

# CLOUD-BASED IT MANAGEMENT IMPACTS

## *Qualitative Weaknesses and Strengths of Clouds*

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**Keywords:** Cloud, Business information system, Cost, Resource, Effectiveness, ITIL, COBIT, TOGAF.

**Abstract:** Although cloud computing is in all mouth today it seems that there exist only little evidences in literature that it is more economical effective than classical data center approaches. Due to a performed qualitative analysis on COBIT, TOGAF and ITIL this paper postulates that cloud-based approaches are likely to provide more benefits than disprofits to IT management. Nevertheless one astonishing issue is the not often stressed ex ante cost intransparency of cloud based approaches which is a major implicit problem for IT investment decisions. This paper shows first considerations how to overcome this issue.

## 1 INTRODUCTION

Providing IT-Services is a complex management as well as technological problem. There exist a lot of parameters on different management, design as well as operation levels which have significant influence on the overall effort efficiency.

Cloud computing is one of the latest developments within the business information systems domain and describes a new delivery model for IT services based on the Internet, and it typically involves the provision of dynamically scalable and often virtualized resources.

Most of the the overall effort efficiency is deduced by capacity efficiency in literature which is intensively proclaimed as a key benefit by cloud service providers. The simple fact that only the used capacity of a cloud-based service has to be paid inveigles to postulate the overall effort effectiveness of cloud-based approaches. Almost every analyzed publication was repeating this more or less unreflected, even (Talukader et al., 2010). This paper does not denial this postulation but advocates a more critical view. The overall effort effectiveness of clouds should not be reduced to their capacity efficiency.

Therefore possible qualitative cloud-based impacts to IT-Management are reflected. Section 2 starts with a brief summary and quintessence of a performed literature review. In section 3 the overall relevance of cloud-based approaches is measured against well known industry best practice management frameworks (COBIT, TOGAF and ITIL). And

section 3 will show that cloud-based approaches are likely to provide more benefits than disprofits to IT management. Nevertheless there exist disprofits and issues which have to be solved. One issue is the ex ante cost intransparency of cloud based approaches which is a major problem for IT investment decisions. This paper presents in section 4.1 first considerations of a planned research program to overcome the issue of ex ante cost intransparency of cloud based services in order to make IT investment decisions for cloud based approaches more reliable and trust worthy.

## 2 THE LITERATURE REVIEW

The literature review was performed<sup>1</sup> using the literature databases arxiv.org, citeseer.org as well as springerlink.de and IEEE literature database in order to cover representative open as well as classical science publication channels.

All relevant publications could be grouped into the following fundamental categories.

Publications covering primarily **non functional aspects** of cloud computing. (Onwubiko, 2010) is regarding special security issues coming along with cloud computing and data storing. (Wood et al., 2010) reflects the inherent data recovery capabilities of cloud based approaches.

Publications covering **technology cost aspects**.

<sup>1</sup>Last validating access to literature databases on 16.11.2010.

Costs are interpreted as additional computation, data transfer, scheduling, etc. efforts which are necessary in cloud based approaches. So these publications concentrate mainly on technological improvements of cloud infrastructures. These improvements can be seen<sup>2</sup> in scheduling (de Assuncao et al., 2010), scalability (Bonvin et al., 2010), as well as general performance (measurements) (Yigibatsi et al., 2009)

Publications covering **monetary cost aspects from a customer point of view**. These publications define a controlled cloud-based setting in order to generate representative costs mostly based on resulting fees of the cloud service provider. (Hazelhurst, 2008) did this for a bioinformatic application, (Berriman et al., 2010) analyzed cloud computing in astronomy, (Kossmann and Kraska, 2010) compared cost per web interactions of different cloud service providers. (Walker et al., 2010) present a mathematical decision model for or against cloud based approaches but limited to storage clouds.

Publications covering **monetary cost aspects from a cloud service provider point of view**. (Daoud et al., 2009) present a brief announcement of a game theoretical model to calculate pricing services of large data centers from a cloud service provider viewpoint rather than from a cloud customer perspective. More detailed models are presented by (Li et al., 2009) and (Woitaszek and Tufo, 2010).

### 3 ANALYZING IMPACTS

So no substantial cost estimation models were found in literature (Truong and Dustdar, 2010). Domain specific cost calculation approaches (Hazelhurst, 2008) and (Berriman et al., 2010) as well as a domain neutral effort calculation method like cost effort per web interaction (Kossmann and Kraska, 2010) seem the most promising approaches for providing representative cost estimation data.

Therefore Business Cloud Computing is now analyzed by well known industry best practice standards. (Krcmar, 2010) depicts in its core three Information Management Domains: Overall Management and Governance Functions, Enterprise Wide Information System Design, Information Systems Development and Information Systems Operation (see figure 1). This paper covers all mentioned IT management domains by three industry best practice standards (COBIT, TOGAF, ITIL).

<sup>2</sup>It is likely that there exist more technological issues but reflecting technological aspects was not in the core focus of the literature review.

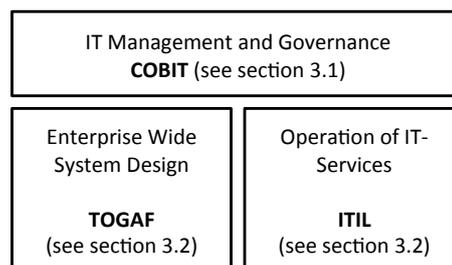


Figure 1: Reflected IT management standards and classification models.

By applying these models qualitative impacts of business cloud computing are deduced. For each of the mentioned models a process tree is used to depict qualitative impacts. An qualitative impact may be positive (effort reducing), negative (effort adding) or neutral (effort invariant). Qualitative impacts are depicted by a color code and are rated in the following way<sup>3</sup>:

- **Positive** (green and marked (+)) if cloud computing may reduce efforts (compared to classical information system approaches).
- **Negative** (red and marked (-)) if cloud computing introduces additional efforts (compared to classical information system approaches).
- **Neutral** (grey) if cloud computing has no effect (compared to classical information system approaches)<sup>4</sup>.

#### 3.1 Impact to COBIT (Governance)

The Control Objectives for Information and related Technology (COBIT) provides a set of measures, indicators, processes and best practices, to assist implementing appropriate IT governance and control in a company. COBIT defines a set of deliver and support, acquire and implement, monitor and evaluate as well as planning processes to operationalize IT-governance in companies (see figure 2).

At this point of research the following **effort reducing effects** are stated.

Within the **deliver and support process** it is likely to reduce efforts for **managing performance and capacity, operations, continuous service as well as managing physical environment** because these tasks are transferred to the cloud vendor

<sup>3</sup>Due to page limitations this paper presents no detailed (but in references existing) reasoning of the postulated qualitative impacts to the analyzed models.

<sup>4</sup>This is mainly due to tasks which are necessary for cloud-based or classical business information systems governance, design, development or operation as well.

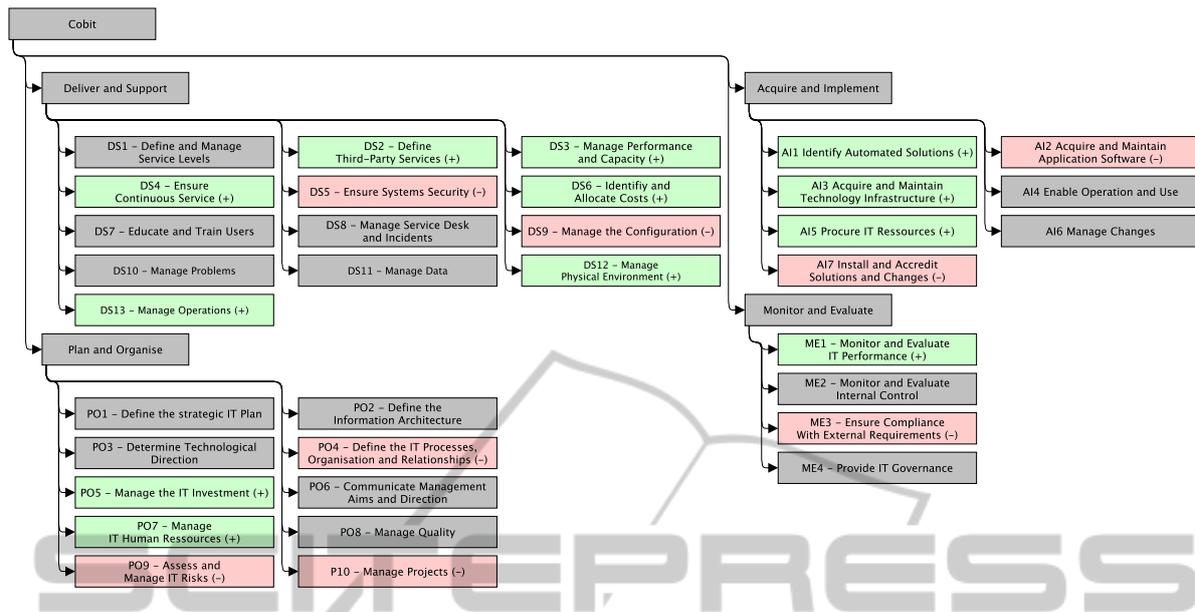


Figure 2: Qualitative Cloud Impact to the Cobit Process Tree.

(Talukader et al., 2010). Furthermore efforts are likely reduced in definition of third party services and identification and allocation cost (done by cloud vendor for billing). Regarding the **acquire and implementation process** it is likely to reduce efforts in **identifying automated solutions, acquire and maintain technology infrastructure and procure IT resources** because these tasks have to be performed by the cloud vendor (Talukader et al., 2010). Regarding the **planning processes** it is likely to reduce efforts in **managing IT investments** (this has to be done by the cloud vendor) as well as **IT Human resources** (tendency to reduce the IT staff). Regarding the **monitor and evaluation processes** it is likely to reduce efforts in **monitoring and evaluating IT performance** (this has to be done by the cloud vendor).

At this point of research possible **additional efforts** to the following COBIT processes are stated.

Within the **deliver and support process** it is likely to create additional efforts due to a lot of **security issues**, (Onwubiko, 2010)) as well as due to a more complex **configuration management** of virtual cloud assets which are not under direct control of the cloud customer. Regarding the **acquire and implementation process** it is likely to create additional efforts due to more complex (PaaS based) **Application development**. Regarding the **planning processes** it is likely to create additional efforts in **assessing IT risks, defining IT processes and relationships as well as managing projects** (due to an additional actor - the cloud vendor). Regarding the **monitor and evalua-**

**tion processes** it is likely to create additional efforts **ensuring compliance** with external requirements (because a cloud provider and its internal processes have to reflected, see (Onwubiko, 2010)).

### 3.2 Impact to TOGAF

The Open Group Architecture Framework (TOGAF) is a framework for enterprise architecture management which provides a comprehensive approach to the design, planning, implementation, and governance of an enterprise information architecture. TOGAF based Enterprise Architectures are typically modeled at four levels: Business, Information Systems (Application and Data) as well as Technology. TOGAF Enterprise Architectures should be developed using the Architecture Development Model Cycle shown in figure 3.

At this point of research this paper states the potential to **reduce the following overall efforts** in TOGAF.

By using cloud-based approaches it is likely to **reduce application design efforts** by using SaaS or PaaS<sup>5</sup> cloud-based services<sup>6</sup> due to the fact that the cloud service providers have to provide precisely defined architecture building blocks which are there chargeable assets. It is furthermore likely to **reduce technology architecture design efforts** due to the

<sup>5</sup>SaaS - Software as a Service, e.g. SAP BUSINESS BY-DESIGN; PaaS - Platform as a Service, e.g. Google Apps.

<sup>6</sup>See (Talukader et al., 2010), (Onwubiko, 2010) or (Truong and Dustdar, 2010) for a definition of SaaS or PaaS.

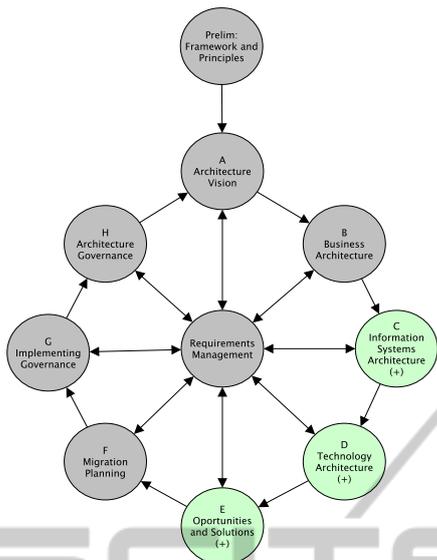


Figure 3: Qualitative Cloud Impact to the TOGAF Process Map.

fact that they are predefined by IaaS<sup>7</sup> cloud service providers. In the most of use cases it is easier to chose a technology architecture than to design one. Both above mentioned facts will likely produce **new opportunities and solutions for business information systems** and their corresponding information architectures.

### 3.3 Impact to ITIL (Operations)

ITIL provides best practice processes to design and operate IT-services for internal or external customers. IT-Services are driven by a general business requirements supporting a service strategy. Figure 4 shows all relevant ITIL processes according to (Böttcher, 2008).

At this point of research this paper states the potential to **reduce efforts** in ITIL.

By using cloud-based approaches it is likely to reduce **service design efforts in capacity, availability as well as continuity management**, e.g (Wood et al., 2010) or (Talukader et al., 2010) mainly due to the inherent capabilities of clouds. It is furthermore likely to reduce **service operation efforts in event, incident as well as problem management** because a lot of efforts have to be handled by the cloud service providers.

At this point of research this paper states **additional efforts** in ITIL.

<sup>7</sup>IaaS - Infrastructure as a Service, e.g. Amazon EC2 (see (Talukader et al., 2010), (Onwubiko, 2010) or (Truong and Dustdar, 2010) for a definition of IaaS)

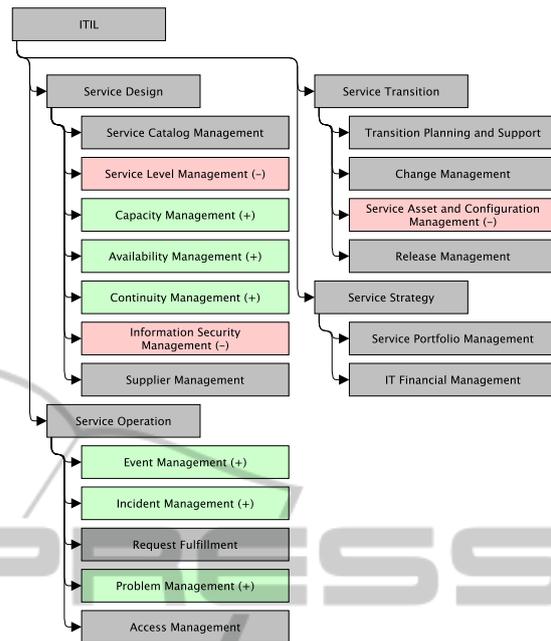


Figure 4: Qualitative Cloud Impact to the ITIL V3 Process Tree.

By using cloud-based approaches it is likely to enhance **service level management** efforts which is due to involving an additional service providing party, see (Talukader et al., 2010). Additional efforts are also likely to perform **information security and compliance management** (Onwubiko, 2010) because aspects like privacy, data ownership, confidentiality, data location, regulatory compliance, forensic evidence, auditing and overall trust issues have to be considered. Furthermore additional efforts are likely to perform a **service asset and configuration management**. A configuration management has to handle and control virtual cloud assets which are not under direct control of the cloud-using service customer.

## 4 QUALITATIVE WEAKNESSES AND STRENGTHS OF CLOUDS

Table 1 shows that the strengths of clouds lay in their inherent structure (scalability, continuousity, availability, etc.) as well as necessary market requirements (provide well defined and therefore billable infrastructure or functional services) reducing efforts on the cloud customer side<sup>8</sup>.

The weaknesses according to table 1 are mainly

<sup>8</sup>Avoiding to provide such services on their own with smaller economical scale effects.

Table 1: Overall weaknesses and strengths of cloud based approaches.

	derived by analyzing	IMM	COBIT	TOGAF	ITIL
Strengths	inherent scalability in capacity and performance		x		x
	inherent continuity and availability	x			x
	ex post cost transparency	x	x		x
	provision of automated infrastructure services	x	x	x	x
	provision of automated functional services		x	x	x
	physical infrastructure free (for customers)	x	x		x
	low level service free (for customers)				x
higher order service enabling	x		x		
Weaknesses	additional cloud SW development skills	x			
	more complex configuration management		x		x
	more complex service and process management	x	x		x
	more complex security management	x	x		x
	more complex compliance management		x		

introduced by the fact that an additional player (the cloud service provider) enters the game - so additional interaction business processes become necessary which results in additional efforts. From this paper point of view these additional service, process and configuration management efforts will be over-compensated by the strengths of the cloud based approaches. Sections 3.1, 3.2, 3.3 showed that more processes have benefits than disprofits.

But let us look closer to security and compliance management aspects. This category of weakness may come along with substantial "showstoppers" for a cloud based approach. Whenever a company has to be compliant to regulatories which can not be full-filled by cloud service level agreements (e.g. privacy requirements, data ownership, confidentiality, data location, forensic evidence, auditing, etc.) cloud-based approaches may be not feasible. But this is not due to economical but higher order considerations.

Nevertheless there exist even an ex ante cost transparency weakness as it is stated for example by (Truong and Dustdar, 2010). This very important weakness is even little reflected in literature so far. To answer the question whether a cloud-based approach is more cost efficient than a classical data center centric approach it has to answered the question how costs are created each month before the application enters operation (Walker et al., 2010). This is very difficult to answer ex ante. Literature review (see section 2) revealed no appropriate cost estimation models for this task<sup>9</sup>.

**This finding is astonishing** because it is often postulated that cloud services are increasing cost transparency (Talukader et al., 2010). This paper

<sup>9</sup>Except (Walker et al., 2010) but limited to storage clouds and self rated as a "first stepping stone", p. 49.

agrees that cloud services will increase ex post cost transparency mainly due to the underlying billing process of cloud service providers. But it seems very hard to estimate cloud costs ex ante. Nevertheless this is needed for IT investment decisions. Without being able to calculate cloud service costs ex ante it is very hard to decide for a cloud-service based or a classical data center centric approach.

### 4.1 A Resulting Research Program

As it was stated in section 4 cloud services provide excellent ex post cost transparency. It was furthermore stated that there exist barley cost estimation models<sup>10</sup> for ex ante cost calculation and transparency. This paper presents an approach to use the strength of ex post cost transparency of cloud services to compensate the weak of ex ante cost estimation.

The core idea is a very simple one. Whenever running a cloud-service based system it is easy to gather the costs ex post. Your cloud service provider will deliver a bill with the used cloud service assets. Whenever you plan another cloud service based system of comparable complexity and usage parameters you can look to your costs of your already running cloud service based system. It is likely that your ex post costs of the existing system will have the same characteristics of your planned system of comparable complexity and usage parameters.

This very simple idea has one evident problem. It will provide only good cost estimations for comparable systems with comparable usage characteristics which is not a very realistic assumption. But what to do when decisions have to be made for non comparable systems? We have to make our model a little bit more complex.

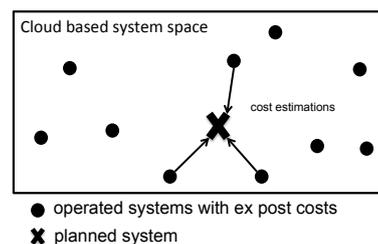


Figure 5: Cloud based system space.

One possibility is to inter- or extrapolate costs from nearest neighbors (see figure 6). Nevertheless we have to describe cost driving parameters in a way that they can be inter- or extrapolated to your planned system and we have to deduce parameters which are ap-

<sup>10</sup>Which are cloud vendor independent.

appropriate to describe the dimensions of a system space (which are most likely much more than two - so figure 6 shows an extreme simplification of the to be encountered problem). A substantial cost calculation model should have the capability to select the most comparable systems out of a given system space in order to inter- or extrapolate the most appropriate cost driving parameters for a cloud based application.

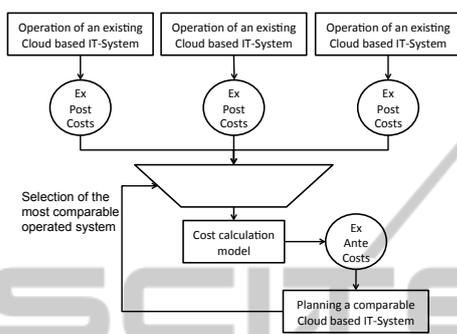


Figure 6: Using most adequate ex post cost data for estimating ex ante estimations

Within our ongoing research we want to develop, validate and optimize categories suitable for finding nearest neighbours necessary to develop cost estimation models. Our long term vision is to populate our in figure 6 presented cloud-based system space with representative cloud-based systems. For these systems ex post cost shall be collected and provided continuously through a public accessible database.

## 4.2 Conclusions and Outlook

For IT management investment decisions an ex ante rather than an ex post cost transparency<sup>11</sup> is needed. But ex ante cost estimation models do not exist so far and have to be established and cross checked. This is the vision for our ongoing research. We presented a model in its early research stages by using the strengths of cloud services (ex post cost transparency) to provide the missing ex ante cost transparency in order to improve IT management decision for or against cloud based realizations. We plan to do this by providing and delivering domain specific and representative applications in order to measure real world efforts and costs and provide them in domain independent indicators like cost per web interaction. The indicators as well as subsequent cost estimation models for cloud based approaches shall cover all relevant cost driving aspects of cloud services from a cloud customer perspective. Indicators and ex ante cost estimation models are planned to be made completely avail-

<sup>11</sup>Which is a often mentioned strength of cloud services.

able to academic as well business public via an open access database.

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