Adoption of Cloud Computing - Case Study in Chosen European Country

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Abstract :

Cloud computing is a technology that is currently considered to be very beneficial and prospective for the future. Many governments are trying to create an environment which encourages a higher level of its adoption in both the private and public sectors. The aim of the paper is to analyse the degree of cloud computing adoption in Europe, with the focus on the Czech Republic. For this purpose, the data from accessible analyses as well as the result of a survey conducted among small and medium firms in the Czech Republic have been used. In-depth interviews were conducted among selected Czech firms and their results are described in order to help understand the context.

Keywords-*cloud computing, adoption, case study, Czech Republic*

I. INTRODUCTION

Cloud computing is receiving a great deal of attention. Information technology (IT) executives around the world rank cloud computing among their top five most important technologies in 2013, according to a study by Gartner [1].

Cloud computing can be seen as the form of services accessible to customers by the means of a communication network as well as all hardware and software tools used by the data centres providing these services [2]. Forrester [2], a global research and advisory firm, widened the above mentioned definition so that it also covers the standardisation of ICT tools on the supplier's side, and self-service principals on the user's side. The definition that has gained wide industry recognition, was created by The National Institute of Standards and Technology (NIST) [3]. According to the NIST "Cloud computing is a model for enabling ubiquitous, convenient, ondemand 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. This cloud model is composed of five essential characteristics, three service models, and four deployment models [4].”Within the field of cloud computing two types of service models can be distinguished: public and private. A service model is a way of providing cloud computing services to the end user. Cloud platforms have been categorised into three main groups according to the type of provided services: infrastructure, platform, and service [5].

The decision whether to implement cloud computing in the organisation is related to benefits and risks. According to many studies, the companies realize the benefits of this technology and they expect growing. For example,

Anderson argues that 77 % of enterprises plan to increase their expenditure in the next two years [7]. Enterprises are moving towards an ondemand model of IT services, expecting cost efficiency, flexibility and an unlimited access to resources [7], [8]. The situation in European countries are different.

The rate of adoption of cloud computing is low. Companies face many barriers associated with the introduction of technology.

The aim of the paper is to analyse the degree of cloud computing adoption in Europe, with the focus on the Czech Republic. For this purpose, the data from accessible analyses as well as the result of a survey conducted among small and medium firms in the Czech Republic have been used. In-depth interviews were conducted among selected Czech firms and their results are described in order to help understand the context.

II. METHODS

The used research methods include a systematic literature review and the results of own questionnaire survey conducted among small and medium-sized firms in the Czech Republic in 2013. Another method was in-depth interviews among selected firms in the Czech Republic and case studies were developed. Given the fact that to assess the qualitative survey directly from the case studies would be confusing, a framework analysis was used - a method of displaying data, which is based on a tabular method.

III. RELATED RESEARCH

The most discussed topics in the literature regarding cloud computing have focused on:

- features, levels of service and models of development (public, private and hybrid) [11-19],
- challenges and technical limitations - cloud interconnection, standards−for implementation in organizations [18-23],
- Security and risk management questions [22-30].

A study by Nuseibeh [31] reveals the (key) success factors for the adoption of cloud services based on the Transaction Cost Theory, Resource Dependency Theory and Diffusion of Innovation Theory. Kaisler [30] investigates service migration in the cloud computing environment by analysing security and integration issues associated with service implementation. In addition, adoption factors related to the Software as a Service (SaaS) model from a government perspective are discussed by Janssen and Joha [33-34]. Many studies also show the specification of the expected benefits [35-41]:

- reduced investment and operating costs,
- innovative approach,
- the lower number of IT staff or reduction of the cost of IT,
- elasticity and scalability,
- support for business processes,
- faster access to the market,

- shorter delivery time, current version of applications, energy saving.

These areas, i.e. attitudes towards the deployment of cloud computing, barriers and benefits are also the subject of studies carried out in the Czech Republic.

IV. Current situation in Europe

Currently, there have been other cloud computing efforts initiated in Europe. World Bank's Government Transformation Initiative recently completed a project cataloguing active cloud computing initiatives in countries around the world, and in Europe, he identified cloud efforts underway specifically in Sweden, France, and Spain [42]. He found that in addition to setting-up internal, private cloud environments (as Spain is presently working on), European nations were beginning to explore the use of cloud-based computing in the following areas:

- management of public sector housing,
- transportation service networks,
- economic development,
- census,
- health services,
- contracting and,
- education services [42].

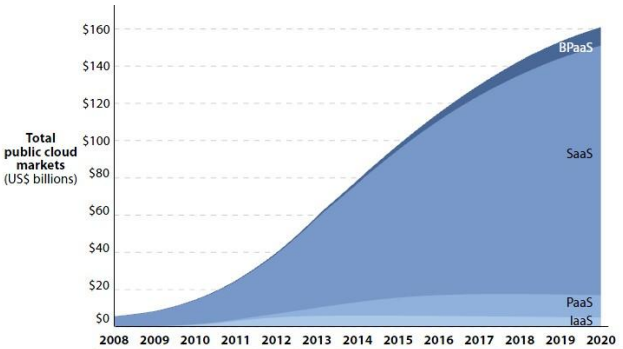
On the European Union (EU)-wide level, it will be seen emerging cooperation of member states on an EU-wide cloud computing effort, which analysts say could well lead towards the creation of a cloud-based, common infrastructure for IT in member states [43].

Several reports and studies coincide that CC is one of the technologies that will have most growth in coming years [4243], occupying more than 12 % of the IT market by 2015 [4446]. In Europe, it is expected that the increase of CC adoption by organizations will make a positive contribution to economic growth, helping to create a million jobs and thousands of new companies [47-49]. The review of existing cloud computing market studies shows that there is broad spectrum within the different forecasts. One reason for this are different methodologies, which in-or exclude different segments. Another one are the basic assumption like overall economic growth for different regions and similar (table 1).

TABLE I. Overview on forecasts in billion US-Dollar for the development of the Public Cloud services market, **Source: [51-53]**

	2011	2012	2013	2015	2016	2017	2020
Gartner	91.4	-	131	-	206.6	244	-
IDC	-	40.0	47.4	-	100.0	107	-
Forrester	40.7	-	-	97.0	113.9		241.0

A more detailed forecast by distribution models is shown in Figure no. 1.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BPaaS ($)	0.15	0.23	0.35	0.53	0.80	1.26	1.95	2.93	4.28	6.00	7.66	9.08	10.02
SaaS ($)	5.56	8.09	13.40	21.21	33.09	47.22	63.19	78.43	92.75	105.49	116.39	125.52	132.57
PaaS ($)	0.05	0.12	0.31	0.82	2.08	4.38	7.39	9.80	11.26	11.94	12.15	12.10	11.91
IaaS ($)	0.06	0.24	1.02	2.94	4.99	5.75	5.89	5.82	5.65	5.45	5.23	5.01	4.78

Figure 1. Global public cloud market size, 2011 to 2020, Source: [54]

A graphic comparing total spending by geography and corresponding growth rates is provided below (figure 2):

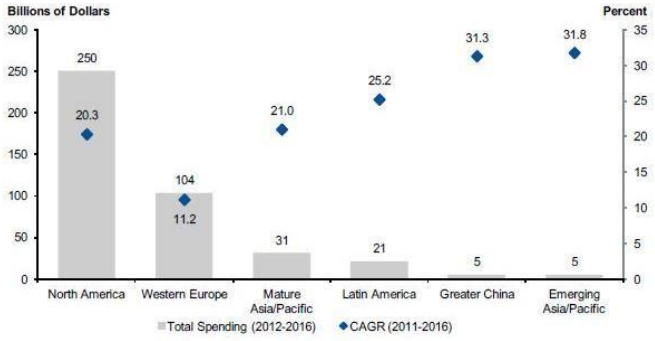


Figure 2. Total spending (excluding cloud advertising) and CAGR, by Region, Source: [55]

59% of all new spending on cloud computing services originates from North American enterprises, a trend projected to accelerate through 2016. Western Europe is projected to be 24% of all spending.

A. Adoption of cloud computing in Czech republic

Companies in the Czech Republic also tend to succeed in the competitive environment and seek to estimate the trends in information technologies for the following years. According to the company T-Systems Czech Republic [56], analytics of Businessworld.cz web [55], and based on the research in the Hradec Kralove region, the key trends for the future of ICT in the Czech Republic include [57]:

- dynamic network services and cloud,
- mobile technology and mobile commerce,
- virtualisation, IT security.

Nevertheless, as shown in the following data, the cloud computing adoption rate is very low, even in comparison with other European countries. Therefore, in the context of in-depth interviews with selected firms, a detailed analysis of barriers to the introduction of cloud computing is carried out.

V. SURVEY OF CLOUD COMPUTING USE IN CZECH ENTERPRISES

In 2013, a own questionnaire survey on "ICT usage in small and medium enterprises in the Czech Republic" was carried out. The survey was conducted in co-operation with the University of Hradec Králové and consulting firm Datank, s.r.o., which carried out the data collection. Companies in the Czech Republic across all sectors of CZ NACE Rev.2 with a focus on small and medium-sized enterprises, were addressed. Overall 208 completed questionnaires were ensured. As respondents were approached managers and CEOs and IT department Executives.

Only 8.7% (i.e. 17 respondents) stated that they have or are planning to implement cloud computing. The research corresponds with the results of the Aspectio Research Agency [5], which took place in the Czech environment at relatively similar sample of firms (small and medium-sized).

One of the biggest obstacles to the use of cloud computing (in the event that the companies consider using it) is the unclear return on investment, ignorance of cloud features, financial requirements. All these barriers show the ignorance of the concept of cloud computing. On the other hand, managers and executives of the companies are aware of and would expect from cloud computing (whether they are planning to introduce it or not) certain benefits that include: scalability and flexibility of services, available online technical support, the ability to work from home and access to corporate data from anywhere. A fundamental aspect of the extent to which firms in the Czech Republic use or are planning to use cloud computing, is the need for change, which in the context of information technologies they argue that they do not need it. Due to the rapid development in mobile technologies and predicted domestic and global trends, it is expected that this attitude will change leading to a greater use of cloud computing [57]. Specifically, the situation is illustrated within the context of the evaluation of in-depth interviews with the selected types of companies.

A. Qualitative analysis of selected companies in the Czech Republic

The method of structured interviews with open questions was used to collect the data to create the case studies. The structure of the questions were constructed after consultation with an expert on cloud technologies from one of the leading companies providing cloud services in the Czech Republic. Interviews were conducted in six companies: activities cover education.

- 1st and 2nd case study - large foreign companies operating in the global market;
- 3rd and 4th case study - Czech companies of small or medium size;
- 5th and 6th case study - public sector entities, whose

One table was developed for each research question, which drew data from all six of the above case studies. Each of the tables contains several options in the rows to answer the specific research questions. In terms of scale of the paper, the chosen ones are listed there.

1) The main reasons for the introduction of cloud computing

The aim of the question was to find out the main reason for the introduction of cloud computing. There are included objectives to be achieved with the introduction of cloud computing as well as the motives that led to the introduction.

A total of 9 reasons that led to the introduction of cloud computing were listed in the case studies. These reasons are given in table 2 which also shows how many corporations indicated the particular reason for the introduction.

TABLE II. MAIN REASONS FOR THE INTRODUCTION OF CLOUD COMPUTING IN INDIVIDUAL CORPORATIONS

	Designation of case studies					
	1	2	3	4	5	6
Effort to unite more branches of a corporation		**X**				**X**
Simplify IT management		**X**	**X**	**X**		**X**
Developing requirements for IT	**X**				**X**	
Personal reasons	**X**			**X**		**X**
The need to solve problems that were brought by previous IT solutions	**X**			**X**	**X**	
Replacement for a formerly used service cancelled by the provider	**X**					
Save costs			**X**	**X**	**X**	**X**
Getting rid of the dependence on own IT			**X**		**X**	**X**
Effort to improve the quality of serviced used				**X**		

The most commonly cited reason was to simplify IT management and save costs. Both of these reasons were stated by four corporations. Given the fact that the reason to "save costs" was stated by both corporations that use some cloud services for free as part of their educational activities (case 5 and 6), the evaluation of this reason is therefore not objective. We are therefore going to focus on the second reason - "simplifying IT management".

Other reasons given are "personal reasons", "the need to solve problems that were brought by the previous IT solutions" and "getting rid of the dependence on own IT" - all of these reasons were given by three corporations. By personal reasons are meant:

- the reluctance of a company to hire more employees as a result of IT requirements - according to the case study 1: "Initially, a company considered to develop solutions by their own means, but due to lack of staff and time, it decided to use the services of another provider of information solutions";
- the effort for more effective use the work of IT workers - according to the case study 4: "CEO of the company also did not like that all employees cannot be fully devoted to major work activities," according to the case study 6: "The main motivation was to save costs and human resources in the context of the simplification of administration".

2) The main benefits of the introduction and use of cloud computing

Another research question is "What an organisation sees as the major benefits of the introduction and use of cloud computing?", i.e. what positive changes has been brought to a corporation by the introduction of cloud computing. Each respondent stated at least nine benefits and in all cases the deployment of cloud computing has

brought the expected changes. Figure 3 lists all of the benefits and illustrates in which case studies they are presented. devices" and "automatic updates and new versions of programs“

3) The negatives accompanying the decision on the introduction of cloud computing and the cons of cloud computing

Given that cloud computing is a relatively new technology, it is associated with a certain distrust, which creates **barriers** to its implementation. Even the corporations that are part of this survey and already use cloud computing, have met some obstacles before the introduction of cloud computing, with which they had to cope and overcome. The barriers stated by these corporations are listed in table 3.

TABLE III. THE BARRIERS ASSOCIATED WITH THE INTRODUCTION OF CLOUD COMPUTING REPORTED BY CORPORATIONS

	Designation of case studies					
	1	2	3	4	5	6
Concerns regarding security	X	X	X	X		X
Limited availability of support	X					
Disagreement on the benefits in leaderships			X			
Concerns that the technical infrastructure of a corporation will be insufficient		X				
Lack of qualified workers	X					
Concern that a move to cloud computing could be financially difficult		X			X	
Unknown functions and possibilities of this technology	X	X				
Concerns regarding the legislation						X

After the introduction of cloud computing corporations can

example, a corporation in case study 1 still does not trust the security of cloud service providers enough to use a public solution, therefore, they use only private and community cloud. An opposite example is a corporation in case study 2, which has been using public cloud for six years and has not encountered any leakage or loss of data. Other cited barriers for the introduction of cloud computing included the fact that corporations were not aware of the features and capabilities of this technology. This means that they had some knowledge about this technology, but they did not know what exactly cloud computing deployment will bring and require.

As shown in table 25, almost all corporations in the context of cloud computing are worried the most with regards to the security of their data stored in the cloud infrastructure. For

More complicated implementation of certain changes		X				

The drawbacks of cloud computing	Designation of case studies					
	1	2	3	4	5	6
Dependence on the provider	X					

Figure 3. Representation of the most frequently mentioned benefits of cloud computing and the amount of and getting rid of the responsibility over certain acts", "reduction of the annual costs of IT operation," "the ability to access corporate data from anywhere and also through mobile corporations that stated these benefits

The most commonly cited benefits of cloud computing include "simplifying the management of information system experience some of its drawbacks. The corporations in the survey reported a total of 4 drawbacks - see table 4

Dependence on the internet connection				X	X	X
Cloud services lack some of the required features (or a tool)					X	

Most corporations mentioned the dependence on the internet connection as a drawback to cloud computing. At the same time they also stated that there is very few situations where internet connection is not available, and immediately after reconnecting to the internet by using the sync process all the changes that have occurred in offline mode are automatically adjusted.

B. Summary

The study survey showed that most companies became aware of cloud technologies separately, based on the need to solve a certain problem or bring improvement. If a corporation had no problems and did not feel the need to change the established information technologies, they would perhaps not find out the possibility to deploy cloud-based technology and take advantage of the benefits that it brings.

Cloud computing is undoubtedly a good solution in the case when an organisation wants to simplify IT management. It was the most frequent reason why the surveyed corporations decided to deploy cloud computing. In all these cases, the deployment of cloud computing has brought the expected results and the related advantages. In addition to this reason, the corporations stated several others benefits, such as the attempt to save IT costs with the introduction of cloud computing, a reduction in staffing capacity or better use of them, to solve the problems with the existing IT solution or get rid of the dependence on their own IT infrastructure. The benefits of cloud computing clearly outweigh the negatives and all the corporations that were included in the research are satisfied with the use of cloud technology.

The biggest barrier against the introduction of cloud computing are concerns of users regarding the means of securing their data stored in the cloud infrastructure or passing through this infrastructure. It should be noted that unlike cloud computing, which is hosted in the USA, cloud computing hosted in Europe does not allow a third party (not even the government) to access data and information of users.

During the survey, none of the companies stated that they would encounter a problem during the use of cloud services, which could be related to data loss and leakage.

VI. DIUSCUSSION

The above summarised the benefits and barriers associated with cloud computing correspond with the existing studies conducted on this topic. Four articles base the potential motivation to adopt cloud services on cost reductions of the underlying scalable cloud infrastructure that permits a highly efficient use of resources [58, 59]. However, eight contributions cite savings to the organization in large upfront investment in physical infrastructure as the dominant enabler and cause of cost savings [60-62]. This, in turn, should lower spatial requirements [62], investment risk [61], switching costs and barriers to entry, which are especially relevant for SMEs and third world countries.

According to Preciado [63], among main barriers belong:

- security, including data loss, phishing and cyberattack,
- the loss of control of the data, transfer of company data to third parties and no control over the infrastructures that manage them,
- not knowing how to measure the real benefits that CC generates and its cost benefit analysis,
- availability and quality of service,
- data lock-in, difficult for clients to change to another provider,
- data privacy, confidentiality and law requirements about privacy, access, protection and location of the data [8].

This again corresponds to the situation in the Czech Republic, where the biggest barrier is considered to be the concerns regarding data security. Overall it can be said that in international comparison we can find a similarity in the attitudes towards cloud computing. The current rate of adoption of this technology in various countries is therefore mainly related to the attitudes of the potential users. In places where is a strong need for change, competitive pressure and trying to keep up with the rapid evolution of technology, there is faster adoption of cloud computing.

VII. CONCLUSION

The aim of this paper was to analyse the degree of cloud computing adoption in European countries, focusing on the Czech Republic. For this purpose, we used the data from available analyses, the results of a questionnaire survey along with the in-depth interviews conducted among selected firms in the Czech Republic. The rate of adoption of cloud computing in the European Union is lower than for example in the USA. In the Czech Republic the situation is even worse. One of the main barriers for adoption include the concerns about data security. In this respect, on the level of the European Union there are steps undertaken that lead to the creation of legislative measures aimed at the functioning and security of cloud computing.

Overall it can be said that cloud computing is seen as an important technology for European industry because it allows companies, especially small and medium-sized, to use costeffective IT and gain business advantage. Furthermore, cloud computing allows access to more advanced ICT and therefore companies can enter new markets faster with less financial risk. The European Commission believes that new opportunities e.g. in the area of innovations, which use of this technology brings, could enhance business productivity and greatly increase the GDP of the European Union. The European Commission in 2012 filed a strategy draft that should adapt the rules to the sector and to encourage businesses to use cloud services.

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