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Business Information Management and the Cloud

by Ashiful Alam

Centre 4 Cloud

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Management Summary

Alignment between the business and Information Technology (IT) has been a key concern for both business and IT managers for several decades. *Information provisioning* functions properly when business and IT are aligned. Successful information management (IM) ensures proper functioning of *information provisioning*. From IM perspective *Information provisioning* incorporates all the information processing processes of an organization along with the means to carry out information provisioning i.e. IT function. In recent past, higher degree of professionalization in IT has been observed such as introduction of ASL, ITIL. However, this professionalization was not observed in the business side. This created unbalanced in business-IT alignment. To reduce the gap between business and IT, managing, controlling and modifying *information provisioning* from business perspective became necessary. Thus professionalization of IM from business perspective, namely business information management (BIM) also became necessary. Realization of this necessity came into action by the introduction of BiSL (Business information Services Library). BiSL provides practical solutions for BIM by enabling business to convey its demands properly to IT. While BiSL was being introduced, cloud computing started getting popularity. Since cloud computing offers IT capabilities but requires minimal management effort or service provider interaction, it tends to leverage control to the business. Rather than depending on the BIM function to convey demands to IT, with cloud computing business can decide for a cloud service and cloud service provider by their own. Some people fear that BiSL may not function properly for cloud computing. Therefore, it becomes necessity to investigate the required changes in BiSL framework when considering cloud computing.

Centre4Cloud together with ASL BiSL Foundation initiated this research to investigate the required changes on the BiSL framework so that it can function smoothly with cloud computing. Centre4Cloud is an initiative of Knowledge Park Twente, Twente University and Caase.com. It is a national knowledge centre focused on open innovation and the development of knowledge about Cloud Computing. ASL BiSL foundation (formerly ASL foundation) is the organization that has been managing the development of the ASL and BiSL frameworks and developing those further. It publishes white papers on ASL and BiSL related subjects, as well as on current topics within the subject area of information supply such as outsourcing, compliance & governance, metrics. The foundation gathers, selects, edits and publishes ASL and BiSL practices and monitors their usage.

This thesis investigates the required changes in the processes of the BiSL framework to accommodate cloud computing. Our approach starts by identifying existing cloud governance models. This ensures

defining the scope of cloud computing for BIM. We, then, identified cloud computing aspects from the governance models which need to be accommodated by BiSL. After that, we mapped the cloud computing aspects to the BiSL processes, after which we analyzed whether the cloud computing aspects were properly accommodated by the corresponding processes. According to the result of this analysis, we proposed adjustments to the processes. For the validation of the work, we have applied a modified version of the Delphi method in which we took the opinion of experts on our work in two rounds, namely face-to-face interview and questionnaire survey. Finally based on the validation, we came to the conclusion that BiSL is capable of dealing with cloud computing but proper guidelines are missing. Based on our conclusion, we have proposed future work to provide guidelines to BiSL users showing its applicability to cloud computing.

Preface

2010 is one of the most noteworthy years of life. In that year I came to the Netherlands leaving behind all of my friends and family. Since then I have had a lot of ups and downs in my life. Finishing my master studies became one of the biggest challenges of my life. This master thesis work was the biggest part of that challenge. But eventually I have overcome all of those obstacles and today I have successfully finished my master studies.

This document contains my master thesis work. It may show my effort for the work but what it cannot express is the support of the people behind this work, without which completing this work would not have been possible. At first I would like to mention about my academic supervisors Dr. Maria Iacob and Dr. Luis Ferreira Pires. I show my sincere gratitude for their enormous support and guidance during the entire project. I would like to thank my external supervisor Dr. Lex Scholten for sparing his time amongst his busy schedule to guide me in this project. I would also like to show my gratitude to Dr. Maya Daneva who was always supportive during my entire study period here in the UT.

At the end of my work I would like to mention about all the members of the Bangladeshi community in this university – Dhrubo Bhai, Reza Bhai, Siraj Bhai, Rezwan Bhai, Kallol Bhai, Mahua Bhabi, Mahdin, Morshed, Rubaiya Bhabi, Anupoma Apa, Shawrav Bhai, Antora and Tumpa. Thanks to all of them for being my family here in the Netherlands.

Finally I would like to thank all of my friends and family back home, whose support has always been a driving force for my life. One name I must mention is my best friend Md. Abu Musa who has always been by my side. Last but not the least I would like to thank my friend Iliana for encouraging me in every step of my work here in the university.

Ashiful Alam

Enschede, July 13, 2012

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Chapter 1

Introduction

This chapter presents the motivation behind our research, our research objectives, research questions and the research approach we applied to answer the research questions. The outline of this research report is also provided at the end of this chapter.

1.1 Motivation

Alignment between Business and Information Technology (IT) has been a key concern for both business and IT managers for several decades (Motjolopane & Brown, 2004). Since late 1970's the importance of this alignment has been well known and well documented (Luftman, 2000). Successful alignment of IT with business strategies and processes is viewed as a key success factor for organization (van der Pols, Donatz, & van Outvorst, 2007). However, in most companies business and IT are not aligned, despite the large number of publications stressing the necessity and desirability of this alignment (Silvius, 2007). Information provisioning functions properly when business and IT are aligned. Successful information management (IM) ensures proper functioning of information provisioning. From the IM perspective information provisioning incorporates all the information processing processes including the means to carry out information provisioning in an organization (van der Pols, Donatz, & van Outvorst, 2007).

A limited view of IM from the business perspective is Business Information Management (BIM). BIM monitors the business approach to information provisioning, i.e., it addresses the demand perspective of information provisioning (van Outvorst, & et al. 2005; van der Pols, & Backer, 2007; van der Pols, & et al. 2007). BIM ensures that demand for information provision matches the business strategies and processes. Choices made by the business (demand side) are translated via BIM to the management on the supply side, i.e., the actual IT service provider or IT function or simply IT.

In the recent past, a higher degree of professionalization of IT services has been observed such as ASL (Application Services Library) framework for *application management*, ITIL (IT infrastructure Library) framework for *technical infrastructure management* (van Outvorst, Donatz, van der Pols, & Meijer, 2005). However this professionalization was not observed in the business side. This caused unbalanced in business-IT alignment. To reduce the gap between business and IT, managing, controlling and modifying information provisioning from business perspective became necessary. Thus professionalization of IM from business perspective, namely business information management (BIM) also became necessary. Realization of this necessity came into action by the introduction of BiSL

(Business information Services Library) in 2005 (van Outvorst, Donatz, van der Pols, Meijer, 2005). The framework is a practical approach for BIM, which aids business to translate its demand to IT. BiSL is a process-based approach for BIM. Processes for BIM are defined in the BiSL framework in terms of goals, outputs and activities. The framework is supported through the use of industry-based best practices. Soon after the introduction of BiSL as a public domain standard in 2007, cloud computing started to grow in popularity (Vouk 2008). In general, cloud computing is defined as a model that facilitates the use of computer networks to make shared configurable computer resources (such as networks, servers, storage, applications and services) available on demand, fastly and easily (Mell & Grance 2011). Since cloud computing requires minimal management effort or service provider interaction, it tends to leverage control to the business organization. Rather than depending entirely on an intermediary function - BIM - to translate business' demands to IT, in the cloud computing era now business can decide what types of cloud services it is going to use and can decide which cloud service provider (external IT service provider) to use.

Cloud computing has its benefits and risks. If business starts deciding on rendering a cloud service by their own, there is a fear that potential risks related to a cloud service may remain unrevealed. Without proper judging all the risks, if a cloud service is rendered then it may endure disaster or loss for the business. For traditional IT service, business places a demand for a service via BIM. BIM analyze all the cost and benefits and considers all the risks and risk response strategies and decides on the demand. Finally it is conveyed to IT. However, with cloud computing a service can be tested before business adopts it. This makes the cost and benefits analysis easier. On the other hand, sometimes it is difficult to calculate all the risk related to a cloud service. Such a risk may be related to the probability of discontinuity of the business of a cloud service provider (CSP) or may be security risk related to the data center of the CSP. So before rendering a cloud service, a careful consideration of all the potential risks is very important. Thus if business avoids BIM function and takes its own decision on a cloud service, there is a chance that potential risks may be overlooked. For illustrating the danger of such case, we provide example of a case with a governmental organization in the Netherlands. The employees of that organization needed to communicate with civilians outside of the organization and the business decided to use the Blackberry messaging services for that purpose. After the project was implemented the organization found that the messages were stored in a Blackberry's data centre in Canada. However, storing public information outside Europe is a serious violation of European privacy legislation. So the entire project was abandoned, causing embarrassment and loss. Apparently this happened because the organization avoided the BIM function to decide on the service. No doubt avoiding BIM functions caused

the organization to overlook the risks related to the Blackberry service. Although BiSL framework for BIM was in practice in this organization, this true story exposes the shortcoming of the framework with cloud computing.

Thus it is necessary to investigate the influence of cloud computing on BIM and changes required to accommodate cloud computing. Therefore it is also important to investigate how the practical approach for BIM i.e. BiSL is affected by cloud computing and define adjustments for it so that it can continue functioning properly with cloud computing. The development of the BiSL framework is maintained by ASL BiSL foundation (ASL BiSL Foundation, n.d.). This foundation gathers, selects, edits and publishes best practices of BiSL and monitors their usage. It is the interest of the foundation to investigate the required changes in BIM function due to the influence of cloud computing. Furthermore, this investigation is expected to be helpful for the current and future users of BiSL.

1.2 Research objectives

The aim of this research is twofold. The research aims to identify the influence of cloud computing on BIM, and aims to propose modifications to the practical approach for BIM (BiSL) so that this approach continue functioning smoothly in the presence of cloud computing.

1.3 Research Question

Based on the objective stated in previous section our main research question of this research is formulated as follows:

"How can the practices of business information management be adjusted in response to the influence of cloud computing?"

The following sub questions were defined to answer the main research question. Answering the sub questions would help us to answer the main research question.

RQ1. What is Business Information Management?

- What is the definition?
- What is the BIM domain?
- What are the BIM functions?

RQ2. How is BIM addressed in practice?

- What are the practical approaches available for BIM?
    - What are the processes defined by the approaches?

RQ3. What is cloud computing?

- What is the definition of cloud computing?
- What are the service models of cloud computing?
- What are the deployment models of cloud computing?
- What are the available cloud governance models?

RQ4. How suitable is the usage of BIM practical approach to deal with cloud computing?

- What are the main issues addressed in Cloud Governance models?
- Are these issues accommodated by the BIM processes?
    - Which BIM processes ask for changes?

RQ5. How can BIM processes be adjusted to compensate the influence of cloud computing?

- What adjustments the BIM processes require?
- How the adjusted processes can be applied in cloud computing?

RQ6. How suitable are the proposed adjustments to compensate the influence of cloud computing?

- Is the approach to find the required adjustments suitable?
- Can the proposed adjustments compensate the influences?
    - Do they require more adjustments?
    - Are any of the adjustments unnecessary?

1.4 Research Approach

The research approach depicted in Figure 1.1 is based on Wieringa's Engineering Cycle (Wieringa 2009; Wieringa & Moralh, 2012). This project has been structured based on the three phases of Wieringa's Engineering cycle, namely Problem analysis, Solution design and Solution validation. In the Problem analysis phase research questions, 1 to 4 are addressed. During this phase, literature review on cloud computing, BIM and practical approach of BIM has been performed. In the Solution design phase, research question 5 has been addressed based on the findings of the previous phases. Literature review has been performed in this phase to identify the required adjustments to the BIM processes. Finally in

the Solution validation phase, our proposed adjustments have been validated by interviewing and surveying experts operating in the area of BIM. This phase addresses research question 6.

RQ1. What is Business Information Management?

RQ2. How is BIM addressed in practice?

RQ3. What is Cloud Computing?

RQ4. How suitable is the usage of BIM practical approach to deal with cloud computing?

RQ5. How can BIM processes be adjusted to compensate the influence of cloud computing?

RQ6. How suitable are the proposed adjustments to compensate the influence of cloud computing?

PROBLEM ANALYSIS

SOLUTION DESIGN

SOLUTOIN VALIDATION

LITERATURE REVIEW

LITERATURE REVIEW

INTERVIEW and SURVEY

Figure 1.1 Research approach

Our research approach is also depicted as a process in Figure 1.2. The process starts with the design of the research scope. The next three parallel activities are literature review on cloud computing, BIM and practical approach to BIM. After that we evaluated the suitability of the BIM practical approach for cloud computing and proposed adjustments to BIM processes. The final activity is to interview and survey the experts in the area of BIM. The aim of this activity is to validate the adjustments and our approach to adjust the BIM processes.
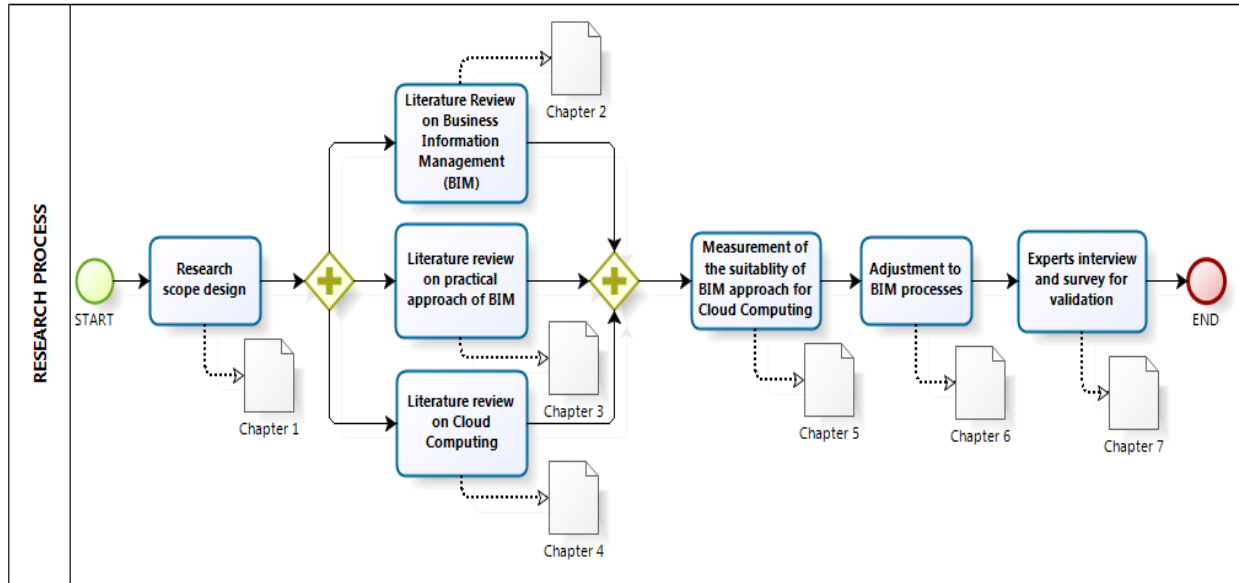
Figure 1.2 Research process

1.5 Report Structure

This document is further structured as follows:

- Chapter 2 defines Business Information Management and also introduces the BIM domain and its processes.
- Chapter 3 discusses the practical approach to BIM.
- Chapter 4 provides background information on cloud computing.
- Chapter 5 measures the suitability of the BIM practice to deal with the cloud computing.
- Chapter 6 proposes adjustments to the processes of BIM practice to compensate the influence of cloud computing.
- Chapter 7 validates the soundness of the adjustments and the approach of work.
- Chapter 8 concludes the research by answering our main research question and proposing topics for future research.

Chapter 2

Business Information Management

This chapter defines Business Information Management and discusses the BIM domain and its functions. This chapter answers the research question:

RQ1: *What is Business Information Management?*

Before discussing BIM, Section 2.1 discusses Information Management (IM). After that, Section 2.2 discusses Business Information Management (BIM). Its domain and functions are discussed in Section 2.3 and 2.4 respectively.

2.1 Information Management

In chapter one, we mentioned BIM as the business perspective of IM. So before discussing what BIM is, we will illustrate on IM. According to Rowley's (1998) view - "Information management includes organization wide information policy planning, the development and maintenance of integrated systems and services, the optimization of information flows and the harnessing of leading edge technologies to the functional requirements of end-users, whatever their status or role in the parent organization". From this view, we can see that the domain of IM includes both the demand side which represents the owner or primary user of the information (business side), and supply side which represents IT service provider. This IT service provider can either be an internal department or be an external organization, which fulfills the need for information provisioning. We simply refer them as IT in this document. Another view of Rowley (1988) refers IM as "to promote organizational effectiveness by enhancing the capabilities of the organization to cope with the demands of its internal and external environments in dynamic as well as stable conditions". Based on this view, Rowley (1998) argues that IM includes both technical and behavioral dimensions, translated into "management of information process" and "management of data resource" respectively. The behavioral and technical dimensions can be illustrated with the role of information managers (Rowley, 1998). The Information managers' central role is to – (i) manage and coordinate the mechanisms to keep business aware of market developments in the IM field and (ii) design, implement, monitor and update information systems (IS) and exploit information to support decision making. The role of information manager, thus, shows responsibilities from the demand (user organization or business) perspective and from the supply (IT service provider or simply IT) perspective. These two perspectives can be found in Fairer-Wessels' view (1997) of IM. Fairer-Wessels views IM as "the planning, organizing, directing and controlling of information within an open

system [i.e. user organization or business]" and "using technology [e.g. computers, information systems, IT] and techniques [e.g. information auditing/mapping] effectively and efficiently to manage information resources and assets … ". We argue that the first view corresponds to the business perspective that intends to recognize, manage and control the demand of the user organization, while the second view corresponds to the IT service provider's perspective that intends to incorporate technical means to supply the demands of the business. Thus from the above views, we conclude that IM is a broad concept as both business and IT perspectives are incorporated in it.

2.2 Business Information Management

According to Chaffey and Wood (2004) BIM is "the process of managing information as a strategic resource for improving organizational performance. This process involves developing strategies and introducing system and controls to improve information quality to deliver value". This view of BIM covers the strategic level of the business. A definition of BIM from a management and operational perspective is given by van der Pols and Backer (2007). According to them, BIM is the part of organization that deals with the management of information provisioning, its design and adaptation, and maintaining and monitoring the function of information provisioning. This definition is also supported by the work of van der Pols, Donatz, & van Outvorst (2007). In their definition, BIM includes day-to-day management of information provisioning and execution of the activities in information provisioning.

Based on the above views we formulate following definition of BIM.

BIM is the business perspective of information management that defines responsibilities for

- *Managing information as a strategic resource for improving organizational performance*
- *Controlling the functions of information provisioning.*
- *Executing day to day activities in information provisioning.*

The importance of such business perspective of IM can be illustrated by highlighting some recent trends observed in business, like the increase in outsourcing of IT activities. One reason behind the increase in IT outsourcing is organizations' interest to concentrate on their core business activities. Scholars argue that the management of IT outsources' delivery activities and the definition of requirements for information provision should never be outsourced (van der Pols, & et al. 2007). Rather the user organization (the business) should be in control of decisions about information provision. Increase in the

complexity within the organizations is another trend that can be observed. Modern organizations are becoming more and more complex as they are experiencing more autonomous growth, frequent mergers and takeovers. Further, organizations now-a-days incorporates various independent units or departments. These various units or departments have control over various parts of Information Systems and they hardly act in each other's interest. Furthermore, many organizations today experience rapid changes and so their strategies and requirements. Therefore, the information provision function of these organizations needs to change rapidly to keep pace with their changing strategies and requirements. Above discussion stresses the importance of managing, controlling and modifying information provisioning from the business perspective. Thus we introduced the definition of BIM that incorporates business perspective of IM and defines responsibilities of information provisioning in all the three levels of the organization.

2.3 Domain of BIM

Although BIM is considered as part of the user organization, BIM is positioned quite differently by different authors in the literatures. For example van der Pols, Donatz and van Outvorst's (van der Pols, Donatz & van Outvorst, 2007) mention BIM as an intermediary between IT and the organization, which suggests that BIM is a separate function than IT and business. In contrast, van der Pols and Backer (2007) mention about exception in organizations where BIM is addressed by the internal IT service provider. Nonetheless, in our definition, we demark the domain of BIM clearly, by placing it as an inseparable part of business. BIM functions neither as an intermediary between business and IT, nor as part of IT. In case IT performs actions enlisted to BIM then we argue that corresponds to IM. Figure 2.1 shows the positioning of BIM.
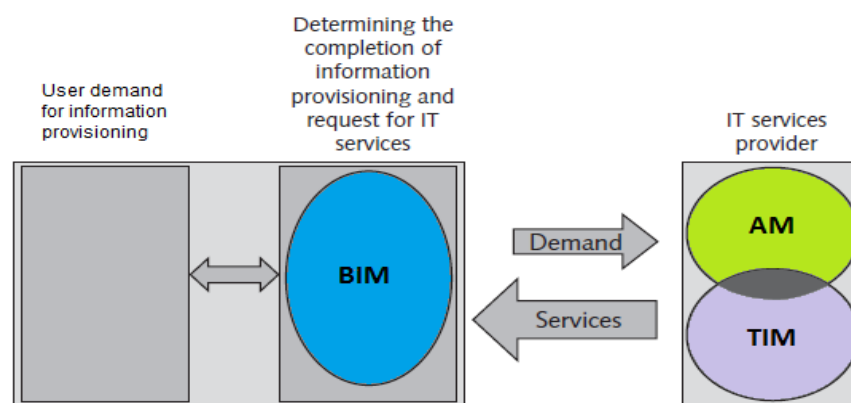
Figure 2.1 Positioning of BIM (van der Pols, & Backer, 2007)

Since IM incorporates both business and IT perspective of information provisioning while BIM incorporates only business perspective only, we say domain of IM incorporates the domain of BIM. However, for successful information provisioning BIM needs to work in cooperation with the other perspective i.e. IT perspective of IM. IT perspective of IM incorporates two functions namely Technology Infrastructure Management (TIM) and Application Management (AM). TIM is responsible for providing and managing the technical infrastructure required for systems and services, while AM is responsible for maintenance, use and adaptation of the applications (van Outvorst, Donatz, van der Pols, & Meijer, 2005; van der Pols, & Backer, 2007). The cooperation between BIM and the functions TIM and AM is shown in Figure 2.2.
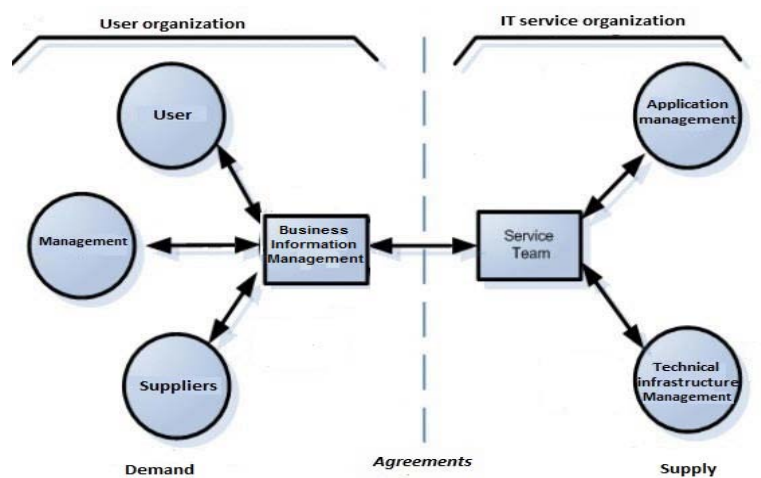
Figure 2.2 BIM working with TIM and IM (van der Pols, & et al. 2007)

The figure shows how demands for information provision is conveyed via BIM to IT, while IT fulfills business demands by providing services in the areas of TIM and AM that are needed to fulfill the requirements for information provisioning.

2.3 BIM functions

From the works of van Outvorst, & et al (2005), van der Pols and Backer (2007) and van der Pols & et al. (2007) we recognize following major BIM responsibilities.

    I.   Recognizing demands of the business.

    II.   Translating demands into solutions.

    III.   Asking IT to fulfill the solutions.

    IV.   Managing, monitoring and evaluating the supply from IT.

V.   Recognizing long term demand for information provisioning.

In the BIM definition provided in Section 2.1, we identify three levels namely strategic level, management level and operational level. These three levels also considered by van der Pols and his colleague (2007).

The Strategic level focuses on long-term vision for business information management and the operational level focuses on short-term operational transformation (Maes, 1999). The middle level often termed as tactical level (Smalley, 2012) forms as a connection between strategic and operational level. Figure 2.3 shows the mapping of BIM responsibilities to the levels.
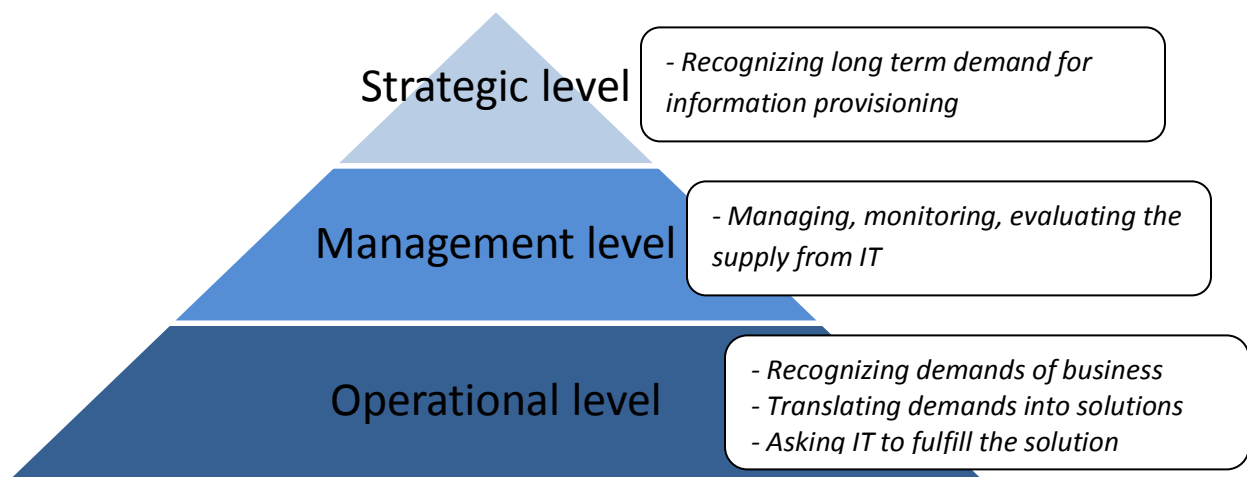
Figure 2.3 BIM responsibilities mapped to organizational levels

2.4 Discussion

To discuss BIM, we started by discussing scholars' view on IM. We wanted to compare IM and BIM. We found that IM is a broader concept than BIM. IM incorporates both business and IT perspective of information provisioning, while BIM incorporates only business perspective. By doing the comparison we showed how the domain of IM incorporates the domain of BIM. However different view of IM also exists. For example, according to the Queensland Government, Australia (Queensland Government Enterprise Architecture Framework 2.0, 2009) - "Information management is defined as the means by which an organization plans, identifies, creates, receives, collects, organizes, governs, secures, uses, controls, disseminates, exchanges, maintains, preserves and disposes of its information; as well as any means through which the organization ensures that the value of that information is identified and exploited to its fullest extent". Clearly this definition has a narrow view on IM as the definition positioned IM on the demand side (Smalley, 2012). A similar view on IM is reflected in the definition of

global community of information professional - AIIM (What is Information Management, n.d.), as it underpins the demand side's responsibility: "Information management is a corporate responsibility that needs to be addressed and followed from the upper most senior levels of management to the front line worker. Organizations must be held and must hold its employees accountable to capture, manage, store, share, preserve and deliver information appropriately and responsibly". We also found some authors (Smalley, 2012) refer to IM while they should be referring to BIM. In this chapter, we also showed the domain of BIM by placing it as an inseparable part of business. In next chapter, we will discuss the practical approach of IM and BIM.

Chapter 3

Practical approaches for BIM

This chapter investigates the literature for the practical approaches for Business Information Management and answers the following research question:

RQ2: *How is BIM addressed in practice?*

In chapter 2, we argued that the domain of IM encompasses the domain of BIM. In this chapter, therefore, we discuss IM practice before discussing BIM practice. Section 3.1 and 3.2 discuss practical approaches for IM and the processes defined in those practices. After that, in Section 3.3 and 3.4 discuss practical approach for BIM and its processes.

3.1 IM practice – Lifecycle Model

The most common practical approaches for IM, we found, are based on the Lifecycle model (Managing the Information Lifecycle, 2012; Customer Content Lifecycle Management, 2012; Butcher & Rowley, 1998; Information Management Strategic Framework, 2004; Dias 2001). We found this model in different variations in different publications. The reason for variation in different approaches is that - each of the approaches to the lifecycle model is its application domain depended. For example, Jisc InfoNet's Information Lifecycle Model (2012) addresses Email management and Records management while Capgemini's Lifecycle model (2012) addresses customer contents management. Butcher and Rowley's (1998) framework – "7 R model of Information Management", and Information Lifecycle Management model developed by Australian Taxation Office (Information Management Strategic Framework, 2004) are somewhat generic. But still they differ in their stages and levels. However the aim and view of the models are more or less identical in all flavors.

The approaches based on the lifecycle model view information created by an organization as one of its most important resource (Dias, 2001) and aim to use their resources properly and extract knowledge out of it (Butcher & Rowley, 1998). The model tries to ensure that right information is available to the right people at the right time (Information Management Strategic Framework, 2004; Dias, 2001). According to Dias (2001) due to the advancement in technologies and wide dissemination of information, many organizations today suffer from information overload which may lead to information chaos. The lifecycle model can guide organization to apply proper information management and deal with this information chaos. Dias argues that in many organizations information is stored in different

systems (computers or databases) in unorganized way, and the organization lacks centralized global view of information, which may cause the information duplication. In this case, knowledge extraction may become difficult for the organization. The Information lifecycle management approach can help the organization cope up with this by striving to centralize and organize information storage. The most notable fact of lifecycle model is that it is conceptual and technology-independent (Managing the Information Lifecycle, 2012). The model can be applied whenever and wherever a new system or process requires to be introduced, a process needs to be introduced due to modifications of existing systems. Being conceptual model is its drawback as well. The model only prescribes the end goal of individual stages to the practitioners and does not give any guidelines about the activities required in each stage. This makes the model difficult to be implemented in practice.

3.2 Processes of Information Lifecycle model

The stages of four approaches of IM Lifecycle model, (Managing the Information Lifecycle, 2012; Customer Content Lifecycle Management, 2012; Information Management Strategic Framework, 2004; Butcher & Rowley, 1998; Dias 2001) we have identified before are shown in table 3.1.

Table 3.1 Stages of four approaches to Information lifecycle model

Approach	Stages
Jisc InfoNet	Creation, Active use, Semi active use, Final outcome
Capgemini	Create, Manage, Audit, Validate
Butcher and Rowley	Reading, Recognition, Reinterpretation, Reviewing, Release, Restructuring, Retrieval
Australian Taxation office	Plan, Create & collect, Evaluate, Organize & store, Dispose, Maintain & store, Review, Use Disseminate, Analyze

In Table 3.1 we observe that four approaches of information lifecycle model defines different stages. As being an approach for lifecycle the main purpose for those four variations is the same. Thus we identify three generic phases or stages in these approaches as shown in figure 3.1.
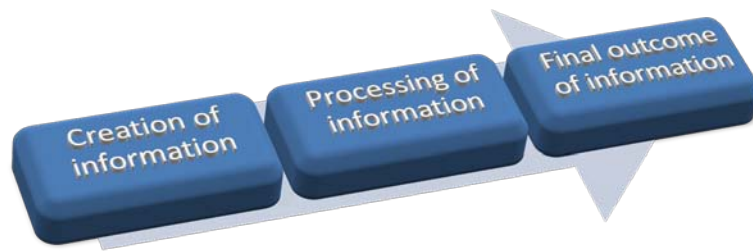
Figure 3.1 Generic phases of Information lifecycle model

As the Figure 3.1 depicts, the lifecycle model starts with the phase *creation of information.* Next is the phase of *processing of information* and the last phase is *final result of the information*. How the stages of aforementioned four approaches can be mapped to these three phases is shown in Table 3.2 and discussed below.

Table 3.2 Mapping of lifecycle models' stages to three generic phases

	Jisc InfoNet	**Capgemini**	**Butcher and Rowley**	**Australian Taxation office**
Creation of information	Creation	Create	Reading, Recognition	Plan, Create & Collect
Processing of information	Active use, Semi active use	Manage, Audit, Validate	Reinterpretation, Reviewing, Restructuring, Retrieval	Evaluate, Organize & store, Dispose Maintain & store Review
Final outcome of information	Final outcome		Release	Use Disseminate, Analyze

a) Creation of information: Except Butcher and Rowley's model, all the three approaches have defined stages that directly correspond to this phase. Jisc InfoNet model (Managing the Information Lifecycle, 2012) argues this stage as the easiest one. This is probably because the application domain of the particular approach is relatively simple (email management). So the creation of information phase in this

case requires limited planning. For the approach defined by Australian taxation office (Information Management Strategic Framework, 2004), the authors argue that proper planning is required before creation of information. This is necessary for the purpose of that model, as we can see the information creation is combined with process collection of information. The purpose of this approach of lifecycle model is to enable users to create information as quickly and easily as possible. The 7R model defines 7 stages that can be combined and mapped to the three phases we defined. The first two stages (reading, recognition) can be mapped onto the creation of information phase, since by reading knowledge and putting that into cognitive framework information is created (Butcher & Rowley, 1998).

b) Processing of Information: After creation, the next phase is processing of information in which information is used or managed. Jisc InfoNet's model only identifies stage to use information, while Capgemini's model's defines three stages (manage, audit and validate) defining management of information. The audit and validate stages ensure accuracy, clarity, and relevance of information (Customer Content Lifecycle Management, 2012). In contrast, reinterpretation and reviewing stages of 7 R model ensures processing of information. Reinterpretation ensures the use of information by transforming it into suitable form, while reviewing aims at ensuring the soundness of the knowledge (Butcher & Rowley, 1998). Butcher and Rowley argue that reviewing also includes management activities such as refereeing and listing. This approach also incorporates the stages restricting and retrieval which ensure post processing or managing of information after being released. So we map these two stages to processing of information phase. The evaluate, organize & store, dispose, maintain & store, review stages of Australian taxation office's model correspond to processing of information.

C) Final outcome of information: After processing of information, this phase ensures the final outcome of the processing of information. According to Jisc InfoNet's model, the final outcome stage decides about the future of the information. That is whether the information (in this particular approach email, messages etc.) are to be deleted or stored for future use. This phase is realized in 7 R model by the stage *release,* which makes information widely available for public use. But they can be argued as part of the information processing phase. The Australian taxation office's approach defines *use disseminate* stage to fulfill the same role. This model also defines the *analyze* stage to measure the effectiveness of information management. In Capgemini's model we could not find any sage that map to this phase.

3.3 BIM practice - BiSL

Apparently BiSL is currently the only framework that is developed specifically to address BIM without being illusive about its field of application. Unlike the IM lifecycle model, BiSL is not a conceptual framework. It defines the essential processes that have to be performed in BIM. The framework also defines the input and output of the process and identifies the roles requires to carry out those processes.

In chapter 2 we have identified three organization levels for BIM. However, in practice these three levels operate independently, i.e., little communication takes place among these levels (van Outvorst, Donatz, van der Pols, & Meijer, 2005). Policy defined at strategic level is not communicated to operational level and the management level seems to be fragmented. This results in organizations' internal inconsistency and lack of uniformity in information provisioning. BiSL addresses this problem. BiSL processes are defined in all three organization levels, making sure activities are carried out while maintaining necessary communication among various levels. These activities are defined for everyone in the user's organization to ensure everyone's participation in information provisioning (van Der Pols, Donatz and van Outvorst, 2007). By defining activities for all participants, including decision makers, managers, users, staff, business information administrators and information managers. BiSL aims to transform the business organization into a system that performs information provisioning. By doing this, BiSL not only aims to ensure uniformity in information provisioning, but also pays attention to draw uniformity in placing demands to IT. This promises advancement in business' alignment with IT. BiSL acts like a checklist that indicates which processes and activities have to be carried out for successful BIM. This makes BiSL a quality instrument as well, since it can help organizations identify the processes, activities, products or services that require improvements.

3.4 BiSL processes

BiSL framework shown in Figure 3.2 portrays the three levels reflected in the BIM definition. A detail figure of the framework can be found in the Appendix A. Figure 3.2 shows the seven process clusters of the BiSL framework. Based on the work of (van der Pols & Backer, 2007; van der Pols, & et al. 2007; van Outvorst, et al. 2005) we identify the purpose each cluster aims to fulfill. Accordingly relevant processes are grouped in those clusters. This clustering facilitates the identification of the processes required to fulfill each specific purpose. This also facilitates the assignment of roles to these processes and enables an organization to identify which processes are not performing properly. Eventually this can also help adjust the activities of the processes.

For example, the purpose of the user management cluster is to aid in the daily use of information provision. The processes encompassed by this cluster are carried out by business information managers or key users. One of the processes belonging to this cluster is business data management, which is responsible for the correct set up and content of the data in information provision. If there is a problem regarding the quality of data, the organization could look for adjustments in the activities belonging to the business data management process.
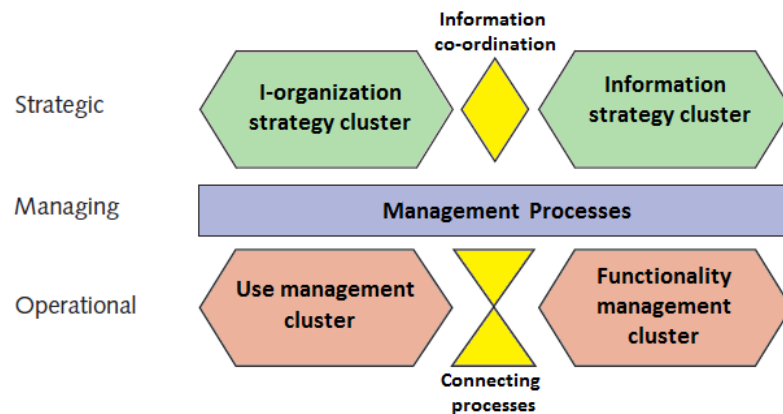
Figure 3.2 BiSL framework (van der Pols & Backer, 2007; van der Pols, & et al. 2007; van Outvorst, et al. 2005)

The BiSL processes are briefly discussed below.

a) Operational level processes

The aim of the operational level processes is twofold: i) aid in the daily use of information provision and ii) design and implementation of adjustments of information provision. The processes that support these two functions are grouped into user management cluster and functionality cluster as shown in Figure 3.3. Another cluster of processes also exists at this level to coordinate the use management and functionality management clusters.
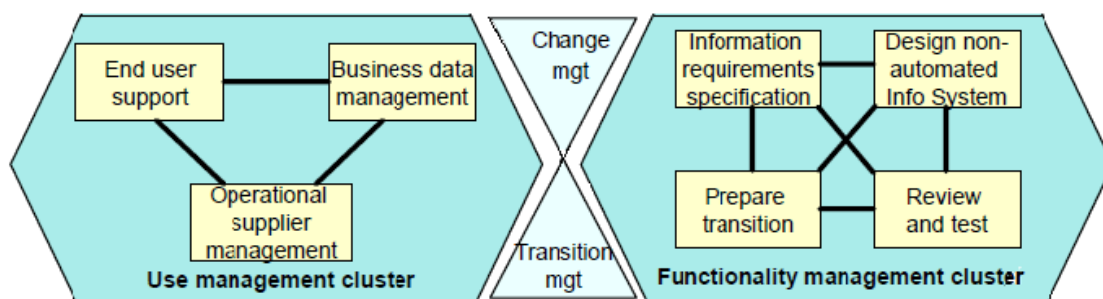
Figure 3.3 Operational level processes of BiSL (detailed view)

I. Use Management cluster: The processes that belong to this cluster aim at optimal and continuous support of information provisioning. These processes provide support to the users in using information provisioning while carrying out their task within their business processes. The processes encompassed in this cluster are: *End user support, Business data management, Operational supplier management.*

II. Functionality Management cluster: The processes incorporated by this cluster deal the changes in information provisioning. They identify shortcomings in the use management cluster and identify required changes to overcome these shortcomings. They are also responsible for carrying out these changes in such way that these they address users' objectives and demands. The processes incorporated in this cluster are: *Information requirements specification, Design non-automated Information Systems, Prepare transition, Review and testing.*

III. Connecting process cluster: Use management and functionality management clusters cannot be considered independently. The objective of this cluster is to decide which changes need to be made to the information provisioning and their actual implementation in the information provisioning within the user organization. The processes belong to this cluster are *change management* and *Transition management.*

b) Management level processes

The processes of this cluster deal with costs, returns, planning and quality of information provision and contracts with the IT provider. The roles like system owner, budget holder and product manager are responsible for the proper functioning of the activities at this level. Figure 3.4 shows the detailed view of the BiSL management level.

Planning and control	Financial management	Demand management	Contract management
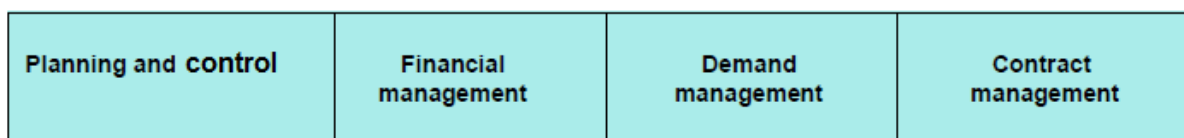
Figure 3.4 Management level processes of BiSL (detailed view)

- *Planning and control:* The objective of this process is planning, monitoring and making adjustments in information provisioning activities to ensure optimal use of information provisioning. This process is also found to be termed as planning and resource management in some literatures.

- *Financial management:* The objective of this process is preparing, maintaining and monitoring the cost-effectiveness of information provisioning from a financial perspective.

- *Demand management:* This process is concerned with the management of the demands of the business processes to be satisfied by information provisioning. The objective of this process is to ensure that the business processes of the organization are supported by information provisioning. The processes of this cluster recognize the demands and decide whether they have to be translated to the IT department for supply.

- *Contact management:* This process is responsible for managing the agreement with IT for the services. The objective of this process is to define and maintain appropriate agreements with the IT department.

c) Strategic level processes

Information provision within an organization is not static (van der Pols, Donatz & van Outvorst, 2007). Now-a-days organizations are frequently facing changes, either in the internal organization or in technology. Due to the changes in an organization, its business processes need to be changed. This, in turn, asks for changes in information provisioning, as information provisioning is aligned with the business processes. To gain competitive advantages, the organization may also urge to make changes in its information provisioning. Strategic level is concerned with information policy that considers future requirements for information provisioning in conjunction with current needs. The objective of this level is to define policies with well-defined actions so that appropriate actions can be initiated at the management level. Figure 3.5 shows, in detail, the BiSL strategic level. This level includes three process clusters, namely I-Organization strategy cluster, Information strategy cluster and information coordination cluster.
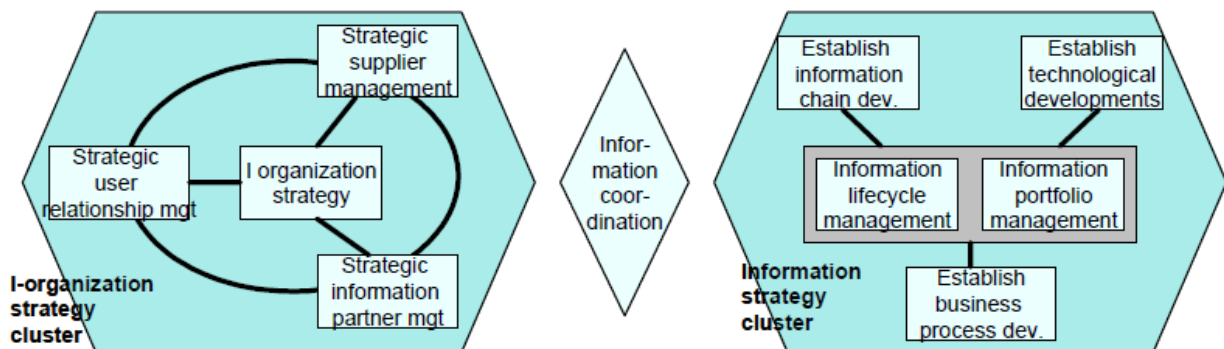
Figure 3.5 Strategic level processes of BiSL (detailed view)

I. I-Organization Strategy cluster: Various parties within the organization, like user departments, business information (systems) management organization as well as parties outside the organization like suppliers, chain partners have opinion regarding information provisioning. But these various parties seldom act in each other's interest (van der Pols, Donatz & van Outvorst, 2007). The coordination among these various parties is the key concern of this cluster. Coordinating the communication, management, structures and methods of those various parties is the focus of the processes of this cluster. The objective of I-Organization strategy cluster is to set up and adjust the organization of information provisioning and determining the strategy to achieve this. The processes incorporated in this cluster are: *Strategic supplier management, Strategic user relationship management, I-organization strategy*, *Strategic information partner management.*

II. Information strategy cluster: The objective of this cluster of processes it to determine the future of information provisioning while considering changes in business process, in organization's surroundings and in technology. The processes incorporated in this cluster are: *Establish information chain developments, Establish business process development, Establish technological developments, Information lifecycle Management, Information Portfolio Management.*

III. Information coordination: This cluster deals with the coordination and communication of the various forms of policy developed in the other two clusters of the strategic level.

3.5 Discussion

In this chapter, we showed that the practical approaches of IM and BIM are quite different from each other. Although in this work we consider that the domain of IM incorporates the domain of BIM, for practical approach to IM is found not particularly useful for BIM. Our intention was to compare these two practical approaches, but due to their large difference we were unable to do so. We were unable to relate IM practice to our definition of BIM either, because the purpose of IM and BIM practical approach were found to be too different from each other. Therefore, this chapter discussed the BiSL framework in detail and summarized its processes to show how BIM is addressed in practice by this framework. Hence rest of thesis is based on the BiSL framework. We focus on identifying the impacts of cloud computing on the BiSL processes and then propose adjustments to these processes to cope with cloud computing aspects.

Chapter 4

Cloud Computing

This chapter provides background information on Cloud Computing. At the end of the chapter this chapter will finish answering the research question:

RQ3: What is cloud computing?

To answer the question Section 4.1 provides definition of cloud computing. Later on Section 4.2, 4.3 and 4.4 discuss cloud computing service models, cloud computing deployment models and cloud governance respectively.

4.1 Definition

In this research, we use the definition of Cloud Computing provided by the National Institute of Standards and Technology (NIST), US Department of commerce (Mell & Grance, 2011).

"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction".

The definition captures following five characteristics of cloud computing:

- **On-demand self-service:** Consumers have on demand access to computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction.
- **Broad network access:** Cloud resources are available over the network and can be accessed though broad categories of platforms such as mobile phones, tablets, laptops, and workstations.
- **Resource pooling:** Computing resources are shared by multiple consumers.
- **Rapid elasticity:** Capabilities can be easily scaled up or down based on consumers demand.
- **Measured service:** Consumers only pay for the service they use ('pay-as-you-go' or by subscription) instead of paying for long-term licenses and/ or investments in hardware.

4.2 Service Model

Three broad categories of cloud service model we found today are Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) (Marinos & Briscoe, 2009; Halpert, 2011;

Conway, 2011; KPMG, 2011; Harms & Yamartino, 2010; Mell & Grance, 2011). Figure 4.1 shows a comparison of traditional IT with these three service models.
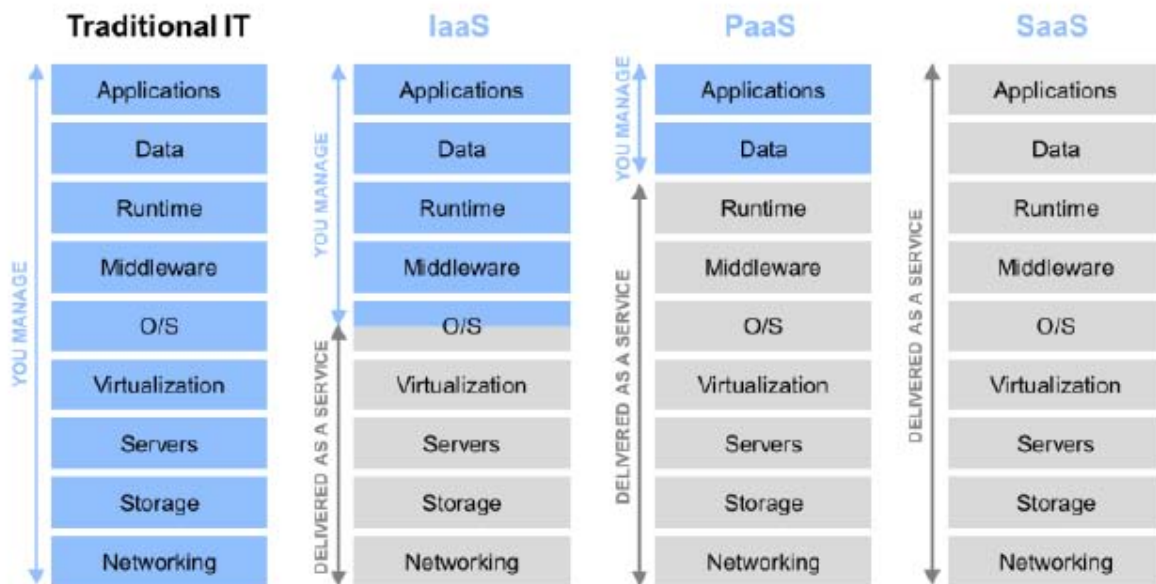
Figure 4.1 Traditional vs Cloud computing service models (Harms & Yamartino, 2010)

4.2.1 Infrastructure as a Service (IaaS)

NIST defines IaaS as capability provided to the consumer to provision processing, storage, networks, and other fundamental computing resources so that the consumer can deploy and run arbitrary software, which can include operating systems and applications (Mell & Grance, 2011). The consumers do not require managing and controlling the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls). Instead of consumers purchasing servers, software, data centre space and network equipment, they buy resources from providers as fully outsourced service (Conway, 2011). Example of IaaS is Amazon Web Services.

IaaS is termed as most basic level of Cloud Computing service model (Marinos, A., & Briscoe, G., 2009). Examples of providers include Amazon and Mosso that provide machine instances to developers (consumers). These instances behave like dedicated servers controlled by the consumers. Consumers have full responsibility for their operation.

4.2.2 Platform as a Service (PaaS)

NIST defines PaaS as a capability provided to the consumer to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider (Mell & Grance, 2011).

Consumers do not require managing or controlling underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

PaaS is a way to rent hardware, operating systems, storage and network capacity over the Internet (Conway 2011). It allows the providers to rent virtualized servers and associated services for running existing applications or developing and testing new ones. Example of PaaS includes Microsoft Azure Platform (Halpert, 2011), Google App Engine (Marinos, A., & Briscoe, G., 2009).

4.2.3 Software as a Service (SaaS)

NIST defines SaaS as consumers' capability to use providers' applications running on cloud infrastructure (Mell & Grance, 2011). Provider provides an application to the consumer as a service on demand which includes the hardware infrastructure and the software product (Conway, 2011).

SaaS also termed as Application as a Service (Armbrust, et al., 2010) is usually accessed by rich web-based interface. Applications are also accessed through program interface. SaaS consumers do not require managing or controlling underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities. An exception is where user-specific application configuration is possible. Examples of SaaS include Google Docs, Gmail and Salesforge.com (Halpert, 2011).

4.3 Deployment Model

There are a number of different deployment models for Cloud Computing. A deployment model is a particular method of delivering Cloud Computing service. Most commonly used deployment models for Cloud Computing found in scholarships are Private cloud, Community cloud, Public cloud and Hybrid cloud (Marinos & Briscoe, 2009; Halpert, 2011; Conway, 2011; KPMG, 2011; Harms & Yamartino, 2010; Mell & Grance, 2011). Following sections briefly introduce these four deployment model.

4.3.1 Private cloud

Cloud Infrastructure is provisioned for the exclusive use of a organization (Mell & Grance, 2011). That organization comprises multiple users such as business units. The infrastructure may be owned, managed and operated by the organization or by a third party or some combination of both. It may exist on or off premises.

In case the infrastructure is provided by the organization then it is usually provided by internal Information Technology (IT) or Information Systems (IS) department (Halpert, 2011). As both user and provider are part of a same organization private clouds allow the user greater control over quality of service provided by the cloud. This control comes at price because organization has to bear full cost of cloud infrastructure.

4.3.2 Public cloud

The cloud infrastructure is provisioned for open use by the general public (Mell & Grance, 2011). It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider. Like many other scholars, Microsoft's view on difference between public and private clouds are same; based on whether cloud infrastructure is dedicated to a single organization (private cloud) or shared between many distinct organizations (public cloud) (Harms & Yamartino, 2010). Examples of Public cloud are Amazon Web Services and Microsoft Azure (Conway, 2011).

Armbrust and his colleagues (2010) refer data centre hardware and software as Cloud and they use the term Private cloud to refer to internal data centers of a business or other organization, not made available to the general public. In contrast, when the cloud is available to public in a pay-as-you-go manner, then they term it as Public cloud.
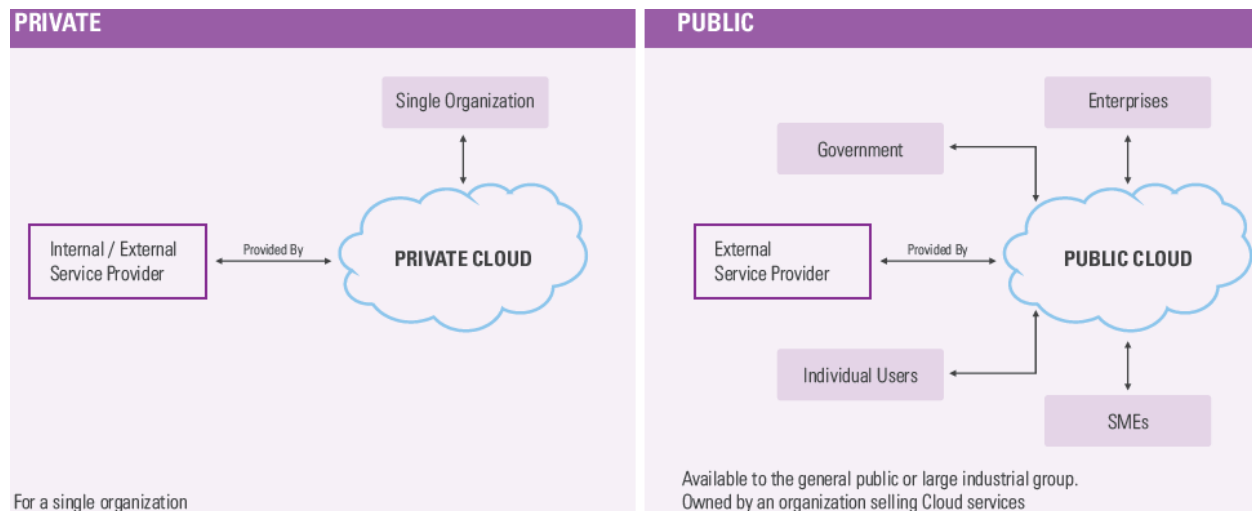
Figure 4.2 Private and Public clouds (KPMG, 2011)

Nonetheless, essence of all scholars' views on Private and Public cloud is more or less same. While Private cloud enjoys control over quality of service, Public cloud has the challenge to assure quality of service (Halpert, 2011). Today many cloud service providers offer little in compensation for missed service level agreements (SLA). There are also security concerns in Public cloud such as data residency requirements. When leveraging Public cloud consumer should take care that their use of cloud is not violating legislative, regulatory or industry requirements.
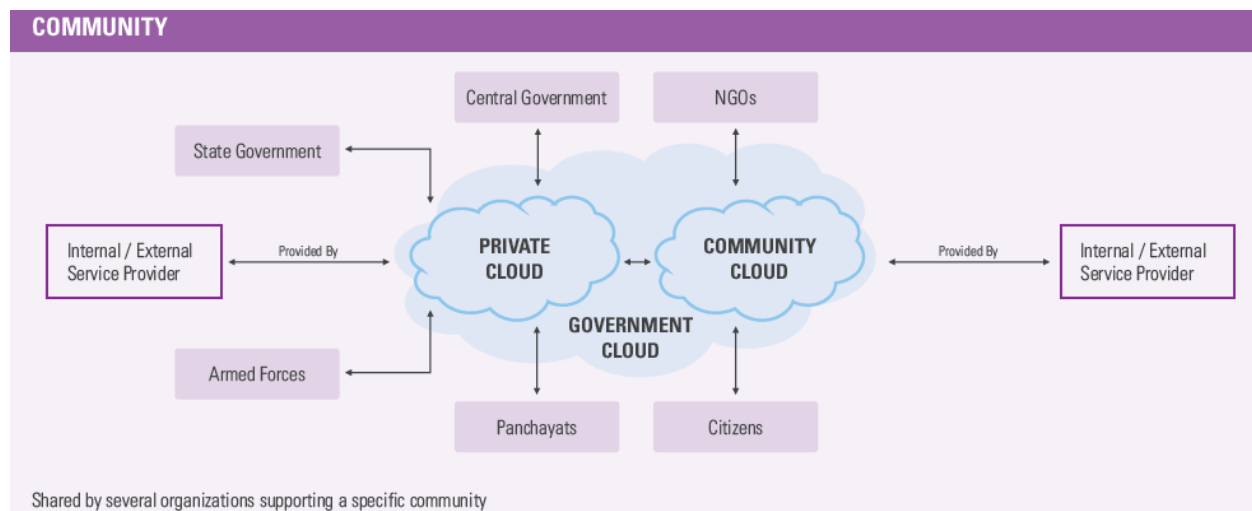
Figure 4.3 Community cloud (KPMG, 2011)

4.3.3 Community cloud

NIST defines Community cloud as the cloud infrastructure provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security

requirements, policy, and compliance considerations) (Mell & Grance, 2011). Like public cloud, it may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises. Organizations in the community collaborate for the purpose of a particular mission or concern (Halpert, 2011). This might be an industry consortium, an awareness group, or another group altogether. In some instances the community cloud is a shared responsibility, either financially or from a compute resource perspective. An example of Community cloud is Google Gov (Conway, 2011).
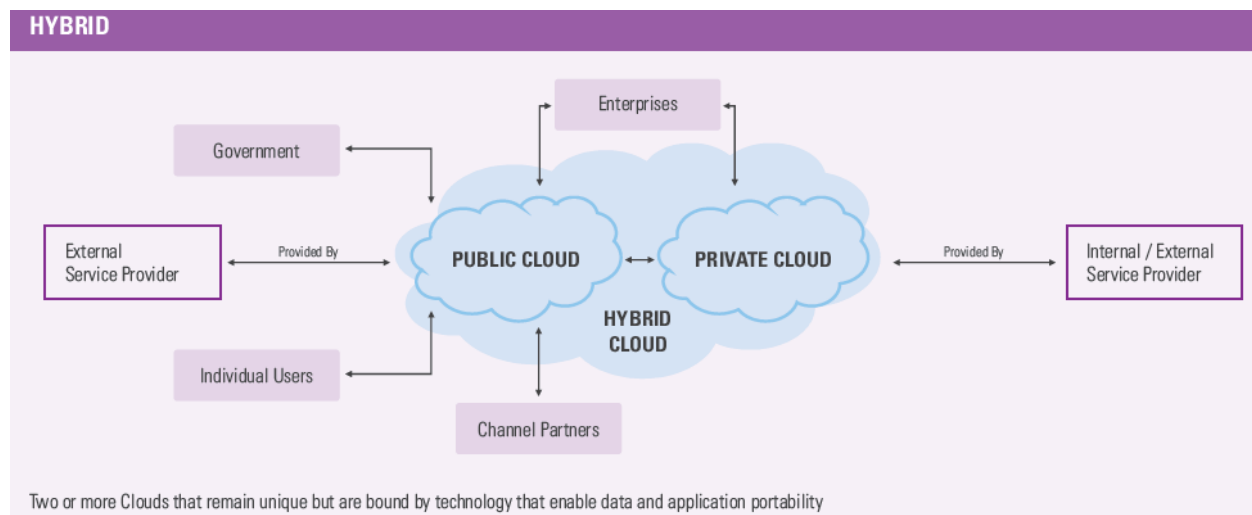
Figure 4.4 Hybird cloud (KPMG, 2011)

4.3.4 Hybrid cloud

The last deployment model Hybrid cloud is actually a composition of two or more distinct deployment models (private, community, public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds) (Mell & Grance, 2011). Usually Hybrid cloud deployment model is chosen to use public cloud's capability to capture task that cannot be run easily on private cloud (Armbrust, et al., 2010). Example of hybrid cloud is a private SaaS application that is based on a public IaaS (Halpert, 2011). Hybrid cloud is usually focuses on driving workload to the public clouds to meet the stringent quality of service requirements. That is why in many cases Hybrid clouds are found to be private clouds, which turn to the capacity of public clouds for peak demand.

4.4 Cloud governance

Although the term cloud computing has been introduced a while ago, the term cloud governance is still has not gained that much popularity. The scarcity of scholarship addressing the term is an indication of this. Thus before looking for cloud governance definition we also looked at the definition of IT governance.

4.4.1 IT governance and Cloud governance

Weill and Ross (2004) define IT governance as - "specifying the decision rights and accountability framework to encourage desirable behavior in the use of IT". This definition focuses on the management and the use of IT to achieve business goal. As the definition suggest, successful IT governance addresses policies and processes for management and use of IT and determines accountability for decision making. De Leusse, Dimitrakos and Brossard (2009) refers IT governance as the subset of corporate governance. This corporate governance which addresses all the aspects of business is defined by them as "the set of processes, customs, policies, laws and institutions affecting the way in which a corporation is directed, administered or controlled" (de Leusse, Dimitrakos & Brossard, 2009). As a subset of corporate governance IT governance focuses on the control, performance and risk of IT systems. However cloud computing is not outside the scope of IT. Rather it is well inhabited by IT. This makes the rationale of need for cloud governance debatable.

A recent article published by the tech media website CNET (Haff, n.d.) relates cloud governance with needed processes, policies and procedures to govern. The article argues that this makes cloud governance not different from IT governance broadly since policies, procedures and processes are also needed and addressed by IT governance. However, based on the same article we argue that the needs for incorporation of dynamic issues like virtualization, workload share or transfer etc. make cloud governance different from IT governance. The rationale of addressing cloud governance is also argued by Wainewright (n.d.) in his article on business technology news website ZDnet. The article warns of mish-mash in cloud services, poor data consistency and inadequate policy management and oversight due to lack of proper cloud governance. Nevertheless, arguing on the need for cloud governance is not our objective. Rather we continue looking at scholarships defining the term and cloud governance models.

4.4.2 Cloud governance definition

The domain of cloud computing is broad. According to Cloud Security Alliance (CSA, 2012) cloud computing is concern of two separate domains. One is governance domain that addresses strategic and policy issues within the cloud computing environment and the other one is operational domain that addresses tactical security and implementation issues within the architecture. The first domain has the business perspective while the second domain has technical IT perspective. While looking for cloud governance we were looking at the scholarships that address business perspective of cloud service management. The reason is that technical perspective of cloud computing is out of the scope of business information management. Nevertheless after a short literature review we gather four views of cloud governance in this section. We do not go for any judgment or comparison on these definitions of cloud computing because this is not the objective of this research.

First, we look at the Microsoft's definition on cloud governance. According to Microsoft (2012) cloud governance is "defining policies around managing the [cloud computing] factors [such as Availability, Security, privacy, location of cloud services and compliance] and tracking/enforcing the policies at run time when the applications are running". Then we have the view of Guo and Song on cloud governance. Guo and Song (2010) refer cloud governance to "the processes used to oversee and control the adoption and implementation of a cloud-based service in accordance with recognized policies, audit procedures and management policies".

Next we look at the definition provided by the master thesis work of Yu He at the University of Twente. Yu He (2011) defines cloud governance as "a framework for the leadership, organizational structures and business processes, standards and compliance to these standards, which ensure that the organization's cloud capability supports and enables the achievement of its strategies and objectives". While governance in cloud computing is viewed by Ahmed and Janczewki as "application of technical security controls and developing set of rules or policies that reflects the intention of users and CP, to protect data and managing shared responsibilities".

4.4.2 Cloud governance models

We observed scarcity of scholarships addressing cloud governance. That is why we made a comparison between IT governance and cloud governance at the beginning of Section 4.4. Referring back to section 4.4.1 we argue that may be maturity of existing IT governance models is the reason for lack of such scholarships. Perhaps scholars are convinced by IT governance models' maturity to handle cloud

computing and therefore reluctant to invest effort to define framework for cloud governance. May be cloud computing only asks for modifications on existing IT governance frameworks rather than a completely new one.

Nevertheless, the four cloud governance models we identified are as follows:

1) Microsft's cloud governance model for Azure cloud platform
2) Guo and Song's cloud governance model
3) Yu He's Lifecycle Process model
4) Ahmed and Janczewski's Life Cycle model for managing security in Public Cloud

Among these four, only Guo and Song's model and Yu He's model address the entire governance issue. While Ahmed and Janczewski's model address security issues of Public cloud and Microsoft's model address PaaS cloud service model. Yu He's work is largely based on Schepers, Iacob and van Eck's (2008) SOA (Service Oriented Architecture) and Guo & Song's governance model. SOA is a closely related field to cloud computing and cloud computing is argued to be an extension of SOA. Many technologies and and practices of SOA governance can be leveraged for cloud setting and therefore SOA governance principles can be reused in cloud governance (O'Neill, 2009). So we also reviewed the lifecycle approach to SOA governance (Scheper, Iacob & van Eck, 2008). This lifecycle approach of SOA governance model and aforementioned four cloud governance models will be examined further to answer the research question 4 and 5.

4.5 Discussion

This chapter discussed the background information on cloud computing. Our intention was to set up a ground for defining the domain of cloud computing for BIM. We put the definition of cloud computing and discussed its three common service models namely SaaS, PaaS, IaaS. We found these service models are quite different from each other. Thus approach to these service models would be different from each other too. For example, in case of SaaS users are left with little customization option. Since they are to use a standard service, they need to ensure their business processes are standardized enough to use the service. On the contrary in case of PaaS, IaaS an organization is not constrained with the requirement to change in business processes. However, they need to measure the security risk more carefully. In this chapter we also discussed different cloud deployment models namely Private cloud, Public cloud, Hybrid cloud and Community cloud. Like in the case with service models, approach to different deployment models would be different from each other. For example in case of private cloud

users do not have be concerned with security issues as cloud services are to be deployed in the premises of the organization. On the contrary in case of public cloud they have to take a closer look on the security issues as the cloud services can be accessed from outside of the organization premises. In our opinion these different cloud service and deployment will have different effects on BIM practices. Thus compensation for their effects may require different adjustments. Finally, we identified four cloud governance models and one SOA governance model. From these governance models, we will identify relevant cloud computing aspect that BIM practice needs to accommodate. After indentifying BIM relevant cloud computing aspects, in next chapter, we will measure the BIM processes suitability to accommodate those aspects.

Chapter 5

BIM and Cloud Computing

This chapter measures the suitability of the BIM practical approach to deal with the cloud computing. Thus this chapter answers the following research question.

RQ4. *How suitable is the usage of BIM practical approach to deal with cloud computing?*

In previous chapter four cloud governance models and one SOA governance model were introduced. In this chapter Section 5.1 briefly discusses cloud governance models, Section 5.2 identifies major cloud computing aspects addressed by the model and section 5.3 discusses the suitability of the BiSL processes to address these aspects.

5.1 Governance models

This section briefly discusses the governance models identified in the previous chapter.

5.1.1 Microsoft's cloud governance model for Azure cloud platform

Microsoft's governance model addresses cloud issues like availability, security, privacy, location of cloud services and compliance requirements for the cloud services. The model focuses on Policy management. According to the model as shown in the figure 5.1, Policy management for cloud services incorporates two responsibilities: Governance policy definition and Governance policy enforcement. Governance policy definition is carried out during design and development time. Thus this is also termed as design time governance. It is responsible for defining corresponding rules and roles for cloud service, Service levels, Quality of service levels, business KPI's, application performance metrics etc. On the other hand, governance policy enforcement which is also termed as run time governance, is responsible for enforcing the defined policies and monitoring the performance of cloud services and compliance requirements.
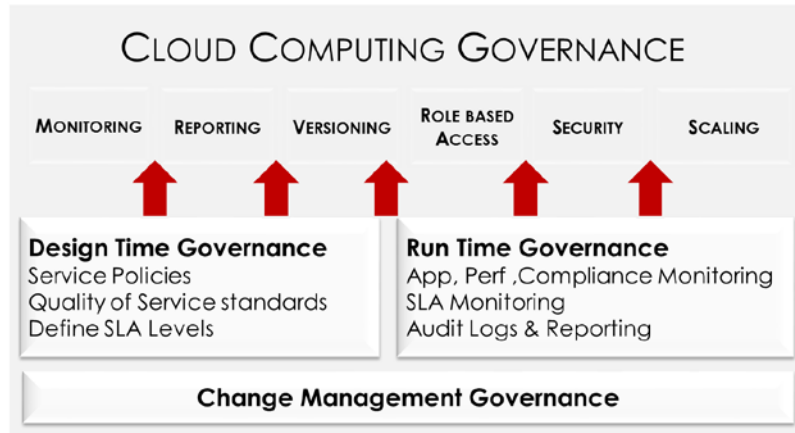
Figure 5.1 Microsoft's cloud governance model (Microsoft, Cloud Governance | Azure Decisions. (2010).

5.1.2 Guo and Song's cloud governance model

Guo and Song's (2010) cloud governance model we found to be the only one that discusses cloud computing aspects in general. However, the model only outlines the underline requirements or objectives of cloud governance. Based on the requirements of cloud governance the model identifies four areas of cloud computing namely Service management, Policy management, Risk management and Compliance management. The model emphasizes on concentrating these areas to meet the requirements or objectives of cloud governance.

5.1.3 Yu He's Lifecycle Process model

Like Guo and Song's model, Yu He's lifecycle process model identifies five areas of interest for cloud governance namely: Strategic planning (vision), Organizational alignment (define), Service lifecycle management (build), Policy management (deliver) and SLA management (operate). Figure 5.2 shows the areas of the model as depicted in a high level process for cloud governance.
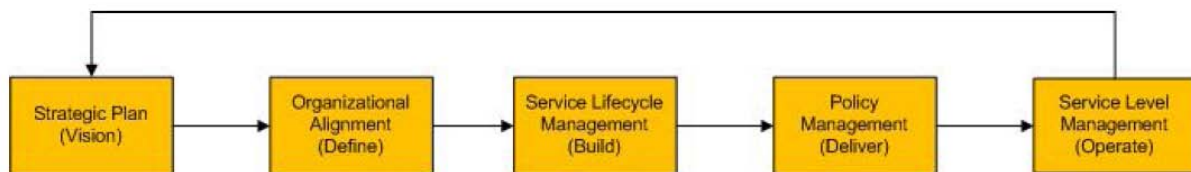
Figure 5.2 Areas of Yu He's model as depicted high level process for cloud governance (He, 2011)

Unlike Guo and Song's model which only outlines the areas, this model follows a lifecycle approach. Each of the lifecycle addresses an area of cloud governance which follows the style of Schepers, Iacob & van Eck's (2008) SOA governance framework which is discussed in section 5.1.5.

5.1.4 Ahmed and Janczewski's Governance Life Cycle framework for managing security in Public Cloud

This framework addresses data security issues for public cloud deployment model. It defines approach for managing user data security in public cloud. As shown in the figure 5.3 the framework incorporates both the domain of cloud user and cloud service provider (or cloud provider). The gap between these two domains is addressed by incorporation of Joint Governance Board (JGB). This JGB acts as a bridge between user and cloud provider and authority for approving various cloud governance issues like risk management, asset management, security policy, monitoring, audit and compliance. The framework addresses these functions in such a way so that balance is managed and responsibility is shared in a controlled fashion.
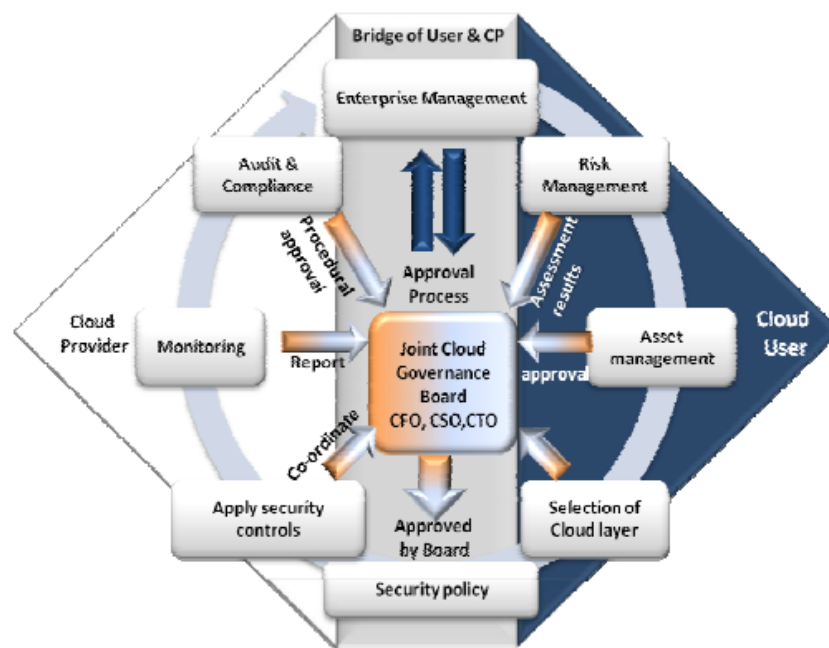
Figure 5.3 Governance Life Cycle framework for managing security in Public Cloud (Ahmed & Janczewski, 2011)

5.1.5 Schepers, Iacob & van Eck's lifecycle approach to SOA governance

Schepers, Iacob and van Eck's (2008) governance model addresses lifecycle approach for SOA governance. The model identifies aspects of SOA and puts them into defined phases of the lifecycle of SOA governance. The phases incorporated by the model are: Vision (defining a SOA strategy), Plan (Organization alignment to SOA), Design (managing the service portfolio), Build (controlling the service lifecycle), Deliver (enforcing policies) and Operate (managing service levels). The model also suggests

processes for the phases. A maturity model is also coupled with the approach so that required effort for governance can be minimized.
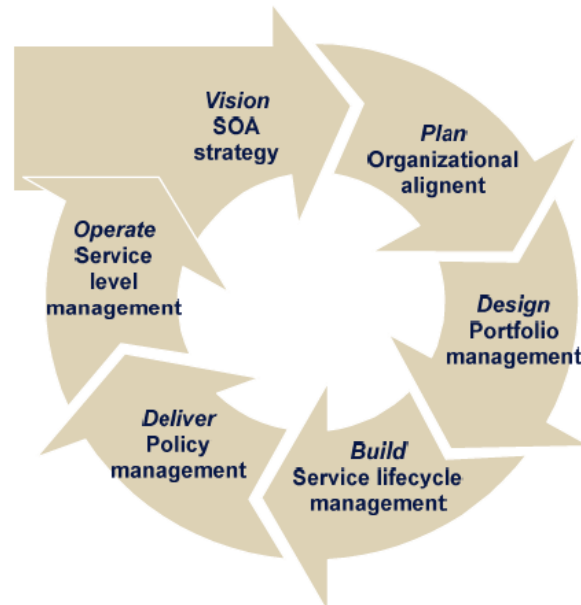
Figure 5.4 Phases of lifecycle approach of SOA governance (Schepers, 2007)

5.2 Aspects of cloud governance models

We observe that different aspects are addressed by those governance models. The cloud computing aspects addressed by corresponding model are shown in Table 5.1.

Table 5.1 Major Cloud Governance aspects

Governance model	Aspects/ issues addressed
Microsoft's cloud governance model for Azure cloud platform	i. Governance policy definition (defining user roles, usages rules, business KPI, SLA, QoS level) ii. Governance policy enforcement (tracking change management, ensuring proper Alerts and Notifications handling, Load balancing).
Guo and Song's cloud governance model	i. Services management ii. Policy management iii. Risk management iv. Compliance management
Yu He's Lifecycle Process model	i. Strategic Planning

	ii. Organizational alignment
	iii. Service lifecycle management
	iv. Policy management
	v. SLA management
Ahmed and Janczewski's Governance Life Cycle framework for managing security in Public Cloud	i. Joint cloud governance board formation
	ii. Risk management (risk analysis of cloud service provider & information asset)
	iii. Information asset management
	iv. Selection of layers (selection of service model)
	v. Security policy management
	vi. Application of security control
	vii. Monitoring and evaluation of security control
	viii. Compliance and audit management
Scheprs, Iacob & van Eck's lifecycle approach to SOA governance	i. Compliance management,
	ii. Financial management (cost and benefit analysis)
	iii. Change consequence management
	iv. Service management (ensuring QoS)
	v. Changing attitude of people

Table 5.1 shows that some aspects mentioned in different frameworks overlap. For example, some issues of *governance policy definition* and *governance policy enforcement* aspects of Microsoft's governance model overlap with *policy management* and *service management* aspects defined in Yu he and Guo & Song's model. Overlapping aspects are grouped together in one aspect. Further we see some of the aspects have same functionality but addressed using different terms. For example, *ensuring Quality of Service (QoS)* mentioned in SOA governance approach is identical to service level management or simply *service management*. Those similar issues are addressed by using one terminology. Table 5.2 briefs about reasons, for which some of the aspects addressed by models are not present in our aspect list. Based on the aspects shown in table 5.1 we identified 11 cloud computing aspects, which are Cloud strategy management, Organization alignment to Cloud, Financial management, Change consequence management, Cloud service lifecycle management, Governance

policy management, Cloud Service management, Risk management, Security management, Compliance management and Audit management.

Table 5.2 Reasons for eliminated issues

Aspect not present	Reason	Rationale
Governance policy definition, Governance policy enforcement,	Overlapping with issues.	Addressed by *policy management* and cloud *service management*.
SLA management, Ensuring QoS,	Identical with other issues	Issues identical with *service management*.
Information asset management,	Covers by other issue	Issue addressed under *Risk management*.
Changing attitude of people	Covers by other issue	Issue addressed under *change consequence management* and *cloud strategy management*.
Joint cloud governance board formation	Not addressed	This is a proposed way of managing issues of cloud governance by Ahmed and Janczewski's framework. They propose formation of a joint governance board between cloud service provider and cloud service user to oversee all the cloud governance issues. In our opinion this kind of way of working depends on individual organization. This may not be preferred by many and may not be feasible in some cases (such as dealing with SaaS service model). Thus. we argue excluding addressing such issue.

5.3 Cloud computing aspects

This section briefly discusses the identified cloud computing aspects.

5.3.1 Cloud strategy management

This activity is concerned with defining long term strategy to foster rendering cloud services. Fostering cloud-based innovation and ensuring uptake of such service are also incorporated in the activity. This

activity ensures informing chain partners and suppliers about rendering such policy. Even it may take responsibility to create awareness about benefits and risks among partners and suppliers. The strategy acts as an input for deciding Go/no go decision on a cloud service or CSP. It also guides the organization to make decision on specific cloud service models (SaaS, PaaS, IaaS) or deployment models (Private cloud, Public cloud, Hybrid cloud).

5.3.2 Organization alignment to Cloud

This activity takes into concern the change consequence analysis report and takes necessary actions for smooth adoption of cloud service. Unlike traditional application development, in cloud computing many responsibilities are shared by both business and IT like formation of security risk agreement (SRA). This activity ensures such joint ventures and assigns responsibility for such task. Creating awareness about the benefits and risks of cloud services among employees and arranging training for employees are also responsibilities of this task.

5.3.3 Financial management (Cost and benefit analysis)

In cloud computing, the main concern of financial management is regarding cost and benefit analysis. Although the cost analysis may seem to be easier, but it is not so easy when choosing cloud services for core business activities/ services. For such case, the cost of mitigating risk also needs to be calculated. Likewise the calculation of benefits is also easier. Rendering cloud services may require business process reengineering or may require changes in the organization which may create unrest among employees. Such scenarios usually make it difficult to realize the actual benefit of cloud services. The report from change consequence management and risk assessment activity is important input for the cost and benefit analysis.

5.3.4 Change consequence management

This activity addresses consequences of impacts or potential changes due to adoption of cloud service. Controlling or taking action to mitigate change consequence is not part of the activity.

a. **Change consequence analysis:** involves identifying required changes in the organization and their impacts. The business process required to be restructured is also identified and impact of such restructuring is also analyzed. This impact analysis acts as an input for Go/no go decision

on rendering cloud services. The report on this analysis includes recommendation to mitigate change consequences.

b. **Change consequence monitoring:** involves monitoring the impacts of changes after rendering cloud service. This involves a post change consequence analysis.

5.3.5 Cloud service lifecycle management

This activity is concerned of creating cloud service using existing cloud platforms and resources. Rather than rendering a new cloud service, existing resources may be used to fulfill users' demand. Thus, this activity helps on build or buy decision. Although this seems to be responsibility of IT department but with the help of service registry business can perform such activity.

5.3.6 Governance policy management

This activity is responsible for defining policies that act as business rules to aid quality of service (QoS), authorization etc. It incorporates following activities:

a. **Governance policy definition:** defines Service Level Agreements (SLA) concept, business critical KPI, risk factors, Metrics for monitoring cloud application's performance.

b. **Policy evaluation:** monitors the effectives of policy and recommends adjustments required to meet the quality of services.

5.3.7 Cloud Service management

This activity is to ensure quality of cloud services. That means this activity aims to manage performance of the CSP. It takes input from governance policy management activity. Although security is argued to be an aspect of QoS but in this case we argue security to be dealt with separately since security is most important issue that cloud computing needs to ensure. Following activities include in Cloud service management.

a. **Cloud service monitoring:** monitors whether the service provided by the CSP meets the QoS level mentioned in the SLA.

b. **Cloud service controlling:** communicates with the CSP in case of service performance degradation or deviation from SLA. This may also initiate switching of service to a CSP in case existing CSP performance degrades reputedly. This activity also takes input from activity Security evaluation and Audit management.

5.3.8 Risk management

Risk management can be defined as the process of identifying and understanding exposure to risk and capability of managing it. Risk management includes pre and post risk evaluation (Ahmad & Janczewski, 2011). That is risk evaluation before and after adapting a cloud service. This risk evaluation has two parts – risk assessment of cloud service provider and risk analysis of user information asset. Pre risk assessment report acts as an important factor to decide on rendering a cloud service. It also provides input to Cost-benefit analysis to weigh the impact of potential risk against the cost to mitigate it (Potoczny-Jones, 2011).

a. **Risk analysis of CSP:** evaluates CSP's potential to provide business continuity and credibility against prevailing security standards. Initially this activity needs to be performed by the business but later on after rendering the cloud service it may be performed by an auditor.

b. **Risk assessment of information assets:** In the cloud computing the main asset of the organization is information (Ahmad & Janczewski, 2011). This activity ensures organization's understanding of the impact of a loss of Confidentiality, Integrity or Availablity (CIA) of its information (or information systems) (Radack, 2009; NIST, 2010) and enables the organization to weigh impact of such loss. Such analysis report helps organization to decide on rendering cloud service, choosing deployment or service model, developing risk response strategy and security management process.

c. **Risk response strategy formation:** After pre risk assessment if business decides to render cloud service then strategy formation is required to respond those identified risk. Risk response strategy formation ensures formation of strategy for each of identified risks. Post risk assessment is done to make adjustments to risk response strategy. Risk response strategy and risk assessment report both act as input for security management activity.

d. **Risk response strategy evaluation:** Monitoring whether risk response strategy still fits to deal with risks and proposes adjustments to the response strategy.

5.3.9 Security management

a. **Security policy definition:** Involves determination of security policy essential to implement and review security control and action plan required in case of policy violation. This activity has two aspects. Security policy definition for the users (including IT) and security risk agreement between business and CSP. The outputs of these two aspects are Cloud Security guidelines and

Security Risk Agreements (SRA) respectively. Security guidelines formation is the responsibility of IT and hence out of the scope of BIM. The main purpose of guideline is to inform users about security aspects of a cloud service. While Security Risk Agreement includes principles of transparency and communication between the cloud service provider and business, definition of security incidents and their severity, level of guarantee offered by the CSP against incidents and the consequences of loss of confidentiality or integrity of information asset (Potoczny-Jones, 2011).

b. **Security control enforcement:** Cloud service model defines the scope of security control work for CSP and IT. The purpose of this activity is to limit users' activity according to the scope defined by the security policy. Sometimes internal IT department may need to implement extra security controls in order to make up for a lack of controls from the CSP (e.g. implementing encryption in the transport layer to make up for the lack of a virtual private network). This issue is also not within the scope of BIM.

c. **Security risk control:** This activity is to measure the performance of CSP to meet the SRA. The output of this activity is monthly report assessing the security risk and security services or a notification in case of SRA violation.

d. **Security evaluation:** This activity is to analyze the security service violation (if any) with the security service agreed. The discrepancies report is escalated to *operational supplier management*.

5.3.10 Compliance management

Compliance can be defined as the awareness and adherence to obligations such as corporate social responsibility, applicable laws, ethical guidelines etc. This process is responsible for specifying all the compliance requirements need to meet by the cloud service as well as responsible for determining any new compliance requirements evolved further after rendering a cloud service.

5.3.11 Audit management

Many scholars argue audit management activity to be the part of compliance management (Ahmad & Janczewski, 2011) because the main purpose of this activity is to verify CSP's conformance to the compliance requirements. However, we argue it to be placed as a separate since an auditor may be chosen to fulfill some other role. For example, an auditor may be chosen to perform Risk analysis of CSP. The output of this activity is audit report that works as an input for evaluating quality of cloud services

(evaluating quality of IS). Also the way of working is a major issue of audit management. For example, Ahmad & Janczewski (2011) argues for formation of a joint governance board to deal with *audit management*. While Cloud Security Alliance's guideline (2012) argues for both internal and external auditors' role in such case, such way of working depends on an individual organization and addressing such issue is not within the scope of this research. However, realization of importance of such issue also urges us to isolate *audit management* as an important issue.

5.4 BiSL process and the Cloud computing aspects

Based on literature review, we continue looking for the BiSL processes that are relevant to accommodate the cloud computing aspects. Our findings are illustrated in the table 5.3. However, there is no one-to-one relation between a BiSL process and a cloud governance issue. For example, both *changes consequence management* and *cloud strategy management* issues can be accommodated by more than one BiSL processes. There are some processes which are not shown as relevant to accommodate any of the issue because in our opinion those processes has either no or in some case very little significant role for accommodating any of the issues.

Table 5.3 BiSL processes and Cloud Governance issues

Level	Cluster	Process	Cloud Governance Model/ Resource
Operational	Use Management	End user support	
		Business data management	
		Operational supplier management	Governance policy management (Governance policy definition), Risk management (Risk analysis of CSP).
	Functionality Management	Information requirements specification	Compliance management, Change consequence management
		Prepare transaction	
		Review and Testing	
	Change management	Change management	Change consequence management, Cloud service lifecycle management, Governance policy management (Governance policy

			definition)
	Transition management	Transition management	
Management	Planning & Control	Planning & Control	Risk management (Risk assessment of information asset, Risk response strategy formation, Risk response strategy evaluation)
	Financial management	Financial management	Financial management (cost & benefit analysis), Governance policy management (Policy evaluation)
	Demand management	Demand management	Cloud service lifecycle management, Cloud strategy management
	Contract management	Contract management	Cloud service management, Governance policy management (Governance policy definition), Security management, Audit management
Strategic	Develop I-organization strategy	Manage user organization relations	Organization alignment to cloud
		Manage supplier relations	Governance policy definition (Governance policy definition)
		Define strategy I-organization	
		Manage partner chain relations	
	Define information strategy	Define partner chain developments	Change consequence management
		Define technological developments	Change consequence management
		Manage information lifecycle	Cloud strategy management
		Manage information portfolio	
		Define business process	Change consequence management

		developments	
		Information coordination	

From the above table we see many BiSL process need to accommodate cloud governance issues and thus ask for changes. In table 5.4 we rank the BiSL process according to their need for changes. The ranking is based on assumed amount of changes the processes require. If the process is found relevant for accommodating three or more governance issue then the process recognized as one that require maximum changes. In case of two issues and one issue the processes are recognized requiring moderate and minimum change respectively. In case of no relevant issue, the process is identified requiring no change.

Table 5.4 Ranks of BiSL process require changes

	Require change	Processes
1	Maximum	Change management, Contract management
2	Moderate	Operational supplier management, Information requirements specification Financial management, Demand management
3	Minimum	Manage user organization relations, Define partner chain developments, Define technological developments, Manage information lifecycle, Define business process developments, Planning & Control
4	No	End user support, Business data management, Prepare transaction Review and Testing, Transition management, Define strategy I-organization, Manage partner chain relations, Manage information portfolio, Information coordination

5.5 Discussion

In this chapter we started with briefing the governance models identified in previous chapter. After discussing the models briefly, we identified cloud computing aspects addressed by the corresponding models. To define the scope of cloud computing for BIM, we then, categorized all the identified aspects into 11 major cloud computing aspects. In our opinion, these 11 cloud computing are the major aspects that need to be addressed by BIM practice. After that, we identified which of these aspects need to be accommodated by which BiSL processes so that BiSL framework can function smoothly with cloud

computing. Although we agree that each of those processes are going to be affected by all of those aspects but many of those effects may be naive or insignificant for this project. We were looking for the processes that would require adjustments to accommodate an aspect. Based on our tracing, we found that the change management and contract management processes are the top potential candidate for adjustments, as they are the processes require accommodating maximum number of aspects.

Chapter 6

BIM processes adjustment

This chapter answers the following research question:

RQ5. *How can BIM processes be adjusted to compensate the influence of cloud computing?*

In chapter 5 we have ranked BiSL process based on potential changes they would require and weighed their suitability to deal with cloud computing aspects. In this chapter we propose adjustments to those processes so that they can compensate the effects of cloud computing.

6.1 Required adjustments for BiSL processes

At first we start looking at the adjustment required by the processes. Identifying adjustments for all the BiSL processes would take a lot of time. Such a work is very difficult to finish within the limited period of time of this graduation project. Therefore we limit our work of proposing adjustments to two BiSL processes namely change management and contract management. Our intention is to show the approach to adjust the BiSL processes. So if our approach can be found sound for two processes then the approach can be applied to adjust other processes. Hence which two processes we select for showing our approach does not affect the research.

We observe many of the aspects are already addressed by the BiSL processes. In some cases aspects are addressed adequately while in some cases aspects are addressed partially. While we also observed that some aspects are addressed by the process but not obvious, that means, they are not explicitly shown in the BiSL process models. Thus before proposing adjustments we need to identify what is the existing situation for the support for the cloud computing aspects on a BiSL process. So we define following four attributes which covers four possible situations regarding the support of a cloud computing aspect by the process.

    i.   ***Not covered:*** If the support for the aspect is not present on the process.

    ii.   ***Covered:*** if the support for the aspect is present on the process.

    iii.   ***Partially covered:*** if the support for the aspect partially exists in the process.

    iv.   ***Implicitly covered:*** if the support for the aspect already exists in the process but not explicit.

Based on the processes' completeness to support corresponding cloud computing aspects we assign attribute to the aspects. The aspects for the change management and contract management process with the assigned attributes are shown in table 6.1.

Table 6.1 Change management and contract management processes' support for cloud computing aspects

Process	Relevant cloud computing aspects to be accommodated	Attribute
Change management	i) Change consequence management,	*Partially covered*
	ii) Cloud service lifecycle management,	*Not covered*
	iii) Governance policy management (Governance policy definition- Risk factors, KPI's)	*Implicitly covered*
Contract management	i) Cloud service management	*Partially covered*
	ii) Governance policy management (Governance policy definition- SLA)	*Covered*
	iii) Security management	*Implicitly covered*
	iv) Audit management	*Not covered*

6.2 Proposed Adjustments

Based on the change management and the contract management processes' support for corresponding cloud computing aspects, shown in Table 6.1, we infer required adjustments to them. Thereby in Section 6.1.1 we propose adjustments to change management process and in section 6.1.2 we propose adjustments to contract management process. Proposed adjustments to the processes are shown in red color in their corresponding figures (Figure 6.1 and 6.2). The original process models, meaning of the notation used in process models can be found in the appendices B, C and D respectively.

6.2.1 Adjustment to change management
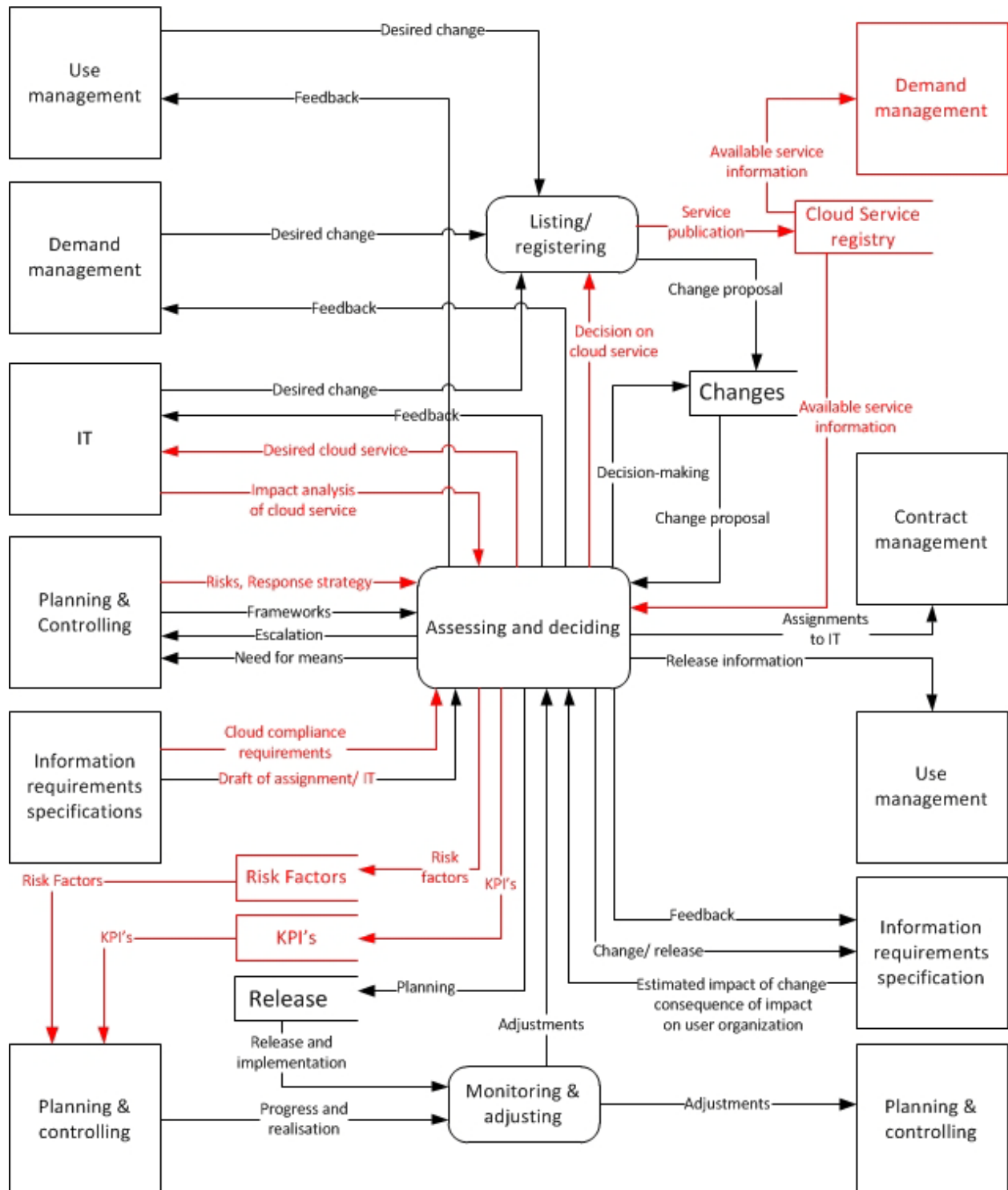
Figure 6.1 Change management process (with proposed adjustments)

Figure 6.1 shows the change management process with our proposed adjustments (showed in red color). Many new data flows are introduced in the process. Cloud compliance requirements are shown to come from the Information Requirements Specification interface. Further the process adjustments show that Impact analysis report on cloud service report is sent by internal IT department. That shows IT department's significant contribution to deal with cloud computing. A data store cloud service registry is introduced, which records all the relevant information on available cloud services. Two other data stores for risk factors and KPI's are also shown in the adjustments. Although risk factors and KPI's are originated in the change management process, they were not shown in the original process diagram. This is may be due to their less significant role in the original process. However, due to their identified importance to deal with cloud computing, they are shown as stores in the adjusted change management process.

6.2.2 Contract management process
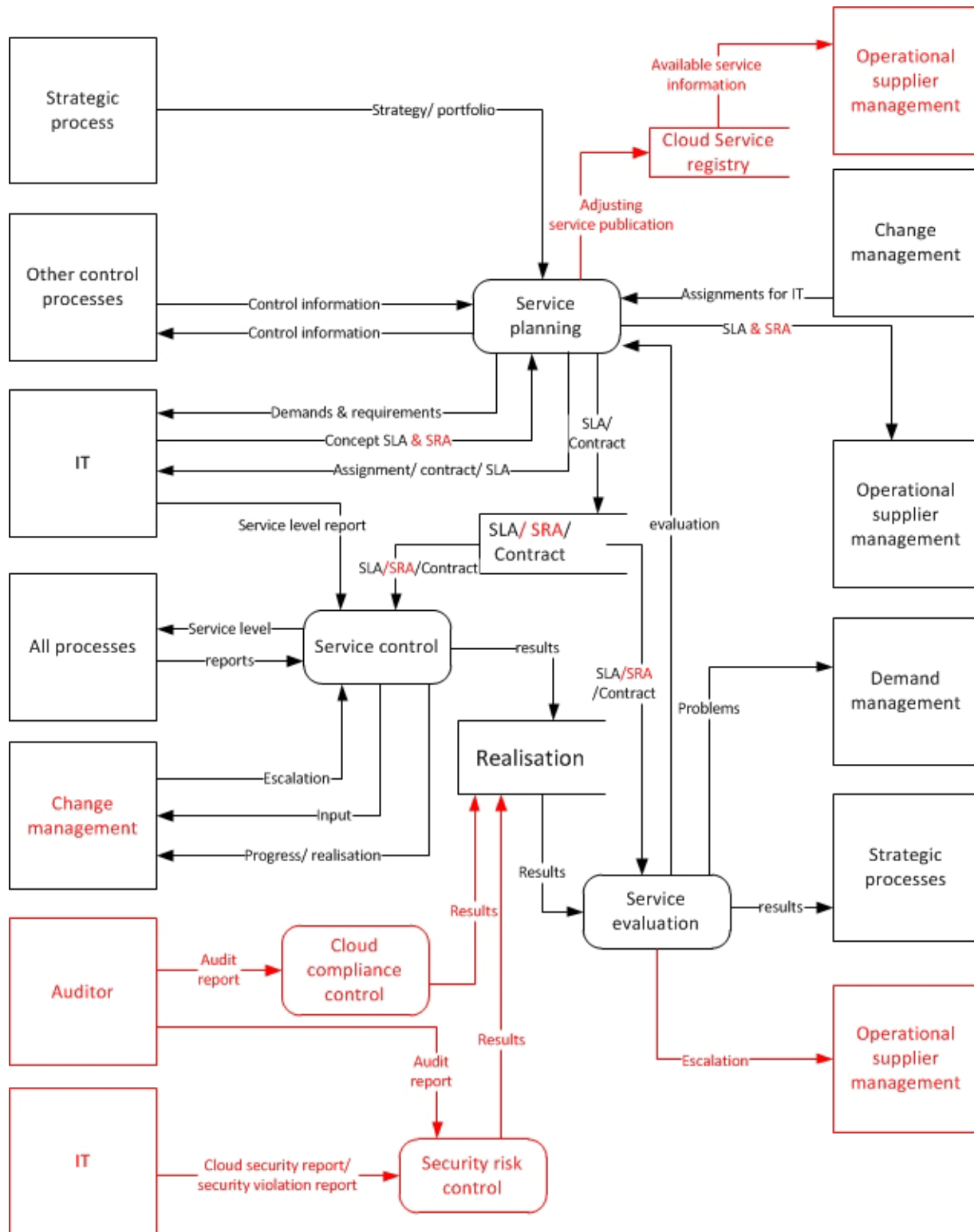
Figure 6.2 Contract management process (with proposed adjustments)

Like in the case of the change management process, many new data flows are proposed in the process contract management (figure 6.2). Data store - cloud service registry - introduced in change management process, is used here to register the adjustments to cloud services. The store for SLAs/Contracts is augmented to store Security Risk Agreements (SRAs), which are specific agreements with CSP for security risk. Two new activities, namely cloud compliance control and security risk control have been introduced. With the help of auditor's report, the cloud compliance control activity is responsible for measuring CSP's compliance, while the security risk control activity is responsible for measuring CSP's compliance with SRAs. Along with auditor's reports, the IT department's monthly security report (or security violation notification) is used for measuring CSP's compliance with security requirements.

6.3 Function of the adjustment

To show the proper functioning of proposed adjustments to *change management* and *contract management* processes we introduce a business process scenario where an organization is *rendering a cloud service*. Our intention is to show the completeness of the processes to deal with the cloud computing. However to illustrate such a scenario with the help of only two processes is quite difficult and may reveal too little information to understand the scenario. Hence we also incorporate *planning and controlling process* to illustrate the scenario.

6.3.1 Overview of the process for rendering a cloud service
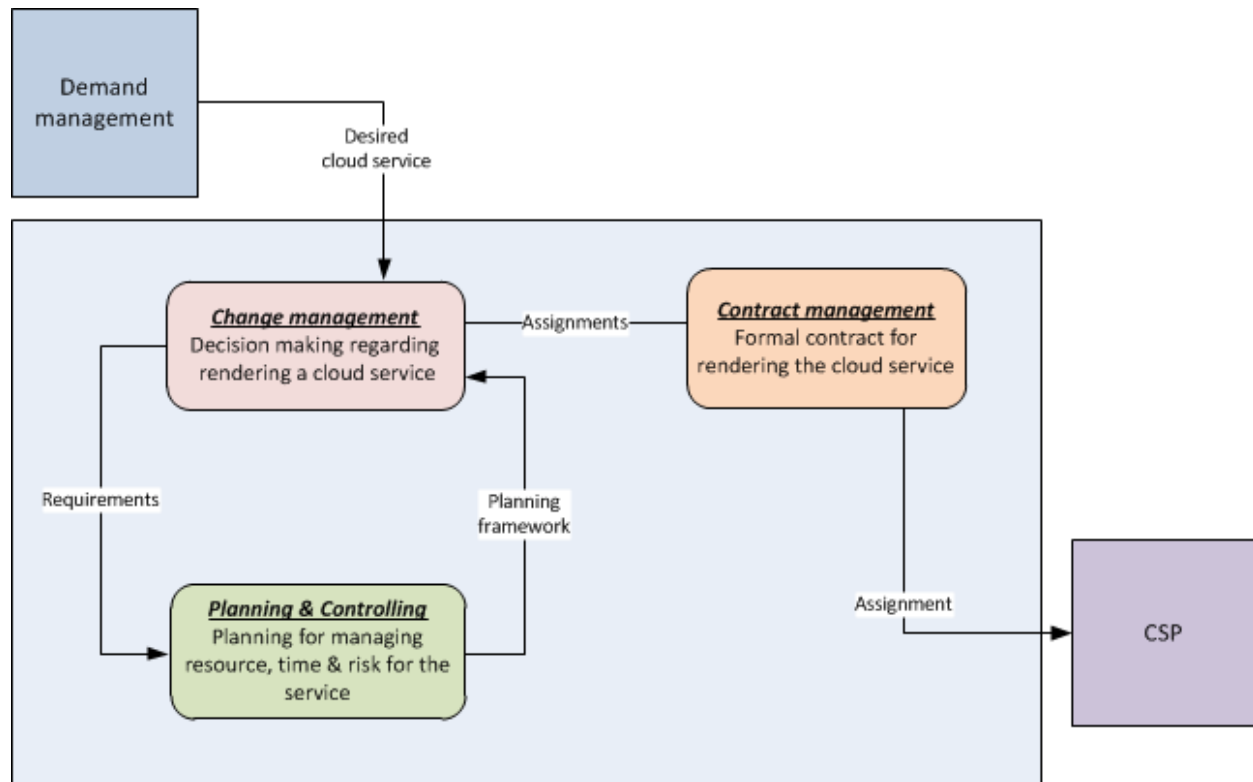
Figure 6.3 Overview of the process for rendering cloud service

Figure 6.3 shows the overview of the process for rendering a cloud service (i.e., adopting or using a new cloud service) by an organization. The process is triggered by the Demand management, which sends a demand for a cloud service (or simply demand) to the change management process. The whole process ends by sending assignment to CSP. The role of change management, contract management and planning and controlling processes are discussed below:

The Change management process acts as the starting point where all the demands are received within the business information management (van der Pols, Donatz & van Outvorst, 2007). Appropriate decision regarding a demand is made within the change management process (BP034 Process Description Change Management, 2010).

The Planning and controlling process ensures necessary use of information provision on time. Along with planning for necessary capacity and required time lines for the required changes, this process recognizes risk and risk response strategies (van der Pols, Donatz & van Outvorst, 2007; BP007 Planning & Control Process description, 2008).

The Contract management process is responsible for making agreements (SLA, SRA etc) regarding IT services (cloud services) (BP014 Contract Management Process Description, 2008). Within this process, the customer role of business for the IT service (cloud service) is realized (van der Pols, Donatz & van Outvorst, 2007).

6.3.2 Business process model of the scenario
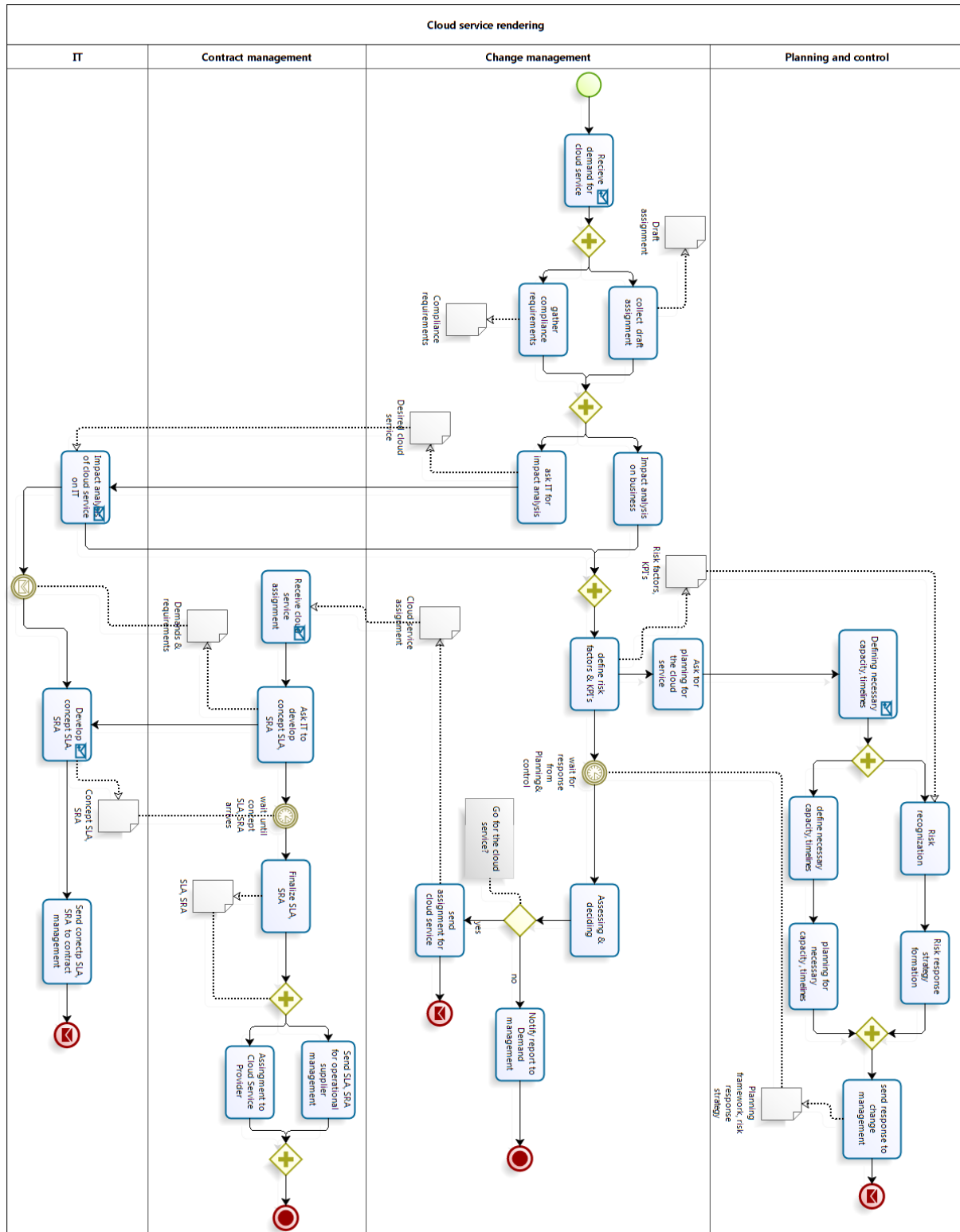
Figure 6.4 Business process model of an organization rendering cloud service

The overview of the process shown in Figure 6.3 is illustrated with a business process model in BPMN, as shown in the Figure 6.4. The model shows activities being carried out in the *change management, contract management* and *planning and control* processes. Along with these three processes, the model shows a few activities being carried out by IT, depicting IT's contribution to the BIM process. This is also an indication of the maturity in business and IT alignment.

The process begins when a demand for cloud service is received by the *change management* process. Then there are two parallel activities: to collect a draft assignment (requirement specification) and to collect compliance requirements for the cloud service. After these two activities finish, the impact analysis for the cloud service is performed. Impact analysis of cloud service on business is performed in the *change management* process, while IT is asked to perform the impact analysis of the cloud service from IT perspective. The risk factors and relevant KPI's are defined. Both impact analyses play an important role in this activity. After this, the *planning and controlling* process is asked to produce the planning for the required cloud service and process is kept waiting for a response.

Risk factors and KPI's defined by the *change management* process act as important input for the activities of the *planning & controlling* process. A planning framework is developed in which allocation of required resource, capacity, timeliness, risk and risk response strategies are defined. Then the planning framework is sent back to the *change management.*

Upon receiving the planning framework, the *change management* resumes and final assessment is done to decide whether to render the cloud service. If the decision is positive, the assignment is sent to *contract management* process for further action. Otherwise, a notification of rejection is sent to the *demand management* process*.*

Upon receiving the assignment, the *contract management* asks IT to develop a concept SLA and SRA and waits for IT to finish the job. After IT sends the concept SLA and SRA to the *contract management*, they are modified (if required) and finalized. The entire process then ends by sending SLA and SRA to *operational supplier management* and assigning a contract for the cloud service to CSP.

Discussion

In this chapter we proposed adjustments to the change management and contract management processes. The reason for selecting change management and contract management processes for adjustments is, their potentiality for processes requiring maximum changes. This doesn't indicate that

other process would not require changes nor we say these processes as the only processes requiring maximum changes. Other processes would require changes and any other processes can be argued requiring similar or more changes. Our selection of these two processes is just a choice of decision we made. Because our intention is to show how the adjustments can be done to BiSL process. If the approach of adjusting these two processes can be found functioning properly then in future other processes can be adjusted by following the same approach. After proposing adjustments we have shown how the processes can handle a cloud computing scenario. To depict the scenario we use the help of planning and controlling process and incorporate the role of IT. In our opinion these type of depiction make BiSL users understand the application of the framework.

Chapter 7

Validation

According to Wieringa (2009), a design validation is a knowledge task in which researchers try to find out whether the design would fulfill the goal of the stakeholders or not. In this chapter, we validate whether adjustments to the BiSL processes can alleviate the influence of cloud computing. If both of our approach of work and adjustments to two BiSL processes, namely change management and contract management, are proved sound then we can argue that the approach can be applied to adjust other BiSL processes. This chapter answers to the following research question:

RQ6. *How suitable are the proposed adjustments to compensate the influence of cloud computing?*

Rest of the chapter is structured as follows: Section 7.1 states the aim of the validation, Section 7.2 illustrates the method used for validation and its application, Sections 7.3, 7.4 and 7.5 discuss the of the validation of our approach to adjust and the adjustments. Finally, section 7.6 shows modified version of proposed adjustments based on validation outcome.

7.1 Aim of the validation

The aim of our validation is twofold, which is discussed below.

7.1.1 Validation of the approach

Figure 7.1 shows our approach to adjust the BiSL processes. As shown in the Figure 7.1, our approach starts with identifying relevant governance models. Then our approach identifies major cloud computing aspects from those models. In the next step our approach maps identified cloud computing aspects onto the BiSL processes. Based on the BiSL processes suitability to accommodate the mapped aspects, we then, propose adjustment to the change management and contract management processes.
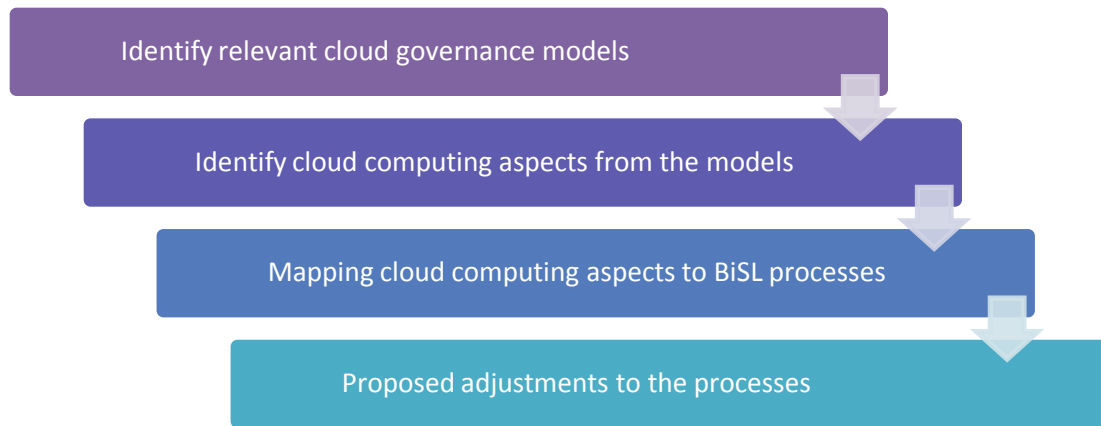
Figure 7.1 Approach of bringing adjustments to BiSL processes

For validating the approach, we define following four quality attributes that we are going to measure during the validation.

i. *Completeness* of the scope of cloud computing: Our approach starts with identifying cloud computing governance models. In our opinion, these governance models should have covered all the required aspects of cloud computing. However, we need to measure whether those governance models could really complete the scope of cloud computing.

ii. *Relevance* of the cloud computing aspect list: In our approach we extracted cloud computing aspects from the governance models. Although those aspects may complete the scope of cloud computing, their relevance for this project can be questioned. Thus it is required to validate relevance of cloud computing aspect list.

iii. *Completeness* of the scope of Cloud Computing aspects: After validating the relevance of cloud computing aspect, it is necessary to measure the completeness of the scope of the list. Even if the list is proved to be relevant for the project, some aspects may be missed out (scope may be argued too narrow) or some aspects may be proved irrelevant (scope may be argued too broad).

iv. *Adequacy* of the mapping process of Cloud computing aspects to BiSL process: Finally before looking for adjustments, cloud computing aspects list was mapped to BiSL process. This mapping was done based on our literature reviews on BIM, BiSL and cloud computing aspects. It is required to measure whether the aspects were adequately mapped onto BiSL processes.

7.1.2 Validation of the proposed adjustments

After validating the approach, we aim to validate the adjustments that we proposed to the change management and the contract management processes. We want to measure following two attributes to validate our adjustments.

i. Completeness of the proposed adjustments: In our approach we mapped relevant cloud computing aspects onto the BiSL processes. We need to measure whether the adjusted process can accommodate the mapped aspects properly or not.

ii. Correctness of the proposed adjustments: After that we need to measure whether the adjustments we proposed are correct or not.

7.2 Validation method

We have used the Delphi method for the validation. The main reason for using this method is that, this method enables us to discuss our approach and adjustments to the participant in detail before achieving their opinion. Unlike many other methods (e.g. structured questionnaire survey) this method does not force for a quick compromise.

7.2.1 Delphi method

According to Adler and Ziglio (1996), Delphi method is a communication process that is structured to produce detailed examination of a topic or problem and discussion from the participating group. This approach consists of surveys conducted in two or more rounds and in the second round participant are provided with the results from the first round and have the opportunity to alter their opinion provided in the first round (Cuhls, n.d.). However, in this case rather than following the standard Delphi method we would follow a modified version of Delphi method. In the first round a face to face interview will be conducted and in the second round a structured questionnaire survey will be performed.

7.2.2 Phases of Delphi method

Although we will follow a modified version of Delphi, we will maintain the standard phases and stages of Delphi. The phases of Delphi are depicted in Figure 7.2. The depiction and description are done based on the works of Linstone & Turoff (1975) and Dobbins (2004). The first phase of the method is to explore the subject under discussion. Participants are given opportunity to contribute with information. The second phase is to determine the group views on the issues such as clarification of proper meaning of a term. The third phase is to explore disagreement and their reasons. In our case, there is little chance of disagreement and this phase would have little value for our validation. However, for our validation this

phase will be driven by Delphi principle which is consensus of opinion (McCallister, 1992). In the fourth phase, a final evaluation is to be done where outcome of the previous phases are considered.

Phase: I	Phase: II	Phase: III	Phase: IV
•Explore the project to the participantes & Give them opportunity to contribute information	•Determine the group views on the issues presented	•Explore disagreement and their reasons	•Final evaluations of gathered information
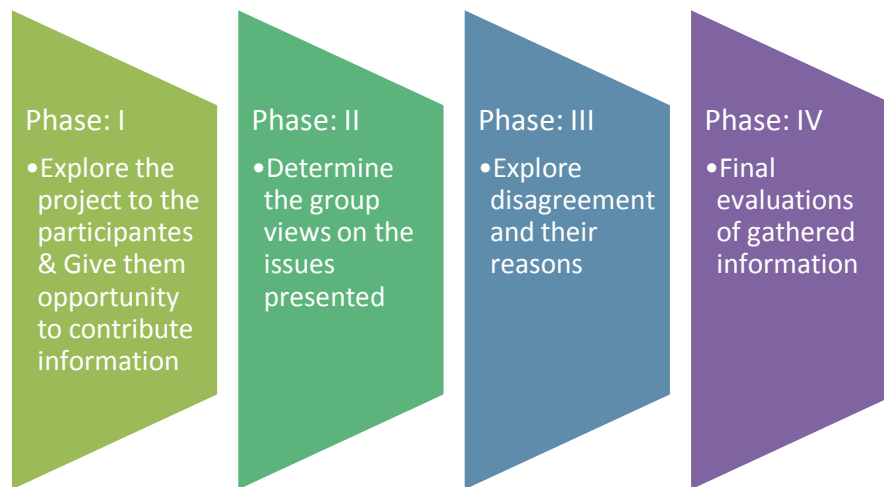
Figure 7.2 Phases of Delphi techniques (Linstone & Turoff, 1975; Dobbins 2004)

7.2.3 Application of Delphi

a) Rounds: For our validation, we will go for two rounds. The first round will address the first two phases where participants will be presented the work in detail. They will be asked to put their comment and opinion. They will have the chance to clarify any confusion on any part of work. On the contrary, we will ask them to clarify and reason for any of their suggestion and opinion. In the second round, the same participants will be asked to score the work presented in the first round. They will also be asked to score the opinion and suggestion made by the participants in the first round.

b) Stages: Aforementioned two rounds will be completed in 8 stages as depicted in the figure 7.3. Stages from I – IV will be addressed during round one and stages from V – VIII will be addressed during round two.
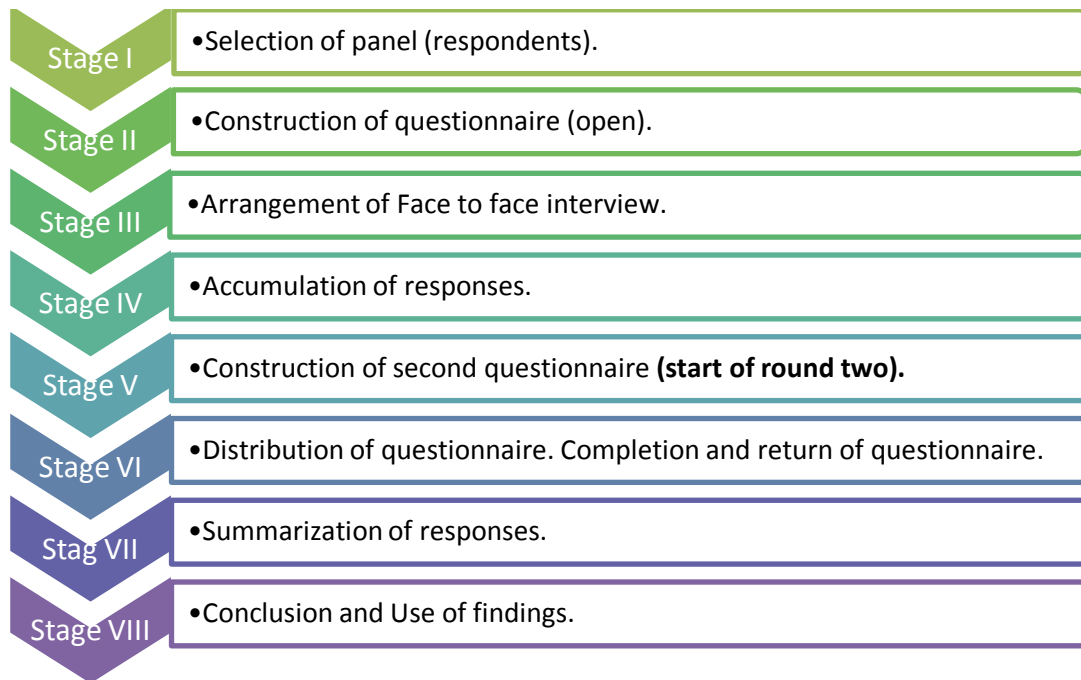
Figure 7.3 Stages followed to apply Delphi technique

I.   Selection of expert panel.

II.   Construction of questionnaire (open). The questionnaire is designed in such a way so that the individual participant can evaluate, elaborate, criticize and comment on topics.

III. Arrangement of face to face interview. During the interview, before asking any question it is ensured that the interviewee has proper understanding of the topic relevant to the question.

IV.   Accumulation of responses. All the suggestions or opinions from the interview are collected. Those are refined, categorized and combined for using in the second round.

V.   Construction of questionnaire survey. Survey questionnaire is designed to allow participants to score items presented in round one and items that are derived from their suggestions during round one.

VI.   Distribute survey questionnaire.

VII. Summarization of responses. 100% response from the distribution of survey questionnaire is ensured and the responses are summarized.

VIII. Make conclusion and use of findings.

c) Setup: In the first round, face-to-face interview will be conducted where participants will encounter unstructured questionnaire (Appendix E). For the second round a structured survey questionnaire has been prepared (Appendix F). The survey questionnaire will be presented online and the questionnaire

will require Likert-type response for every question. Second round survey will check users' agreement on different suggestions made by them in first round interview and will show users agreements on the soundness of the approach and correctness of the adjustments. As the Delphi method suggests the participants should have expertise on the presented issue. The panel selected for our validation consists of 4 experienced consultants who work for ICT consultancy companies, and one senior product project manager who works for an insurance company.

7.3 Validation of the Research approach

In the first round, a series of face-to-face interviews has been conducted and qualitative analysis on data retrieved from interview has been performed.

7.3.1 Results on the first round interview

Here we present the result of the questions that were asked to validate our research approach. Questions Q1 to Q5 and Q8 were asked for this purpose. A complete list of questions for the face to face interview can be found in the Appendix E. The intention of the first round interview was to present the work to the participants in detail and then ask for their opinion. Participants were also given chance to suggest about the approach during the interview. Participants were also asked to reason their opinion or comment.

Q1. This project uses four cloud governance models and one SOA governance model. Do you know any other cloud governance model (or similar model) that could be considered?

Quality attribute: Completeness of the scope of cloud computing.

Summary response: Two models were identified by the participants that could be used, namely Basel III and ISO 38500. Basel III is a global regulatory standard on bank capital adequacy, stress testing and market liquidity risk (Basel III - Wikipedia, the free encyclopedia, n.d.) and ISO 38500 is a standard for IT governance (ISO 38500 (ISO38500) IT Governance Standard, n.d.). However, when the participants were asked to reason for their opinion, none could clearly give the reason. Furthermore, participants gave their comments on appropriateness of using such governance models for this project. All participants except one agreed on appropriateness of using these models. The participant who did not agree on using these five models, argued that using only one cloud governance model would be sufficient to complete the scope of cloud computing.

Outcome: Scope of cloud computing is quite complete. However, Basel III and ISO 38500 could be considered for this research.

Q2. This project considers a list of cloud computing aspects. Do you think this list contains relevant aspects?

Quality attribute: *Relevance* of the Cloud Computing aspect list for this project.

Summary response: All the participants agreed that the cloud computing aspects list is relevant for the research.

Outcome: Cloud computing aspect list is validated as relevant for the research.

Q3. Is there any other cloud computing aspects that should be considered?

Quality attribute: *Completeness* of the scope of Cloud Computing aspects.

Summary response: Although participants argued that the list is quite complete as it covers most of the important relevant cloud computing aspects, however, some of the aspects were identified by the participants that could be considered for the project. One participant pointed the resource management issue and he argues this aspect needs to be addressed before starting with the *contract management* process. He termed it as pre-contract management process. According to his opinion, this issue enables the organization to look at the resources in a different way while deciding on rendering a cloud service. He argues that resource management needs to be addressed in a different way for cloud computing. Another participant pointed at IT architecture (infrastructure) issue. He argues sometimes new cloud services need to function with existing traditional systems. That requires IT to take concern of the infrastructure before rendering a new cloud service. However, when the participant was asked to reason why he thinks this issue to be within the scope of BIM rather than within the scope of IT, the participant could not give satisfactory reason. Another participant pointed out the issue of interoperability, data portability and reversibility. According to the participant, this issue is an important one which needs consideration when cloud users want to switch between CSP or want to move from public cloud to private cloud. Ownership issue has been pointed out by one participant. The argument was that within an organization, different departments own different cloud services (or systems) which are shared among different departments. This issue needs consideration because changing such a shared service is a difficult task, as it requires concern of others who are using. Finally one participant pointed out that issue related to different cloud service model. He argues depending on the type of service model the

activities (such as SLA/ contract development) within the change management and contract management process may vary.

Outcome: The scope of cloud computing aspects is not found fully complete, i.e., the scope is found to be a bit narrow. Identified aspects that could be considered in the project are i) resource management ii) IT architecture (infrastructure) issue iii) interoperability, data portability and reversibility iv) Ownership issue v) issue related to cloud service model.

Q4. Is there any aspect that should not be considered?

Quality attribute: Completeness of the scope of Cloud Computing aspects.

Summary response: All the participants argued that none of the aspects of cloud computing is irrelevant.

Outcome: The scope of cloud computing aspect is found not too large.

Q5. This project prescribes that the 'Change management' process requires accommodating 3 cloud computing aspects namely: i) Change consequence management ii) Cloud service lifecycle management iii) Governance policy management. Do you agree with this?

Quality attribute: Accuracy of the mapping of cloud computing aspects onto the change management process.

Summary response: All the participants agreed that the three aspects indeed require to be addressed within the change management process. However, two of the participants pointed out that two of the newly identified aspects namely IT architecture (infrastructure) issue and ownership issue should be addressed in the *change management* process.

Outcome: The mapping process of cloud computing aspects to the change management process is found to be accurate. The two new aspects identified necessary to be addressed by the participants, do not affect the accuracy of mapping process, as they were not identified in the prior stage of the research.

Q8. This project prescribes that 'Contract management' process requires accommodating 4 cloud computing aspects namely: i) Cloud service management ii) Governance policy management iii) Security management iv) Audit management. Do you agree with this?

Quality attribute: Adequacy of the mapping process of Cloud computing aspects to the Contract management process.

Summary response: Similar to the change management process, participants also agreed that these four aspects are indeed required to be addressed within the change management process. However resource management and Interoperability, data portability and reversibility issues are identified to be addressed by the contract management process.

Outcome: The mapping process of cloud computing aspects to the contract management process is also found to be accurate. Like the case of change management, the other two new aspects identified necessary to be addressed by the participants, do not affect the accuracy of mapping process as they were also not identified in the prior stage of the research.

7.3.2 Findings from the first round interview

We find that although usages of governance models seem to cover the scope of cloud computing scope sufficiently, it is not the case. As the participants identified several missing aspects of cloud computing, namely resource management, IT architecture (infrastructure) issue, interoperability, data portability and reversibility, ownership issue and issue related to cloud service model, this indicates that the scope of cloud computing aspects is not fully complete. We also observed that this missing of aspects, makes the mapping process of cloud computing aspects to BiSL processes incomplete. Although participants argued that the mapping process to be quite accurate, the absence of several cloud computing aspects makes our approach questionable.

7.3.3 Results of the second round survey

From the result (Q 1, 3, 5 and 6) of second round survey (Appendix H) we see that users have different opinion regarding *relevance of governance* for the research. We found this consideration was relevant in some aspects. On the contrary participants agreed that the many of the cloud computing aspects are relevant. Thus we can say, this governance model consideration left some cloud computing aspects unidentified.

Further, we found the mapping process of cloud computing aspects to BiSL process quite satisfactory. Participants agreed upon the three cloud computing aspects that the change management process needs to accommodate. For the contract management process they also agreed upon three aspects which require to be accommodated. They only moderately agreed that the cloud service management

aspect requires to be accommodated by the contract management process. Complete response to the survey and criteria for deriving participants' agreement can be found in appendix H.

7.3.4 Findings from the second round survey

The result of the second round survey reflects participants' opinion found in the first round interview. However, only the new view we found that participants show moderate agreement on the fact that cloud service management requires to be accommodated by the contract management process.

7.4 Validation of the proposed adjustments

7.4.1 Results of the first round interview

Here we put the result of the first round interview questions that were asked to validate our proposed adjustments. Questions Q6 and Q9 were asked regarding the completeness of our adjustments to compensate with the influence of cloud computing while Q7 and Q10 were asked to validate the accuracy of those adjustments. Finally Q12 asked to verify the applicability of the proposed adjustments to deal with a cloud computing scenario.

Q6. Consider the proposed adjustments to the 'Change management'. Do you think these adjustments are complete?

Quality attribute: Completeness of the adjustments proposed to the change management process.

Summary response: All the participants agreed that the adjustments made to the change management process is quite complete to deal with cloud computing aspects. However they argued that missing aspects - IT architecture (infrastructure) issue and ownership issue - could make the change management process more adjusted to compensate the impacts of cloud computing.

Outcome: Although missing cloud computing aspects could make the adjusted change management process more complete, the adjustment proposed are found to be complete.

Q9. Consider the proposed adjustments to the 'Contract management' processes. Do you think these adjustments are complete?

Quality attribute: Completeness of the adjustments proposed to the contract management process.

Summary response: Participants agreed that the adjustments made to the contract management process, are quire complete like they agreed with the change management process. But it is also pointed out that missing aspects – resource management and Interoperability, data portability and reversibility issue- could make the contract management process more adjusted to compensate the impacts of cloud computing.

Outcome: Although missing cloud computing aspects could be made the adjusted contract management process more complete, the adjustment proposed are found to be complete.

Q7. Consider the proposed adjustments to the 'Change management'. Do you agree with these adjustments?

Quality attribute: Correctness of the adjustments proposed to the contract management process.

Summary response: While validating the correctness of the proposed adjustment we found some interesting comments. Three participants agreed that adjustments proposed are quite correct. Some new adjustments are also proposed by them. One participant argued that IT should not be shown responsible for impact analysis. One participant suggested that new release information should be shown to trigger demand. So data - release information - flowing from the activity accessing & deciding to the demand management process should be shown. Two participants who are closely working with the development of BiSL framework identified some flaws that were present in the original process model (appendix B). This original process model was taken from the work of van der Pols, Donatz & van Outvorst (2007) which is a translated version of the original Dutch work. They admitted that the translation was not by original authors of the book and the translated work has some vagueness in it, which is the reason for presence of such flaws in the model. One flaw they identified is that, the 'Management processes' was translated to 'Controlling process'. Therefore in our model it was termed as 'Planning & Controlling' process. This flaw couldn't be identified as 'Planning & controlling' process was also part of 'Controlling processes' or 'Management processes'. One of the participant informed a newer version of the book is going to be available soon where it is shown data flow 'Terms/Conditions' to be flown from 'Management processes' (formerly 'Controlling processes') to *Assessing and controlling* activity. In the process model that we have used, this was shown as frameworks. Furthermore, two of the participants argued that the cloud service registry should not be part of the change management process. They also argued that all the management level processes, change management process and IT should be responsible for identifying Risks and KPI's. They reasoned that,

change management can define risk related to bring a new change, and planning and controlling can only define risk with capacity and resources; however there are other risks like finance risk, contract risk etc. Thus all the management processes should be shown responsible for defining Risks and KPI's.

Outcome: Since there were some flaws in the change management process that we have used as a starting point for adjustment, we argue not to derive any conclusion on the correctness of the change management process. In the second round survey, participants are asked to score all the extra adjustments or remarks they have made on the process model. After removing these flaws and accommodating participants proposed adjustments or remarks a new change management process model is developed in Section 7.6.

Q10. Consider the proposed adjustments to the 'Contract management'. Do you agree with these adjustments?

Quality attribute: Correctness of the adjustments to deal with cloud computing.

Summary response: Like in the change management process, a flaw was identified in the contract management. Interface 'other control management' processes should be 'other management processes'. Another flaw was pointed out that, the escalation should be shown from the operational supplier management to the contract management process. Besides these flaws, participants agreed with other adjustments. They also proposed some adjustments. Two of the participants argued that SRA is not required to be mentioned as it is already covered by the term contract. One participant argued operational supplier management need to be shown keeping demand management updated about new supplier. So data flow - new supplier information - from the operational supplier management to the demand management need to be depicted in the model. A participant argued that cloud service registry should not be part of contract management, it can rather be part of application management. Other participant suggested it is not required to be shown separately as he argued it is part of data store for SLA/SRA/Contract. Another suggestion came out that security violation report should be shown to move from IT to demand management.

Outcome: We also do not derive any conclusion regarding correctness of adjustments proposed for the contract management process. Rather we asked the participants in the second round survey to score all the extra adjustments or suggestions they have proposed. After removing flaws and accommodating participants proposed adjustments or remarks a new contract management process model is developed in Section 7.6.

Q12. Consider the scenario where an organization renders a cloud service. The process diagram is shown with the help of three processes – Change management, Contract management and Planning and Control. Do you miss any activity in this process?

Quality attribute: Applicability of the BiSL processes to deal with cloud computing.

Summary response: Participants agreed with the completeness of scenario depicted with the three processes – change management, contract management and planning & controlling. They argued incorporation of more processes in the scenario, would make the depiction more complete. However, they agreed that this is complete in case of such limited scope of the scenario. But several remarks were made by the participants. The most important one was that the planning and controlling process could be replaced by all management processes. They argued that this would make the scenario more complete as all the management processes are responsible for defining risks and KPI's. We agree with this remark and we state this could not be realized before due to the existing flaws in the initial change management process model which we have already discussed in the previous section. Some of them also argued that 'receive demand for cloud service' should be replaced with 'demand for change'. A participant pointed out that the notification of rejection should be shown to the party who place the demand for the change (here cloud service) not to the demand management only. A participant pointed out that a link between 'Risk factors, KPI's' and IT while developing concept SLA/SRA/Contract should be shown. A participant remarked that 'gather security requirements' by the change management process should be shown explicitly as 'gather compliance requirements' is shown.

Outcome: From the outcome of this question we see that participants are quite satisfied with the applicability of the processes to deal with the scenario where an organization is going to render a cloud service. Although they argued incorporation of more processes in the scenario would make the depiction more complete but no major missing aspect was identified that could lead to failure to deal with impacts of cloud computing.

7.4.2 Findings from the first round interview

We find that our approach could not identify several cloud computing aspects. Thus we thought our proposed adjustments to the change management and contract management processes would be argued as incomplete. Surprisingly participants were positive regarding the completeness of the adjusted processes. Furthermore, we find that despite missing aspects in the adjusted processes, participants agreed that the adjusted processes dealt with a cloud computing scenario adequately.

Further we find out that there were few flaws in the process models from which we started our adjustment work. Although participants argued that the proposed adjustments are not incorrect but with the presence of these flaws in adjusted process models, we argued not to conclude anything regarding the correctness of the adjustments. Therefore, we decide to remove those flaws and design new models for the change management and contract management processes later in this chapter. In the second round survey participants were asked to score the adjustments they proposed in the first round interview. The adjustments, on which participants agreed, are also accommodated in the newly designed process models.

7.4.3 Results of the second round survey

From the result of survey (Q 7, 8, 10, 11 and 13) we see that participants agreed that the adjustments processed to the processes are complete. However, regarding correctness participants showed difference in opinion. In our opinion, the participants who identified the flaws in the initial models did not agree with the correctness. This response was expressed by them during the first round interview. However, participants agreed that the process scenario for cloud computing developed using adjusted process is complete. Complete response of the survey can be found in appendix H.

7.4.4 Findings from the second round survey

From the first round interview, we identified flaws on the initial process models on which we started our adjustment process. These flaws were reflected in the adjusted process model and thus the correctness of the adjustments could not get higher rank in the survey. However, we also observe that these flaws were not identified by all the participants and they ranked correctness of the adjustments differently. From this we can argue that there are ambiguities regarding the use of BiSL framework. Further we see participants expressed that the process model developed for the cloud computing scenario is complete. Thus we argue that BiSL framework is suitable enough to deal with cloud computing.

7.5 Other findings

During the first round interview and second round survey users were also asked questions other than to validate the approach and the adjustments. From the first round it was identified that Basel III and ISO 38500 could be considered along with the five governance models. However, when in the second round participants were asked to rank their relevancy, they showed difference in opinion. In the second round, interview participants were asked to score the relevancy of the missing aspects. We found that participants agreed on two aspects - IT architecture (infrastructure) issue and interoperability, data

portability and reversibility issue – as missing aspects. Participants showed different opinions on other issues and no conclusion could be derived due to difference in their opinions.

7.6 Modified process models

During the first round interview, few flaws in the original process models were identified. Also participants expressed their opinions regarding proposed adjustments and also proposed few adjustments. By removing identified flaws and incorporating participants' opinions, two new models for the change management process and contract management process are developed as shown in Figure 7.4 and 7.5.

In the previous adjusted models, adjustments were shown in red color. In these new models, green and yellow colors have also been used. Green colored adjustments are the adjustments that came due to removal of existing flaws or from the proposal of the participants, while yellow colored adjustments are the adjustments that are argued to be removed by the participants.
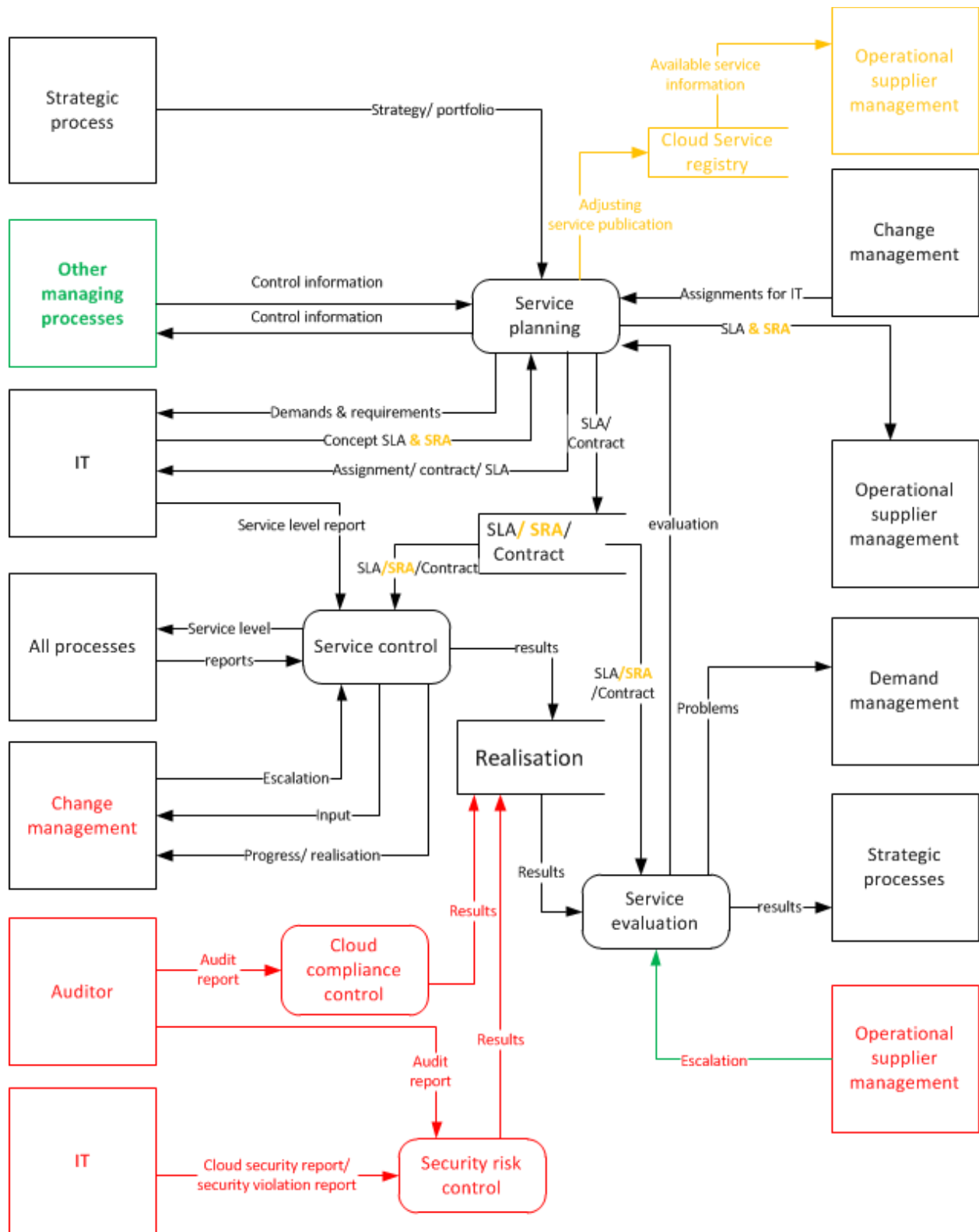
Figure 7.4 Change management process with adjustments (after validation)
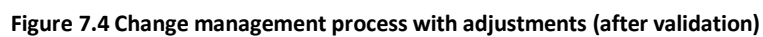
Figure 7.5 Contract management process with adjustments (after validation)

7.7 Discussion

From our validation, we see that despite several missing aspects in the adjusted processes, the processes dealt with a cloud computing scenario quite adequately. This finding urges us to think that BiSL processes are capable enough to deal with cloud computing. However, due to the processes' generic nature users have ambiguity regarding their applicability with cloud computing. Proper guidelines and examples could be used to show their applicability.

While bringing adjustments to the change management and contract management processes, we identified that many of the required adjustments are already present there, but not shown explicitly. For example, SRA was not mentioned in the models. It is argued to be covered by the term SLA/Contract. However, due to its significance in the cloud computing scenario we have made it explicit. Another example is Risk, KPI's. Their data store has been depicted but origin is not explicitly mentioned in the models. We realize the importance of risk factors, risks and KIP's for the cloud computing and argue to mark their origin and their flow explicitly in the process model. Based on the interview, it is our opinion that, due to the generic nature of BiSL, users are facing difficulties when encountered with a cloud computing. However, one participant reasoned that, BiSL only shows 'what to do'; 'how to do' depending on the organizations that are using the framework.

Chapter 8

Conclusion

In this chapter we reflect on our research objective stated as in the following main research question:

"How can the practices of business information management be adjusted in response to the influence of cloud computing?"

To answer this research question we defined 6 sub questions, 5 of which address the objective and one validates the soundness of the approach we have taken. In Section 8.1 we summarized the answers to the sub questions that we answered in the previous chapters. This indicates how we have reached the answer to the main research question. After that, in Section 8.2 we discuss the limitations of our research and finally in Section 8.3 we give recommendations for future research.

8.1 Answer to the research questions

To demark the domain and scope of this research, our first three sub questions (RQ1-3) have aimed to define BIM, its practice and cloud computing. The next research question (RQ4) aimed to look at the practical approaches to BIM (i.e., BiSL) to deal with cloud computing. This eventually enabled us to identify required changes to the BiSL processes. After that, RQ5 considered how BiSL processes need to be adjusted to compensate the influence of cloud computing, and RQ6 finally addressed the soundness of our approach.

RQ1. What is business information management?

Our work started with considering the definition of BIM. We have observed that different authors have different opinion about the concept of BIM. To answer this question we started by comparing BIM with IM. We have shown how IM can be considered a broader concept than BIM. We have argued that the domain of IM encompasses the domain of BIM, and have shown how BIM is a limited view of IM that takes only the business perspective of IM into account. Finally, we come up with a working definition of BIM that clearly indicates its working area while mentioning its major functions. We define BIM as the business approach to information management that defines the processes for

- Managing information as a strategic resource for improving organizational performance

- Controlling the functions of information provisioning.

- Executing day to day activities in information provisioning.

Along with this definition we have also shown BIM's position and working with other two management functions TIM and AM. We have also discussed the functionalities of BIM in order to properly delimit the scope of our work.

RQ2. How is BIM addressed in practice?

This research question aimed to look at the BIM practices. However, we found few publications addressing BIM practices. We found only one practical approach for BIM namely BiSL. Our initial idea was to look at all the practices of BIM and then compare the processes of these approaches. Since we could not identify other BIM practices than BiSL, we considered IM practices for comparison. Since IM domain incorporates the BIM domain we thought that by looking into IM practices we would be able to identify similar processes in those approaches. However, we noticed that IM practices have different variants that are not comparable with BiSL. Thus our answer to this research question only covers the BiSL framework and its processes. The subsequent research questions have been discovered based only on the BiSL framework.

RQ3. What is cloud computing?

Cloud computing is a very broad domain. By providing answer to this question our aim was to define the scope of cloud computing for our work. So rather than looking into different definitions on cloud computing, we used the definition of Cloud Computing provided by the National Institute of Standards and Technology (NIST), US Department of commerce (Mell & Grance, 2011). According to NIST, "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction".

Further we looked at the different service models and deployment models of cloud computing. We identified three common service models for cloud computing, namely IaaS, PaaS and SaaS and identified four common deployment models, namely private cloud, public cloud, community cloud and hybrid cloud. Finally we looked for governance models for cloud computing. Our idea was to consider governance models to identify all the relevant cloud computing aspects, to be able to understand how they affect the BIM processes and the kind of adjustments BiSL processes require for accommodating

those aspects. However, we observed low number of publications and level of maturity in cloud governance. We identified four cloud governance models, namely 1) Microsoft's cloud governance model for Azure cloud platform, 2) Guo and Song's cloud governance model, 3) Yu He's Lifecycle Process model, and 4) Ahmed and Janczewski's Life Cycle model for managing security in Public Cloud. Along with these cloud governance models, we also considered lifecycle approach to SOA governance by Scheper, Iacob & van Eck (2008). Although none of these models is widely accepted, we think investigating governance models has been useful as these models were only used to identify the cloud computing aspects to delimit the scope of cloud computing for BIM.

RQ4. How suitable is the usage of BIM practical approach to deal with cloud computing?

This research question aimed to find out whether BiSL processes can cope with cloud computing aspects. For this purpose we started by identifying cloud computing aspects from the five governance model identified in the answer to the previous research question. We identified 11 cloud computing aspects, namely (1) Cloud strategy management, (2) Organization alignment to Cloud, (3) Financial management, (4) Change consequence management, (5) Cloud service lifecycle management, (6) Governance policy management, (7) Cloud Service management, (8) Risk management, (9) Security management, (10) Compliance management, and (11) Audit management. After that we mapped these aspects onto BiSL processes. Since the cloud computing aspects were successfully mapped onto the BiSL processes, we conclude that the BiSL processes can in principle cope with cloud computing. This also suggests that many of these aspects are already accommodated by the BiSL processes.

RQ5. How can BIM processes be adjusted to compensate the influence of cloud computing?

After the mapping cloud computing aspects onto BiSL processes, our target was to propose adjustments to the BiSL processes in case any of the mapped aspects found not accommodated properly. However, adjustments to all the BiSL processes would take a lot time, which is not feasible in the short period of time of a Master's graduation project. Thus we decided to propose adjustments to two BiSL processes, namely change management and contract management. In our opinion successful adjustments to these processes can be generalized and applied to adjust other processes.

In our mappings we observed that the change management process is required to accommodate three cloud computing aspects, namely Change consequence management, Cloud service lifecycle management and Governance policy management. In contrast the contract management process is required to accommodate four aspects, namely Cloud service management, Governance policy

management, Security management and Audit management. Many of these aspects are already addressed by the corresponding process. Some of the aspects are found to be addressed by the process but are not shown explicitly in the process model. Considering these observations, we made some adjustments to these processes. Some adjustments consisted of defining new elements such as introduction of auditor interface in the contract management while some adjustments made exiting unseen things explicit such as introduction of SRA.

RQ6. How suitable are the proposed adjustments to compensate the influence of cloud computing?

Finally, this question aimed to validate our adjustments to the BiSL processes. During the validation we identified that some more cloud computing aspects like Resource management, Ownership issue, IT architecture (infrastructure) issue, Interoperability, data portability & reversibility issue, Issue related to Cloud service models (SaaS, PaaS, IaaS). However, the proposed adjustments to the processes were found complete, i.e., these processes are capable of dealing with cloud computing satisfactorily, but proper guidelines and examples are required to show their applicability.

8.2 Limitation of the research

We have identified following two major limitations in our work.

i) Lack of realistic case study: The first and foremost limitation we faced was lack of a realistic case study. In the first version of our research methodology we depicted our aim of starting with a realistic case study. It would be more appropriate if we could interview users of BiSL and cloud computing to identify impacts of cloud computing on BiSL and its limitations to deal with cloud computing. However, that would require the access to an organization that is using BiSL and also adopting cloud computing. We could not get access to such a company and thus we had no other option than to study existing literature and search for a different path. Even at a later stage, while proposing adjustments and devising argument for the adjustments we felt the need for consulting BiSL and cloud computing users.

ii) Lack of authoritative work on Cloud governance: The final limitation we faced was the lack of authoritative work on cloud governance and lack of maturity in the existing literature. Although the governance models we identified look satisfactory to cover the scope of cloud computing, they could not cover the scope of cloud computing in our research. For example, none of those governance models addresses cloud deployment and cloud service models. Governance for different cloud deployment models or different cloud service models would ask for different approach. Missing of these issues in the

governance models affected our approach. Our approach missed some cloud computing aspects like issues with cloud governance and deployment models, as the scope of cloud computing was bounded by those governance models we based our work on.

8.3 Future research

Possible activities for the future research are discussed below.

i) Realistic case study: For future research a realistic case study should be performed. This case study would require access to an organization that is using BiSL and also adopting cloud computing. In that case, personnel of that organization who are working with BiSL processes should indicate the limitations they encounter in the BiSL processes while dealing with cloud computing. Thereby adjustments to those BiSL processes could be proposed.

ii) Interviews with BiSL and cloud users: In this research we have identified a list of cloud computing aspects. Since our list is based on literature, in future this list should be extended to make it complete. By interviewing the BiSL and cloud users, the list could be extended, which should ensure proper delimitation of the scope of cloud computing for BIM. In this research we have also developed a business process model for a cloud computing scenario where an organization is rendering a cloud service. The model was developed with the help of BiSL processes. By interviewing BiSL and cloud users a list of similar scenarios for cloud computing could be developed. Further one could try to ensure that the developed scenarios cover all the cloud computing aspects. Interviews with BiSL and cloud users would also be helpful in this case. When developing business process model using BiSL processes the limitations of BiSL processes to deal with particular cloud computing scenarios can get exposed. In such cases adjustments to those BiSL processes could be proposed.

iii) Develop concrete guideline: In this research we have argued that users do not have clear guidelines for the applicability of BiSL processes to cloud computing. Concrete guidelines regarding how to apply BiSL processes in cloud computing, should be developed. The guidelines could consist of business process model templates for different cloud computing scenarios. Preferably they should be illustrated with proper examples for each scenario.
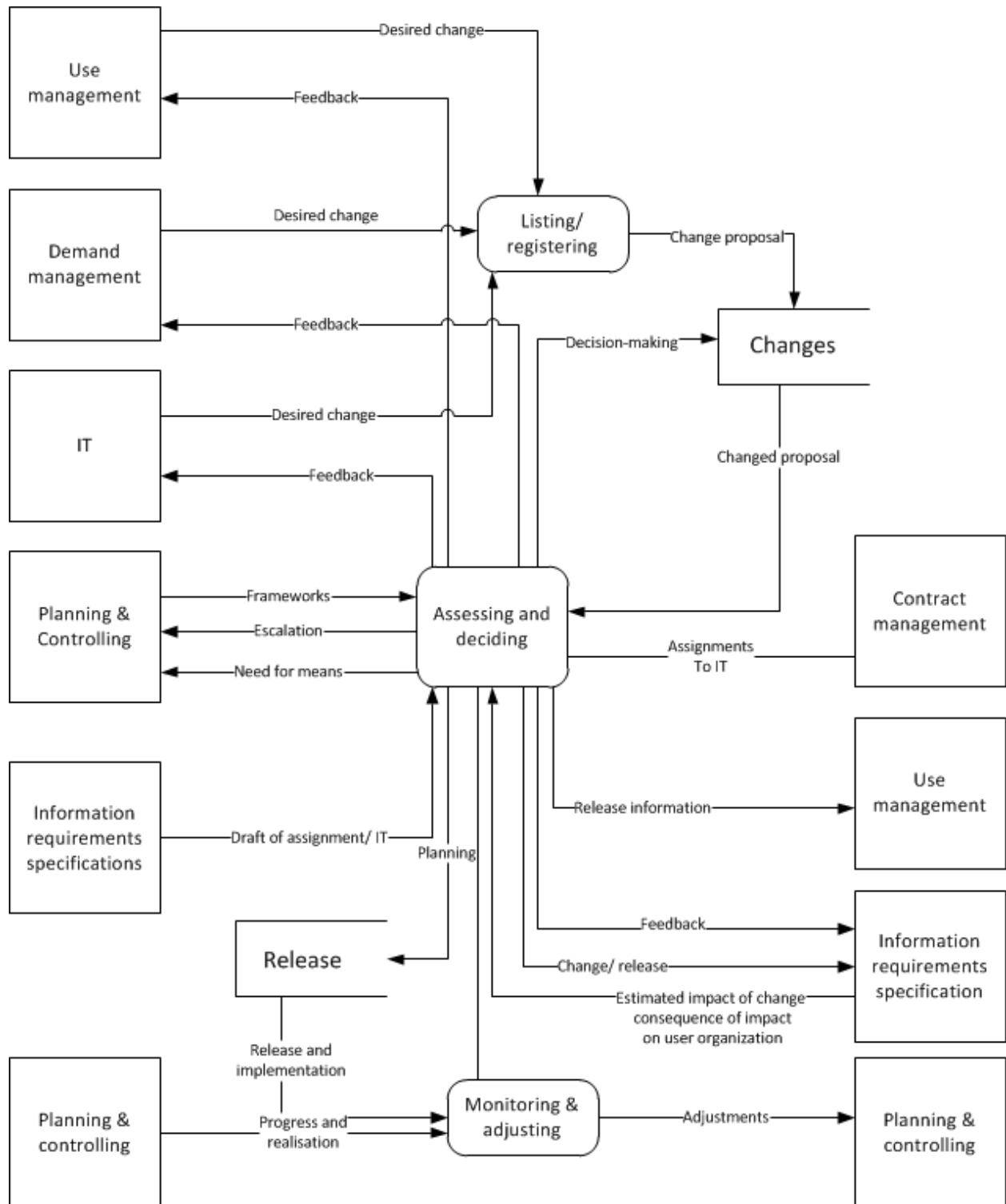
Appendices
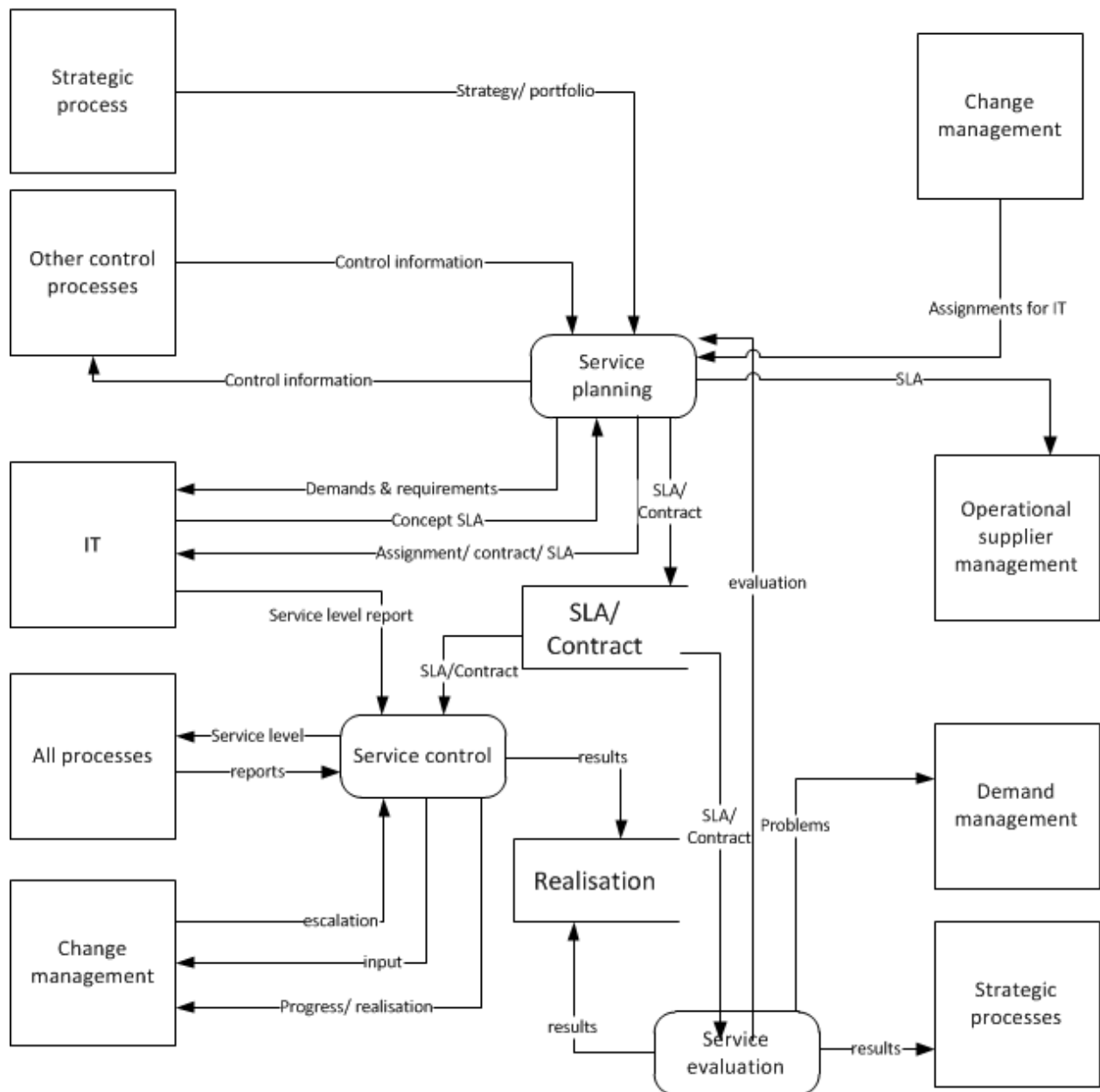
Appendix A: BiSL framework
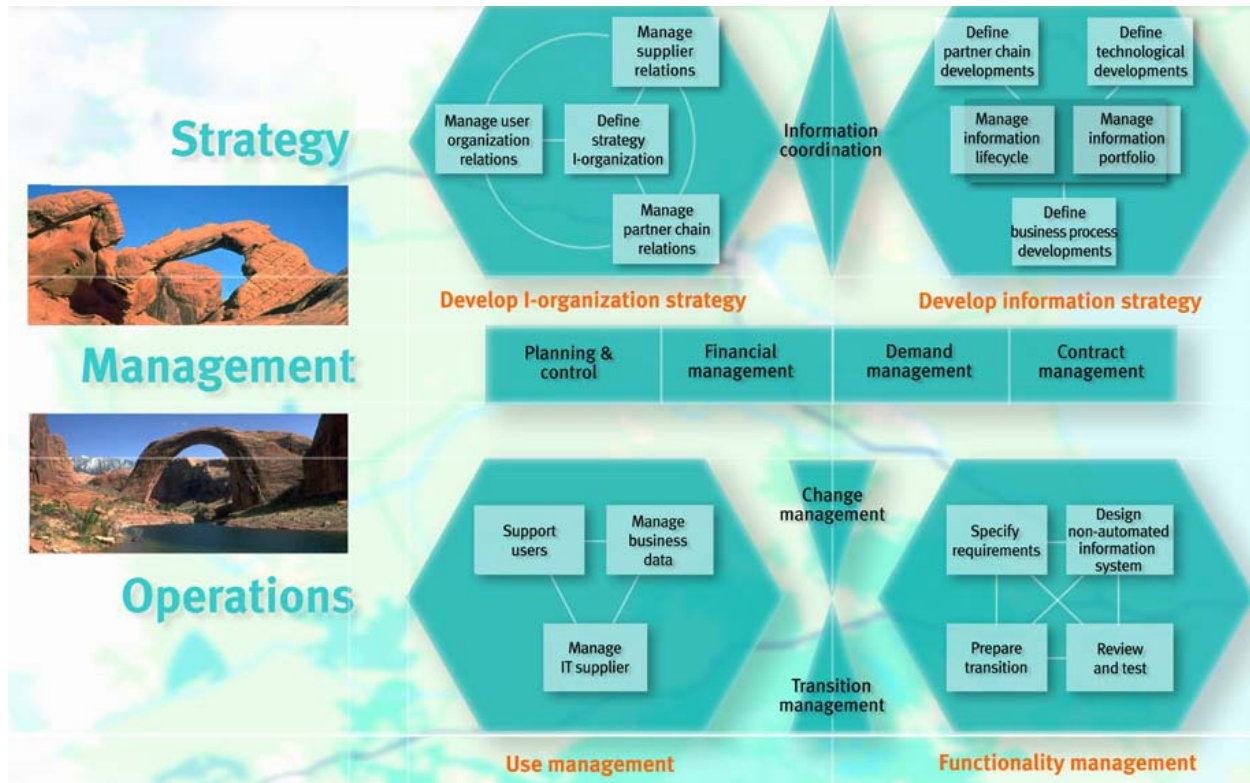
Note: This is an updated version of the BiSL framework a bit different from the one used in this thesis. However the update has been done by modifying few processes name. The purposes and functions of the processes remain unchanged.
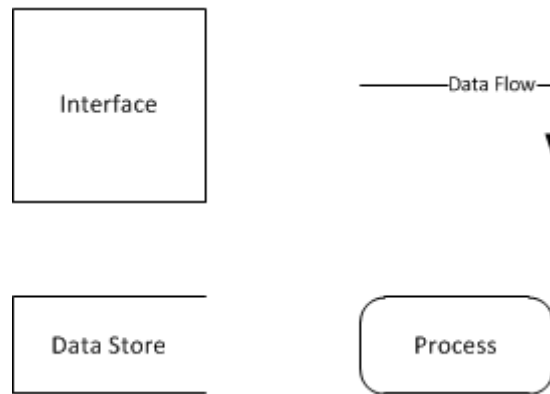
Appendix B: Change management process model

Appendix C: Contract management process model

Appendix D: BiSL process diagram notation

Appendix E: Round one questionnaire (interview)

Q1. This project uses four cloud governance models and one SOA governance model. Do you know any other cloud governance model (or similar model) that could be considered?

Q2. This project considers a list of cloud computing aspects. Do you think this list contains relevant aspects?

Q3. Is there any other cloud computing aspects that should be considered?

Q4. Is there any aspect that should not be considered?

Q5. This project prescribes that the 'Change management' process requires accommodating 3 cloud computing aspects namely: i) Change consequence management ii) Cloud service lifecycle management iii) Governance policy management. Do you agree with this?

Q6. Consider the proposed adjustments to the 'Change management'. Do you think these adjustments are complete?

Q7. Consider the proposed adjustments to the 'Change management'. Do you agree with these adjustments?

Q8. This project prescribes that 'Contract management' process requires accommodating 4 cloud computing aspects namely: i) Cloud service management ii) Governance policy management iii) Security management iv) Audit management. Do you agree with this?

Q9. Consider the proposed adjustments to the 'Contract management' processes. Do you think these adjustments are complete?

Q10. Consider the proposed adjustments to the 'Contract management'. Do you agree with these adjustments?

Q11. Can you think of any other issues that are relevant for the 'Change management' and 'Contract management' processes but cannot be accommodated in the process model?

Q12. Consider the scenario where an organization renders a cloud service. The process diagram is shown with the help of three processes – Change management, Contract management and Planning and Control. Do you miss any activity in this process?

Appendix F: Round two questionnaire (survey)

Q1. The research presented to you in the first interview considers five governance models. How do you score the relevance of governance models in the research?

Q2. During the first interview the panel identified that Basel III and ISO 38500 could be considered along with other governance models. How do you score the relevance of these for this project?

Q3. The research presented to you in the first interview considers a list of cloud computing aspects. How do you score the relevance of the cloud computing aspects in this research?

Q4. The following supplementary cloud computing aspects were identified during the first interview. How do you score their relevance for this project?

Q5. Indicate if you agree with that the following cloud computing aspects should be addressed in the CHANGE MANAGEMENT process.

Q6. Indicate if you agree with that the following cloud computing aspects should be addressed in the CONTRACT MANAGEMENT process.

Q7. Score the completeness of the proposed adjustments made on the CHANGE MANAGEMENT process (Figure 1) to deal with cloud computing.

Q8. Score the correctness of the adjustments that were made on the CHANGE MANAGEMENT process (Figure 1).

Q9. During the first interview the panel proposed following adjustments to the CHANGE MANAGEMENT process. Score your agreement with following statements.

Q10. Score the completeness of the proposed adjustments made on the CONTRACT MANAGEMENT process (Figure 2) to deal with cloud computing.

Q11. Score the correctness of the adjustments that were made on the CONTRACT MANAGEMENT process (Figure 2).

Q12. During the first interview the panel proposed following adjustments to the CONTRACT MANAGEMENT process. Score your agreement with following statements.Q13. Figure 3 shows a scenario of an organization rendering a cloud service using CHANGE MANAGEMENT, CONTRACT MANAGEMENT and PLANNING & CONTROLLING processes. Score the completeness of the scenario.

Appendix G: Survey Response

Criteria defines participants agreement on an issue:

i.	If 3 participants put the same rank in an opinion then we argue users are found to be agreed on that opinion.
ii.	If 2 participants put the same rank in an opinion and next opinion found to be ranked by 1 or 2 participants then we will considers the former opinion.
iii.	If any of the above two condition is not found to be true then we argue that participants disagreement in the opinion and

Survey Response:

Q 1) The research presented to you in the first interview considers five governance models. How do you score the relevance of governance models in the research?

	Irrelevant	Relevant only in few aspects	Relevant in some aspects	Relevant in many aspects	Strongly relevant
Relevancy of governance model	0	2	2	1	0

Q2) During the first interview the panel identified that Basel III and ISO 38500 could be considered along with other governance models. How do you score the relevance of these for this project?

	Irrelevant	Relevant only in few aspects	Relevant in some aspects	Relevant in many aspects	Strongly relevant	No Comment
ISO 38500	1	0	2	2	0	0
Basel II	0	2	0	0	1	2
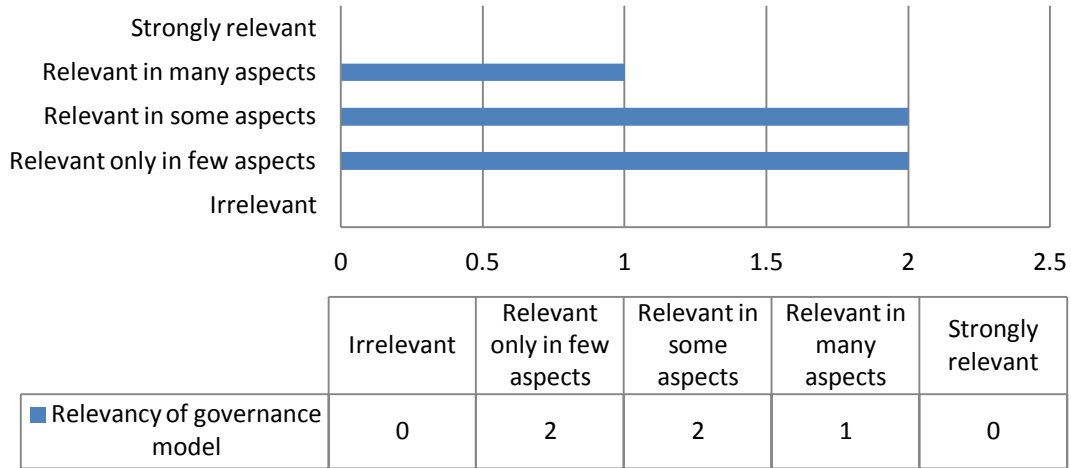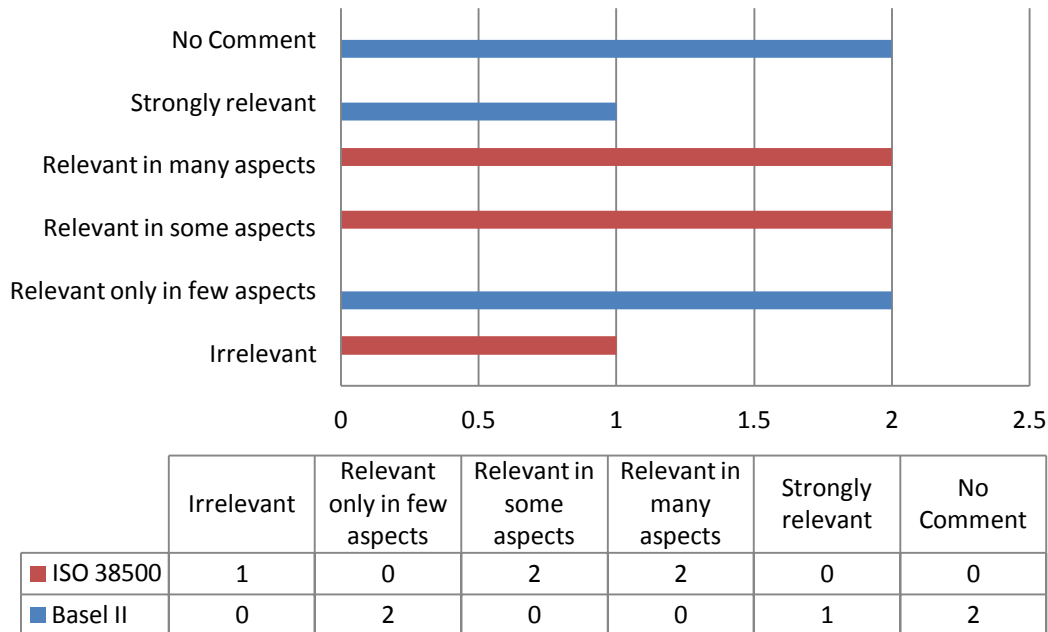
Q 3) The research presented to you in the first interview considers a list of cloud computing aspects. How do you score the relevance of the cloud computing aspects in this research?

	Irrelevant	Slightly relevant	Moderately relevant	Mostly relevant	Strongly relevant
Relevancy of cloud aspect list:	0	1	1	3	0

Q4) The following supplementary cloud computing aspects were identified during the first interview. How do you score their relevance for this project? [Please click here to look at a short note on following aspects]
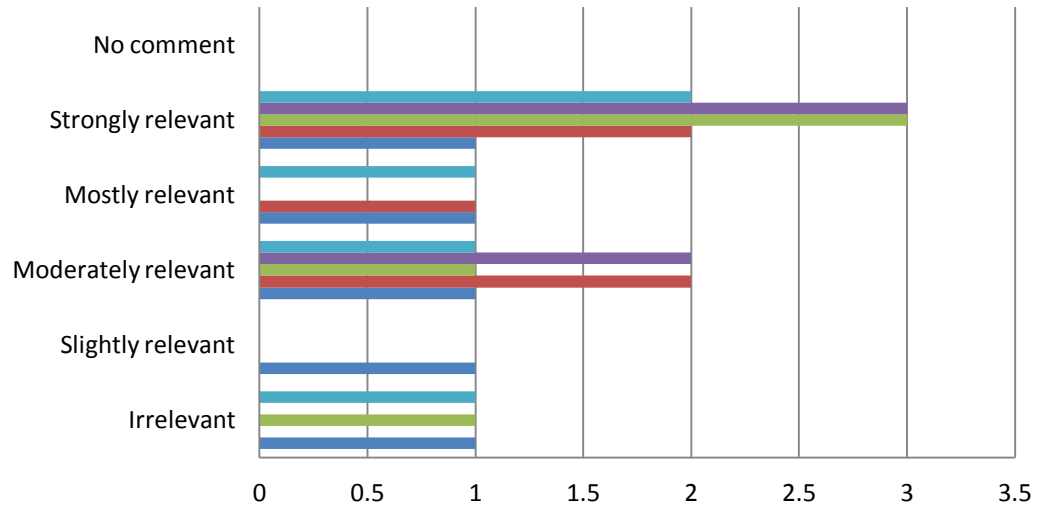
	Irrelevant	Slightly relevant	Moderately relevant	Mostly relevant	Strongly relevant	No comment
Issue related to cloud service models	1	0	1	1	2	0
Interoperability, data portability & reversibility issue	0	0	2	0	3	0
IT architecture (infrastructue) issue	1	0	1	0	3	0
Ownership issue	0	0	2	1	2	0
Resource management	1	1	1	1	1	0

Q 5) Indicate if you agree with that the following cloud computing aspects should be addressed in the CHANGE MANAGEMENT process.
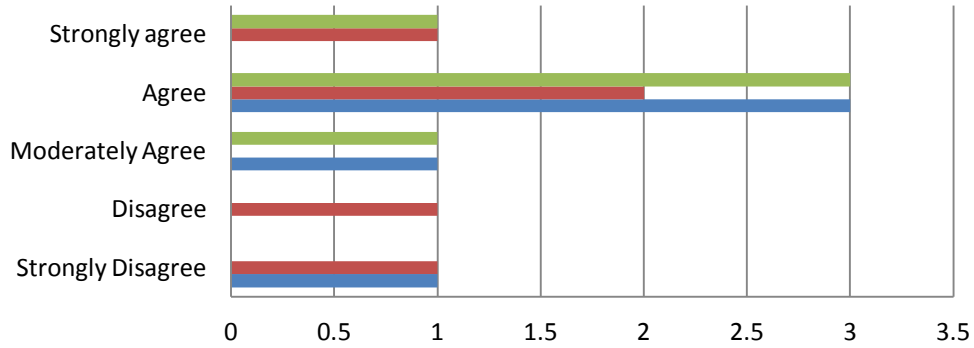
	Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly agree
Governance policy management	0	0	1	3	1
Cloud service lifecycle management	1	1	0	2	1
Change consequence management	1	0	1	3	0

Q 6) Indicate if you agree with that the following cloud computing aspects should be addressed in the CONTRACT MANAGEMENT process.
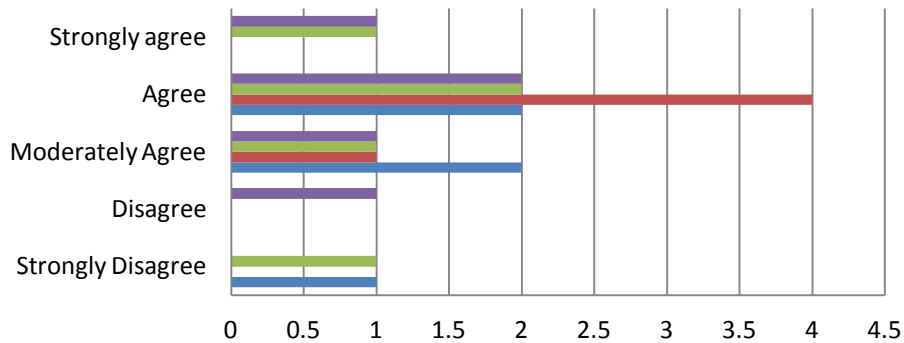
	Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly agree
Audit management	0	1	1	2	1
Security management	1	0	1	2	1
Governance policy management	0	0	1	4	0
Cloud service management	1	0	2	2	0

Q7) Score the completeness of the proposed adjustments made on the CHANGE MANAGEMENT process (Figure 1) to deal with cloud computing.

	Incomplete	Somewhat complete	Moderately Complete	Complete	Entirely complete
Completeness of change management process	0	0	0	4	1

Q8) Score the correctness of the adjustments that were made on the CHANGE MANAGEMENT process

	Most adjustments incorrect	Few adjustments correct	Moderately Correct	Few adjustments incorrect	All adjustments correct
Correctness of the adjustments in change management	2	0	0	1	2

	Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly agree
Risk, KPI's should come from all management processes (not only from PLANNING & CONTROLLING process)	0	0	1	**4**	0
IT should also be responsible for identifying risks (data - Risks - flows from IT to the CHANGE MANAGEMENT process)	0	**1**	**1**	**3**	0
IT should not be responsible for impact analysis	1	1	1	**2**	0
Cloud service registry should not be part of Change management	0	1	0	**3**	1
New release information may trigger demand (data - release information - flows from 'Accessing & deciding' to 'Demand management')	**1**	**1**	0	**3**	0

Q10) Score the completeness of the proposed adjustments made on the CONTRACT MANAGEMENT process to deal with cloud computing

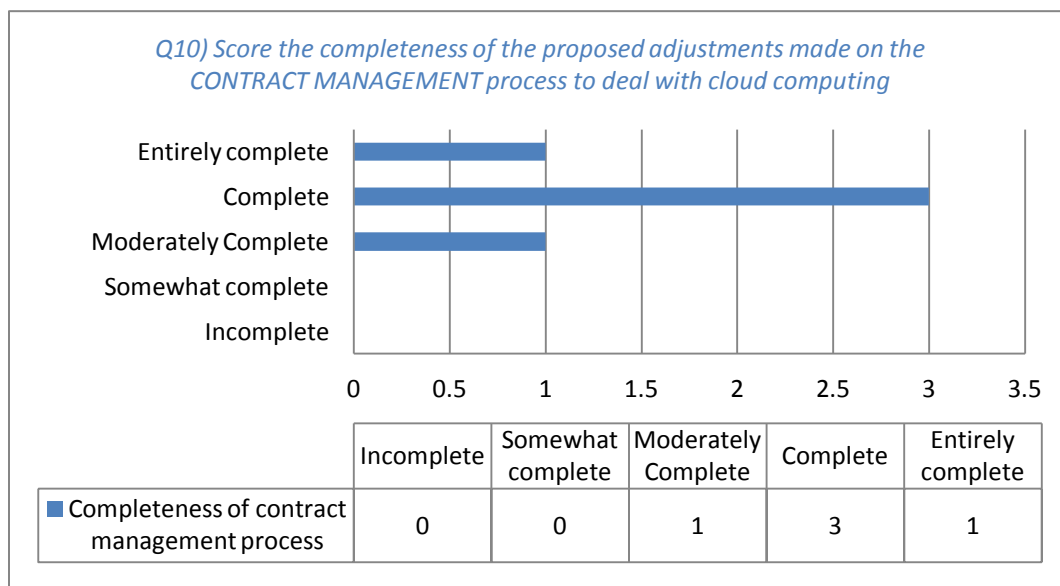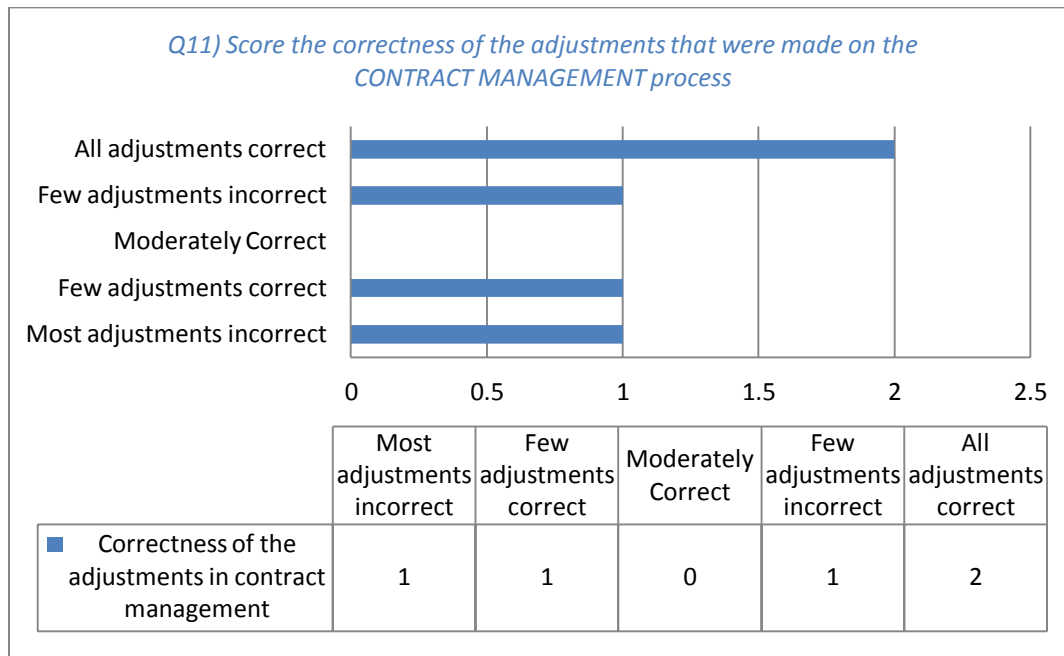|	Incomplete	Somewhat complete	Moderately Complete	Complete	Entirely complete
▪ Completeness of contract management process	0	0	1	3	1

Q11) Score the correctness of the adjustments that were made on the CONTRACT MANAGEMENT process

	Most adjustments incorrect	Few adjustments correct	Moderately Correct	Few adjustments incorrect	All adjustments correct
■ Correctness of the adjustments in contract management	1	1	0	1	2

Q12) During the first interview the panel proposed following adjustments to the CONTRACT MANAGEMENT process. Score your agreement with following statements.

	Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly agree
Operational supplier management keeps Demand management updated about new supplier. (data - new supplier information - flows from 'Operational supplier management' to DEMAND MANAGEMENT process)	**3**	0	0	2	0
Security Risk Agreement (SRA) do not have to be mentioned explicitly.	0	2	0	**2**	1
Security violation reports should go from IT to DEMAND MANAGEMENT process (not from IT to CONTRACT MANAGEMENT process)	0	0	**3**	1	1

The cloud service registry should not be part of CONTRACT MANAGEMENT process (can be considered within Application management or IT)	0	**1**	**1**	2	**1**
Data store for Cloud service registry is part of data store for SLA/SRA/Contract (should not be shown as a separate data store).	0	1	**2**	1	1

Q13) Figure 3 shows a scenario of an organization rendering a cloud service using CHANGE MANAGEMENT, CONTRACT MANAGEMENT and PLANNING & CONTROLLING processes. Score the completeness of the scenario.

	Incomplete	Somewhat complete	Moderately Complete	Complete	Entirely complete
■ Completeness of the scenario	1	0	0	4	0
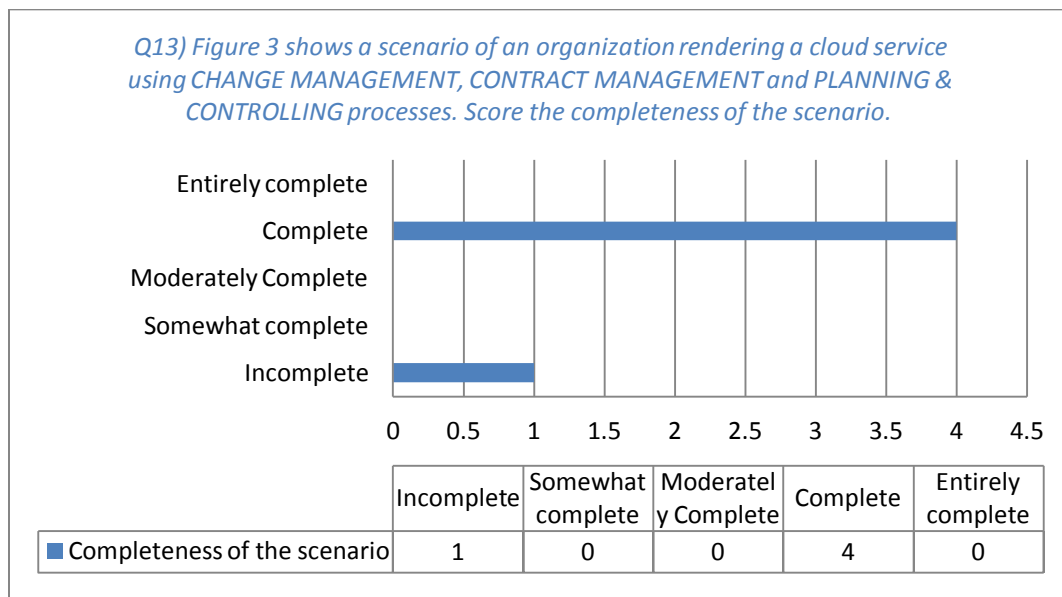
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