A comprehensive framework for software as a service adoption

by

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ABSTRACT

Software as a Service (SaaS) as one of service models of cloud computing offers without a doubt a lot of advantages for enterprises. But there are also disadvantages and risks, which should be taken into account, when an organization is considering migration of an application to the cloud. Therefore, comprehensive framework for SaaS cloud migration is needed. Costs are the key factors, which influence the decision making; therefore Total Cost of Ownership (TCO) is included in our framework. Also other criteria (benefits, risks,…) affect the final decision. Thus, the framework based on multi-criteria method is introduced in this paper.

Keywords:

Software as a service, SaaS, decision making, cloud service adoption, Total Cost of Ownership

INTRODUCTION

Software as a Service (SaaS) is the capability provided to the consumer by the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser or a program interface. The consumer does not manage or control the underlying cloud infrastructure (network, servers, etc.). The consumer can't manage even individual application capabilities, with the possible exception of limited user specific application configuration settings [1]. SaaS helps organizations to avoid capital expenditure and because of the subscription payment model, operational costs are arisen.

The aim of the transition to the cloud may be for example lower costs, increased effectiveness of business processes, improvement of system availability and reliability, ability to scale IT resources etc. On the other hand, decision to migrate to cloud or not is not an easy task. All types of benefits, risks and costs should be considered before decision is made. This decision process involves multiple, often conflicting economic, technical and strategic criteria. Therefore there is a need for guidelines and decision support tools for enterprises, which are considering cloud migration. There are already research reports concerning about what type of workload to move the cloud and when [2,3,4,5]. These different approaches are shortly described in the following related work section. Although, we miss complex solutions, which would take decision maker (DM) trough the whole process of decision making – from workload definition to TCO calculation and other criteria consideration. Hence, we propose a new, more complex approach going into this direction.

In this paper, we present a framework to facilitate the process of decision-making specifically with respect to SaaS cloud adoption. The paper is structured as follows. We are reflecting related works in the next section. Then, the proposed framework is described, including description of all steps of the framework in related subsections. Finally, conclusion and future work is given in the last section.

RELATED WORK

There are several approaches which support decision making during cloud computing adoption. Some approaches are general, providing only a kind of overview of all possible alternatives, or sequence of steps to be completed in the transition to the cloud. Other approaches take into account only costs, and do not take into account any benefits that arise

from the transition. Sophisticated solutions see cloud computing adoption as more complex problem and thus they try to solve it as a decision problem by using a variety of multi-criteria decision making methods.

One of the basic approaches by IBM [2] provides a general approach to this issue - explains basic alternative options provided by cloud computing (SaaS, PaaS, IaaS as well as private, public or hybrid cloud). However, it does not provide an answer if company is ready for cloud adoption, or which solution is the best one for particular organization.

Microsoft's framework [3] provides an analysis of particular software application into two segments and then assess whether the application is or is not appropriate for the transition to cloud computing. It focuses on SaaS solutions, but does not take into account the transition costs and potential benefits that cloud solutions deliver.

The solution based on multi-criteria decision method is proposed by researchers from India [4]. The Analytic Hierarchy Process technique is used as a multi-criteria method. In this approach, authors include benefits and risks into account. On the other hand, not complex costs structure is included and cost calculation is not addressed.

The most comprehensive approach offer scientists from IBM Research [5]. Their solution is also based on multi-criteria decision methods and tries to answer the question, which service model and deployment model of cloud computing to implement and which provider to choose (this option is only outlined). It does not reflect only the costs but also positive aspects of cloud computing adoption. The outcome of this approach is most appropriate alternative based on chosen multi-criteria method. This approach, however, does not analyze organization's suitability for particular cloud solution in the context of entire organization and do not answer the question whether the organization is ready to adopt or not. Also, costs and other economic indicators are listed in the model only as some of the criteria, which are estimated in advance, but do not address their actual calculation.

THE FRAMEWORK FOR SAAS ADOPTION

The goal of our framework is to help decision makers to determine best alternative of cloud software as a service for their organization. To make as good decision as possible, we need to make decision in the context of specific workload. Without specific workload defined, decision framework would be too abstract. Thus, for our framework we assume that the IT manager knows which workload could be transferred to the cloud. Our comprehensive framework leads IT managers step by step from workload definition up to the proposal for

the most appropriate alternative. The goal is to help IT managers to evaluate if the workload is appropriate for the adoption to cloud and if yes, also to propose, which alternative is the best one. One of the most important factors which influence decision making is costs; therefore a key step of the process is the calculation of Total Cost of Ownership (TCO).

Proposed SaaS adoption framework consists of the following steps (as Fig. 1 shows): 1) Workload definition, 2) Definition of Alternatives, 3) TCO Calculation, 4) Definition of criteria, 5) Selection of the best alternative. We describe each of the steps in greater details below.

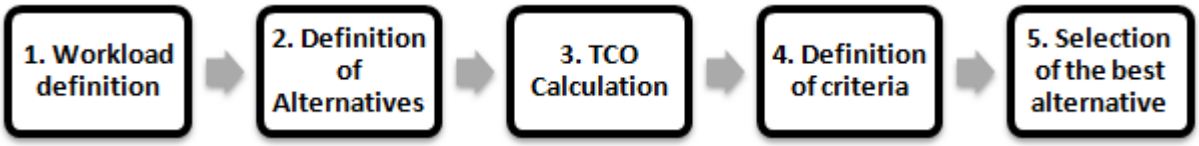

Fig. 1. SaaS adoption framework

1. Workload definition

Workload is defined (according to [6]), as the kind of (IT-based) work that an organization needs to accomplish. Workloads have different characteristics, which make them run most efficiently on different types of hardware and software. There are different requirements for different types of workloads, like some demand fast transactions (e.g. ATMs), others intense calculations (e.g. predictive analytics). Another definition [7] says that workloads represent collections of key IT system components and the relationships among them (e.g. web servers and application servers, databases…). In our framework, as mentioned above, we assume that decision maker knows the workload under consideration.

According to cloud service model, we can divide workloads into three main groups - software as a service, platform as a service and infrastructure as a service workloads. For the purposes of our model, software as a service workloads are important. Software as a service workload type includes applications which are used by users through a web browser, such as e-mail, ERP applications etc. We have identified most used SaaS workloads based on the literature analysis, mainly based on [5,6,7]. The resulted SaaS workloads are shown in Table 1.

Table 1. Examples of SaaS Workload

Workload type based on cloud services models	Example	References
Software as a service (SaaS)	E-mail	[8], [6], [9]

	ERP applications
	Customer relationship management (CRM)
	Desktop
	Data mining, text mining and other analytics
	Audio/Video/Web conferencing
	Graphics intensive applications
	Productivity applications
	Web applications
	Business intelligence and data warehouse

Definition of proper software as a service workload from workload taxonomy is first step of the whole decision-making process. Defined workload is important input to the second step of our process – Definition of alternatives.

2. Definition of alternatives

Alternatives are the different options among which a decision maker can choose. These alternatives need to be explicitly specified in the beginning of the decision process. At least two alternatives should be defined for particular workload. It is recommended that one of these alternatives should be also on-premise solution (or existing solution), so it's possible to compare cloud alternatives and non cloud solution and make the right decision when considering cloud adoption possibility for given workload.

When cloud computing provision of the workload is under consideration, there is almost never just one solution. We can therefore define a set $S = \{a_1, a_2, \ldots, a_m\}$; $m \geq 2$ of finite number of available alternatives a_i (provided e.g. by different cloud computing vendors). All alternatives need next to be compared with respect to a set of criteria, which will be defined in 5th step of our decision-making process.

3. TCO calculation

Costs are one of the most important factors affecting the decision on the adoption of any IT solution. To calculate the cost of each alternative in our framework, the Total Cost of Ownership (TCO) method is used.

TCO expresses the total cost of implementation and operation of particular workload (e.g. direct costs on hardware and software, operation and maintenance costs, administration costs, users training, costs of inactivity due to system patches, updates, etc.). In the context of cloud computing we are calculating TCO for each cloud service model differently. Calculation of TCO of software as a service was introduced by many cloud vendors, but the most comprehensive approach is described in [8], [9]. An example of TCO for SaaS type of workload is shown in Table 3. For TCO calculation, it is very important to make the calculation with respect to ongoing costs also (if possible at least 5 years) to make more precise analysis.

Table 2. TCO for SaaS type of workload includes the following parts:

	Initial Cost	Ongoing Costs
Capital Expenses		
Hardware		
Software or License costs		
Support and Maintenance		
Upgrades		
Facilities/Datacenter Expenses		
Design and Engineering		
Integration/Implementation		
IT and Helpdesk Staffing		
End User Training		
Scheduled Maintenance		
Unscheduled Maintenance and Outage Recovery		
Monitoring and Security		
Migration cost		
Legal/Purchasing and General Administration		

For each alternative, TCO is calculated. After that, we can simply compare alternatives to determine which alternative is most appropriate from a cost perspective (the lower the total cost, the better). The disadvantage of this method is that other criteria are not taken into

account. Therefore, we are using results of the TCO method within the next step just as one of the criteria used for taking the final decision.

Note that our framework can easily be extended also with the calculation of other important economic indicators such as e.g. Return of Investment (ROI) by including it as one of the criteria in the following step of our methodology.

4. Definition of criteria

In this step, we identify all relevant criteria and their values in order to take the final decision about SaaS (or on-premise) adoption with respect to particular alternatives defined in step 3. We have created a hierarchy of criteria for software as a service type of workload. Let our set of criteria for SaaS workload type has n different criteria. Criteria hierarchy was created based on literature review, mainly [5,6,10,4] and criteria for SaaS type of workload are depicted on Fig.2.

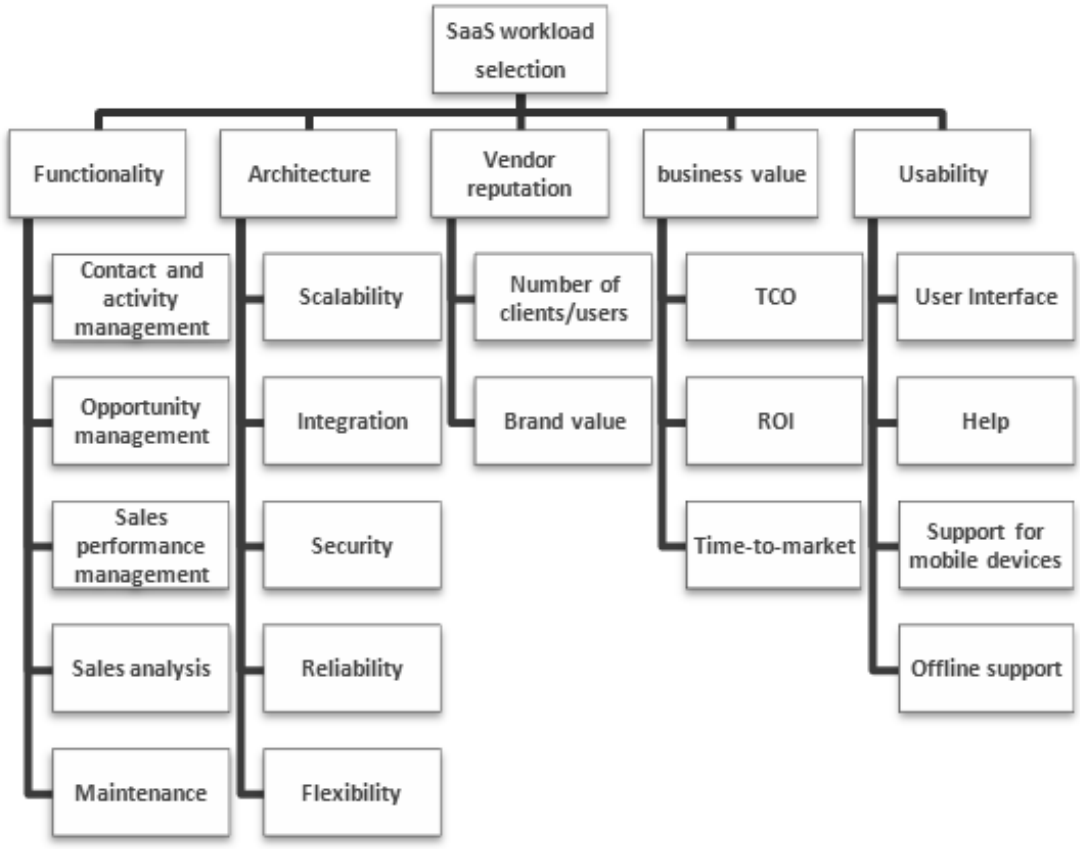

Fig. 2. Criteria hierarchy for SaaS type of workload.

Once we have selected a set C of n criteria c_j ($j=1..n$) for particular workload and particular organization, the value of each criterion needs to be defined for each alternative solution a_i

(in our case *m* alternatives form the set *S* defined above in step 2). A multi-criteria decision problem can be then formally represented as a matrix, where each row corresponds to one alternative and each column to one criterion, i.e. our matrix has size *m* x *n*. Moreover, weight for each criterion is defined, i.e. $W = \{w_1, w_2, ..., w_n\}$.

Delphi method [11] is recommended to gain experts' evaluation of each criterion. Delphi method is a structured communication technique, developed as a systematic and interactive forecasting method which relies on a group of experts. As a rule, it involved a team of experts, who make estimates independently of each other and the facilitator summarizes the materials, which are then distributed to experts for next round etc. Standardized questionnaires are sent by electronic mail. The procedure can be repeated until there is reached an agreement between independent experts.

Then, each alternative a_i is rated by DM according to all criteria c_j from *C*. The rating of alternative a_i with respect to criterion c_j while w_j is the weight of criterion c_j is stated as a real number x_{ij}. Each criterion can be either of benefit type (i.e. the higher value, the better, e.g. ROI) or of the cost type (i.e. the lower value, the better, e.g. TCO). Next, to gain comparable scales, a simple normalization technique is used. For benefit types of criteria, $r_{ij} = x_{ij} / x_{max}$ is used, for cost types of criteria $r_{ij} = x_{min} / x_{ij}$ is applied. After normalization, a multi-criteria method, which is described in next step, is applied in order to get the best alternative decision.

5. Selection of the best alternative

There are several decision rules and algorithms, which can be applied when looking for the best alternative. In our framework, we used Simple additive weighting (SAW) decision rule [11], which is one of the most widely used methods. SAW basically calculated the weighted sum of criteria values for each particular alternative. I.e. the value V_i of each alternative a_i is calculated as follows:

$$V_i = \sum_{j=1}^{n} w_j r_{ij}, i = 1, \ldots, m$$

where V_i is the value function of alternative a_i; w_j is the importance (weight) of j^{th} criterion and r_{ij} is the normalized rating of the i^{th} alternative for the j^{th} criterion. After calculating the value for each alternative the one with the highest value is recommended as the best one.

CONCLUSION AND FUTURE WORK

Software as a service is changing the way that software is being bought and sold today. "Buy and use" is not the only way how to obtain software for organization anymore. Cloud is becoming increasingly interesting for providers who bring new, better and more sophisticated solutions. The problem is, however, which solution is the best for particular organization and if it is worth to adopt the cloud solution in particular workload. Right decision to facilitate cloud adoption is therefore crucial.

We present a comprehensive framework for software as a service adoption in this paper. Proposed methodology, consisting of 5 steps helps decision makers to select the best alternative for their organization. As far as we know, this is the first decision-making framework focused on SaaS, which takes also TCO into account.

In future, we plan to include research of suitability in cooperation with experts. Since not each organization is ready for cloud, we think readiness assessment for cloud is needed as a first step in decision process.

We see high potential of this framework in particular for small and medium enterprises as well as organizations of all types which are using various IT services in their work. It is also planned to implement the framework as web-based decision support system.

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