The Impact of Cloud Computing on ITIL Service Design Processes

Mohamed Basel Almourad & Mohammed Hussain

Zayed University

Department of Interdisciplinary Study

Dubai, UAE

basel.almourad@zu.ac.ae; mohammed.husssain@zu.ac.ae

Abstract*:*

Cloud computing is a model where computing resources and services are available when needed, and its customers pay for their use the same way as for household utilities. When an organization adopts cloud computing it quickly becomes apparent that the traditional approach to IT service management frameworks such as Information Technology Infrastructure Library (ITIL) needs to be reviewed. This paper is focusing on the ITIL Service Design process and the impact of cloud computing on its sub processes implementation. Four case studies from organizations who either partially implemented or are planning to implement cloud computing have been consulted to propose enrichment to ITIL when cloud computing is adopted.

Keywords-Cloud Computing; ITIL; IT Service Management; IT Service Design

I. INTRODUCTION

Cloud computing is relatively new model of enabling convenient and on demand network access to a pool of configurable computing resources and services. Cloud services deliver compute, storage, software, applications, etc. via Internet to customers on a self-serve basic. Customers can subscribe to these services based on their requirements. These services are flexible, adaptable, and utility based where customers pay for their subscription as they use it. Despite the growing recognition and importance of cloud computing however, little effort has been made towards incorporating it into established IT Service Management (ITSM) frameworks like Information Technology Infrastructure Library (ITIL). Cloud computing is an entirely new form of infrastructure with its own unique components, process and users. There is a need to accelerate the design and implementation of ITSM processes and capabilities to manage the cloud and consequently help reduce operational expenses and increase efficiency of cloud-based infrastructure [1]. ITIL is part of a suite of best-practice publications for IT service management (ITSM). ITIL provides guidance to service providers on the provision of quality IT services, and on the processes, functions and other capabilities needed to support them. ITIL is used by many hundreds of organizations around the world and offers best-practice guidance to all types of organization that provide services. The best practice processes promoted in ITIL support and are supported by the British Standards Institution's standard for IT service Management (BS15000). The ITIL originated as a collection of books, each covering a specific practice within IT service management. After the initial publication in 1989–96, the number of books quickly grew within ITIL v1 to more than 30 volumes. In 2000/2001, to make ITIL more accessible (and affordable), ITIL v2 consolidated the publications into 8 logical "sets" that grouped related process-guidelines to match different aspects of Information Technology (IT) management, applications, and services.

In July 2011, the 2011 edition of ITIL V3 was published. It provides a more holistic perspective on the full life cycle of services, covering the entire IT organization and all supporting components needed to deliver services to the customer. Furthermore, ITIL V3 enables organizations to deliver appropriate services and continually ensure they are meeting business goals and delivering benefits. The ITIL framework is based on the five stages of the service lifecycle as shown in Fig. 1, with a five core publications providing best-practice guidance for each stage. The service lifecycle uses a hub-and-spoke design, with service strategy at the hub, and service design, transition and operation as the revolving lifecycle stages or 'spokes'. Continual service improvement surrounds and supports all stages of the service lifecycle. Each stage of the lifecycle exerts influence on the others and relies on them for inputs and feedback. In this way, a constant set of checks and balances throughout the service lifecycle ensures that as business demand changes with business need, the services can adapt and respond effectively.

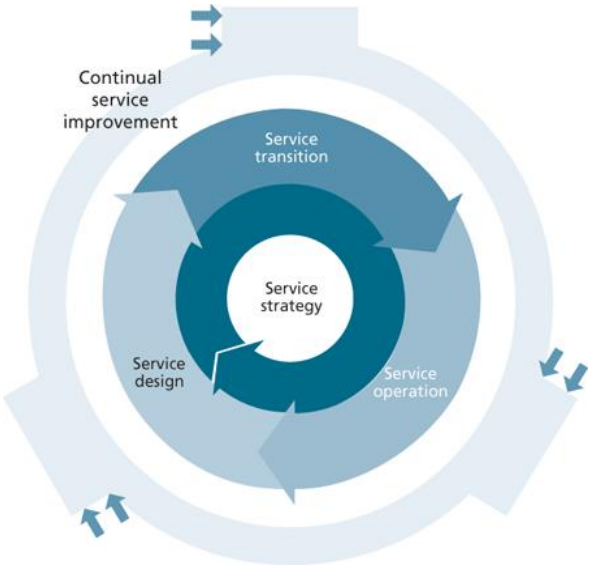

Figure 1 Service Life Cycle

II. MOTIVATION AND THE GOAL OF THIS RESEARCH

As organizations move toward cloud services, many IT leaders find their existing ITIL structures do not support cloud well, resulting in frustration and limiting the value of cloud promises. This will expose the business to unnecessary complexities with no accountability for the end services being delivered and poses serious risks for any IT organization migrating to cloud solutions. The most significant ITIL 2011 edition was published at the end of July 2011. The review of the new five published books reveal limited considerations about ITIL and the new industry trend of cloud computing. The majority of cloud-related content can be found in the ITIL Service Strategy book [2]. The book introduces the characteristics and attributes of cloud services and the various types of service delivery and deployment models.

Generally, empirical research in the IT service management domain is in it's immaturity [3], lacks scientific discussions [4] and has only just emerged [5]. Most of the research in this area is still focusing on ITIL implementation and best practices [6] [7] [8]. Interest in deploying IT service management tools in the cloud is great, and ITIL framework is applicable to manage cloud computing when adopted but there are elements that need to be approached

differently [9] [10]. This research argues that in order for ITIL to support Cloud computing, ITIL phases and associated processes must be carefully revamped and extend its capability so it can incorporate the cloud computing in the process of IT service management. For example, the cloud computing charging model is based on consumption (pay as you go). The financial management processes should be enhanced to consider this new model.

Four different organizations that have either partially implemented or about to implement cloud computing have been consulted to get their views about the impact of the Cloud computing on the implementation of ITIL processes. Successful adoption to cloud computing starts with careful strategy processes planning followed by the design, transition and operation. Early phase of this research had focused on the impact of cloud computing on ITIL service strategy processes [17]. Because the scope of this research is too big, this paper only focuses on the impact of cloud computing in the ITIL service design processes and what factors that must be considered when implementing ITIL service process. Section 3 explains the cloud computing, it's service layers, and deployment model. Section 4 defines ITIL service design and it's main processes. Section 5 represents the research methodology. Section 6 discusses the findings of this research. Section 7, provides the conclusion of this research.

III. WHAT IS CLOUD COMPUTING?

Cloud computing is the delivery of on-demand computing resources everything from applications to data centers over the Internet on a pay-for-use basis [11]. Cloud computing represents a major shift in IT architecture, altering the way IT services are sourced and delivered. Software and information are provided to computers and other devices on-demand, like a public utility. Consumption is billed on a utility or subscription basis with little or no upfront cost, creating a low barrier to entry. This new approach reduces upfront capital expenditures but there may be extra cost for operating expenses.

A. Cloud Computing Service Layers

Cloud computing providers provide different kinds of services to cloud computing consumers. The cloud computing service model has three different service layers or categories also known as the cloud stack [12]. The cloud computing service layers are briefly explained in the following:

- Software as a Service (SaaS): is cloud computing layer where users simply make use of a web-browser to access software that others have developed, maintain and offer as a service over the web. At the SaaS level, users do not have control or access to the underlying platform and infrastructure that is being used to host the software. Google gmail are popular examples that use the SaaS model of cloud computing [13].
- Platform as a Service (PaaS) providers offer computing middleware. The consumers develop their applications and software using a set of programming languages and tools that are supported and provided by the PaaS provider. PaaS provides developers with a high level of abstraction that allows them to focus on developing their applications. Developers can provide their customers with an custom developed application without the hassle of defining and maintaining the infrastructure. Just like the SaaS model, users do not have control or access to the underlying infrastructure being used to host their applications at the PaaS level. Google App Engine and Microsoft Azure are popular PaaS examples [14].

- Infrastructure as a Service (IaaS) providers allow their customers access to different kinds of infrastructure (e.g. CPU power, memory and storage) and use the resources to deploy and run their applications through the use of virtual machines which automatically can scale up and down. IaaS gives users flexibility to deploy any software stack on top of the operating system. However, flexibility comes with a cost and users are responsible for updating and patching the operating system at the IaaS level. Amazon Web Services' EC2 and S3 are popular IaaS examples [15] Cloud computing models.

B. Cloud Computing Implementation Models

Cloud computing has a number of different implementation models. An implementation model is a specific method of providing a service. In the case of cloud computing these are unique methods of implementing a cloud computing service. Implementation models often have particular characteristics that suit them to appropriate workloads. The most commonly used three-cloud implementation models are:

- Private cloud: Created and run internally by an organization or purchased and stored within the organization and run by a third party
- Hybrid cloud: Outsources some but not all elements either internally or externally
- Public cloud: No physical infrastructure locally, all access to data and applications is external

The concerns for revamping ITIL service processes mainly exist when the public or private cloud is hosted with third party. When services of private cloud are hosted internally there will be no substantial alteration in the way of using ITIL framework.

IV. ITIL SERVICE DESIGN PROCESSES

ITIL Service Design provides guidance for the design and development of services and service management practices [18]. It covers design principles and methods for converting strategic objectives into portfolios of services and service assets. The scope of ITIL Service Design is not limited to new services. It includes the changes and improvements necessary to increase or maintain value to customers over the lifecycle of services, the continuity of services, achievement of service levels, and conformance to standards and regulations. It guides organizations on how to develop design capabilities for service management. Service Design is a serious business; it defines eight processes, more than any other stage. Key design processes rely on their additional definition from the Strategy stage. The following processes achieve ITIL Service Design:

1) *Design Coordination*
2) *Service Catalogue Management*
3) *Service Level Management (SLM)*
4) *Availability Management*
5) *Capacity Management*
6) *IT Service Continuity Management*
7) *Information Security Management (ISM)*

8) Supplier Management

The cloud computing will not change ITIL service strategy objectives, the above ITIL service strategy processes should be revamped so it can adopt the new era of the cloud computing.

V. RESEARCH METHODOLOGY

A qualitative research using case studies is used to identify the impact of Cloud computing on the ITIL service design processes. We adopted qualitative method, as this research is exploratory in nature. The case study method provides the opportunity to ask penetrating questions and to capture the participant rich experiences and thoughts. A total of four case studies reflecting four different organizations are carefully selected and case semi-structured interviews with ITIL personnel were conducted. The selected organizations from United Arab Emirates (UAE) have either partly adopted cloud computing or thinking to adopt it. Due to commercial sensitivity of the information and comments, the actual names of the organizations can't be disclosed. The four cases are referred to throughout the case discussion as case A-D. Table 1. introduces each organization in terms of size, nature, ITIL version, cloud computing adoption, stage of cloud computing implementation and reason of cloud computing implementation. ITIL experts in these organizations were interviewed and questioned.

TABLE I. ORGANIZATION CASE STUDIES

Organizations	Case A	Case B	Case C	Case D
No of Staff	700+	1000	2500	500
No of IT staff	600+	45	100	20
Government (G)/Semi-government (S)	S	G	G	G
ITIL Version	V3	V3	V3	V2
Cloud Computing adoption (Largely (L), Partially (P), Planning (PL), None (N))	P	P	PL	PL
Stage of Cloud Implementation (if adopted)	Done	Partially Done	-	-
Reason for Cloud adoption (if any) Internal/External/Both/Other	Internal	Both	Both	Both

Based on the main service design processes objectives and literature review, we formulated some questions, which are open in nature. The questionnaire contains three main parts: Part A, contains questions about the organization (i.e. size, nature, number of IT staff, etc.). Part B, contains questions about the impact of the cloud computing on ITIL service design process. Part C, gathers feedback about the consideration of the service design processes when adopting cloud computing. The questions are used as a guide through the interviews. However, we did not rely on these questions only, other emerged questions and ideas during the interview were also considered.

VI. DISCUSSION AND FINDING

The interview's questionnaire outcome of the four case studies were analyzed to identify patterns and summarize

the main characteristics of approach and to select quotations that are supportive of the patterns and themes identified across all cases [16]. The cross case analysis of the four organizations has generated important cloud computing impacts that must be considered when implementing ITIL service design processes. The impacts of every process are detailed and illustrated with quotations from the ITIL personnel who has been interviewed and questioned.

A. Design Coordination

Design Coordination has been added as a new process, in ITIL 2011 guidance. The process is responsible for coordinating the design activities carried out by other Service Design processes thus the impact of this process is aligned with the impacts of the whole service design phase.

B. Service Catalogue Management:

An IT service catalog, sometimes called an IT service portfolio, is a list of available technology resources and offerings within an organization. The catalog contains information about operational services and those being prepared to be run operationally. The aim of service catalog management is to ensure the accuracy and availability of the items provided within the service catalogs. When an organization is considering to host a service on cloud computing the main key question to ask: "How will services be bundled and packaged for consumption?" (Cases A, C). If a cloud service is to be included in the service catalogue it must be ensured that the service is defined with appropriate interconnects with the service portfolio. Updating the service catalogue is essential task as it will assure the service provider that the charge of cloud based service have been appropriately and accurately determined and are published and announced to the customers.

C. Service Level Management

Service Level Management (SLM) negotiate, agrees and documents appropriate IT targets with representatives of the business, and then monitors and produces reports on the service provider's ability to deliver the agreed level of service. SLM documents the service level targets and the responsibilities in the Service Level Agreements (SLA). When designing new or changing a service in a cloud computing the SLM needs to reflect that. The main concern of SLM when adopting cloud computing is to determine the SLAs and the Operational Level Management (OLAs) that are needed to meet the business objectives (Cases A, B, C, D). Top issues that must be reviewed and include in the SLA are [19]:

- Support for outages: what will happens in a cloud outage?. What are the liability issues associated with lost business and revenues?
- Assurance of data
- Incident response procedures
- Auditability of security
- Financial compensation for lost business
- Certification of Trust

While traditional SLM requires the service provider to ensure that the service levels have been defined and agreed with the customer, it is the (OLAs) that are also crucial here (Cases A, D). Appropriate OLAs with the cloud provider will ensure that the organization is able to deliver on the SLAs that have been agreed upon with the end customers.

D. Availability Management

The objective of availability management is to ensure that all the IT services are available and are functioning correctly whenever customers and users want to make use of them in the framework of the SLAs in force. The responsibilities of Availability Management include:

- Determining availability requirements in close collaboration with customers.
- Guaranteeing the level of availability established for the IT services.
- Monitoring the availability of the IT services.
- Proposing improvements in the IT infrastructure and services with a view to increasing levels of availability.

The availability management is very important process in the migration to the cloud computing. The fundamental question is "how we will ensure the availability of services in the event of a major business disruption" (Cases A, B, D). After a service is migrated to the cloud it is very difficult for customer to obtain the same information that it has in-house from cloud service provider to maintain same level in the availability management. The IT service manager can overcome this challenge by ensuring that the SLAs signed with the cloud provider are definite and effective (Case B). For example, in an IaaS cloud computing category it is vital to have a guaranteed amount of memory in the probably virtual environment. On other hand, in an SaaS cloud computing category, it is vital to agree the response time of a certain service in the SLA.

E. Capacity Management

The capacity management is responsible for ensuring the capacity of IT services matches the evolving demands of the business in the most cost-effective and timely manner. As the usage of IT services change and functionality evolves, the amount of processing power, memory etc. also changes. Understanding the demands being made currently, and how they will change over time, makes the planning for IT service growth becomes easier and less reactive. The fundamental assumption in the cloud computing is that all resources are shared so we can't assume that computing capacity is dedicated to a group of users or group of processes. The main question here: "what capacity need to be in place and may be reserved to meet the business demand" (Cases B, C, D). The capacity planning in cloud computing is very complex process and need modeling approaches and technologies to accommodate such planning complexity (Case B). Until such models and technologies are available resolute a firm OLA must be in place to assure the capacity of business demand (Case D).

F. IT Service Continuity Management

IT Service Continuity Management is concerned with managing an organization's ability to continue to provide a pre-determined and agreed level of IT services to support the minimum business requirements following an interruption to the business. Effective IT Service Continuity requires a balance of risk reduction measures such as resilient systems and recovery options including back-up facilities. Cloud computing brings additional set of risks when it comes to planning for IT service continuity. The major question is "how the cloud based services will be restored in the event of major business disruption" (Cases A, C, D). Cloud computing architecture (hot, warm or cold) provides the distributed structures necessary to respond regional disasters, but companies also need the cloud management capabilities necessary to fail over their operations to multiple infrastructures in a way that keeps things up and running (Cases A, D).

The IT service manager should take into consideration the accidental of a disaster happening not only at their business site but also the cloud service provider's site (Cases C, D). The IT Service Continuity Management process and policy offered by the cloud service provider has to be evaluated and analyzed to understand its relevance to organizational service continuity and business continuity policy. If need be then the offered service continuity process, policy and plan should be negotiated upon to address the organizations needs and concerns (Cases A, C, D).

G. Information Security Management

IT security management is the process of planning and managing a defined level of security for information and IT services, including all aspects associated with reaction to security incidents. It also includes the assessment and management of risks and vulnerabilities, and ensuring information assets confidentiality, integrity and availability. Information security is a priority concern for all the customers of cloud computing. The key questions to be answered are: "What is the cloud provider's framework on information security" (Cases A, B, C). "How to secure the services and data across the cloud?" (Cases A, B, C, D). "Is the cloud computing provider able to protect confidentiality, integrity and availability of the information it contains?" (Cases A, B, C, D). "Is the cloud computing provider able to provide encryption and authentication services. Can the cloud computing supplier provide an audit trail for data access?" (Cases A, B).

H. Supplier Management

Supplier Management ensures that external services and configuration items, which are necessary for the service delivery, are available as requested and as agreed at the service level. Supplier Management is responsible for fusing requirements for external services and supplies, scanning the market for providers, negotiating with a chosen supplier, and for the contracting and monitoring of external services and service providers. Management of supplier relationships and supplier performance are additional tasks. Supplier Management is also responsible for establishing and updating the basic supplier framework, which is a Supplier Strategy and Supplier Policies. The main activities of Supplier Management are:

- Identify Business Requirements
- Evaluate and select new suppliers

- Categorizing suppliers and contracts
- Introduce new suppliers and contracts
- Manage performance of suppliers and contracts
- Renew or end a contract

The main activities of the Supplier Management become critical actions for a Cloud service provider. IT service managers should ensure that they select the appropriate cloud providers who understand the importance of their business (Case B, C, D). So the selection is not only in terms of the real cost savings from their supplier but also in terms of having an excellent relationship so that they can fall back on their supplier as and when needed. Cloud computing requires a renewed effort in supplier management processes and contracting rigor to ensure meeting terms, conditions, and target of agreements (Cases B, D).

VII. CONCLUSION

Adopting cloud computing is a serious business decision. IT service management frameworks such as ITIL is essential and plays a critical role to manage the cloud computing. Although ITIL has been around for almost 20 years it must be reframed and consider the context of the cloud computing. The cloud computing will not change ITIL service design objectives, the ITIL service design processes should be revamped on the light of the above discussion. Performing careful service design will reduce the possibility of exposing the business to unnecessary complexities with no accountability for the end services being delivered and poses serious risks for any IT organization migrating to cloud solutions.

REFERENCES

[1] R. Sreekumar., and P. Prabhakara. "ITIL for Enterprise Cloud Deployment." Infos Labs Briefings 9, no. 5 (2011).

[2] D. Cannon. ITIL Service Strategy. The Stationery Office., 2011.

[3] S. Conger, M. Winniford, and L. Erickson-Harris. "Service Management in Operations." American Conference on Information Systems (AMCIS). 2008.

[4] A. Hochstein, G. Tamm, and W. Brenner. "Service Oriented IT Management: Benefit, Cost and Success Factors." The European Conference on Information Systems (ECIS). 2005.

[5] J., Iden, and L. Langeland. "Setting the Stage for a Successful ITIL Adoption: A Delphi Study of IT Experts in the Norwegian Armed Forces." Information Systems Management 27, no. 2 (2010): 103-112.

[6] C. Pollard, and A. Cater-Steel, A. "Justifications, Strategies, and Critical Success Factors in Successful ITIL Implementations in US and Australian Companies: An Exploratory Study." Information Systems Management 26 (2009): 164-175.

[7] M. B. Al Mourad, and R Johari. "Resolution of Challenges That Are Facing Organizations before ITIL Implementation." Edited by Prof. Mohamed Othman. International Journal of Future Computer and Communication (IACSIT Press) 3, no. 3 (2014): 210-215.

[8] M. Nicho, and M. B. Almourad. "Success Factors for Integrated ITIL Deployment: An IT Governance Classification." Journal of Information Technology Case and Application Research 14, no. 1 (2012): 25.

[9] M. Jansen. "Will Cloud Computing Change Standards in ITService Management?" INTERNATIONAL JOURNAL OF COMPUTERS AND COMMUNICATIONS 1, no. 6 (2012).

[10] IBM Global Technology. Integrated service management and cloud computing: More than just technology best friends. White Paper, IBM Global Technology Services, 2010.

[11] Mell, P., and T. Grance. "The NIST Definition of Cloud Computing (800-145)." National Institute of Standards and Technology (NIST) National Institute of Standards and Technology (NIST), 2011.

[12] Schuller, S. *Cloud stack* . 2010. http://www.saasblogs.com/images/uploads/2008/12/cloud_stack.gif.

[13] Armbrust, M., Fox, A., Griffith, R., Joseph, A., Katz, R., Konwinski, A., et al. "Above the clouds: A berkeley view of cloud computing." EECS Department,, University of California, Berkeley, 2009.

[14] Boniface, M., B. Nasser, J. Papay,, S. Phillips, S., and et al. "Platform-as-a-Service Architecture for Real-time Quality of Service Management in Cloud." *Fifth International Conference on Internet and Web Applications and Services (ICIW).* Barcelona. 2010.

[15] Murphy, M., Abraham, L., Fenn, M., & Goasguen, S. "Autonomic Clouds on the Grid." *Journal of Grid Computing*, 2009: 1-18.

[16] Creswell, J. W. Qualitative inquiry and research design: Choosing among five designs. CA: Sage., 1998.

[17] M. B. Al Mourad**,** and M. Hussain. The Impact of Cloud Computing on ITIL Service Strategy Processes**.** International Journal of Computer and Communication Engineering, Vol. 3, No. 5, September 2014

[18] L. Hunnebeck. ITIL Service Design. The Stationery Office., 2011.

[19] L. Smith .Enterprise adoption of the public cloud hinges on liability policies. http://itknowledgeexchange.techtarget.com/total-cio/enterprise-adoption-of-the-public-cloud-hinges-on-liability-policies/ (accessed August 2010).