

# The impact of the cloud computing model on functioning and competitive abilities of SMEs

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**Abstract.** The aim of this paper is to analyze the potential impact of utilization of the cloud computing model by small and medium sized enterprises (SMEs) on their functioning and ability to compete effectively. It is composed of six parts. The first part offers a brief overview of the development of these new technologies and their impact on businesses. The next part is focused on the notion of cloud computing, the basic elements of this model and the most important reasons for its development. The following part is devoted to an analysis of the benefits to SMEs of using the cloud computing model, while the fourth part focuses on the most significant challenges connected to its use. The fifth part discusses the most important elements connected to the implementation of cloud computing solutions. The final part of the paper provides a summary of the most significant conclusions.

## Introduction

Cloud-based solutions have quickly become the dominant contemporary computing paradigm. According to the predictions of the McKinsey Global Institute, by 2025 most IT and Web applications and services will be cloud-delivered or cloud-enabled [1].

The importance of this technology has been confirmed by various studies. According to the results of the 2014 Technology Innovation Survey, conducted by KPMG among almost 800 global technology industry leaders, cloud computing is a top technology that will have the greatest impact in driving business transformation for enterprises [2]. The results of a survey of ICT professionals, carried out by the German Federal Association for Information Technology, Telecommunications and New Media, also confirms the importance of this technology, with 64 per cent of those surveyed considering cloud computing as the leading information and communication technology trend [3].

There is a growing number of organizations of various types and sizes which are interested in, and wish to use, this utility-like computing approach (see e.g. [4], [5]). Small and medium-sized enterprises (SMEs), which make up the majority of firms operating in almost every country (e.g. 99.8 per cent of firms operating in the EU are SMEs [6]), are particularly interested in the solutions offered by the cloud computing model.

This interest in cloud-based solutions is confirmed by the results of various studies. For example, according to the results of Poland-wide research conducted in May 2012 by the Keralla Research Institute, 50 per cent of all surveyed would eagerly use software in the SaaS model. Companies employing 10-249 were the most interested in it [7]. Further, a survey conducted two years later by Idea Bank and Tax Care among Polish one-man companies showed that 60 per cent of those surveyed knew about and used various types of cloud-based solutions [8]. In 2013, Ipsos MORI conducted a survey, commissioned by Microsoft, among SMEs from 22 European markets and Turkey employing fewer than 25 people. According to the results of the survey, 65 per cent of respondents from Central and Eastern Europe confirmed usage of cloud-based services. In the case of respondents from Western Europe the cloud adoption rate was 45 per cent [9].

Small and medium-sized enterprises in Asia, who make up over 90 per cent of companies there, are also very interested in the cloud computing model. The Asia Cloud Computing Association

predicted that in 2014 SMEs will spend about 2 billion USD on cloud-based services in the developed and emerging Asia Pacific. In the case of the emerging Asia Pacific, they estimated the growth rate for cloud services at around 42 per cent [10]. Indian SMEs are also strongly interested in cloud solutions. According to the Circle Research Global Report, 90 per cent of SMEs there consider cloud adoption as increasingly important for the success of their business in the context of such aspects as innovation and operating more quickly, smarter and more sustainably [11].

Therefore, in the context of the growing interest of small and medium-sized enterprises in the cloud computing model, it is important to analyze a few of the associated key aspects, including:

- the opportunities and benefits which a cloud computing model brings SMEs,
- the most important problems and challenges faced by organizations when using a cloud computing model,
- the key implementation aspects of cloud computing solutions.

This paper will primarily provide an analysis of these issues.

### **Opportunities and benefits offered by the cloud computing model**

#### **The most significant possibilities and opportunities for enterprises through the use of cloud computing utilization**

There is no one commonly accepted definition of cloud computing [12]. The most frequently used of these, in this context, highlight various characteristic features [13], [14]. The most commonly cited definition of cloud computing was coined by the National Institute of Standards and Technology, which stated that “cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction”. Additionally, three basic service delivery models (SaaS, PaaS, IaaS) and four deployment models (public, community, private and hybrid clouds) are commonly distinguished within the scope of this computing model [15].

There are many diverse benefits and opportunities arising from the adoption of the cloud computing model by enterprises operating in our rapidly changing economy. Although cost related issues are very often cited as one of the main drivers, ([13], [16]) there are, in fact, much more important advantages associated with this approach. According to the results of the 2014 Technology Innovation Survey, conducted by KPMG among almost 800 global technology industry leaders, there are four main categories of benefits connected with this technology. They include [2]:

- improved business efficiencies/productivity (37%),
- cost reductions (22%),
- faster innovation cycle (11%),
- accelerated time to market (10%).

Other reports also often indicate considerations such as increased agility; opportunities connected with the implementation of new business models; improved collaboration among business units and partners and geographic expansion [1], [17].

When considering an organization’s productivity, there are two main elements, namely [2]:

- infrastructure and operating expenses,
- application development and packaged software.

According to estimates by the McKinsey Global Institute, in relation to the first of these, productivity gains will reach 20-30 per cent as a result of [1]:

- reduced infrastructure and facilities footprint,
- high task standardization and automation.

In the second case, the McKinsey Global Institute estimates that productivity gains will reach 10-15 per cent as a result of [1]:

- standardization of application environment and packages,
- faster experimentation and testing.

There are many aspects of the cloud computing model which can result in lower costs. For example, in the case of the physical IT infrastructure, the most important aspects include:

- reduction or elimination of waste related to the low level of hardware utilization,
- reduction of costs connected with hardware maintenance,
- lowering costs related to energy consumption (especially in the case of large organizations),
- possibilities for the permanent analysis of costs and selection the optimal service level.

In the case of software utilization, the cloud computing model can lead to the reduction or elimination of costs connected with:

- purchase and installation of software, its maintenance and upgrade,
- purchase of wrongly selected software,
- low level of software usage,
- developing and testing of applications.

There are many new factors connected with cloud computing which have an impact on faster innovation cycles. Easy and cheap access to tools for the development and testing of new products or services, e.g. cloud-based Big Data tools, are a good example [18], [19]. Big Data tools are already being used for this purpose by a growing number of companies [20].

Simultaneously, the implementation of cloud-based solutions leads to a diminishing demand for IT department employees responsible for the maintenance of an organization's physical IT infrastructure, thereby enabling the release of some of the budget previously allocated for this purpose. This allows for a reinvestment of the savings on innovative products or services. According to the results of a survey conducted by the Manchester Business School and Vanson Bourne, this occurred in the case of 62 per cent of the companies surveyed [16].

Usage of the PaaS model is a good example of accelerated time to market. In this case, companies which develop their own software instead of creating their own environment can instantaneously use ready-made tools for the application building process, delivered to them as a service.

Cloud computing significantly increases the agility of companies, due to the fact that utilization of the cloud-based model considerably broadens opportunities for the quick and flexible adjustment of an organization's IT infrastructure to new needs or new market situations. Such situations can require the implementation of new applications, adding new services or increasing computational capacity. In addition, using cloud-based solutions can be quicker than in the case of using a company's own staff [1].

Utilization of the cloud computing model also provides organizations with ample opportunities to implement new business models. In many cases, these business models would not be feasible without usage of this computational model. An innovative business model called car sharing, implemented by the Zipcar company, is an example of such a situation. This business model is based on a complicated management system of a single set of cars which are shared by many users, which would not be possible without an advanced IT system where one of the key elements is the utilization of the cloud computing model [21], [22].

Improved collaboration among business units and partners is made possible by the provision, through the cloud, of easily accessible, continually developing ([23]), applications. This aspect, combined with the above mentioned opportunities to build and implement new business models, provides organizations with new possibilities for geographic expansion.

### **The possibilities and benefits connected with the utilization of the cloud-based services by SMEs**

Small and medium-sized enterprises may gain even more from cloud-based services than large corporations [1]. Of course, the benefits connected with them will differ depending on the size of the firms belonging to this group i.e. micro-enterprises (up to 9 employees), small enterprises (10-49 employees) and medium-sized enterprises (50-249 employees). The benefits described in the previous subsection are important for all organizations, regardless of size and in the case of SMEs

they are particularly important for those belonging to the last group. But there are benefits which are especially important from the point of view of smaller enterprises belonging to the first two groups.

In the case of the smallest SMEs or start-ups with only small levels of capital at their disposal, opportunities to access hardware and software which, because of financial barriers, would be not achievable in the traditional computational model, are key. This is particularly the case for the purchase of hardware and software and the employment of skilled IT workers to cover maintenance. The cloud model and the associated possibilities of “hiring” services connected with the physical IT infrastructure or applications, enables smaller firms to more effectively compete with large organizations [13]. This is due to the fact that the cloud computing model allows them easy access to such advanced applications as CRM and ERP systems or advanced business analytics tools, which would have been previously prohibitive for SMEs, especially the smallest ones.

According to the data from the Central Statistical Office of Poland, 34.9 per cent of medium-sized enterprises and only 16.5 per cent of small enterprises were using CRM systems in the country in 2013. For ERP systems the situation, in the case of small firms, looked even worse. Such systems were utilized by only 10.8 per cent of them (in the case of medium-sized enterprises it was 37.8 per cent) [14]. The above mentioned data shows how big the gap is between small and medium-sized enterprises alone in the use of advanced IT systems. The gap is significantly bigger when large companies are included, where ERP systems, according to the same data, were used by 76.6 per cent of organizations belonging to this group and CRM systems by 59.3% [14].

The above mentioned situation results from the fact that in the traditional computational model ERP and CRM systems were out of reach of many SMEs due to both financial and organizational issues (e.g. lack of skilled IT workers). The growing availability of cloud-based CRM systems and cloud-based ERP systems provide them with new possibilities through the subscription model. It results from the following issues [5]:

- easy and quick implementation,
- lower cost barriers to entry (no need to purchase expensive hardware and software necessary to support the new system, lower implementation costs),
- access to best practice business processes "out of the box".

The cloud computing model also allows SMEs access to advanced cloud-based analytical tools, described as analytics-as-a-service (AaaS) [19]. It relates to BI (*business intelligence*) systems and Big Data solutions that have significantly expanded the possibilities available within the scope of BI tools (especially in the case of big, real-time, unstructured data sets) [20], [24]. Their implementation and maintenance in the traditional computational model is difficult, expensive and requires powerful infrastructure, which is typically out of the reach of SMEs [12]. But the fact that such organizations as Amazon, Google or Microsoft have turned data processing into a utility (see [25]) has meant that enterprises can easily build their own cloud-based analytical ecosystem based on three basic service delivery models (i.e. IaaS, SaaS, PaaS).

IaaS solutions (e.g. Amazon Web Services, Windows Azure or Citrix CloudPlatform) provide the infrastructural foundation for the deployment of advanced analytical services available in the SaaS model. They include such solutions as: Amazon Elastic MapReduce, Google BigQuery, Rackspace Hadoop or Windows Azure HDInsight. In addition, when necessary enterprises can easily use multiple analytical SaaS applications for various business needs such as sentiment analysis, risk management or asset performance. An element of cloud-based analytical ecosystems are also PaaS solutions such Google App Engine, Force.com or Vmware Cloud Foundry, as they can serve as the development platform for advanced analytical applications [19]. Generally, the development of cloud-based analytical solutions has meant that advanced analytical tools have become easily and cheaply accessible to enterprises of any size, including start-ups [18], which allows them to increase their competitive abilities.

### **The most important problems and challenges connected with the utilization of cloud-based services**

As is the case for all IT solutions, those offered in the cloud model bring not only benefits and opportunities but also problems and challenges. Most of them impact on every type of organization, regardless of size, but some of them are more relevant to SMEs.

According to the results of the above mentioned 2014 Technology Innovation Survey, there are three main groups of challenges connected with the cloud computing model. They include [2]:

- security (23%),
- technological complexity (16%),
- risk management (15%).

Security anxiety is undoubtedly the key concern connected with this technology, and is confirmed by the results of other studies [1], [26]. According to the Cloud Security Alliance, there are various types of security concerns including data loss/leakage; account, service, and traffic hijacking; shared technology vulnerabilities and insecure application programming interfaces [27]. Of course the level of the potential risk depends on many factors, including the type of cloud being used, the service provider, the technologies being used (including data encryption) as well as the procedures it uses, and the procedures applied by a client-organization. In the latter case, it also relates to the phenomenon called shadow IT, which is the use, by employees, of cloud-applications for business purposes which have not been approved by the organization's IT department [28]. This last issue can be especially important in the case of medium-sized enterprises.

The spread of the cloud computing model should also reduce the issue of technological complexity, due to the fact that service providers are likely to do everything to make their solutions as simple as possible and easily manageable. Such a trend is already perceivable. An example of which is a management tool called AWS Config, offered by Amazon within Amazon Web Services. Its goal is to make the management of companies' cloud services easier. The significance of such tools will grow as enterprises increase the number of systems based in the cloud [29]. Generally, the problem of technological complexity can be particularly important from the point of SMEs, because of their often limited resources in relation to skilled IT employees.

The third issue which causes the biggest anxiety among managers is the risk management connected with the utilization of the cloud computing model. Apart from the above mentioned security-related issues, some of the most important challenges are those connected with the availability of services. The deeper the dependency of an organization on cloud-based solutions, the more important this issue is. In spite of numerous publicized cases of problems with the availability of cloud services from well known providers, availability of this type of service is generally at a very high level. This fact is confirmed by the results of various studies. In research conducted in France between 2007 and 2012, average availability was 99.92 per cent [30]. According to the results of AppNeta, a company monitoring the cloud-based service providers market, the average uptime of cloud services was 99.95 per cent, which means an average unavailability of 4.6 hours per year [31]. Regardless of the level of availability of cloud services, every organization which utilizes the cloud computing model has to have appropriate procedures and technological solutions in place in case of problems with access to services. The same relates to the management of other types of risks.

Apart from the above mentioned issues, there are other challenges and limitations connected with the implementation and utilization of the cloud computing model. In the case of technical issues, one of the most important and often underestimated issues, in the context of an organization's cloud readiness, is that connected with network capability [32]. This is due to the fact that cloud-based technology is deployed through massive data centers that necessitate high-capacity bandwidth [1]. Simultaneously, requirements concerning network capability, characterized by such parameters as: download speed, upload speed and network latency, can significantly differ. It depends on the type of cloud-based application an organization wants to utilize. For example, basic cloud applications,

such as text communications (e-mail, instant messaging), Internet telephony (VoIP) or Web browsing, have relatively low network requirements. In the case of the intermediate cloud applications, such as ERP/CRM systems, HD video streaming or SD Video conferencing, they are significantly higher. Advanced cloud applications (HD video conferencing, virtual office or Ultra HD video streaming) require significant network resource [33]. Thus, it is vital that organizations take the above mentioned issues into consideration when utilizing cloud-based applications or solutions. It especially relates to SMEs, where their network capabilities may not be sufficient for the implementation of systems such as ERP or CRM.

The next element can constitute a significant hurdle in the process of adoption of the cloud computing approach, which is a lack of trust in cloud-based solutions. Such reservations are typically connected with issues such as concerns about placing sensitive data on third-party servers based somewhere in the world. An important element of these concerns is the earlier mentioned issue relating to the reliability of cloud-based solutions. In spite of improvements in cloud technology, high-profile downtime accidents continue to take place. As a result, they affect public perceptions of the reliability of cloud-based solutions.

The next significant challenges which can constitute an important barrier to the implementation of cloud-based solutions are structural issues and cultural resistance in organizations' IT departments. This is connected with the fact that usage of such a model causes significant changes in IT management practices and to the functioning of IT departments. It can, and in many cases does, lead to raising concerns about loss of control and the lowering of significance and position of these departments in companies. The newly required skill sets are the next issue which can be a source of fear and which can cause resistance. Another significant factor is connected with the complexity of migrating enterprise IT systems to the cloud [1]. Both issues seem to be of particular importance in the case of bigger firms belonging to the medium-sized enterprises group.

There are also many legal challenges. They relate to such aspects as: regulations concerning the place of data storage and access to that data; data ownership, privacy and data protection issues; the applicability of the law connected with data protection and the scope of vendors' responsibility (including liability for data residing in a particular online location). These issues have yet to be settled by policy makers and a significant barrier is the fact that the law in many countries does not address these issues. An important constraint in the ability to take advantage of some of the benefits of cloud-based solutions (especially those connected with public clouds) is the fact that in many countries data protection laws restrict the possibility of storage and transfer of some types of data outside their borders [1], [32].

### **The most important elements connected with the implementation of cloud-based solutions and of a cloud migration strategy**

There are numerous potential problems and challenges connected with implementation of the cloud computing model and many aspects have to be carefully analyzed and planned. It is obvious that implementation of cloud-based solutions is simplest in the case of companies without any previous "burdens" and legacy systems i.e. start-ups. But as a company increases in size, with many complicated business processes, so the scale of the challenges grows significantly. Because of this fact, the implementation of cloud-based solutions is easier in micro- and small enterprises than in medium-sized ones. Additionally, it is worth noticing that each of the groups belonging to SMEs have their own specific problems and challenges, while there are also ones which are common to all.

As far as micro-enterprises and small enterprises are concerned, they typically do not have their own IT department or employees, making use of external services for information technology-related issues. These external service providers may support small organizations in the implementation of new IT solutions or help solve IT-related problems. Therefore, it is highly likely that the support of external service providers in relation to a potential part or full migration to the

cloud would be required. Support in this context includes the vital process of assessment of potential providers of the cloud services and the final selection of one.

The above mentioned aspect is of the particular importance to SMEs in the context of the involvement of the selected cloud services provider in the whole migration process. It relates not only to the implementation process but also to much earlier phases such as the initial audit and planning processes. The basic goal of such types of activities should be to determine what the enterprise needs and what concrete solutions the provider can offer, taking into consideration various criteria [34].

An additional important issue, which should be worked out with the provider, is the approach of the migration process. Namely, whether the company should choose a stepped (phased) approach or an all-in approach. According to the majority of opinions, a stepped approach is better for SMEs, due to the fact that most enterprises belonging to this sector are not technologically-savvy. Thus using their existing systems in tandem with the cloud-based services gives them time to accustom to the new solutions and allows them to migrate full-scale when they are comfortable with the cloud technologies [34].

In the context of the utilization of cloud-based solutions and of the migration strategy, enterprises should additionally take into consideration such issues as:

1. The migration goals (improvement of productivity, cost reduction, increased agility, new business models implementation etc.).
2. Choosing a business processes which is cloud-supported.
3. Appraisal of the risk connected with the migration process in the context of the potential impact on it of internal and external factors.
4. Assessment of which key stakeholders would be impacted by the migration process and how.
5. Comprehensive assessment of the readiness of the organization to the migration process.
6. Selection of the deployment model (cloud type) which will be used by the organization.
7. Selection of the delivery model(s) (SaaS, IaaS, PaaS) which will be applied and determination of the scope of their utilization (type of cloud-based applications, elements of the infrastructure which will be moved to the cloud etc.).
8. The means of integration of the cloud-based solutions with those which function in the traditional way (legacy systems).
9. Organizational changes (especially in the IT department) i.e. their scope, their implementation and overcoming potential cultural resistance.
10. Determination of a disaster recovery plan and procedures including a risk management program and incident management.
11. Necessary training and its scope.
12. Contracting issues (including such aspects as a Service Level Agreement or the scope of a vendor's responsibility).

Some of these issues relate to the bigger medium-sized enterprises only (e.g. points 8 and 9). Such companies will also have more possibilities regarding the human resources necessary to analyze and plan for the above mentioned aspects, establishing for this purpose special committees composed of stakeholders, who are particularly important for securing a successful migration process. Of course, these organizations may also choose to employ the services of an external support service to help with or run the migration process. As far as smaller enterprises are concerned, they are highly likely to need outside support (i.e. IT firms which they have previously cooperated with and vendors). In the case of contract issues they will also need the support of lawyers specializing in cloud computing related problems.

## Conclusion

Cloud computing has captured the interest of businesses of all sizes, moving into the mainstream IT strategy of contemporary organizations. This includes enterprises belonging to the SMEs sector, which have the potential to become the main beneficiaries of this new computing approach.

Undoubtedly, cloud-based solutions carry many opportunities. These cover such issues as the reduction of IT-related costs, productivity improvements, a faster innovation cycle, increased agility as well as opportunities for the implementation of new business models. More and more organizations are noticing that without cloud-based solutions it would be more difficult to be able to store, analyze and use the rapidly increasing amounts of data critical for their market success and development [35]. This includes SMEs which have the additional considerations of affordability and accessibility and which are often the major drivers of their migration to the cloud [34].

But cloud computing also brings numerous potential challenges and concerns related to such issues as the reliability of cloud-based systems, data security, privacy or cloud-platforms compatibility. Also the migration process to cloud solutions includes many aspects which have to be well thought out and carefully planned. This relates both to purely technical issues but also to organizational and legal ones. Further, a lack of so called “best practices” which could be applied by organizations during their migration process is a real challenge [17]. In the case of SMEs, especially the smallest ones, an additional problem is the lack of suitable human resources with the required knowledge base.

In the context of the above mentioned remarks, it is necessary to underline that an incorrect and ill-considered approach to utilizing the cloud computing model or merely following some IT market trends can lead to a situation where instead of expected gains, problems arise, negatively or destructively influencing an organization’s ability to function and to the achievement of its goals. As a result, every organization, regardless of size, has to assess the usefulness of this new computing model and determine its own approach to implementation and utilization.

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