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Application of the Cost Benefit Analysis method in Cloud Computing in the Czech Republic

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Abstract

The aim of this paper is to introduce the expression of efficiency of the adoption of cloud computing in the Czech Republic, using the Cost Benefit Analysis method. The article will firstly specify the qualitative and quantitative benefits of cloud computing. Within the case study of private cloud implementation in the Czech medium-sized enterprise, the Cost Benefit Analysis method will be applied. The possibility of transferring all the implications of this technology to the financial statements will be outlined through the method.

Keywords: Company, cloud computing, efficiency, cost benefit analysis;

1. Introduction

Cloud computing is a broad and highly innovative approach, representing the transfer of traditional IT services to the new business model – the so-called cloud, which represents a unique area with new business opportunities and models. It is the fact that Czech companies invest into manufacturing industry large amount of money (Hamplová, et. al., 2011) (including information technology equipment). Vaquero et al. [(Vaquero et al., 2009) in his article summarizes and defines a cloud as a large group of easily usable and affordable virtualization resources (hardware, development platforms, or other services). These resources can be dynamically reconfigured and adjusted according to the changing range of the nature of services, while allowing optimum use of resources. Carr defines cloud computing as a step in the commoditization of IT investments (Carr, 2003) One of the currently discussed questions, which has to do with cloud computing, is return on investment. Many important implications on cloud computing that are qualitative in nature and are not included in the return of investment (ROI) indicators. This fact may have a negative impact in company decisions on the introduction of this technology. There exist a lot of methods that involve assessing qualitative benefits (Bureš, 2006). It is difficult to compare these benefits with financial costs on investments, though. Cost-Benefit Analysis, translating quantitative costs into financial representation, is a method, which strives to solve this problem. It has already been applied in many areas. Cost-Benefit Analysis belongs to the ratio approach to decision-making processes. The perception of costs in this perspective is slightly ambiguous. The costs should be defined as any negative impact of a project (Sieber, 2004). This method assumes the possibility to measure and express the value of negative and positive impacts in monetary terms. This is not usually ensured at the beginning of the analysis. The outcome of Cost-Benefit Analysis provides a set of standard indicators, which facilitate to compare projects among themselves (Marešová et al., 2011).

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The aim of this contribution is to show by means of a case study feasibility of applying the methods of Cost-Benefit Analysis in cloud computing. The given method will allow enterprises to respond to the question of whether the use of cloud is more efficient than its own information technology.

2. Related works

For enterprises to use cloud computing, they have to consider the benefits, risks and effects of cloud computing on their organizations. Case studies provide an effective way to investigate these areas in real-life organizations. This section takes a brief look at the related work in these areas (Khajeh-Hosseini et al., 2010).

Hoganś (Hogan, 2008) case study illustrates the potential benefits and risks associated with the migration of an IT system in the oil & gas industry from an in-house data center to Amazon EC2 from a broad variety of stakeholder perspectives across the enterprise, thus transcending the typical, yet narrow, financial and technical analysis offered by providers (Hogan, 2008). Results show that the system infrastructure in the case study would have cost 37% less over 5 years on EC2, and using cloud computing could have potentially eliminated 21% of the support calls for this system. Next study compares and contrasts the performance and monetary cost-benefits of clouds for desktop grid applications, ranging in computational size and storage (Kondo et al., 2009). In (Deelman et al., 2008), the authors determine the cost of running a scientific workflow over a cloud. Another study analyzes the economic impact of its gradual introduction in the next years and he emphasizes its role in fostering business creation and competition thanks to the reduction of the fixed costs of entry in ICT capital (Etro, 2010). Klems et al. (Klems et al., 2010) presented as a framework that could be used to compare the costs of using cloud computing with more conventional approaches, such as using in house IT infrastructure. In (Garfinkel, 2007), the author conducts a general cost-benefit analysis of clouds. However, no specific type of scientific application is considered.

In the above-mentioned case studies is an interest to quantify the costs and benefits. Those procedures don´t solve these problems comprehensively, but they are only focused on a selected area of costs and benefits. Aim of this article is to solve this issue more comprehensively. This issue will be outlined in a specific example of the introduction of private cloud into a company. For the purposes of this analysis, the notion of private cloud will be seen according to Armbrust et al. (Armbrust, 2009), who sees the essence of private solution in in-house data centers, which makes their services available only to their own organization and not the public or other entities.

3. Application of the Cost Benefit Analysis method in cloud computing - a case study

The nature of many significant benefits of cloud technology is at first glance qualitative. However, there are methods that many of these benefits can also express quantitatively. One of these methods is the Cost Benefit Analysis. Negatives (costs) of the project include for example the software price, cost of consultants, installation and training of its users. Positives (benefits) of the project may include an improved business process leading to savings in production costs, improve the decision-making process and increase employees´ morale due to a better feeling working with new equipment. Specifically, it is for example, the benefit study of hybrid electric cars, as well as the software managing in the U.S. land area of about 192 million acres, in the total of 44 states.

Application of the CBA method will be outlined in the example of the introduction of a private cloud in a mid-size company in Central Europe. Electro technology Co. is a production company based in the Czech Republic. It was founded in 1993 with the business of Manufacturing Electronic and Electromechanical Components. Today, the company employs 380 workers, 60 workers are THP. Electro technology Co. is a subsidiary company of Electro technology GmbH based in FRG, which has 100% business share and relations with the parent company are carried out in normal trade.

3.1. To Establish a Set Of Alternative Projects

As alternative projects that will be compared, are the inherent IT department in the company and the private cloud. Currently, 110 normal computers and 7 physical servers are in operation in the company. The office

computers are using software means from Microsoft and servers use operating systems of Windows Server 2008 and 2003 from Microsoft. Computer network is based on the Star topology with the backbone optical network of a Bus type. The company has servers, which can be marked as critical and supportive. The total costs of current operations of the IT department in the Electro technology Co. are expressed in Table 1.

Table 1. Tab. Operating costs of IT Departement

Description	**Price (euro)**
Electricity for the operation of servers	6 400
Upgrading servers every three years	9 000
The cost of servers downtime	1 400

Source: custom processing according to (Šafář, 2012).

In order to increase the safety and accessibility of services, it is necessary to separate the individual services systemically; it means to use one server for one service. Services on the servers must be divided in such a way that two critical services will never be on one server, so they cannot interact with each other in the case of a software error and system crashes (Table 2).

Table 2. Costs of private cloud in the company

Investment cost	Price (euro)	Operating cost	Price (euro)
Two physical servers, processors, memory, accessories and labor	14 314	Electricity for the operation of the server	1 240
Arrays, installation	12 753	Upgrading servers every three years	3 600
Software	10 640	The cost of server downtime	200
RACK, UPS, labor	6 625		

Source: custom processing according to (Šafář, 2012).

The total cost of the investment option in Electro technology Co. was valued at 44 000 euro.

3.2. To Convert Positive And Negative Effects To Money

The impacts that must be converted to the financial statements include:

Reduction of server down time.

Profit of the company for the functionality hour of critical computer systems* number of hours of downtime

Improving service scalability

Savings on investment costs to extend the service + saving on wages of IT expert to extend the service

Lower risk of server failure.

The loss to the company for an hour of malfunction of critical computer systems * number of hours

Simplify and streamline IT management.

Salary * saving on the hours spent over the management of tasks.

For example, as part of this benefit is meant solutions of server downtime, which can be addressed from anywhere in this way, which means time of IT workers is saved on commuting etc.

Greater customer satisfaction.

Increasing sales per a customer * number of customers

Saving, during the implementation of changes in technology.

IT employee´s wage * the number of hours saved

Number of new customers.

Revenue per customer * number of new customers

Due to new technologies, the company has the opportunity to address and manage to handle other tasks in connection with new clients and their other specific requirements.

Less time spent on repetitive tasks.

Number of staff hours spent on repetitive processes * wage per hour * number of employees.

Within this benefit, there is a saving in time due to the sharing of information and knowledge in one place, there is no duplication of sharing knowledge through reading and sending of emails, etc.

3.3. Calculation Of The Investment Return

3.3.1. ***ROI (Return Of Investment)***.

The following data was used to calculate the return on investment in Electro technology Co. Average annual profit from the investment: 14 189 (EUR) (savings through the Introduction of investment). The total cost of implementing the investment is 44 164 (EUR). After the calculation, the return time = 3,08. The return period on investment exceeds about 28.5 days the life-time of the servers. This calculation was carried out without regard to the qualitative benefits of the project and without trying to convert them to quantitative terms. The inclusion of additional benefits would have a major impact on the outcome. The following procedure can be used to calculate the return on investment with regard to all benefits:

Profit from investment = cost of the original IT solution - the cost of the investment option + other benefits from the investment

$$ROI = \text{profit from the investment} / \text{total costs of the investment} * 100\% \quad (1)$$

3.3.2. NPV (Net Present Value).

The total cost of implementing the investment is 44 164 (EUR). This paper considers as the yield of the project saving, which is achieved thanks to the newly deployed technology. The annual yield is 14 189 (EUR) . The life-time of the project is 3 years. The discount rate is 4%. After calculating, the net present value of the project is: -2 136 (EUR). Net present value of the project beyond the lifetime of the project is in the negative value.

When using the methods of evaluating the effectiveness of the investment, the invisible benefits are not regarded, but they are very important factors in the overall evaluation of the investment. Involvement of all the benefits of cloud computing is expressed as follows: *Rt* = financial revenue from the investment + qualitative benefits converted to money - spending on the investment.

Furthermore, it is possible at the end of the servers' lifetime to sell them and increase the net present value. It is hard to estimate the residual cost of servers in advance. The residual price will depend on market situation and the development of technology in the server area. It can be assumed that with the speed of IT and computer technology development that the residual value will be in up to several tens of thousands EUR.

When comparing operating costs in case of a private cloud and IT department, it is possible to claim that 33% of operating costs will be saved.

4. Conclusion

The aim of this paper was to address the issue of the qualitative and quantitative impacts expression of cloud computing and their financial describing. The company implemented a private cloud implementation project despite the fact that the ROI and NPV indicators did not show favourable values. The indicators did not include qualitative benefits. The case study outlined the possibility to express these benefits in the financial scale.

Cost savings were counted at 33% of operating costs per year with the return on investment in three years' time. This situation corresponds with the case study, where the author says that the system infrastructure in the case study would have cost 37% less over 5 years on Amazon EC2, and using cloud computing could have potentially eliminated 21% of the support calls for this system.

Limits to this study are mainly in the field of concrete qualitative benefits of Electro technology Co. They were specified by this organization but then the company was unwilling to provide data so that they could be expressed in money. At the moment, the case study provides concrete instructions how to convert chosen qualitative benefits of cloud computing into financial expression. It depends on every organization how thoroughly it will do these calculations. In the near future it is planned to use further case studies in order to verify the proposed system of translating qualitative benefits into financial expression. The main effort will focus on achieving concrete data that will enable to count NPV already with respect to qualitative benefits. If necessary, the method will be modified with respect to the companies' requirements, and more financial indicators, into which qualitative benefits will be reflected, will be involved.

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