IT CAPABILITIES AND ORGANIZATIONAL UTILIZATION OF PUBLIC CLOUD COMPUTING

Complete Research

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Abstract

Cloud computing (CC) as an emerging phenomenon promises multiple business-related advantages such as faster time to market, scalability, and lowered barriers to innovation. In order to achieve potential advantages from CC investments, firms must be able to utilize CC resources. Literature suggests that in order to gain advantages from IT, firms are required to possess a bundle of IT capabilities. However, until now it is not clear if these capabilities also apply for CC. Along prior IT capability research and studies on CC, this research, therefore, aims to deductively derive technical, human, and organizational capabilities related to CC. It is argued that these capabilities facilitate organizational CC usage. To test these propositions, quantitative research has been conducted among mid-sized ICT firms in Germany. The results demonstrate that especially capabilities of the organizational dimension, namely strategic thinking and planning, contribute to CC usage. In contrast, we found no effect of capabilities related to the human dimension (technical integration and sourcing skills of the IT staff) on CC usage. Interestingly, the flexibility of existing IT infrastructure is negatively related to the utilization of CC resources.

Keywords: Cloud computing, IT capability, Diffusion, Infusion, Usage

1 Introduction

This research is intended to examine to which degree organizational capabilities as discussed in IT capabilities research facilitate the utilization of cloud computing in firms. Cloud computing (CC) emerges as phenomenon representing a “fundamental change in the way information technology (IT) services are invented, developed, deployed, scaled, updated, maintained and paid for” (Marston et al., 2011, p. 176). Often regarded as paradigm shift where IT resources are outsourced to third-party providers over the internet and paid on-demand, CC is a result of two major trends in IT: efficient IT resource utilization and the use of IT to enhance business agility (Marston et al., 2011). Although cost reduction is commonly seen as the dominant benefit, CC promises further business related advantages such as faster time to market, handling of unsteady demand through resource scalability, and lowered barriers to innovation (Iyer and Henderson, 2012; Marston et al., 2011).

However, albeit the high promises of CC, recent research indicates that CC will significantly impact the way IT is managed. Some already claim that “a fundamental overhaul in the organization of the IT function” (Janssen and Joha, 2011, p. 12) is required to manage the new service delivery model and to achieve successful organizational deployment of CC resources. In that respect, literature assumes that

CC has a profound impact on several organizational aspects, ranging from the overall IT/business strategy to architectural considerations, sourcing competencies and ultimately to potential job redefinitions (Loebbecke et al., 2012; Suo et al., 2011). Although CC poses organizational challenges, CC creates likewise new opportunities for a firm's IT to focus on core competencies and on strategic involvement (Suo et al., 2011). Hereunto, recent research indicates that firms orchestrating a set of complementary capabilities are rather able to utilize CC resources (Aral et al., 2010; Garrison et al., 2012)

In regard to these complementary capabilities, prior research proposed the concept of IT capability, which refers to a firm's "ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities" (Bharadwaj, 2000, p. 171). Grounded in the resource based view (RBV) of a firm (Barney, 1991), research on IT capability considers the successful use of IT as highly dependent on a firm's unique bundle of technology, human skills, and aligned IT/Business goals (Ross et al., 1996). Prior research on IT capabilities identified a diverse, yet generic set of IT capabilities among technological, human, and organizational dimensions (Schäfferling, 2013). Within the context of CC, however, little is known about if these IT capabilities contribute to the organizational utilization of public CC resources. Consequently, the research question arises:

> *Are IT capabilities as proposed by IT capability research relevant for the organizational utilization of public cloud computing?*

In this research, we aim empirically test if the IT capability theory is able to explain organizational utilization of public CC. The rest of this paper is structured as follows: first, we briefly present the concept of CC, IT capabilities, as well as findings of our literature review on CC-related IT capabilities and potential indicators for potentially relevant capabilities. Next, we develop our conceptual research model, which builds on these findings and is aimed to examine the relationship between the proposed set of CC-related IT capabilities and CC usage. Subsequently, our research methodology and the results of data analysis are outlined. Finally, we discuss the findings, draw conclusions and propose further research directions.

2 Research Background

2.1 Cloud computing: Definition and scope of research

In literature CC has been defined in several ways and from different perspectives (Leimeister et al., 2010). Especially the National Institute of Standards and Technology's (NIST) definition of CC (Mell and Grance, 2010) gains popularity and acceptance in practice and academic alike. Bounded by the perspective of Armbrust et al. (2010), CC is defined as an IT deployment model for utilizing IT resources as services over the internet from an external provider, that can be provisioned dynamically on-demand (Armbrust et al., 2010; Mell and Grance, 2010).

These services are commonly categorized as (1) Infrastructure-as-a-Service (IaaS) providing fundamental resources such as processing, storage, etc. in a virtual manner, (2) Platform-as-a-Service (PaaS) serving development and deployment environments for applications through APIs and frameworks, and (3) Software-as-a-Service (SaaS) delivering applications accessible from various devices (Mell and Grance, 2010). Although these services can be accessed through different deployment models (Mell and Grance, 2010), this research focuses on the public cloud model, as to what CC, its characteristics and benefits commonly refers to (Armbrust et al., 2010; Yang and Tate, 2012). Within the public cloud model, the offered services are off-premise, available and managed from a third-party cloud vendor. Thus, exclusive, internal or self-managed datacenters (private cloud) and deployment variants (hybrid and com-munity clouds) are excluded from this research.

With respect to the scope of our research, public CC is considered as a variant of IT outsourcing (ITO) that differs from traditional ITO in terms of standardization (offering, contract), automation (execution, self-management and –selection), and flexibility (scalability, billing, contracts) (Matros, 2012).

2.2 Theoretical foundation: IT capability

Using CC resources is expected to enable a firm to support business objectives, enhance business agility, while optimizing its IT spending (Marston et al., 2011). However, in order to gain these benefits, a firm has to be able to apply CC resources. In this regard, literature has introduced the concept of IT capability, defined as a firm's "ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities" (Bharadwaj, 2000, p. 171). A firm's IT capability is seen as "key to leverage IT investments and [to] achieve desired outcomes" (Schäfferling, 2013, p. 1).

IT capabilities are considered as heterogeneously distributed between firms and serve as the basis to achieve advantages and value from IT investments, such as increases in firm's performance and agility (Bharadwaj, 2000; Bhatt and Grover, 2005; Schäfferling, 2013). Illustrated by prior research, the IT capability of a firm is considered as a rather multidimensional construct, which is expressed by several distinct yet related facets (Bharadwaj et al., 1999; Schäfferling, 2013). These facets represent lower level capabilities and have been primarily classified into technological, human, and organizational dimensions (Kim et al., 2011; Schäfferling, 2013). Table 1 illustrates selected conceptualizations of the IT capability construct. Following the concept of the RBV (Barney, 1991), research highlights the complementarity between organizational capabilities and resources and those native to the IT function (Schäfferling, 2013). According to Ross et al. (1996), a firm's bundle of technology, human skills, and aligned IT/Business goals enable the successful use of IT. Some authors even consider these capabilities not only as complementary, but rather as mutually reinforcing (Ravichandran and Lertwongsatien, 2005; Ross et al., 1996). Depending on researchers' objective, various lower-level capabilities for the IT capability construct have been conceptualized and proposed along the three dimensions as follows:

Author	**Technological**	**Human**	**Organizational**
Ross et al. (1996)	Technology base	Competent IT human resource	IT & business management partnering relationship
Bharadwaj et al. (1999)	IT infrastructure; External IT linkages	IT management	Business IT strategic thinking; IT business partnerships; IT business process integration
Bharadwaj (2000)	IT infrastructure	Human IT resources	IT-enabled resources
Melville et al. (2004)	Technological IT resources	Human IT resource	Organizational resources
Ravichandran and Lertwongsatien (2005)	IT infrastructure flexibility	IS human capital	IS partnership quality
Bhatt and Grover (2005)	IT infrastructure quality	IT business experience	Relationship infrastructure

Table 1. Selected IT capability conceptualizations, lower-level capabilities and underlying resources (adapted from Kim et al., 2011; Schäfferling, 2013)

The **technological dimension** commonly refers to the IT infrastructure of a firm, defined as "the composition of all IT assets (software, hardware, and data), systems and their components, network and telecommunication" (Kim et al., 2011, p. 493). Literature highlights flexibility as key technical characteristic of an IT infrastructure (Bhatt and Grover, 2005; Duncan, 1995; Ravichandran and Lertwongsatien, 2005). Manifested in qualities such as connectivity, compatibility, and modularity (Duncan, 1995), a flexible IT infrastructure enables fast and efficient development, diffusion, delivery, and support of various system components, technical solutions and 'cutting edge technology' (Broadbent et al., 1999; Duncan, 1995; Kim et al., 2011; Ravichandran and Lertwongsatien, 2005).

The **human dimension** refers to the distinctive knowledge, skills and experience of the staff within the IT department (Bharadwaj, 2000; Bhatt and Grover, 2005; Mata et al., 1995) and is considered as the "mortar which binds all the IT components into robust and functional services" (Broadbent et al., 1999, p. 160). The lower-level capabilities within the human dimension are commonly distinguished along technical skills and IT management competencies. Literature highlights particularly IT management skills as dependency for efficient IT utilization (Ross et al., 1996). These managerial capabilities refer to the management's ability to conceive of, develop and exploit IT applications to support and enhance other business functions (Mata et al., 1995). IT management capabilities typically cover functional areas such as planning, systems development, support, and operations (Ravichandran and Lertwongsatien, 2005) and often involve competencies such as IS planning and design, IS applications delivery, IT project management, or architectural planning for IT standards and controls (Bharadwaj, 2000; Bharadwaj et al., 1999; Mata et al., 1995; Melville et al., 2004).

Even though lower-level capabilities within the **organizational dimension** are "not necessarily native to the IT function" (Kim et al., 2011, p. 491), they represent complementary capabilities facilitating the former two dimensions. Arguing that a strong partnership between IT unit and other functional areas enables both to become more effective at planning, developing, and using IT (Ross et al., 1996), research frequently place an emphasis on internal IT/business relationships (Wade and Hulland, 2004). Ravichandran and Lertwongsatien (2005) even argue, that firms, which strongly relate IT planning to corporate strategic planning, are more likely to utilize IT for strategic purposes. In that respect, Powell and Dent-Micallef (1997) further regard IT and business strategy integration as 'advantage-producing' complementary capability by linking business and IT strategic planning. Although termed differently as 'business IT strategic thinking', Bharadwaj et al. (1999) similarly highlights the ability to integrate IT and business planning and to envision the contribution of IT to business value.

2.3 Research on capabilities for cloud computing

As outlined above, the concept of IT capability seems to provide a useful lens for investigating CC utilization in terms of valuable resources. Along the set of higher-level capabilities as proposed by IT capability research, literature was analyzed aiming to identify a subset of more specific capabilities that are proposed to facilitate organizational CC utilization. For that purpose, a literature search along the AIS Basket of Eight, the top 15 ABS journals complemented with MISQe and BISE, as well as along the top 5 conference proceedings listed by AIS was conducted during July 2014. We applied variations of the keywords «cloud», «cloud computing», «capability», and «capabilities» and limited results to the timeframe of 2004-2014. This search procedure revealed two papers using the lens of IT capability for investigating the utilization of CC in organizations. These papers are discussed next.

Venkatachalam et al. (2012) conceptually identified capabilities for sourcing and leveraging SaaS by SMEs on the basis of the nine core IS capabilities proposed by Feeny and Willcocks (1998). The authors consider leadership (integration of IT efforts with business purpose), business systems thinking (e.g. business problem solving, process reengineering), informed buying (management of sourcing processes), and vendor development (identifying suppliers' added value) as important capabilities. However, their results are only targeted at the SaaS layer and lack of empirical support.

In contrast, Garrison et al. (2012) empirically revealed that certain technical, managerial, and relational capabilities allow firms to achieve 'cloud deployment success' in terms of realizing strategic, economic and technological benefits from CC. Even though their results provide strong support for the applicability of the IT capability concept within the CC context, their research lacks of clear definitions, which yield to rather abstract conceptualizations call for further research. Lastly, their research is not limited to the public CC model.

In order to reveal further indications for potential lower-level IT capabilities relevant for the use of CC, we expanded our literature search using the broad keyword «cloud computing» within the above-mentioned outlets and complemented the results with recent literature reviews on CC (see also Hoberg et al., 2012; Marston et al., 2011; Venters and Whitley, 2012; Yang and Tate, 2012). We then assessed the resulting articles guided by the three IT capability dimensions. Table 2 illustrates the collected indications for IT capabilities that are potentially relevant for the utilization of CC and are outlined next.

Indications	Sources
Technical and architectural supportiveness of the existing IT infrastructure ensuring seamless integration of CC	Iyer and Henderson (2012), McGeogh and Donnellan (2013), Qian and Palvia (2013)
Technical competencies required to integrate CC from various providers and to connect with internal systems; shift from development to composing and integration	Janssen and Joha (2011), Kaisler et al. (2012), Lacity and Reynolds (2014)
Focus on provider selection and reliability assessment (analysis of risks, reliability and regulatory compliance), monitoring performance and security, and development of contingency plans	Abokhodair et al. (2012), Clemons and Chen (2011), Janssen and Joha (2011), Martens and Teuteberg (2011), Qian and Palvia (2013)
Focus on the joint analysis of organizational needs, strategic objectives and business goals in order to envisions the strategic role of CC	Abokhodair et al. (2012), McGeogh and Donnellan (2013), Prasad et al. (2014)
Tight integration of business and IT for developing and executing adequate plans to deploy CC within the firm	Hahn et al. (2013), Janssen and Joha (2011), Loebbecke et al. (2012), Suo et al. (2011)

Table 2. Indications for potential capabilities derived from literature

On the one hand, literature indicates that firms possessing mature IT infrastructures do not tend to utilize CC resources (Suh and Chang, 2013). On the other hand, others also stress out that flexible IT infrastructure facilitate CC utilization (Iyer and Henderson, 2012; Qian and Palvia, 2013). However, Iyer and Henderson (2012) states that firms frequently end up with a mix of traditional and cloud-based solutions. Subsequently, being able to smoothly integrate CC into existing in-house application platforms and IT infrastructure seems to be a critical capability (McGeogh and Donnellan, 2013; Qian and Palvia, 2013). Particularly, IT should be capable to access and integrate IT components from inside and outside the firm (Ross and Westerman, 2004). In that respect, literature also considers that the IT staff needs to possess the technical skills connecting CC resources from various providers and with internal systems (e.g. Kaisler et al., 2012; Lacity and Reynolds, 2014), thereby shifting competencies from application development to CC service composition and integration (Janssen and Joha, 2011).

Literature further argues that CC demands managerial focus on appropriate CC sourcing strategies (Janssen and Joha, 2011) emphasizing provider selection, vendor assessment, as well as contract and performance monitoring (Abokhodair et al., 2012; Durkee, 2010; König et al., 2013; Qian and Palvia, 2013). While assessing potential CC vendors, firms should analyze potential legal issues requiring contractual expertise ensuring compliance with legislative requirements concerning privacy, data ownership and data residence (Abokhodair et al., 2012; Clemons and Chen, 2011; Janssen and Joha, 2011). Likewise, security, performance, and reliability risks have to be considered and contingency plans in case of provider failure need to be developed (Janssen and Joha, 2011).

To leverage the potential benefits and achieve value of CC utilization, firms need to analyze their needs and goals (Abokhodair et al., 2012) as well as to ensure a solid vision on the role of CC as a potential competitive differentiator (McGeogh and Donnellan, 2013; Prasad et al., 2014). As such, exploiting CC within the company is argued to have a long-term impact requiring certain organizational changes (Janssen and Joha, 2011). Subsequently, firms need to determine carefully crafted plans ensuring the smooth integration of CC into business operations (Hahn et al., 2013; Loebbecke et al., 2012; Qian and Palvia, 2013). Selecting the “wrong services for the cloud” could harm a firm’s business strategy (Loebbecke et al., 2012, p. 11). Consequently, aligned business and IT goals are considered as a necessity to design, build and run efficient CC solutions (McGeogh and Donnellan, 2013; Prasad et al., 2014).

3 Model Development

Based on our analysis as discussed above and as depicted in Figure 1, we discuss the key concepts of our model and their effect on organizational public CC utilization below.

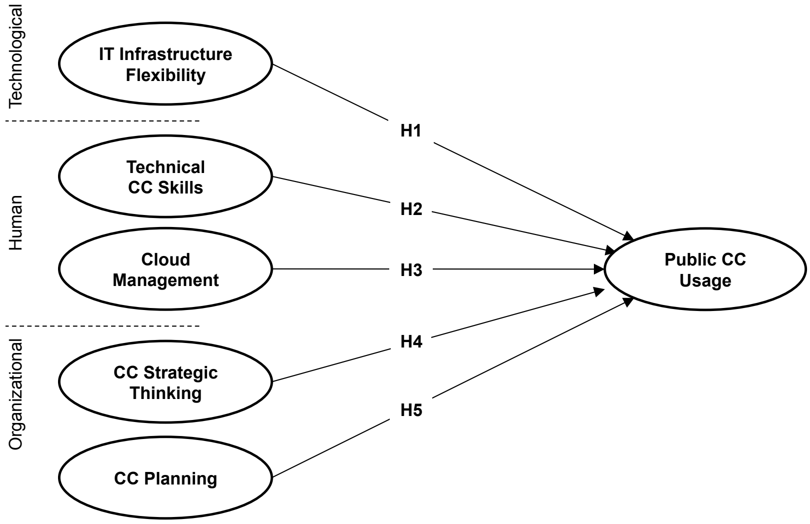

Figure 1. Research Model

3.1 Public CC usage

Technology assimilation theory states that the degree to which a technology is used and to which extend it penetrates the firm is a result of three staggered adoption phases: pre-adoption, adoption, and post-adoption (Cooper and Zmud, 1990; Gallivan, 2001; Kwon and Zmud, 1987). Literature argues that attaining IT implementation success is essentially dependent on the post-adoption stage (Saga and Zmud, 1994) and particularly reflected by infusion. Infusion (also termed depth) refers to the extent to which deployed IT resources are implemented in the organization's work systems and integrated with existing business processes (Eder and Igbaria, 2001; Gallivan, 2001; Saga and Zmud, 1994). Prior research further demonstrates that infusion is related to the diffusion of a technology within a firm, which refers to the spread (also termed breadth) of a technology. Diffusion reflects the number of users and uses within the firm (Eder and Igbaria, 2001; Gallivan, 2001; Zmud and Apple, 1992).

Kishore and McLean (1998) argue that research concerned with the implementation of a new technology should consider both, the diffusion and the infusion perspective. The dimensions of breadth (how *extensively* technology is deployed) and depth (how *well* technology is implemented and integrated) have been applied in previous research for various IT artifacts, such as EDI usage (Massetti and Zmud, 1996) or extent of ERP implementation (Karimi et al., 2007; Liang et al., 2007).

Following these lines, **CC Usage** is defined as the extent to which CC resources are part of the firms IT environment, utilized among business operations and intertwined with existing systems.

3.2 IT capabilities facilitating public CC usage

As a result of our literature review and structured along the three dimensions of the IT capability construct, we identified the following CC-related IT capabilities as potential determinants of CC usage.

In coherence to the IT capability research stream, the technological dimension is confined to **IT Infrastructure Flexibility**, defined as the degree to which the existing IT infrastructure of a firm is sufficiently flexible and based on a modular architecture. As current studies on CC reveal, firms are confronted with the complexity to connect and integrate CC services into the existing systems (BITKOM and KPMG AG, 2013; Iyer and Henderson, 2012). As a consequence, we assume that firms do not solely use CC services, but rather in combination with in-house IT components. In order to ensure technical interoperability between public CC resources and in-house systems and to accordingly achieve benefits from 'best of breed' solutions, the flexibility of the existing IT infrastructure plays a key role to easily add, modify, or even discard CC services from the firm's IT environment in a 'plug-and-play' manner (Iyer and Henderson, 2012; Ross and Westerman, 2004; Xin and Levina, 2008). Following recent empirical studies on the positive impact of IT infrastructure flexibility on CC or grid computing utilization (Garrison et al., 2012; Wolf et al., 2012), we hypothesize:

H1: The flexibility of the existing IT infrastructure positively impacts CC usage.

Complementary to IT Infrastructure Flexibility are IT capabilities of the human dimension. Adapting the distinction between technical and managerial competencies of the IT staff, we propose Technical CC Skills and Cloud Management as capabilities relevant for the utilization of public CC resources.

Technical CC Skills reflects the IT staff's in-depth knowledge about CC and abilities to integrate various CC services into the existing IT infrastructure by developing technical interfaces (Wolf et al., 2012; Zhu and Kraemer, 2005). The IT personnel must be capable to configure, customize, and finally implement various CC resources into the existing IT infrastructure from a technical perspective (Qian and Palvia, 2013). Since CC resources are often technically provided through proprietary standards (Rimal et al., 2011), firms need to use or develop appropriate middleware for the seamless interaction of CC services and existing systems. As such, an emphasis is placed on applications integration skills rather than traditional development competencies when using CC (Lacity and Reynolds, 2014). Accordingly, we assume that technical skills enable CC usage by hypothesizing:

H2: Mature technical skills related to CC technologies facilitate public CC usage.

Cloud Management refers to the ability to develop vendor requirements, to select and monitor vendors, and the handling of CC system outages, data-loss or vendor discontinuity. Since public CC is considered as a form of ITO and associated risks are identical to any other forms of ITO (Clemons and Chen, 2011), the proposed managerial capability builds upon abilities, such as 'informed buying' and 'contract monitoring' (Feeny and Willcocks, 1998), anchored in the realm of traditional ITO (see e.g. Dibbern et al., 2004; Lacity et al., 2009). Within the domain of CC, firms are concerned with legal issues (e.g. privacy, compliance, data ownership and data residence) and potential CC threats in terms of security, performance, and reliability risks (Abokhodair et al., 2012; Clemons and Chen, 2011; Iyer and Henderson, 2010). As firms intertwine CC resources with existing systems and utilize CC services within their business operations, we argue that Cloud Management is a critical capability ensuring the continuity, security and quality of utilized CC services. We consequently hypothesize:

H3: Cloud management skills facilitate public CC usage.

The effective use of IT within a firm is not solely dependent on the abilities native to the IT function, but likewise on the organizational IT capability dimension. Based on the indications from our literature review on CC, we derived Business CC Strategic Thinking and CC Planning as further capabilities enabling organizational utilization of public CC resources.

Business CC Strategic Thinking reflects the ability to envision how CC adds values to the business and to actively search for new ways to leverage CC to create business opportunities (Bharadwaj et al., 1999; Lu and Ramamurthy, 2011; Wade and Hulland, 2004). Inherent to this capability are strong internal relationships and shared visions of the business and IT function (i.e. social and intellectual alignment) about the role and contribution of IT to strategic objectives of the firm (Bharadwaj et al., 1999; Peppard, 2007). As the CC landscape is rapidly evolving, innovative CC services might emerge that could deliver new value for the company (Marston et al., 2011) and should be accordingly evaluated through fast, strategic experiments (Iyer and Henderson, 2012). As firms are committed to the deployment of CC resources, they should be likely using CC. We hypothesize:

H4: Envisioning and actively seeking the strategic value of CC in terms of Business CC Strategic Thinking is positively associated with public CC usage.

CC Planning reflects the ability to collectively define and enforce adequate plans for the introduction of CC (Ravichandran and Lertwongsatien, 2005). Research on IT capability considers planning as an important operational process enabling the identification of business priorities and ensuring the alignment of business and IT goals (Kim et al., 2011; Ravichandran and Lertwongsatien, 2005). As discussed in the literature review on CC, firms need to determine a carefully crafted plan ensuring the smooth integration of CC into business operations for the enterprise-wide utilization of CC (Hahn et al., 2013; Prasad et al., 2014; Qian and Palvia, 2013). Following these lines, we hypothesize that:

H5: Collectively determined and enforced plans for CC facilitate public CC usage.

4 Research Methodology

In order to test the conceptual research model and the proposed hypothesis as depicted in Figure 1, we conducted an empirical quantitative study. Despite the general low adoption of CC in Germany, recent studies indicate that CC adoption is highest in the information and communication technology (ICT) sector (BITKOM and KPMG AG, 2013; BITKOM and KPMG AG, 2014). Hence, we focused CIOs and internal IT decision-makers of medium-sized firms (European Commission, 2003) in Germany with an emphasis on IT and information services as key respondents.

4.1 Measurement instrument

Since the proposed constructs of the research model are mostly based although adapted from prior research, measurement items have been accordingly derived from established literature and adapted to the CC context when necessary, except for ‘Technical CC Skills’ and ‘Cloud Management’ where measurement items have been newly developed based on indications from relevant CC literature.

In order to assess conceptual validity we followed corresponding guidelines (Lawshe, 1975; MacKenzie et al., 2011; Straub et al., 2004). Based on the conceptual definitions of the proposed constructs, we created an initial pool of potential items. Then we conducted discussions with six experts (2 academics, 4 IT executives of the sample) to evaluate the initial measurement instrument. Based on the given definitions of the presented constructs, the experts judged whether each item of each construct is essential to describe and reflect an aspect of the construct’s content (Lawshe, 1975) and whether all as ‘essential’ judged items together cover the entirety of a construct’s content. During that process, we iteratively refined the measurement instrument by modifying, adding, or dropping items. Lastly, two research assistants tested the resulting measurement instrument. All constructs were finally measured through reflective items by 7-point Likert scales (from -3 to +3). The final measurement items and their related sources can be found in the appendix.

Besides the model-related data, we also collected some descriptive data to gain deeper insights on the utilization of public CC resources within the layers of SaaS, PaaS, and IaaS.

4.2 Data collection

Targeted firms have been identified using the database Hoppenstedt (Bisnode, 2014) by applying corresponding filters on industry (‘Information and communication’) and branch (‘Provision of IT services’ and ‘Information services’), as well as on turnover (min. 10m EUR; max 50m EUR) and employee size (min. 50; max. 250) according to the definition of the European Commission (2003). Out of the firms within our scope, a random sample of 520 firms was chosen. Corresponding CIO’s or internal IT decision-makers have been asked to participate in this survey via telephone and email. The final survey was subsequently distributed to 140 firms using an online survey tool. Data was collected during a period of eight weeks between June and July 2014. At the end of the study period, 105 completed questionnaires (approx. 20% response rate) were collected, whereby 23 have been excluded due to missing data or inappropriate respondents’ roles. The final sample consists of 82 complete responses. Table 3 illustrates the key sample characteristics of our final sample.

Turnover		Employees		Industry	
< €11M	12%	50-250	76%	Information and communication	77%
€11-50M	61%	251-500	18%	Provision of other services	16%
€51-125M	6%	> 500	6%	Others (e.g. energy, transport, health)	7%
> €125M	7%				
Not available	13%				

Table 3. Key characteristics of the dataset (n = 82)

4.3 Data analysis

Table 4 provides a first impression on the utilization of CC services within the targeted sample. Albeit several firms generally obtain public CC services among all three CC layers, the usage of these services can be considered as relatively low with deviations of about 10-15%. The use of SaaS is in comparison to the other CC layers quite high. Especially respondent's statements on SaaS reflect a high diversity of services obtained through public CC in contrast to rather typical ones in PaaS and IaaS.

CC layer	Firms with > 0% usage	Mean	S.D.	Mentioned types/examples of used services
SaaS	62%	12.07%	0.14	Office applications, CRM, ERP, development and helpdesk tools, other services (e.g. data exchange, invoicing, HR)
PaaS	37%	6.22%	0.12	Microsoft Azure, Heroku, CloudBees
IaaS	41%	8.41%	0.14	Amazon S3, other storage services

Table 4. General usage and share of software, platform, and infrastructure components obtained as public CC services (measured on a percentage scale with 10% steps)

In order to test our proposed research model and its hypotheses, we adapted it into a structural equation model (Chin, 1998a) using the partial least squares (PLS) method (Barclay et al., 1995; Lohmöller, 1989) with the software SmartPLS 2.0 (Ringle et al., 2005). Although the data sample is small (n=82), it is sufficiently large to evaluate the model according to the rule of ten (n>=50) (Hair et al., 2011). Moreover, by assuming a medium effect size according to Cohen (1988), the according minimum sample size of 58 required to obtain a power 0.80 is similarly exceeded by our sample size.

As a first step of the data analysis, we ran Harman's single-factor test and conducted an exploratory factor analysis (Malhotra et al., 2006; Podsakoff et al., 2003). These analyses revealed the presence of six distinct factors with Eigenvalue greater than 1.0. This finding suggests that common method bias is not of great concern. Next, we performed PLS analysis to evaluate the measurement model. Convergent validity of the measurement model was confirmed by meeting the following criteria (e.g. Gefen and Straub, 2005; Hulland, 1999): First, the loading of each item is significant ($p < 0.001$) and above the cut-off value of 0.70. Second, composite reliability (CR) and Cronbach's alpha (CA) for each construct are above the frequently cited cut-off value of 0.80. Average variance extracted (AVE) also exceeds the threshold value of 0.50. Table 5 depicts the results of the measurement model assessment.

Construct	AVE	CR	CA	Mean	S.D.
IT Infrastructure Flexibility (INFLEX)	0.730	0.915	0.879	1.237	1.050
CC Technical Skills (TECH)	0.821	0.948	0.927	0.578	0.598
Cloud Management (CCMAN)	0.759	0.926	0.901	-0.216	1.572
CC Planning (PLAN)	0.722	0.912	0.872	-0.459	1.622
Business CC Strategic Thinking (STRAT)	0.695	0.901	0.854	-0.212	1.500
Public CC Usage (CCUSE)	0.797	0.940	0.914	-1.391	1.430

Table 5. Average variance extracted (AVE), composite reliability (CR), Cronbach's alpha (CA), and descriptive statistics

In accordance to literature, we further assessed discriminant validity. As illustrated in Table 6, we ensured that the correlations between constructs were below 0.85 (Brown, 2006) and that the square root of AVE for each construct exceeds the correlations between that construct and any other construct (Gefen and Straub, 2005).

	CCMAN	INFLEX	PLAN	STRAT	TECH	CCUSE
CCMAN	**0.871**					
INFLEX	0.194	**0.855**				
PLAN	0.571*	0.019	**0.850**			
STRAT	0.506*	-0.015	0.640*	**0.834**		
TECH	0.348*	0.121	0.344*	0.559*	**0.906**	
CCUSE	0.312*	-0.290*	0.565*	0.684*	0.342*	**0.893**

Table 6. Inter-construct correlation matrix (square root of AVE shown in bold)
** p < 0.01*

As the measurement demonstrates good psychometric properties, we evaluated the structural model. To determine the significance of the paths in the structural model, the bootstrap re-sampling method (82 cases; 5,000 samples; construct level sign changes) was applied (Hair et al., 2014). All commonly used criteria provide support for the validity of the model. Coefficient of determination (R^2) shows that the exogenous variables explain solid amounts of the variance in CC Usage (R^2=0.579).

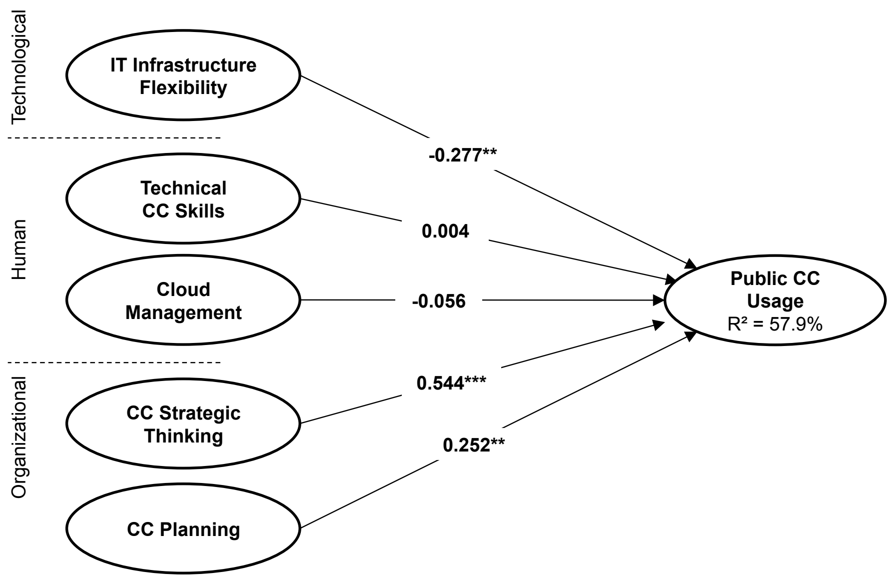

*Figure 2. Results of PLS estimation (*** p < 0.001; ** p < 0.01; * p < 0.05)*

The results of the structural model validation are presented in Table 3 and Figure 2. Except the path coefficients between Technical Skills (TECH) and CCUSE, and Cloud Management (CCMAN) and CCUSE, path coefficients exceed 0.200 and are at least significant at the 0.050 level. Effect sizes (f^2) of all constructs with significant path coefficients are at least weak (> 0.02) (Chin, 2010). Furthermore, following Chin (1998b), the blindfolding procedure with a common omission distance of 7 was carried out to calculate the Stone-Geisser Criterion (Q^2) for the endogenous variable CCUSE (Q^2 = 0.433). Q^2 exceeds the threshold value of 0.00 suggesting sufficient predictive validity.

Hypothesis	Path	Path coefficient (β)	t-value	Effect size	Effect	Result
H1	INFLEX → CCUSE	-0.277**	2.913	0.168	Medium	Not supported
H2	TECH→ CCUSE	0.004	0.046	0.000	-	Not supported
H3	CCMAN → CCUSE	-0.056	0.558	0.004	-	Not supported
H4	STRAT → CCUSE	0.544***	4.109	0.310	Medium	Supported
H5	PLAN → CCUSE	0.252**	1.971	0.076	Weak	Supported

*Table 7. Results of measurement model validation (*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$, effect size interpretations according to Chin (2010))*

During the evaluation procedure we further assessed the influence of control variables in terms of organizational characteristics on the dependent variable CCUSE to rule out rival explanations. Neither employee size (β = -0.015; p = 0.876), nor turnover (β = 0.031; p = 0.728), and industry (binary variable, 0 = not ICT/1 = ICT; β = 0.031; p = 0.728) had a significant impact on CCUSE.

5 Findings and Discussion

Prior research on IT capabilities indicates that a firm's ability to mobilize and deploy IT-based resources (Bharadwaj, 2000, p. 171) is seen as key to achieve desired outcomes from IT investments (Schäfferling, 2013, p. 1). However, little is known whether the IT capability concept is also suitable as an explanatory antecedent of public CC utilization in firm. In order to contribute to this research gap, we deductively derived IT capabilities potentially relevant for public CC utilization as proposed by prior literature. By explaining about 58% of the variance in CC usage, our empirical results demonstrate that the IT capability concept generally provides a meaningful lens for research on CC utilization. However, the results also reveal that the impact of the human dimension is limited and that the effect of IT infrastructure flexibility is contrary to our derived assumptions. Below, we discuss our findings and their implications in detail.

First of all, both facets of the organizational dimension reveal a strong and positive impact on public CC utilization within our sample. Particularly, our results demonstrate that Business CC Strategic Thinking most strongly impacts the level of organizational CC usage. It is likely, that business executives of firms with higher levels of public CC usage in core- and non-core business processes not only possess a positive 'mind-set' towards public CC, but also regard CC as a mean for gaining competitive advantages. They actively seek for prospects of CC offerings potentially adding value to their business and regularly initiate proof of concepts of promising CC services.

Furthermore, our results show that incorporating procedures for evaluating and discussing the integration of public CC resources through joint planning activities between business and IT, as captured within the CC Planning capability, is also significantly related with higher CC utilization. The results suggest that clear procedures for the determination of IT resources and applications, which can be transferred to the cloud, facilitate the deployment of CC resources within core and non-core processes of the firm. In sum, the empirical results most likely support prior literature's notion on the need to develop well-defined plans for deploying CC resources (e.g. Iyer and Henderson, 2012).

Concerning the technological dimension, prior research highlighted the flexibility of a firm's IT Infrastructure as an enabler for the rapid integration of CC resources in a 'plug-and-play' manner. Contrary to these arguments, however, our results indicate that implementing public CC resources does not necessarily require flexible IT infrastructures. As Suh and Chang (2013) revealed that firms with a high IT infrastructure maturity tend to avoid CC adoption, we assume that firms which do not assess their IT infrastructure as distinctively flexible, deploy CC services following some kind of 'best-of-breed' approach. Potential explanations might be on the one hand, that in-house IT resources may not provide enough flexibility and are not capable to fulfill their requirements. On the other hand, the relative advantage of CC in terms of adaptability to fast-changing circumstances, especially in the ICT sector, may motivate business to evaluate CC alternatives and adopt CC services to increase flexibility.

Also contrary to our expectations, technical and managerial CC facets of the human dimension were not found to impact the extent to which CC is utilized. Regarding Technical CC Skills, it was assumed that firms require profound knowledge about CC technology and deployment environments, as well as the ability to technically connect various cloud resources with internal systems (see also Lacity and Reynolds, 2014). However, our results do not provide support for this proposition. In the same vein, Cloud Management, encompassing capabilities related to provider selection, controlling and risk-management, was not found to significantly impact the degree of CC usage. Both findings are somehow counter-intuitive. However, assuming that the deployment of CC resources may primarily follow a best-of-breed approach, technical and management capabilities may be not as important as expected. Since our results indicate that implementing CC resources and utilizing them within existing business processes is not significantly related to the possession of deep technical and managerial skills, we assume that firms do not develop strong dependencies between public CC services and existing infrastructure components/applications. Subsequently, they are most likely not in the need to possess deep integration knowledge and do not overemphasize management and monitoring of cloud services.

In addition to these potential explanations, Wolf et al. (2012) argued in a related study on grid computing, that it is also likely that firms in IT-intense industries do not perceive these technologies as extraordinary ones, but rather as 'smooth evolutions' of established concepts that not necessarily demanding specific competencies. Nevertheless, further research is needed to examine why the importance of technical and managerial skills decreases in CC context.

In sum, our results suggest that the IT capability construct is capable to explain a large portion of the variance in public CC usage. However, further research is needed to explain why critical IT capabilities such as human and managerial skills are insignificant in public CC contexts and to identify further CC specific capabilities. Nonetheless, capabilities anchored in the organizational dimension are found to play a key role for the organizational utilization of CC. This implies that CC usage is, most likely, more dependent on strategic considerations and planning processes than on technical competencies. Subsequently, one could conclude that CC implementation is particularly driven by top management's ability to envision potential added value for the business in the cloud.

6 Implications and Limitations

The findings of this research provide several theoretical and practical implications. As a contribution to IS research, our research provided meaningful support for the utilization of the RBV and IT capability concept within the context of CC. We deductively identified a subset of the IT capability dimensions for organizational CC usage. This subset serves as a major extension to previous research on IT capabilities in the context of CC (i.e. Garrison et al., 2012; Venkatachalam et al., 2012). Moreover, this study confirms prior assumed implications for CC deployment related to strategic considerations and carefully crafted plans for the deployment of CC, but also questions prior assumptions on the role of the existing IT infrastructure, technical skills, as wells as sourcing and risk management competencies. Lastly, the proposed model and measurement instrument serves as a basis for further research on organizational configurations and CC utilization.

From a practitioner's perspective, the findings imply that firms should assess and enhance their capabilities when seeking for a broad and deep utilization of CC resources. Establishing well-defined plans for the migration to the cloud as a collective process between IT and business can be considered as organizational enabler. Opting for a broad and deep utilization of CC reflects rather a strategic than a short-termed decision, as well as consciousness about the role and contribution of CC in achieving 'value through IT'. For firms, particularly business units seeking to enhance the flexibility of the existing IT infrastructure, public CC resources might be a serious option by gaining access to 'cutting-edge' IT resources. However, IT executives are well advised to participate in CC adoption decisions in order to prevent the rise of shadow IT infrastructures.

Considering the limitations of this research, it has to be first of all acknowledged that the scope of the empirical study is restricted. Since the survey was conducted in an IT intensive industry, as well as along a rather small sample of medium-sized firms only, the findings are only generalizable to some degree. Particularly the insignificance of the effect of the human dimension may be contingent on the research context. Hence, research should be investigated along a heterogeneous sample in terms of different industries and firm sizes. Secondly, even though the derived capabilities capture a solid amount of variance in CC usage, there might be additional factors and capabilities influencing the degree of CC utilization in firms, such as technological characteristics of the CC technology or external motivators such as environmental pressure. Hence, qualitative research should be carried out to identify further aspects and dependencies along the proposed and confirmed capabilities of our research. Thirdly, we considered CC in its broadest sense. Further research should investigate capability-related effects along the distinctive facets of SaaS, PaaS, and IaaS. Lastly, even though usage is considered as a "missing link" for gaining IT benefits, the relationship between capabilities, usage, and outcomes in terms of promised benefits of CC (e.g. advances in efficiency, agility, innovation, or competitive advantage) should be conducted, potentially as longitudinal study.

7 Conclusion

Intended to fill the gap in literature on how firms can achieve potential benefits of CC investments, this research provides new insights by exploring CC-related IT capabilities for CC usage in firms, regarded as a "missing link" (Devaraj and Kohli, 2003) for potentially attaining performance outcomes of CC investments. Derived from prior literature on CC, IT capabilities along technological, human, and organizational dimensions were empirically tested on medium-sized firms in the ICT sector in Germany. Building on the empirical results of this study and considering its limitations, it can be concluded, that the concept of IT capability offers a useful lens to investigate CC utilization in firms.

The initial research question whether IT capabilities as proposed by IT capability research are relevant for the organizational utilization of public cloud computing, can be answered as that organizational facets, in terms of CC Strategic Thinking and CC Planning, serve as enabling capabilities for a high degree of CC utilization. In contrast, flexible IT infrastructure does not necessarily enable higher degrees of CC usage. Rather firms might opt in for a 'best-of-breed' approach. Both capabilities from the human dimension, Cloud Management (i.e. sourcing and risks management) and Technical CC Skills do not reveal a significant effect on CC usage and require further research.

Concluding, it is argued that firms should carefully plan their investments in CC, thereby clearly considering not only the value of CC, but also the general contribution of IT assets to their business, as a major long-term strategic decision. In summary, this research shed light on complementary capabilities for CC as a first step to gain potential business value from cloud investments.

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Appendix: Measurement instrument

Construct	ID	Item (translated from German)	
IT Infrastructure Flexibility [1]	InFlex1	The IT systems in our company are highly scalable	Adapted from Bhatt and Grover (2005), Chung et al. (2005), and Ravichandran and Lertwongsatien (2005)
	InFlex2	Our IT infrastructure is highly flexible	
	InFlex3	From a technical perspective, various systems can be easily added to or modified in our existing IT infrastructure	
	InFlex4	The architecture of our IT systems is modular	
CC Technical Skills [2]	*Please rate the knowledge and skills of the IT function concerning:*		Newly developed based on indications of Janssen and Joha (2011), Kaisler et al. (2012), and Lacity and Reynolds (2014)
	Tech1	Development of custom interfaces between public cloud services and existing systems	
	Tech2	Integration of various public cloud services into the existing IT infrastructure	
	Tech3	Cloud management tools (interfaces for configuration and monitoring of cloud computing services)	
	Tech4	Cloud Computing in general	
Cloud Manage-ment [1]	CCMan1	We have clear requirements on public cloud service providers regarding contracts, service level agreements and pricing models	Newly developed based on indications of Qian and Pal-via (2013), Clemons and Chen (2011), Abokhodair et al. (2012), Janssen and Joha (2011), and Martens and Teuteberg (2011)
	CCMan2	We have appropriate performance standards to monitor the quality of the deployed public cloud services	
	CCMan3	We have clear processes for identification and handling of public cloud computing risks	
	CCMan4	We continually review our security systems and procedures to assess vulnerabilities of public cloud computing	
Business CC Strategic Thinking [1]	Strat1	Our firm's business executives consider public cloud compu-ting as a mean to gain a competitive advantage	Adapted from Bharadwaj et al. (1999), Lu and Ramamurthy (2011), Powell and Dent-Micallef (1997), and Tallon (2008)
	Strat2	Business executives are clearly committed to the deployment of public cloud services in our firm	
	Strat3	We constantly seek for new ways to achieve added value through public cloud computing for our firm	
	Strat4	We regularly perform proof of concepts for the utilization of promising public cloud services	
CC Planning [1]	Plan1	We have a long-term strategic plan for the use of public cloud computing	Adapted from Lu and Ramamurthy (2011), Powell and Dent-Micallef (1997), and Ravichandran and Lertwongsatien (2005)
	Plan2	We have clear defined procedures for the determination of those services that can be transferred to a public cloud	
	Plan3	Business functional management of our firm participate in the planning processes for the use of public cloud services	
	Plan4	We regularly evaluate the compliance of deployed public cloud services regarding our standards and plans	
CC Usage [1]	Use1	We obtain a substantial portion of our IT solutions through public cloud services	Adapted from Cho and Chan (2013) and Massetti and Zmud (1996)
	Use2	Our deployed public cloud services are deeply integrated into our IT infrastructure	
	Use3	Public cloud services are used intensively in our firm's core business processes	
	Use4	Public cloud services are used intensively in supporting busi-ness processes of our company	

Table 8. Measurement items, seven-point Likert-type scales were used for all the items
[1] -3 = 'strongly disagree'; 0 = 'neutral'; +3 = 'strongly agree'
[2] -3 = 'not at all competent; 0 = 'neutral'; +3 = 'highly competent'