepticism. Differences are highlighted and a list of influencing factors as possible reasons is derived, each with some background, reference proofs and explanation.

1 INTRODUCTION

By its essential characteristics, which are *On-demand self-service*, *Broad network access*, *Resource pooling*, *Rapid elasticity* and *Measured service* according to (Mell and Grance, 2011), Cloud Computing has many potentials for enterprises such as total cost reduction, transforming capital expenditures to operational costs, leveraging the focus on core competences and huge flexibility for the consumed resources and licenses (Lin et al., 2016). Cloud Computing is also one of the main enabling technologies for fields like Industry 4.0 and the Internet of Things (IoT), where even small and medium-sized enterprises (SME, following the definition of (European Commission, 2003), i.e. a maximum of 50 million euros turnover and less than 250 employees) often have to handle huge amounts of data and need varying infrastructure resources for business intelligence applications and machine learning approaches to optimise application areas such as predictive maintenance and automated scheduling of workloads. Only few technology investments are as critical to the customer experience and competitiveness of enterprises as Cloud Computing (O'Donnell et al., 2018). In addition, sharing the data with a cloud provider is a key issue for many customers while using cryptography in databases decreases performance and restricts the ability to search (Ryan, 2013). Furthermore, while

often only the storage security and privacy is considered, also the computation security can be an issue (Wei et al., 2014). Example software categories used in the Cloud are Document Management Systems (DMS) or Enterprise Content Management Systems (ECM). DMS contains the strategies, methods, technologies and tools for company-wide capturing, creating, managing, distributing, storing archiving and deleting documents and information. By using DMS, organisations have the possibility to deliver relevant documents and information to users where and when they need it (Gartner Inc., nd). A document management system maps all the phases of the entire document life cycle: This cycle begins with the creation or input of a document and ends with the archive or defined disposal. Protecting outsourced data in cloud especially when using DMS is a complex problem which has advantages but also many disadvantages and limitations (Wu et al., 2017).

1.1 Cloud Adoption at First Glance

The overall relevance of cloud technologies for enterprises as well as the general adoption of cloud computing have vastly grown over the last years (Illsley, 2017). Many current surveys show that the predominant share of enterprises even uses Public Clouds. Bain & Company state, that 48 of the Fortune Global 50 companies have published their cloud

adoption plans (Brinda and Heric, 2017). According to RightScale, the adoption of Public Clouds has increased from 89 percent in 2017 to 92 percent in 2018 and even 96 percent when Private Clouds are included (RightScale, 2018). For German enterprises, the Cloud Monitor by KPMG and bitkom states that 29 percent of the German enterprises use Public Cloud Solutions and 65 percent use a Public or Private Cloud in 2016.

2 BEHIND THE SURVEYS

First, this section gives an overview of several cloud surveys, explains their meta information, highlights their differences and discusses them. After that, some surveys with more background knowledge are shown and explained and again, their differences are shown and discussed. After that, a list of hypotheses is derived and remarks for reading and writing surveys related to the meta information are given.

2.1 Adoption

When trying to answer a question based on survey results, the results usually vary. This section lists cloud adoption results from several cloud surveys, gives an overview and compares the results as well as investigates reasons for the differences in the topic area. In general, the results vary heavily in the topic area of cloud computing as it can be seen in the following. At first, the meta information of the illustrated surveys is given:

- **State of the Cloud Report.** The State of the Cloud Report is an annual Cloud survey by RightScale. Participants of the newest version were questioned in January 2018, range from technical executives to managers and practitioners and include various enterprise sizes and industries. 19 percent of the participants are RightScale customers and small and medium sized enterprises are defined as enterprises (SME) with less than 1000 employees (RightScale, 2018).
- **Cloud Monitor 2018.** The Cloud Monitor survey series is an annual survey by KPMG realised by bitkom and exists since 2011. The participants are solely German IT-managers from enterprises with at least 20 employees and the newest data was acquired from November to December in 2017. The enterprises are distinguished regarding their number of employees with less than 100 and less than and more than 2000, therefore SME are considered to be enterprises with less than 2000 employees (Bitkom Research GmbH, 2018).

- **Studie IT-Trends 2017.** Capgemini evaluates current ICT-trends in German speaking countries, i.e. Austria, Switzerland and Germany in a series of surveys called *Studie IT-Trends*. The considered version is from 2017 and evaluates data from September to October 2016 (Scheid et al., 2017). Whereas the currently newest version is from 2018 with data from September to November 2017 containing the same core evaluations for cloud computing (Scheid et al., 2018), not all the summarised values are given in the latest version which prevents comparability of the overall cloud adoption. However, the difference in the share of cloud solutions of all ICT-solutions is stated to be nearly unchanged for the year between the two surveys from 2017 and 2018 and the share of cloud solutions (public and private) has only changed from 46.8 percent in the end of 2016 to 47.3 percent in the end of 2017 (Scheid et al., 2018). Enterprises are distinguished by revenue whereat SME cover three classes: up to 50 million euro, up to 500 million euro and up to 1 billion euro.

- **Cloud Computing Survey.** The Cloud Computing Survey is a cloud survey series by IDG Communications conducted by six IDG brands (CIO, Computerworld, CSO, InfoWorld, ITworld and Network World) representing IT and security decision makers across multiple industries. This was a targeted research effort – to be considered qualified respondents must have reported cloud utilisation was planned or currently leveraged at their organisation. Furthermore, respondents must have reported personal involvement in the purchase process for cloud solutions at their organisation. The 2018 version is based on 550 participants and there is no information given about the enterprise sizes (IDG Communications, 2018).

An overview of the number of participants, the share of small and medium-sized enterprises (SME) and the survey time is given in Table 1.

Table 2 then gives an overview of the cloud adoption following the four considered surveys distinguished in public cloud adoption, private cloud adoption and the general cloud adoption (using public or private cloud). The largest difference is the public cloud adoption between the Cloud Monitor and the State of the Cloud Report, whereat these two are the continuous upper bound in case of the State of the Cloud report and the continuous lower bound in case of the Cloud Monitor. This difference is nearly a factor of three in the double-digit percentages for the public

Table 1: Overview of the number of participants, the share of small and medium enterprises (SME) as well as the survey time of the considered surveys in a tabular representation.

Survey	Participants	SME Share	Survey Time
State of the Cloud Report (RightScale, 2018)	997	47%	01/18
Cloud Monitor 2018 (Bitkom Research GmbH, 2018)	557	95%	11/17 - 12/17
Studie IT-Trends 2017 (Scheid et al., 2017)	148	56%	12.09.16 - 21.10.16
Cloud Computing Survey (IDG Communications, 2018)	550	-	-

cloud adoption.

2.2 Scepticism

In addition to the previously presented surveys and as an additional puzzle piece for understanding differences and influencing factors, an extract of three more surveys is presented for which more background knowledge exists. For the scepticism, three different surveys from Germany are compared.

- **Cloud Computing im Mittelstand 2017.** The online survey (translated: Cloud Computing in SME 2017) is a requirements analysis within the framework of the transfer project *Agentur Cloud* (Agency Cloud) in the German government program *Mittelstand Digital* (Mid-sized Sector Digital). The survey was designed specifically to optimise support offers for the needs of influencers and SME. Influencer such as Chambers of Commerce and Industry, Chambers of Crafts etc. as well as medium-sized enterprises in Germany and especially in Baden-Württemberg answered questions about current trends, hurdles and other SME related topics of cloud computing. It was an online survey with 123 participants and about 90 percent influencers (108 of 123) which was conducted from 27th of July 2017 to 15th of September 2017 (Frings et al., 2017).
- **Digitalisierung im Mittelstand.** The *document-management-systems (DMS) for SME* survey was carried out by the Fraunhofer Institute for Industrial Engineering (IAO). It investigates the development status of the use of DMS at SME. The content was designed for companies and organisations in German-speaking countries and was conducted as an online survey with some open and some standardised questionnaire. Two participant groups were distinguished: those with DMS and those without DMS in use. The questions have

been selected according to the target group. The questionnaire for the target group with DMS had 29, the questionnaire for the target group without DMS had 27 standardised questions. The questionnaire was distributed via Fraunhofer IAO mails predominantly to German SME and social media platforms as well as by the Chamber of Industry and Commerce Stuttgart.

The results of the survey are based on information given by 137 respondents (60 without DMS, 77 with DMS in use), who took part between 2016 and 2017 and twenty additional interviews, which took part during DMS projects in SME. Among the participants, the largest group is the service sector (36.4 percent of the respondents with DMS and 30 percent without DMS). The second largest group is composed of industry and retail (15.6 percent vs. 18.3 percent). 20.8 percent of the respondents, using a DMS, didn't give further information, also 13.3 percent of the respondents, who don't use a DMS.

All in all, 11.7 percent of the companies, which use a DMS have up to 9 employees, of those, which don't use a DMS it's 18.3 percent. In companies with up to 49 employees, 11.7 percent use a DMS and the same percentage don't use a DMS. In companies with up to 250 employees 15.6 percent use a DMS and 8.3 percent don't use a DMS. A quarter of the participants come from companies with up to 2500 employees (29.9 percent with DMS, 20 percent without DMS). There were also companies, which didn't give information considering company size (27.3 percent with DMS, 26.7 percent without DMS). (Bauer et al., 2018).

- **Cloud Mall Baden-Württemberg.** The survey is about the cloud adoption of SME in Baden-Württemberg and in addition to the adoption also asks many details about the different kinds of solutions used, plans to use cloud solutions in the

Table 2: The Cloud Computing adoption that was shown in the four considered surveys distinguished to the adoption of public, private and general (at least one public or private) cloud solutions.

Survey	General	Public	Private
State of the Cloud Report (RightScale, 2018)	96%	92%	75%
Cloud Monitor 2018 (Bitkom Research GmbH, 2018)	66%	31%	51%
Studie IT-Trends 2017 (Scheid et al., 2017)	-	79.6%	75%
Cloud Computing Survey (IDG Communications, 2018)	73%	-	-

future, reasons for hesitating to or not using cloud and also the number of used cloud solutions. It also investigates these aspects for different industry sectors. For inviting the participants, contact lists from Baden-Württemberg were used in addition to business development enterprises and Chambers of Industry and Commerce. The data were collected from 21.11.2016 to 31.03.2017.

There were 46 percent high-level managers, 30 percent from middle management and 24 percent non-manager employees taking part in the survey. From the content-related perspective, 42 percent have an IT background, 27 percent are mainly management, 17 percent marketing, 11 percent finance and 10 percent research and development. 58 percent of the participants already had experience with using or establishing cloud solutions. 15 percent of the represented enterprises had 1-9, 24 percent had 10-49, 23 percent had 50-249, 6 percent 250-999 and 18 percent 1000-4999 employees. Three major groups were identified: manufacturing, IT and retail with 50 percent, 23 percent and 17 percent of the participants respectively. (Falkner et al., 2018).

Table 3 shows results from the three described surveys and emphasises the relevance of the privacy and security concerns of German enterprises regarding cloud computing.

2.3 Understanding the Differences

Using (Public) Cloud or cloud adoption in the context of surveys usually means, that at least one solution is consumed as SaaS from a Public Cloud which can be basic software like email, collaboration tools or file sharing. The survey of Capgemini has shown, that the percentage of the share of the used IT solutions in the case of Public Cloud solutions with 10.2 percent is rather small compared to Private Cloud solutions with 36.6 percent (Scheid et al., 2017).

Besides numbers, formulations and legal aspects, there are also the survey participants obviously affecting the survey results they take part in. The following quote addresses their understanding and preciseness:

Imagine I am participating in a cloud computing survey. When I watch Netflix at work, is my enterprise using public cloud computing then?

Jürgen Falkner

Although the statement is overblown and ironic, it addresses some central issues with complex surveys: the understanding and knowledge of the participants. This ranges from understanding the question - not everyone knows the precise definitions of all the terms, and some of them might be ambiguous in addition - over their position within their enterprise to the formulation of the question within the survey.

The major influencing factors to survey results we identified during our research of surveys in the context of cloud adoption are given, described and argued in the following. An overview of the accessible meta information of the investigated surveys for the identified influencing factors is given in Table 4.

- **The Business Section.** When taking a deeper look into the details of cloud adoption, it turns out that there are huge differences depending on the industry section of the enterprises (Candel Haug et al., 2016). Whereas the majority of surveys does not consider the industry sector differences, e.g. for Baden-Württemberg it was shown, that especially ICT-related enterprises, the adoption is far more advanced than in other business sections such as retail sale, logistics and craft businesses and particularly manufacturing (Falkner et al., 2018).
- **The Enterprise Size.** Independent from the varying definitions of SME by revenue or different

Table 3: The privacy and security barrier regarding the cloud adoption resulting from the three previously considered surveys. Privacy / Security were given as a part of a set of predefined answers for all three surveys and are the largest barrier in each case.

Survey	Barrier Relevance	Translated Question
Cloud Computing im Mittelstand 2017 Influencer / SME (Frings et al., 2017)	58% / 69%	What are the major barriers of using cloud computing?
Digitalisierung im Mittelstand (Bauer et al., 2018)	53%	What are the backgrounds for not using DMS cloud solutions in SME?
Cloud Mall Baden-Württemberg Security / Privacy (Falkner et al., 2018)	67% / 63%	Which concrete challenges or barriers do you see for your enterprise related to the cloud topic?

Table 4: An overview of the meta information availability for the seven surveys previously discussed, structured by the nine different categories of influencing factors (● extensive information available – ◐ partial information is available – ○ little or no information available).

Influencing factors	Cloud Computing im Mittelstand 2017	Digitalisierung im Mittelstand	Cloud Mall Baden-Württemberg	State of the Cloud Report	Cloud Monitor 2018	Studie IT-Trends 2017	Cloud Computing Survey
Business Section	●	●	●	●	◐	◐	●
Enterprise Size	○	●	●	●	●	●	◐
Ambiguities and Understanding	◐	◐	◐	○	○	○	○
Culture and Legislation	●	●	●	●	●	●	○
Competence and Knowledge	◐	◐	◐	◐	◐	◐	◐
Participants Role within the Enterprise	◐	◐	◐	◐	○	○	●
Participants of the Same Enterprise	◐	◐	○	◐	●	●	●
Kind of the Enterprise	●	○	○	○	○	○	○
Participants Acquisition Methods	●	●	●	◐	●	○	○

numbers of employees, there are noteworthy differences such as the public cloud adoption for which a difference from 50 percent for enterprises with more than 2000 employees was shown in contrast to only 29 percent for enterprises with 20 to 1999 employees (Bitkom Research GmbH, 2017).

- **Ambiguities and Understanding.** Even for experts, some commonly used terms can be ambiguous and therefore complicate the understanding of survey questions. As an example from the cloud context, the term Platform as a Service (PaaS) has at least four different meanings in the literature: PaaS as cloud IDE (integrated development environment), PaaS as managed IaaS (Infrastructure as a Service), PaaS with middleware and PaaS as DevOps (Development Operations) (Kutzias and Kett, 2018). Following the definition of the National Institute of Standards and Technology, PaaS

is one of the fundamental three service models and therefore a part of the definition of cloud computing (Mell and Grance, 2011).

- **Culture and Legislation.** Usually German enterprises are rather cautious when it comes to using (Public) Clouds with critical data such as personal data or documents containing crucial information about the expertise of the enterprise or technical processes. Germany in particular, has some of the strictest privacy laws in the world – creating a more restrictive environment for enterprises (Bailey, 2015). After the EU General Data Protection Regulation (GDPR) taking effect this might be even more relevant. Before taking effect, Forrester predicted, that 80 percent of the effected enterprises will not comply with the EU GDPR (Forrester, 2017). After taking effect, a survey by Talend states, that 70 percent fail the EU GDPR (Talend, 2018) and for Canada and the US, Miglicco

also states, that most enterprises are most probably not compliant (Miglicco, 2018).

- **Competence and Knowledge.** Depending on the background and experiences, the qualification for giving complete and correct answers to all survey questions might differ between participants. The Cloud Monitor states for example, that employees often do not perceive a difference between intern IT solutions and cloud solutions (Bitkom Research GmbH, 2018).
- **Participants Role within the Enterprise.** As stated before, many employees might not realise the difference between cloud and intern IT. While some surveys are open to all, others require certain positions within the enterprises, such as the Cloud Monitor, which restricts participants to be IT-managers (Bitkom Research GmbH, 2018). A manager making the decisions might know more, but time management is one of the hardest parts of a manager's job (Kolowich, 2015) which has been investigated by many researchers for a long time due to its importance (Oshagbemi, 1995). When classifying tasks to A tasks - must be done, B tasks - should be done, C tasks - could be done, D tasks - delegate to somebody else and E tasks - eliminate, most managers admit that 80 percent of their time is spent on tasks of type C, D and E. Relevant points for the quality of the survey answers are then, how the participation in a survey is classified for a manager and how precise the manager fills in the answers as well as the depth of knowledge of the manager, since especially in large enterprises, not every manager is involved in or knows about everything.
- **Participants of the Same Enterprise.** Whether the participants acquisition and data evaluation allow for more than one participant of the same enterprise can effect the results. Even though the answers can differ, e.g. depending on knowledge and position, strong biases on the enterprise level are possible.
- **Kind of the Enterprise.** In addition to the business section, enterprises and institutions also differ in their tasks and structure. Chambers of Industry and Commerce have the duty to assist enterprises in using new technologies and therefore have a different perspective while researchers might have an affinity for new technologies.
- **Participants Acquisition Methods.** The methods of participant acquisition can have huge influence on the participants composition and therefore the survey results. For the State of the Cloud Report from RightScale (a cloud provider), 19

percent of the participants are users of RightScale solutions (RightScale, 2018) and for the Cloud Computing Survey, IDG used IDG brands for participants acquisition and to be considered qualified respondents must have reported cloud utilisation was planned or currently leveraged at their organisation. Furthermore, respondents must have reported personal involvement in the purchase process for cloud solutions at their organisation (IDG Communications, 2018). In contrast, the surveys from Section 2.1 used the help of Chambers of Commerce and Industry for participants acquisition, which mainly addresses enterprises in need for help with new technology.

Summing up, there are many different influencing factors in addition to the variances inherent for surveys. These influencing factors are not necessarily independent, e.g. it might be possible that an employee of a small enterprise knows more or less every used IT-system, it is unequally harder if not impossible for an employee of a very large concern. This might also be affected by the position, yielding a dependence of the enterprise size, the role within the enterprise and the knowledge of the person.

3 CONCLUSION

The cloud adoption has vastly increased over the last years, but even if some surveys show adoption rates with almost 100 percent, a deeper look at different surveys and to the circumstances and the background of the surveys show, that cloud computing is not yet omnipresent and still several problems especially in the areas of security and privacy have to be solved, or at least regarding the perception of these aspects, for many hesitating enterprises to accept the technology.

For better understanding and the derivation of influencing factors for surveys, especially in the context of cloud computing and the cloud adoption, seven surveys were investigated with special attention to their meta information and backgrounds. Summing up, nine main influencing factors were identified, namely: the business section, the enterprise size, ambiguities and understanding, culture and legislation, competence and knowledge, the participants role within the enterprise, participants of the same enterprise, the kind of enterprise and the participants acquisition methods.

Even with complete information about these influencing factors, which might be unrealistic to have (none of the seven presented surveys has deep information on all the identified influencing factors), also the absence of meta information can give good expla-

nations for huge differences in the results such as very high adoption rates without information about the participants acquisition which could be solely cloud users.

For these reasons it is strongly recommended for survey publishers to give as much details about the meta information as possible. For readers the influencing factors provide a structured way of checking the presence and absence of meta information for better understanding survey results.

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