PROBLEMS OF TRANSITION FROM CLASSICAL DEDICATED ICT SYSTEM TO CLOUD COMPUTING

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Abstract

Technological solutions, which most of ICT processes are still based on in business systems, are classical desktop systems and client-server systems. Some typical characteristics of such systems are poor utilization of processing possibilities, overcapacity of storage systems, data and application redundancy, relatively high security as well as relatively low portability and scalability.

The paper deals with advantages and shortcomings of the conceptual model of capital expenses and operational expenses of classical ICT systems compared to the cloud computing with an emphasis on the problem of demands definition and their valuation, as well as ICT capacity utilization. Also, the costs of classical and potential cloud computing options are investigated, especially in the context of total costs of ownership. The paper has revealed a problem of precise historical data availability for different kinds of ICT expenses. The model and TCO have been analysed on the case of one big Croatian company.

Keywords: *Cloud computing, classical computing, overcapacity, undercapacity, TCO*

JEL Classification: L63, M15, M19

INTRODUCTION

The emergence of new technological attainments or evolutionary upturns, as is the case in the information and communication technologies, pose challenges for all business systems, regardless of their industry, size, organizational structure or socio-economic environment in which they operate. Existing technological solutions are the foundation or the consequences of their organizational solutions, methods of implementation, performance of business processes, workflows, creation of value chains, managerial styles and methods, business goals (from operational through tactical to strategic), economy and productivity as well as relations with the environment.

A new technological paradigm which has emerged in recent years, considering collection, processing, storing, distributing and using of data and information is cloud computing. Cloud computing is not a single technology but a set of technological solutions which have evolved in the field of information and communication technology based primarily on the development of computer architecture, computer networks and protocols, new server and client operating systems, virtualization, software and hardware solutions, scripting languages, tools and databases. Listed technological solutions enable the fulfilment of the new requirements for data and information regarding their shape, size, place of occurrence, type of processing, storing, dissemination and presentation.

Technological solutions, on which most of ICT processes are still based on in business systems, are classic desktop computers (which have also undergone revolutionary changes in last two decades) and client-server systems. A typical characteristic of such systems are poor utilization of processing possibilities, overcapacity of storage systems, data and application redundancy, relatively high security as well as relatively low portability and scalability.

The suitability assessments of, new technological paradigms, especially those in the domain of information and communication technologies, usually are based on the following sets of parameters:

- Businesses demands, strategic, tactical and operational objectives, key business processes and their outcomes as well as business continuity;
- Financial requirements;
- Timing requirements in terms of estimates of the moment of introduction and the time required to introduce the new technological paradigm;

- Organizational ability for technology acceptance;
- Change management skills and abilities;
- Security aspects;
- Ability to manage technological development;
- Compliance with legal regulations.

For the assessment, development and implementation of new technological paradigms, numerous models and methodological frameworks have been developed that are (or pretend to be) suitable for each aspect, phase or integration of all aspects relevant to the development and implementation of new technological solutions [1] (AGIMO, 2012).

The aim of this paper is to point out some of the problems and limitations of the conceptual model used to justify transition from classic dedicated information systems to cloud computing as well as the problems of calculating the total cost of ownership of some technological variants.

CONCEPTUAL FRAMEWORK (MODEL) FOR JUSTIFICATION OF TRANSITIONING TO CLOUD COMPUTING

Cloud computing is considered as a set of computer services provided to the user in the amount, time, how and when they are needed. It encompasses the following types of services:

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

Besides the criteria mentioned above, following arguments are used to justify transition to the cloud computing:

- Cost savings of equipment and costs of personnel that are committed to maintaining computers, servers, software and network architecture;

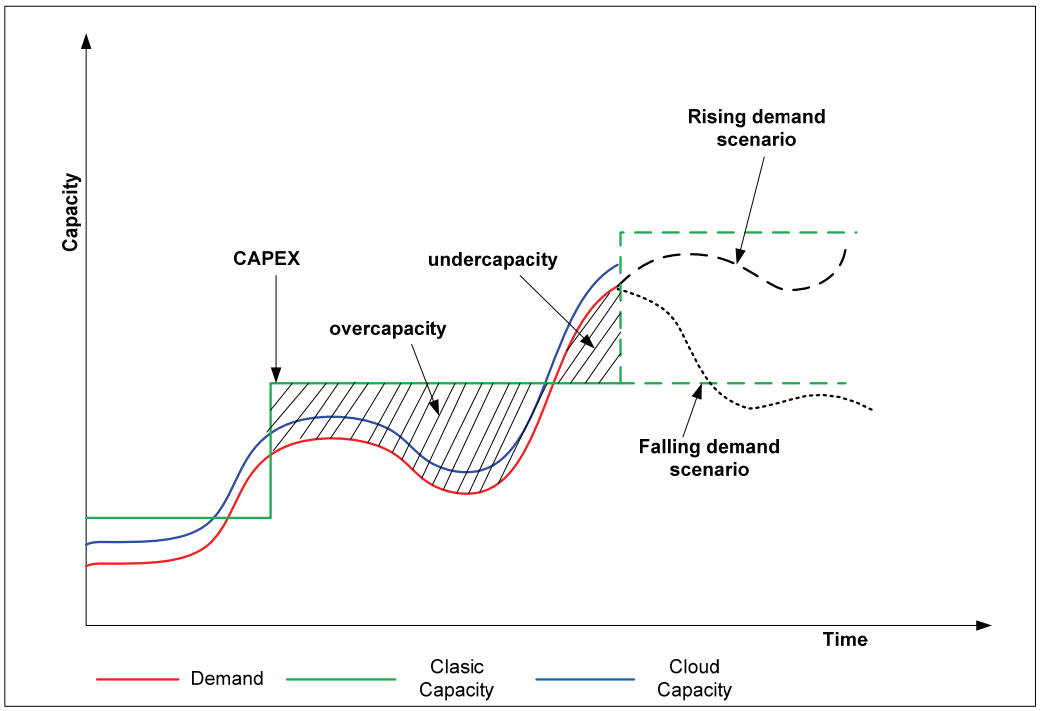
[1] Examples of metodologies, metamodels or standards are: classical SWOT analysis and Capability-Maturity Model, Zachman framework and its variants, CobIT, ITIL, ISO/IEC 27002, TOGAF and others.

- Continual software upgrade and depriving users from taking care of new version of operating system, general purpose application (eg. office tools) and miiddleware;
- Security concerns;
- Scalability etc.

The conceptual framework (model) which justifies the transition from on premise systems to cloud computing is shown in Graph 1. Graph illustrates how a technological change occurs in typical desktop and client-server IT systems (technological leaps) and how they change working capacity, storing capacity and consequently their ability to adapt to current customer requirements (green line). Due to upturns in capital investments a problem of overcapacity of IT resources occurs in the initial stages and after some time the problem of undercapacity begins to occur due to the growing demands and new technological changes which influence the needs for new capital investments.

The basic idea of CC providers is that the requirements (red line) for new hardware and software solutions could be met by renting of these solutions as a service in the amounts and time of how much a user need with addition of a safety margin (blue line). In this way, the user is spared from higher capital expenditures which are left to the provider of CC services. By using the new technology solutions (processor architecture, storage capacity, operating systems, virtualization, Internet technology grid, development of platforms and application solutions) service providers are able to offer individual or groups of services that are now popularly called cloud computing.

Graph 1: Curve of capacity utilization in classic (dedicated) systems and in the cloud Source: adapted according to : Rackspace Support,, Moving your Infrastructure to the Cloud, San Antonio, 2011



However, even a superficial and in particular a systematic analysis reveals multiple problems for the applicability of this concept in practice. The first problem is how to clearly define requirements in their quality (nature), the amount and (wherever possible) in value. It is important to assess those requirements at a certain point of time on the one side and the foreseeable time perspective on the other side.

Capacity is a hardware-software solution that has solved the task - meets the users requirements. Whether it comes to capacity of processors to perform (speed), software solutions, RAM capacity, disk capacity and connection speed? If so then in a given architecture we can reach the configuration and cost required for such configurations and architectures. In the default settings usually those capacities exceed the needs. Another issue is why and for how long is the green line such as it is and whether it is a constant? When we talk about technological leaps, experience has shown that it can take a period of 5 years as it is today a common cycle for changing the technological basis of computer systems. Why is the curve straight? It could mean the following: in the initial year we have new technology (hardware, software, networks ...); next year we invest in the value of amortization and we have capital investments that are constant.

According to the model, cloud computing would not require such investments on the user side. Instead the demand can be fulfilled in a way that the user invests a minimum of the necessary funds and the rest would be bought from the service providers in an amount that is necessary. Such explanations are acceptable for systems that are faced with a dilemma of choice of one or other variant at the beginning of its activity. However, for systems that are architecturally established in past, the analysis must take into account many other factors to which the existing system needs to adapt to as new solutions and whose costs can significantly surpass the renovation of the existing system.

The usefulness and effectiveness of the model is studied by using an example of a big business system in the Republic of Croatia.

REVIEW OF PREVIOUS RESEARCH

There are numerous studies about various aspects of the problem of transition from classical, on premise or dedicated systems and client-server system to cloud computing. A short overview will be made on research that was more focused on the costs or cost-benefit analysis of the transition from classical computing to cloud computing. Kondo et al (2010), have examined:

- What are the performance trade-offs in using one platform over the other in terms of platform construction, application deployment, compute rates, and completion times?
- What are the specific resource requirements and monetary costs of creating and deploying applications on each platform?
- Given those performance and monetary cost-benefits, how do VC platforms compare with cloud platforms?
- Can cloud computing platforms be used in combination with VC systems to improve cost-effectiveness even further?“

Kristekova & al (2012) started from „difficulties to determine the total costs caused by offering own services in the cloud as well as to compare them with the costs caused by an in-house datacenter. They proposed„ a simulation model that covers such dynamic aspects and supports decision makers in analyzing cost-benefits of cloud computing versus own datacenter“.

Chandra and Borah, 2012 have made a Cost-Benefit Analysis of Cloud computing in Education in India, emphasizing the advantages of simple devices

that will be used by a growing body of student population on the one hand and the use of such a concept as 'in the cloud' on the network of universities of India on the other hand.

Alford, T., Morton (Alford, Morton, 2010), investigated "potential savings of the federal plan, focusing on IT data centers and using a proprietary cost model and extensive experience in cost and economic analysis of government IT programs. Results generally confirm the government's expectations of significant cost savings."

Rutland (2012) examined CAPEX TO OPEX problem emphasizing its applicability to systems that are starting from scratch projects (startup) and systems that have built their portfolio of requirements and services that are far more complex. He pointed out that TCO analysis of both variants is more appropriate.

M., Dias de Assunção, A.,di Costanzo, R., Buyya, 2010 (Dias, 2013) have „showed that the cost of increasing the performance of application scheduling is higher under a scenario where the site's cluster is under-utilised. In addition, request backfilling and redirection based on the expansion factors (i.e. selective backfilling) showed a good ratio of slowdown improvement to the money spent for using Cloud resources."

At a time when cloud computing is becoming increasingly more acceptable technology the number of service providers of CC is rapidly growing and service users are faced with a dilemma of how to choose the best provider that will today and in the foreseeable future of at least five years be able to fulfil all the necessary requirements of the user, taking into account the technological progress (Perry, 2010).

Investigati ROI Kepes (Kepes, 2011) point out that "for companies it is important to find a way to increase the benefits while reducing the risks when migrating to CC. Given the multitude of providers of these services on the market, it is very important, even crucial, to the success of CC that the most competent program is chosen that meets the specific needs of users".

RESEARCH ON OVERPROVISIONING/UNDER-PROVISIONING OF INFORMATION RESOURCES - THE PROBLEM OF IDENTIFYING THE COSTS AND DEMANDS

Observed company, belongs to large business systems. It has over 8,000 employees, with about 3,000 different computers and about 30 different servers. Although software development it is not the core business of the company, most of the business software has been developed by their own development team. Largest numbers of applications are desktop applications, hierarhicaly organized. Locally processed data are sent on the higher level as packages and processed afterwards. The database and development tools are outdated and manufacturers no longer support them. Some applications are carried out on client server systems with new versions of (MS SQL) database being located on separate servers. There are also web applications through which certain data and programs are accessed or used in a web environment.

Beside their own applications there are applications from external manufacturers for whose use as well as use of platforms (OS, software for business process management, database, GIS, etc.) licence fees are paid..

The problem of overcapacity can be considered on two levels. First is hardware overcapacity – total provisionig of disk space that is explored in a sample of one organizational unit and because of the similarity with other organizational units is approximated on the whole system. It has been determined that the utilization of disk space is at a level between 18 and 20%.

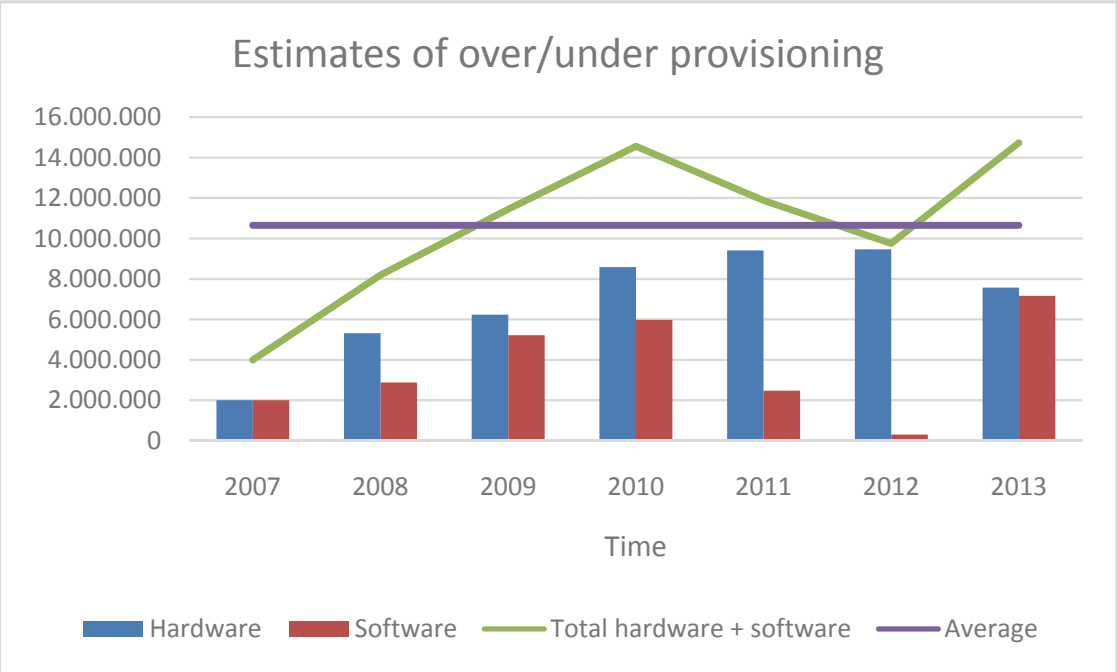
Total under/over-capacity of hardware and software resources was observed on the basis of investments in hardware and software solutions in the period from 2008. to 2012. with the plan for 2013., as shown in Graph 2.

For creation of chart the starting point was set out on the realistic assumption[2] about equal value of software and hardware in 2007 at the amount of 2 million Kunas each. Starting from these values and that the technological cycles change about every five years, a value correction is derived for adjustment of equipment and software with 20% write-off yearly to which the investment

[2] We gained this orientation data on the basis of data about the purchase value in the period from 2008. to 2012. and the cumulative value of the equipment (separately for hardware and software) in the period from 1989. to 2008.

value was added for each year and successively corrected until 2012. Under/over-capacity can then be conditionally viewed as the ratio of the total value of hardware and software compared to an average for the period. It may also be assumed that good compliance of the hardware and software value probably lead to overcapacity of resources in classical dedicated and client-server architecture.

Graph 2. Estimates of over/under provisioning of ICT capacities based on investments in hardware and software in period 2008-2012



CALCULATION FOR TOTAL COSTS OF OWNERSHIP.

Problem with Graph 2. consists primarily that costs of creating and renovation of their business applications are not included. These costs are included in the salaries of the design and development team and what they really are can only be approximated. The total costs of ownership of some ICT variants may include the following:

TCO = Purchase + Financing + Maintenance + Upgrade + Enhancements + Deployment + Security + Depreciation + Decommissioning + Disposal + $Cost_n$

For our research purposes, they are decomposed in to hardware costs, software costs, the cost of human labour and the cost of communications.

$TCO = C_h + C_s + C_{hr} + C_k$

C_h – costs of hardware

C_s - costs of software

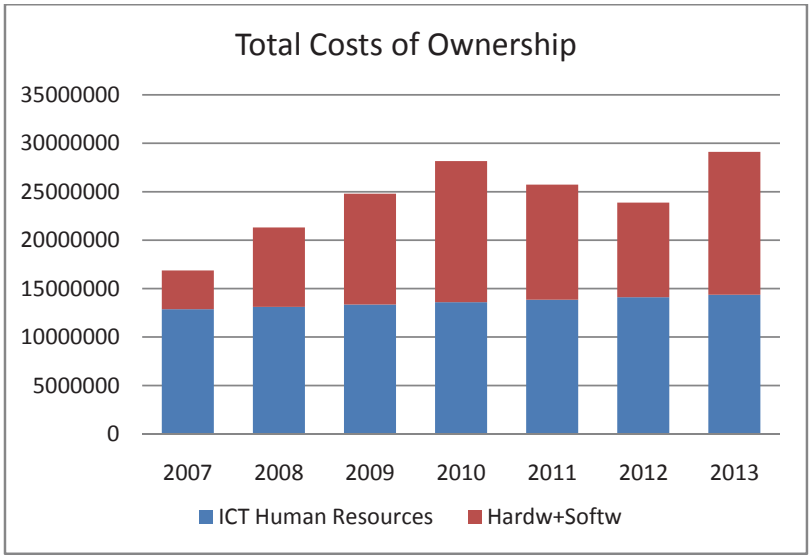
C_{hr} – costs of ICT staff

C_k – costs of communication

Given the way of bookkeeping, communication costs are not taken into account.

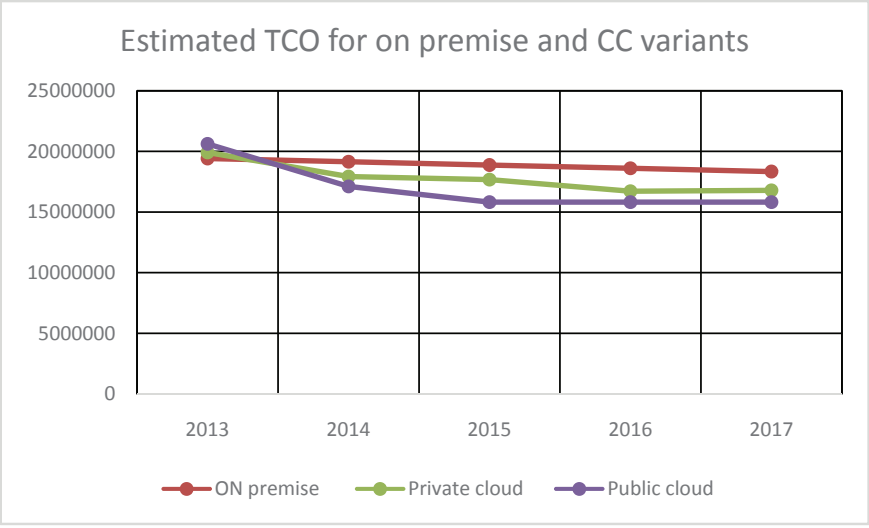
Total costs of ICT ownership in the previous period is shown in Graph 3.

Graph 3. TCO of actual ICT paradigm (on premise, desktop and client-server application)



Estimated total cost of ownership for the assumed future period from 2013. for option of existing ICT is derived by approximation based on data from the period of 2008 to 2012 and the investment plan for 2013. TCO for CC is derived from successive reduction in capital investments by 10-15% in all years except in the initial year when, because of the cost of developing new business solutions and costs of migration, should expect that the costs will be significantly higher than those years with conventional technology solutions. The cost of personnel employed in the ICT was equally successively reduced. The cost of CC services was included as the cost for renting of EC2 integrated services of Amazon cloud computing for large customers (Graph 4.)

Graph 4. Estimated TCO of current ICT, private and public cloud



The largest share of the total cost of ownership of existing on premise versions of computer solutions are staff costs employed in maintenance, development and management of ICT. Although at this point it is not known what the costs will be in the future, it is realistic to assume that a part of these human resources will remain surplus, especially at middle management levels as well as at the levels of operations management and some administrator functions. Their increased involvement can be expected, provided that they have the capacity, in adapting existing and developing new applications for CC. Adjustment or completely new development of business applications that can run in the cloud can be cost-demanding.

It is reasonable to predict that, due to the costs of adapting existing business applications, it will initially require significant investments In the future period are excluded employee related costs at middle level management of IT from the total cost of ownership of cloud computing which is why in the long run according to TCO cloud computing stands as a more favourable option.

CONCLUSION AND RECOMMENDATIONS FOR FURTHER RESEARCH

Most arguments for the transition to the new paradigm of information technology - cloud computing, favor its cost-effectiveness and the problem of over/under provisioning of ICT resources or "gap" between conventional capital investments and the (increasing) demand for individual resources in the classic desktop and client-server systems.

Assessment of "gap" between conventional capital investments and the increasing demand for individual resources in the classic desktop and client-server systems is derived through the analysis of capital investments in ICT and the total cost of ownership in the period from 2008. to 2012. Important insights about the "gap" of capital investments and the growing needs has been confirmed through the analysis of investments in hardware and software solutions that are assumed to sufficiently accurately reflect the ICT needs.

Although most of the arguments for the transition to the new information technology paradigm emphasize its cost-effectiveness, it has been shown that the cost estimates are not an easy task. It turned out the fact that the actual accounting data are not sufficiently organized and it is necessary to introduce additional calculations and estimates for the comparative analysis to be proven effective for making the decision to transition from one technological paradigm to the other. A particular problem with the cost of cloud computing providers is that there is a need for a thorough analysis of everything that is included under a particular kind of service and what kind of hidden costs of migration to a new technological paradigm can occur.

Equality (model):

$$T_h + T_s + T_o + T_k = T_{SaaS} + T_{PaaS} + T_{IaaS}$$

T_{SaaS} – expenses of software as a service,

T_{PaaS} – expenses of platform as a service,

T_{IaaS} – infrastructure expenses as a service

that connects the total cost of ownership and cost of services of cloud computing is the basis for analysis and "altering" of cost variants. Thus, based on well-defined requests for services, platform and infrastructure (which will, after all, represent elements for forming of a service contract - SLA) for each member of the right side of the equation a sufficiently reliable estimate of TCO or certain categories of expenses can be carried out. Those estimates will be equally possible for options of private, hybrid or public clouds, provided that the content of a particular service is fully or for the most part known.

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