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Supporting the Digital Transformation of Small Enterprises through Cloud Computing

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Abstract: Cloud computing enables enterprises to access professional IT services without having to setup a professional IT production environment (data center) first. Especially in times of digital transformation, this could be a big chance for smaller enterprises which usually are challenged in accessing professional IT services. Theoretically, cloud computing seems to put professional IT service within reach of these enterprises. Additionally, advances in cryptography seem to sweep aside common security and privacy concerns. This paper argues that, on the current level of cloud computing and even assuming advances in cryptography, small enterprises in general will fail to seize this opportunity, making it more difficult for them to take part in the process of digital transformation. We propose a way for addressing this problem by providing automated cloud brokerage on SaaS level for smaller enterprises based upon sector specific IT architectures with variation points, thus making IT architectures and complete system environments accessible from the cloud and providing cloud brokerage as a service.

Keywords: Cloud computing, cloud brokerage, cloud services, smaller enterprises, digital transformation.

1 Introduction

Today, cloud computing [Na11] is a technical and social reality [Ma13]. For some years now, cloud computing service provider like Amazon [Am16], Google, Microsoft, Salesforce etc. report growing sales figures in a now multi-billion Dollar business [Ga16]. Cloud computing is IT industrialization put into practice. It revolutionizes the IT business as well as the production of IT services in every organization and is one of the key technologies of digital transformation, which is the consequent exploitation and integration of digital technology in all business aspects.

At the same time, the usage of cloud computing is still in its early stages: Especially in Germany, although the usage is growing for several years now up to 44% of all enterprises [KP15b], security and privacy concerns have been limiting the use of cloud services [KP15a][St14a]. Equally, according to recent studies [KP15a], private cloud is the deployment model of choice leaving only rudimentary benefits of cloud technology compared to public cloud.

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Advances in cryptography ([Po11], [Ca13], cf. also [Ta13]) suggest now that these obstacles will be overcome: Platforms [Pa15], tools like Cloud Security Access Broker [ML15] and cloud based information systems using searchable encryption schemes are entering the market, even for the medical sector with its very sensible kinds of data [BH14]. This might make way for a broad use of cloud computing and public clouds throughout industry. Especially smaller enterprises could profit, using cloud computing in public clouds as a means for accessing the professional IT services needed in the process of digital transformation. This way they could catch up with middle or large enterprises, which can more easily access professional IT services and thus benefit more easily from the consequent exploitation and integration of digital technology.

Nevertheless, even when these obstacles around security and privacy concerns will be overcome, additional obstacles for smaller enterprises in accessing cloud services will come into focus and will prevent intensive usage of cloud services in smaller enterprises as it would be needed in the process of digital transformation.

In the next section, we describe the challenges smaller enterprises experience while trying to access professional IT services. We explain obstacles for using cloud computing as means for producing and accessing professional IT services for smaller enterprises in section 3 and conclude by suggesting ways to make cloud computing more useful for smaller enterprises in section 4.

2 Challenges for Smaller Enterprises in Accessing Professional IT Services

Smaller enterprises (by which we mean enterprises having 1-20 employees) are easily challenged in accessing professional IT service. We start with explicating the situation of such an enterprise with the help of a case study before generalizing.

2.1 Case Study: Medical Practice

Our case study for such an enterprise is a medical practice in Germany. Other possible case studies could include smaller architecture firms and their planning and communication work and coordination of construction subsections through part lists etc.

Consisting of typically 1-4 physicians and 2-8 medical assistants, medical practices usually do not grow any further leaving them roughly around 3-12 employees (this setting can be found for example in general practitioner practices, there are specific settings like ambulatory healthcare centers and medical professions like radiologist that operate differently). These medical practices operate in a complex, highly regulated and in regulation as well as knowledge constantly changing sector with very high privacy and security requirements. This leads to two practical consequences: First, because of the complex and constantly changing settlement with insurance organizations, nowadays,

without supporting medical information systems a medical practice cannot be run economically reasonable. Second, although there is a lot of money in the German medical sector, medical practices are highly cost-conscious because they are bound to complex regulations regarding the maximum revenue they can generate.

In our medical practice case study, there is a middle-sized server operating a central medical information system (manages also direct settlement with statutory health insurance and billing for private insurance companies) and a file server. In addition, it is running fax software because, in the medical sector, fax is still considered the only general communications method for simple and secure transfer of documents. Several PCs are being used for accessing the medical information system, documents, office and communication software (e-Mail) and the internet. There is a NAS system used for backups, additionally there are external hard drives for mirroring backups for external storage.

In a medical practice, the amount of IT systems used often does not justify occupying a room of its own. At the same time, rooms are important resources needed to optimize the treatment of patients and generate revenue. IT systems are then put into shared spaces.

No one working in a medical practice will have more than customary knowledge of IT. For this reason, IT service providers will take over technical tasks in setting up or operating the IT systems and services. The Management of these service providers often will be done by a physician, most likely the owner or one of the owners. This, and this is most likely to be typical for owners of smaller enterprises, will put this physician into a conflict, since physicians are also the main source of revenue in a medical practice, and the highly regulated medical sector takes its toll on administrative work as well. Therefore, services should be integrated and not too fine-grained to be manageable.

Loss of data from the medical information system means a direct economic loss for all treatments of patients documented in the missing data since the direct insurance settlement and billing is not possible. From talking to people from several medical practices, we learned in two cases that they had experienced such data losses that spanned several days each.

Financial and payroll accounting usually will be done externally. Often, there will be a website informing about services and opening hours.

So far, we only did describe a basic set of IT services. When thinking of digital transformation of medical practices, for example better integration or exploitation of existing services by using technology or offering additional services for patients with a growing share of digital natives, there still is a lot of potential, but not a lot of human resources for this task. Nevertheless, in some cases there are first services like offering an online self-service for scheduling appointments in medical practices. Overall, medical practices should strive for reducing IT overhead while gaining flexibility and raising quality without raising costs.

2.2 General Case

As we have seen in the case study, typical medical practices as an example for smaller enterprises

- do need quite a lot of IT services and suffer direct economic losses in case of any problems regarding their most important IT services and
- at the same time, they do usually lack IT knowledge and are challenged in operating IT systems in a professional way.
- Additionally, the management of IT services and IT service providers takes resources which otherwise could generate revenue. Other internal resources are not available.

This situation generalizes to smaller enterprises outside of the IT sector: They usually do lack IT knowledge if it does not belong to the core business domain. They need to concentrate on their core business and cannot afford to employ persons fully for this task, or they cannot find persons for part-time employment having the strategic and operative knowledge necessary. According to the German Federal Statistical Office, the share of enterprises employing IT personnel among those having 10-49 employees dropped from 15% in 2014 to 14% in 2015 [St14b], [St15]. We could not find statistics about enterprises having less than 10 employees, but we do assume that the situation in those is even worse.

Consequently, there is no make-or-buy-decision to be made because the option “make” does not exist neither for constructing nor for operating an IT service. This leaves outsourcing as the only option: These enterprises need service providers to plan, build, operate and constantly monitor these services, organizing reliable data back-ups and IT security. They need consulting services starting with selection of service providers, services and their possible combination into an integrated IT portfolio.

The IT services, depending on the services needed and available on the market, might be operated in-house or using external facilities.

Across the whole lifecycle of these services, smaller enterprises have to manage the service providers constantly. This last step and the first one regarding selection of service providers and / or selection of consulting cannot be outsourced and remain difficult, complex and unpopular tasks for people that are no IT experts.

Obtaining a complete IT system environment means substantial effort and cost. But the smaller these enterprises are, the less IT budget is available and the more uninteresting they are for professional IT consultants and system vendors particularly when it comes to operating and monitoring the IT system environment. These reasons can easily lead to insufficient advice in setting up the IT environment or, combined with cost-consciousness, a way of operating the IT environment that is inefficient or even risky, especially when IT systems are operated in-house or not monitored sufficiently.

Complexity and costs grow with more demanding IT services, for example accessing internal IT services from outside the office over the internet.

One possible solution reducing effort and complexity is to use highly standardized components, combined in a standardized way and configured to specific needs regarding the most important requirements. Furthermore, complexity in operating and monitoring could be reduced while increasing security at the same time when it is possible to use professional external facilities for operating the IT environment. Cloud computing could be such a way to realize outsourcing using standardized components.

So far, we dealt only with standard IT services. When thinking about digital transformation and consequent exploitation and integration of digital technology into all business aspects, the situation grows more complex because digital transformation requires a "digital view" on business and perceiving as well as taking chances that digital tools offer. Here, standardized services could support as well with cloud computing being the realization method of choice.

3 Cloud Computing for Smaller Enterprises and Usage Obstacles

In addition to being a realization for outsourcing using standardized components, cloud services offer many advantages for smaller enterprises making it worthwhile to deal with potential obstacles in their usage.

3.1 Advantages through Cloud Services for Smaller Enterprises

There has been a lot of writing about the advantages that cloud computing has to offer ([SV13], [BVS13] among others). With regard to smaller enterprises, they might be summarized as follows:

- SaaS solutions, which would be the most likely cloud service model for smaller enterprises, do need only the most basic hardware on premise;
- cost efficiency through pooling of standardized resources in a multi-tenant-model;
- no upfront investment, but "pay as you go" as services are being used, perhaps using pricing models based directly on key performance indicators for the sources of revenue (in our case study this might be the number of patients with billing or direct settlements with insurance organizations);
- rapid elasticity and scalability when demand is higher or lower even only temporarily;
- professional operation of the services with higher reliability and higher security as smaller and especially non-IT enterprises might achieve on their own.

Of course, the cloud service providers' license agreements might cut back these advantages in one aspect or another, for example by restricting elasticity through minimum term of contracts.

In the process of digital transformation cloud services might be a chance for smaller enterprises in competing with medium-sized or larger enterprises offering them the same kind of professional IT services and possibilities for growth while limiting costs.

3.2 Current Usage of Cloud Services in Smaller Enterprises

How is the current usage of cloud services in smaller enterprises? In Germany, one of the problems in finding statistical evidence is that statistics found so far do not cover enterprises with less than 10 or 20 employees.

- Without differentiating between private and public cloud as deployment models, official statistics [St14b] (focusing on >= 10 employees) show that, overall, the usage ratio of cloud computing correlates highly with the size of the enterprise with highest usage ration among large enterprises.
- Among the smaller enterprises using cloud services, the services used are in 50% or more of all cases e-Mail and file storage [St14b]: This does not come as a surprise, because these applications are among the most standardized and first useful cloud services available for small enterprises and are often used in the private sector as well.
- [KP15a] unfortunately does only cover enterprises starting from 20 employees, but distinguishes between private and public cloud showing that public cloud is a niche market particularly for small enterprises and that private cloud usage is stagnating for large enterprises and growing for small and medium-sized ones. While being an interesting observation, it is not sure whether or not this trend might be extrapolated for enterprises having less than 20 employees. Usually, because private clouds cause technical overhead and especially for smaller enterprises do not use economies of scale or pooling of resources, we think that it is doubtful that they might be of any real use to smaller enterprises.

Thus, the statistical evidence found so far already hints at a low usage ratio of cloud service among smaller enterprises. We will now take a look at possible reasons.

3.3 Obstacles

Currently, obstacles very often referred to using cloud computing are security, privacy and reliability. As we have argued in section 1, we assume that security and privacy obstacles will be overcome through advantages in cryptography. We can learn from section 2 that reliability in a cloud system might even be better than using on premise systems.

But other obstacles which are rarely referred to come into focus after these other obstacles have been removed:

- Cloud computing solves the issue of producing professional IT services, but does not solve the issue of setting goals and managing the achievement of goals. After all, cloud computing is outsourcing, and outsourcing means management of service providers. Thus, the complex task of choosing service providers and services and managing service providers is not solved. Additionally, the more individual service providers are the more complex this management grows, especially because of standard contracts for each cloud service that might diverge from another in their terms and usually cannot be negotiated.
- Since cloud computing aims for economies of scale, smaller enterprises need to identify a cloud service as a possible source to their IT demand in highly standardized, broad service offers.
  - On the level of SaaS, this is easier since they try to address end users on a non-technical level, but in the end, it amounts at least to the often complex selection of a professional software system.
  - On the level of IaaS or PaaS, from the point of view of a typical decision maker in smaller enterprises cloud services are as complex as IT services on premise.
- It is easy to use a single cloud service, especially a Software (as a) Service, but it is still complicated to build an integrated environment from several such services, especially for an enterprise with very limited resources and without any IT specialists.
- From its basic idea, cloud brokerage could contribute to a solution. But from our observation, existing efforts in cloud brokering seem to address mainly hybrid cloud deployments and infrastructure services (IaaS) and do not hide technical complexity (e.g., [Pa12] or [Gr04] as a commercial tool). As a consequence, smaller enterprises would need to master a very complex cloud broker tool aimed at IT experts or use extensive counseling both of which is difficult for smaller enterprises especially outside the IT sector. Furthermore, cloud brokerage just as cloud computing does not operate starting from business goals.

So far, smaller enterprises often do not use the advantage of cloud services. When they should try to, they would have to overcome the obstacles listed above. While cloud services have the potential to reduce complexity in IT service production, the remaining complexity still poses quite a challenge for people that are no IT experts.

Enterprises that can deal with these obstacles might make use of cloud computing and all its advantages in the process of digital transformation, thus gaining an advantage compared to the other enterprises and leaving them even more behind.

4 Professional IT Services for Smaller Enterprises using Cloud Services

In this section, we propose solutions to make cloud services more accessible for and putting complete IT system environments into reach of smaller enterprises. Since this section describes work in progress, we address also directions for further investigation and research. We start by giving an overview of our planned result as a vision and then describe possible elements for turning it into reality while briefly touching on related work.

4.1 Vision

To solve the issues addressed in sections 2 and 3, we need to make IT architectures and complete system environments accessible in a highly standardized way using cloud services without revealing the complexity of cloud brokerage. We need to design a new cloud service provisioning model which combines mainly SaaS offers but also IaaS offers into a complete service covering the entire IT system environment of an industrial sector, delivering it using internet and web standards.

The user should be able to get a complete system environment for his or her business with all characteristics of cloud computing: minimal provider interaction (highly automatized provisioning supported by minimal service provider interaction), paying only as much and as long as you need, high elasticity, using a pool of resources, broad access over the internet.

Ideally, all the customer should need locally would be internet access, LAN, devices for accessing the internet using web standards (PCs, tablets, smartphones) and communication devices for accessing a phone service (which might be softphones provided through standard PCs).

The starting point for an individual setup of an instance of this new service model should be ready made IT strategies that the user (which is not an IT specialist) might, assisted through an automated mechanism, vary in points that are important to his business. This configured, standardized strategy then is mapped to a standardized IT architecture, which in turn is the foundation for generation of an individual service instance.

This new cloud service provisioning model, Cloud-Brokerage-as-a-Service, solves the issues described in section 2 and 3:

- It is goal oriented and supports smaller enterprises in formulating a basic IT strategy.
- It reduces the problem of choosing service providers and services to the minimum possible. In the same way, it reduces the effort for managing the service providers, divergent contracts and the achievement of goals.

- It eases greatly the identification of cloud services as a possible source for IT demand.
- It hides technical complexity and complexity emerging from integration, especially from cloud brokerage, moving cloud brokerage into reach of smaller enterprises.

4.2 Elements of the New Cloud Service Provisioning Model and Related Work

Cloud-Brokerage-as-a-Service could be realized with several core elements all of which are elements of further research:

- Ready-made IT strategies and IT architecture templates for industrial sectors with configurable variation points based upon domain modeling. We expect that these IT architectures share common elements in (domain specific services) and across sectors (communication and storage services, for example). These architectures will be service-oriented and use elements from SOA.
- SaaS and IaaS service catalogues as a basis for offering implementations of concrete IT architectures. These catalogues are divided into basic IT services (communication and storage services, for example) and sector specific IT services and should be hidden from the end user configuring the IT environment.
- Integration and integration services for cloud services.
- Mapping templates of IT architectures to service catalogues using the variation points.
- Cloud broker technology for technical implementation of a concrete IT environment.

In its structure, Cloud-brokerage-as-a-Service might be similar to elements from Business-Process-as-a-Service (BPaaS, e.g. [Ly14]).

5 Conclusion

To successfully undergo digital transformation, for smaller enterprises (having 20 or less employees) accessing professional IT services is of utmost importance. Because of lack of IT knowledge, resources and the inherent complexity of developing an IT strategy, choosing and managing IT service providers easily leads to insufficient IT system environments or risky IT operations.

Standardized services provided by cloud computing and being combined in a standard way would be a solution, but even when security and privacy concerns for cloud services have been overcome, severe obstacles around selection, composition and management of cloud services remain.

Our solution proposal describes Cloud-Brokerage-as-a-service as work in progress, which works based on business goals, hiding technical complexity and offering entire IT system environments as a service, moving professional, cloud-based IT services into reach of smaller enterprises.

Additionally to working on the core elements of Cloud-Brokerage-as-a-service in further research, we plan to add further case studies to broaden and deepen our understanding of the situation of smaller enterprises.

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