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A Role Allocation Model For IT Controls In A Cloud Environment

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ABSTRACT

The rapid adoption of cloud computing by organizations, along with the need to comply with relevant IT governance (ITG) controls, has increased the complexity of governance in the cloud. This transition from a classical data center to a virtualized data center has resulted in the reallocation of roles and responsibilities of IT personnel for managing and accounting for the relevant IT controls. With a lack of guidelines or model for practitioners to choose from, with regard to the allocation of roles and responsibilities, there is a lack of clarity on the responsibilities and accountability for these IT controls.

The purpose of this paper is to propose a theoretical model for assigning roles and responsibilities for IT controls for an organization operating in a cloud environment. The proposed model is based on a strong theoretical grounding and can be used to inform good practice.

Keywords: IT Governance; Cloud Computing; Roles & Responsibilities; Theoretical Model; Criteria

INTRODUCTION

The rapid adoption of cloud computing, through aligning of core IT competencies and putting technology where it belongs, are two out of the seven indisputable trends that will define 2015 (Andriole, 2012). Cloud computing is a complex model with different dimensions covering the deployment model, service level and essential characteristics (Mell & Grance, 2009). Consequently, migration of an organizations' IT functions to clouds produces challenges, especially in relation to the changing role and responsibilities of the personnel concerned with the governance of the relevant IT controls. Currently, organizations govern IT systems through the use of internal IT controls by assigning roles and responsibilities for them. The IT department is the department that is normally entrusted with the responsibility for the project of migrating relevant services/models to the cloud environment (Repschlaeger, Zarnekow, Wind, & Klaus, 2012). When this restructuring happens, there is a corresponding restructuring of roles and responsibilities relating to changed internal IT controls in the new environment. With hardly any guidance available to IT practitioners from the academic as well as the non-academic forum, such cloud migration projects are fraught with challenges (Rashmi & Sahoo, 2012).

This paper is structured as follows: First a review of the selected IT governance (ITG) models, frameworks and best practices is conducted to identify the research gap. This is followed by a discussion of the underpinning theoretical models and frameworks. The paper concludes with a model that defines the criteria to be used for the allocation of organizational roles and responsibilities for IT controls in a cloud environment.

LITERATURE REVIEW

Allocation of roles and responsibilities is an ITG activity as it involves leadership, control and directions from those in the organization with the necessary authority (Webb, Pollard, & Ridley, 2006a). Governance frameworks, like ITIL and COBIT, use RACI charts for defining the roles and responsibilities of different stakeholders for IT processes. In COBIT, it is still at a very high level and too generic for practical use (Zhang & Le, 2013) and ITIL provides only generic guidelines for employing RACI for the non-cloud environment. Apart from a

few general attributes given in ITIL (*ITIL - Service design*, 2007), no criteria were found in COBIT or ITIL that can be used to allocate roles and responsibilities for IT controls in a cloud environment.

A review of literature in the Association of Information Systems' (AIS) database also showed a considerable gap in research in this domain. A title search using the words 'roles and responsibilities', 'IT governance', and 'cloud computing' was conducted in the (AIS) journals database (www.ais.com) spanning the years 2008 to 2013. The topics that relate to this domain, from these sources, mainly focus on the critical success factors for the service receiver of IT outsourcing (Hodosi & Rusu, 2013), organizational integration of green IS through specific roles and responsibilities (Loeser, 2013), suggestions to help IT practitioners in organizations look beyond SOX regulations at governance of end-user developed content (Leon, Abraham, & Kalbers, 2010), organizational change resulting from IT innovations (Suo, Techatassanasoontorn, & Purao, 2011), and the importance of adequate IT management capabilities, manifested in IT governance (Kim, Shin, Kim, & Lee, 2011). Thus, there is a lack of clarity in role allocation in a cloud environment. With cloud computing becoming a rapidly growing market (Repschlaeger et al., 2012), there is a need to explore this further through the research question, *What is the criteria for allocating roles and responsibilities of IT controls in a cloud environment?*

THEORETICAL FRAMEWORK

In an effort to propose a model with a strong grounding in theory (Lewin, 1945; Gregor, 2006), the authors decided to look at theories employed in ITG (IT controls), organizational design (role allocation), and cloud computing.

Since migrating to cloud is transformation of the IT organization as a whole, or in part, the authors looked at the strategic alignment model of Henderson and Venkatraman (1993) which was found to be focusing more on the role of IT in organizational transformation rather than role allocation. Cloud migration affects both technology and people, especially in an ITG environment. An evaluation of the socio-technical theory of Bostrom and Heinen (1977) revealed that it concentrates only on providing MIS practitioners and researchers with guidelines on system design approach. Moving into a more human resource approach, due to the question of 'role allocation', the authors analyzed the human resource framework of Lepak and Snell (1999), but it identifies forms of human capital that can be used as a source of competitive advantage. The task-technology fit model of Goodhue and Thompson (1995) were also evaluated, which provide guidance on the impact of IT on user performance and, hence, could not be used to explain role allocation.

Cloud computing has been considered as the latest trend to outsource some or complete IT operations to run a business from the public cloud (Dhar, 2012). Allocation of responsibilities in the form of a RACI chart has been used not only for outsourcing (Ramakrishnan & Pro, 2008; Simonova & Zavadilova, 2011), but for managing governance in outsourcing (Meng, He, Yang, & Ji, 2007). Rai (2011) employed the Viable System Model in the cybernetics domain to decide on the functions/activities to be outsourced and the necessary supporting systems in an outsourcing engagement.

Cybernetics', which means 'to govern' (MWD), focusses on how systems (including sociotechnical systems, such as organizations) control their actions and how they communicate internally or with other systems (Wikibooks, 2014). Moreover, ITG focuses on control mechanisms (Webb et al., 2006a), and organizations with strong ITG have well developed IT controls, enabling key line managers to define the roles and responsibilities of IT staff (Karimi, Somers, & Gupta, 2001).

Stafford Beer's (Stafford, 1985) Viable System Model (VSM) is the best known of the many cybernetic models (Leonard, 2009) that enables people to address organizational issues. It is particularly useful for organizations using technology to distribute work amongst geographically separated workers (Hilder, 1995). VSM has been used earlier as an ITG base model (Lewis & Millar, 2009), for evaluating models of ITG (Davies, 2007), and for discussing theories of ITG (Dowse & Lewis, 2009).

Cybernetics (Viable Systems Model)

Beer (1984) conceptualized all viable systems as a network of communication channels bonding five main management functions - operations, co-ordination, control, intelligence, and policy, referred to as Systems 1 to 5, respectively. The main function of System 3 is the internal and immediate control of organization (Hilder, 1995), including the control of resource allocation (Brocklesby & Cummings, 1996). The task of assigning roles and responsibilities for IT controls can thus be positioned in System 3 as it matches its activities of regulating day-to-day activities of the organization's internal operations (Hilder, 1995), operational planning of the operational units (Davies, 2007) and supervision of control activities by senior management.

Identifying the characteristics of VSM helps in identifying the requirements of a viable organization in terms of resource planning and control functions.

Viability

An organization is considered to be viable if it can survive in a particular sort of environment (Stafford, 1985), while maintaining its independent existence. In a cloud context, customers have concerns over the viability of cloud service providers (CSP) (Gartner, 2013) leading to concerns about their own viability. Organizational viability also depends on addressing regulatory requirements (CSA, 2009) on role allocations.

Homeostasis

For an organization to survive, it must maintain itself in a state of equilibrium (Hilder, 1995). Cloud is bringing in many organizational changes, including changes in jobs, skills, leadership roles and structures (Gartner, 2013). These changes create complexities in defined roles and responsibilities, accountability, and expectations of roles (CSA, 2009). Organizations can maintain homeostasis by canceling these surplus complexities coming from the cloud environment into the operations, by creating variety in the skills and capabilities of the workforce.

Variety

According to the law of requisite variety, an organization should be sufficiently complex to handle the variety of conditions it will meet in its environment (Ashby, 1957). In a cloud computing environment, decision-making involves cross functional and inter-organizational boundaries, thus making clear role-allocation decisions essential and more complex. An organization needs to balance this complexity (Ashby, 1957) by having sufficient variety in terms of human IT skills and capabilities (Garrison, Kim, & Wakefield, 2012).

Autonomy

According to VSM logic, autonomy and independence is ceded to System 1 units (Brocklesby & Cummings, 1996) and is considered to be one of the logical requirements for ensuring effective organization, especially in a rapidly changing environment (Espinosa, Harnden, & Walker, 2008). In a cloud architecture, System 3 (where roles and responsibilities allocation is positioned) needs to break down the silos within IT and other autonomous system1 units, ensuring that they are much more cross functional (Gartner, 2013). This will lead to effective strategic and role-allocation decisions.

Recursion

Recursion is defined as “a next level that contains all the levels below it” (Stafford, 1985). In terms of cloud computing, all the organizational attributes should be evident and followed by the CSPs. Hence, organizational jobs and role related requirements apply to CSP(s) too.

Transduction

Whenever a message crosses a boundary, it needs to be “translated” to the language of the receiver. In a cloud environment, information crosses the organizational boundaries between cloud providers, brokers and customers. Variety, in terms of people’s skills and inter-operability knowledge to facilitate inter-departmental communications, will be required in a cloud environment (Suo et al., 2011) and the same will form the basis of roles allocation.

Self-Organization

This is the ability of systems to continuously re-create themselves, while being recognizably the same (Hilder, 1995). In a cloud computing environment, IT departments act not only as technology service providers, but as a strategic partner that assumes responsibilities in business technology alignment (Suo et al., 2011). Technical and managerial capabilities within an organization determine how well cloud services achieve the organization’s goals and potential competitive strategy. A self-organizing business in a cloud environment must have IT capabilities to change strategic direction by allocating the right people together quickly around risks or opportunities.

Apart from using above seven characteristics of cybernetics to address the roles allocation in a cloud environment, it has been noticed that organizational design influences the decision-making process (Rowland & Parry, 2009), personnel decisions (Carley, Prietula, & Lin, 1998) and can help in identifying how to reshape and channel organizational structures and roles to meet the new business strategy (Wikipedia, 2014a). Some researchers have given direct relation between organizational design and structures by suggesting the use of ambidextrous organizational designs (defined by an interrelated set of roles, structures and senior team processes) for executing innovation streams (Tushman, Smith, Wood, Westerman, & O’Reilly, 2010).

Organization Design And Its Impact On Role Allocation

Organizations are composed of individuals and competitive strategies and performance of an organization certainly depends significantly upon its resources and capabilities (Sharma & Vredenburg, 1998). Channeling of these resources can be dictated by organizational design decisions. Nadler and Tushman (1997) explain the relationship between organizational design and the work that people in the organization do, as a set of formal structures and processes and appropriate informal operating environment that gives people the skills, direction and motivation to do the work necessary to achieve the strategic objectives. One of the most widely-used and accepted organizational design frameworks, proposed by Galbraith (1995) and used for around 50 years, is the “Star Model Framework”.

This framework provides tools with which management must become skilled in order to shape resource allocation and other management decisions effectively. This model is based on five design principles which are related to strategy, structures, processes, rewards and people (see Table 1). These principles of Galbraith’s Star Model have been used to study how people’s roles depend upon the strategy, structure and processes in an organization.

Table 1. Roles Allocation Criteria Deduced From Organization Design

Design Principle	Implications On Role Allocation
Strategy	Identifies IT tasks to be undertaken
Structure	Identifies job specialties, number of people required to perform IT tasks and the authority level of these people
Processes	<ul style="list-style-type: none"> - Activities that people will be allocated to; - Build interpersonal relationships among units and organizations
People	Must have skills and mind-sets to perform IT tasks
Reward	Motivation to perform better

Strategy

Cloud computing is an IT-related strategy of redirecting resources toward core business activities (Garrison et al., 2012). It has been argued that the value of the tasks and the availability of human capital capabilities will define the selection of cloud solutions to complement the business strategy and decision whether to allocate internal or external human resource to these complex IT controls (Arthur, 1992; Snell & Dean, 1992). Organizations require agile leaders to match the agility brought in by cloud strategy (Gartner, 2012) and to achieve self-regulation.

Structures

Structures focus on identifying and distributing IT-related decision-making rights and relate to VSM's Systems 3, 4 and 5. Roles and responsibility allocation depends upon the structures adopted by the organization to balance the complexity of the cloud environment while providing autonomy to all the VSM System1 units.

Processes

For an organization to be viable, its primary process is to contribute to the viability of the whole, and System 3 is needed to manage this contribution of the primary process (Achterbergh & Vriens, 2011). In terms of ITG, an organization needs processes to control and manage accountability and risk (Sambamurthy & Zmud, 1999; Peterson, 2004; Webb, Pollard, & Ridley, 2006b; De Haes & Van Grembergen, 2008). Senior management in System 3 must ensure that they need to implement procedures to assess the risk and use that as a basis to allocate the roles and responsibilities of the IT controls. This implies that business, as well as IT at various levels (whether strategic, management or operational level (Van Grembergen, De Haes, & Guldentops, 2004) and from various systems (of VSM), are involved in role allocation.

People

Effective ITG necessitates clear and unambiguous definition of roles and responsibilities of involved parties. People in the organization must possess the requisite variety in their skills, capabilities and mind-sets to be able to deal with the variety in the cloud environment. People can be critical sources of competitive advantage if their skills are unique (Stewart, 2007; Wright & McMahan, 1992) and it can be a primary deterrent of mode of employment for their development (Lepak & Snell, 1999). That means the decision that whether a firm should develop and allocate internal employees to the IT controls or depend on cloud providers for such skills depends upon the uniqueness of an employee's skills too.

Reward

Rewards are used to motivate people to perform to address organizational goals. At this point, the researchers of this study have not been able to deduce any entities for rewards.

Allocation of roles and responsibilities of IT controls is an ITG decision-making mechanism (Sambamurthy & Zmud, 1999) and ITG is a function of organizational design. IT architecture that supports organizational design complements ITG structures (Tiwana & Konsynski, 2010). Hence, it is a rational decision process to support an organizational design theoretical model with an ITG model for identifying the roles' allocation criteria.

IT Governance Models

ITG is based on three constructs; namely, structures, processes, and relational mechanisms (Peterson, 2004; Weill & Ross, 2004; Van Grembergen et al., 2004; De Haes & Van Grembergen, 2008).

Processes and structures have already been identified as criteria for role allocation (Galbraith, 1995). One additional construct (as shown in Table 2) identified by ITG is added to the criteria as "Relational Mechanism". Based on the similarities of concepts in Galbraith's process design principle (building interpersonal relationships through work rotations) and ITG best practices (e.g. Job rotation), it is useful to group them all together under the 'Relational Mechanisms' construct.

Table 2. Role Allocation Criteria From ITG Model

Organizational Constructs	Implications On Role Allocation
Relational Mechanisms	Practices followed by people to build interpersonal and collaborative relationships among units and organizations.

Relational Mechanisms

Stakeholder constituencies (business and IS management) take different lead roles and responsibilities depending on the way IT in an organization is controlled and coordinated (Sambamurthy & Zmud, 1999). A method to build collaborative relationships among IT and business management is through ‘Relational Mechanisms’ (Peterson, 2004).

For any viable organization, communication among the stakeholders from different systems and levels must be transduced. According to VSM, any communication link that crosses a boundary, it must be translated. All five systems in the VSM have their own languages, their own criteria, their own figures-of-speech and their own satisfactions (Stafford, 1985). People who have the capability to translate the information to the cloud provider’s language must be allocated to the cloud integrations and related tasks.

Size

Both the ITG frameworks (COBIT and ITIL) use RACI chart extensively in role allocation for managing the IT controls in an organization. While COBIT does not use any criteria for role allocation, ITIL stipulates five factors related to the roles allocation as skills, attributes, competencies, size and strategy of the organization. All of these factors, except “size of the organization”, have been covered either in Star Model design principles or the ITG framework constructs. Hence, ‘size’ is added as an additional organizational construct to the proposed model. The updated model will have a seventh construct as shown in Table 3.

Table 3. Roles Allocation Criteria Of ITIL

Organizational Constructs	Implications On Role Allocation
Size	Number of people in the organization

When an organization is geographically dispersed throughout the cloud, system units tend to have greater number of interactions between units to get work done (Lawler III & Worley, 2011). These complex organizations with more “surface area” will not spontaneously self-organize (Galbraith, 1995). Employees in these large and complex organizations are unlikely to be able to gain a broad view to make the right decisions about how units should be configured and who should interact with whom. It is the job of leaders and managers to manage the complexity created by the organization’s size, by having clear roles and responsibilities allocation.

ROLES AND RESPONSIBILITY ALLOCATION MODEL (RRA Model)

Cross-referencing the seven IT governance and organization constructs with seven VSM components for a cloud organization provides a basis for defining criteria in the allocation of roles and responsibilities, thus arriving at the two dimensional model (Table 4) where the letters represent the allocation criteria (letters inside the cells of the matrix) defined in Table 5. Criteria have been derived through a search of the literature. An organization that has migrated - or is planning to migrate to the cloud - can use the constructs from the two dimensions to identify the criteria for allocating IT personnel who are responsible, accountable, consulted, and/or informed (RACI) on the selected IT controls. The model being theoretical is planned to be validated in different sectors of the industry in two countries.

Table 4. RRA Model For An Organization In A Cloud Environment

		VSM							
		Components							
IT Governance & Organizational Constructs		Viability	Variety	Homeostasis	Autonomy	Transduction	Self-Organization	Recursion	
	Strategy			A				B	C
	Structures				D	E			
	Processes	F							
	People	G	H, I, J				K		
	Size			L					
	Rewards								
	Relational Mechanisms			M					

Table 5. RRA Criteria

Criteria For The Allocation Of Roles And Responsibilities In A Cloud Environment	
A	Variety of tasks and internal/external human capabilities (Arthur, 1992; Garrison et al., 2012; Snell & Dean, 1992)
B	Organizational strategy to bring in right people together (Garrison et al., 2012)
C	Organizational requirement for job and roles to be followed by CSP too(Stafford, 1985)
D	Structures balancing the organizational complexity. (De Haes & Van Grembergen, 2008; Galbraith, 1995; Gartner, 2013; Peterson, 2004)
E	Cross-functional/boundary access to information required for autonomy (Gartner, 2013)
F	Task allocation based on risks / opportunities (De Haes & Van Grembergen, 2008; Peterson, 2004; Sambamurthy & Zmud, 1999; Webb et al., 2006a).
G	Roles allocation to meet based on regulatory requirements to achieve viability (CSA, 2009).
H	HR policies that define skills and mind-sets required for task execution (Arthur, 1992; Snell & Dean, 1992).
I	Capabilities: like inter-organizational interaction, participation on teams, flexibility and joint decision making.(Galbraith, 1995)
J	Skills: like negotiation, collaboration, conflict resolution, advocacy, relationship and network building.(Galbraith, 1995)
K	Ability to transduce at the organizational and unit interfaces. (Suo et al., 2011)
L	Large size leading to more complexity and hence more clear and firm guidance on roles and responsibilities. (Galbraith, 1995; Lawler III & Worley, 2011)
M	Balanced movement of power: Job rotation.(De Haes & Van Grembergen, 2008; Galbraith, 1995)

CONCLUSION

The principles of Stafford Beer’s Viable System Model (VSM) and ITG frameworks were used to build a theoretical model for the allocation of roles and responsibilities of IT controls in a cloud environment. The resulting model, with six organizational constructs to design and seven VSM characteristics, are identified as the criteria that have an impact on the roles and responsibilities allocation of IT controls within an organization. While the constructs are targeted at the IT controls of IT governance, validation will be done for IT controls related to information systems’ standards, as a whole, to generalize the model to the wider industry audience.

AUTHOR INFORMATION

Shafaq Khan is an Assistant Professor at the University of Dubai. Since joining the University of Dubai in 2001, she has received awards, such as ‘Excellence in Teaching’ and the ‘Best Faculty Award from Alumni’. Her educational qualifications include a Masters in ‘Computing and Information Systems’, Masters in Electronics, ‘Post Graduate Diploma in Computer Applications’, Physics Honors, and Bachelors in Electronics. She is a certified cloud infrastructure specialist, certified project management professional (PMP), and a SAP certified ERP foundation consultant. Her research work has been published in several ranked journals and conference proceedings.

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