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Cloud-based business services innovation: A risk management model

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ABSTRACT

Cloud computing providers and their software-as-a-service offerings have become more profuse and mature, making cloud technology an increasingly important platform for business services innovation. Although the cloud offers rich opportunities for transforming businesses—innovating existing services and introducing creative new ones—it also involves risks that business managers must identify and resolve to successfully drive innovation efforts. However, no comprehensive models are available to help managers assess and mitigate the risks they face. To address this void, we reviewed extant literature on cloud computing from a business innovation perspective to uncover the myriad challenges managers confront as they seek to leverage cloud technology in the ongoing transformation of their organization's service offerings. Combining this systematic literature analysis with relevant theory, we synthesized an integrated model for managing risk during innovation of cloud-based business services. The model identifies three types of risks (services, technology, and process risks) and four types of resolutions (stakeholder engagement, technology development, innovation planning, and innovation control). The model also helps managers identify their organization's general risk profile and link that profile to a specific configuration of resolutions.

1. Introduction

As a technology-enabling platform, cloud computing is increasingly seen as a major driver for business innovation. Although cloud computing is disruptive and can adversely affect companies (Werfs, Baxter, Allison, & Sommerville, 2013), once adopted, it offers organizations considerable innovation opportunities (Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011; Willcocks, Venters, & Whitley, 2013). Cloud not only provides computing capability through large pools of automated, scalable computing resources (Cafaro & Aloisio, 2011; Venters & Whitley, 2012) and associated applications (Cusumano, 2010; Venters and Whitley, 2012), it also inspires cloud-based creativity by letting organizations use open source computing resources from third-party application providers to augment the established cloud platform. Through this ecosystem, organizations can outsource their technological needs and flexibly select the required prepackaged software capabilities to ignite their business outcomes. As such, cloud technology providers give organizations access to a rich pool of instruments to architect innovative solutions that both meet their needs and lower the barriers to innovation (Marston et al., 2011).

Our research specifically focuses on how an organization can leverage Software-as-a-Service (SaaS) to deliver cloud-based business services to its customers. SaaS delivers application functionality and related services through the Internet (Sultan, 2010; Low et al., 2011). Here, we view *innovation* as an organization's ability to develop and realize an idea that addresses a specific challenge and achieves value for its businesses or customers. Hence, cloud-based business services offer innovative solutions from a service provider to its customers, enabled by the cloud.

Cloud-based business services innovation presents a multiplicity of risks for the providing organization. Venters and Whitley (2012) posit that the cloud severely affects an organization's IT structure and interfaces, introducing key risks related to identity management, governance, compliance, software isolation, security responses, and so on (Ratten, 2016). Still, no comprehensive models exist to help managers assess and mitigate the considerable risks they face. Our research addresses this void by analyzing and synthesizing extant literature to offer a model of how cloud-based business services providers can manage the risks involved in innovating services for their customers.

2. Literature background

To position and frame our research, we review the literature on cloud-based business service innovation and offer key concepts from

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risk management theory.

2.1. Cloud-based business service innovation

According to Sean Marston and his colleagues, cloud computing is

> "an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location. The resources required to provide the requisite quality-of-service levels are shared, dynamically scalable, rapidly provisioned, virtualized and released with minimal service provider interaction" (Marston et al., 2011; p. 177).

Cloud technology encompasses public, private, and hybrid models. It represents a paradigm shift enabled by both technological maturity and the shift toward service-centric offerings. The first strand of cloud computing emerged from technological innovations such as virtualization, high-performance networks and data center automation (Armbrust et al., 2010; Boss, Malladi, Quan, Legregni, & Hall, 2007; Venters & Whitley, 2012). The second strand emerged from an increasing emphasis on service-based perspectives (Etro, 2009; Vouk, 2008; Venters and Whitley, 2012). A distinctive feature of cloud services is the pay-as-you-use attribute.

Although cloud-based services come in the form of Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS), the focus of this research is SaaS, which delivers application functionality and related services through the Internet (Sultan, 2010; Low et al., 2011). Hence, as Fig. 1 illustrates, we are concerned with how cloud-based business services providers manage the risks incurred as they rely on cloud providers to innovate SaaS for their customers.

The original driver behind cloud computing for both large and small-to-medium enterprises (SMEs) was mainly the desire to outsource supporting tasks and focus on core business outcomes. They thus shifted attention from managing technology assets to considering the customer value in using technology services (Grönroos, 2011; Venters and Whitley, 2012). As such, cloud services based on the pay-as-you-go model give businesses a flexible budgetary framework to outsource their technological needs while they focus other resources on enriching business capabilities. Venters and Whitley (2012) articulate what businesses desire from the cloud in terms of *equivalence* (technical services that are at least equivalent and *abstraction* (technical services that abstract away unnecessary complexity), as well as scalability, efficiency, creativity, and simplicity.

As cloud providers and cloud offerings have become more profuse and mature, the cloud has developed into a platform that drives creativity. Cloud computing's distinctive nature offers many possibilities for innovating business (Willcocks et al., 2013). Cloud-based creativity arises from an ecosystem that leverages open source computing resources, with third-party application providers complementing the cloud platform and offering a comprehensive set of tools and building blocks for architecting desirable end-to-end business outcomes. Cloud providers give organizations access to a rich pool of instruments to architect innovative solutions for their customers, thereby lowering the barriers to innovation (Marston et al., 2011).

However, this complex environment of cloud-based business services innovation introduces a host of risks for cloud-based business services providers, their partners, and their customers. From the customer's perspective, the decision to shift from on-promise to the cloud could be precarious. Moreover, Venters and Whitley (2012) posit that shifting to the cloud influences intra-organizational interfaces. Key cloud computing risks for organizations relate to identity management, governance, compliance, software isolation, and security responses (Ratten, 2016). As such, the cloud's impact goes beyond IT and affects the entire business (Werfs et al., 2013). Jan Damsgaard, Kettinger, and Lacity (2014) propose that managers stop thinking about how cloud services can transform the IT function and instead ponder how cloud services can transform the entire business. The decisions entailed have potentially dire consequences. Furthermore, Marston et al. (2011) add to this burden by suggesting that business leaders proactively develop an overall strategy and timeline regarding which applications they can move to the cloud (Prasad & Green, 2015).

In summary, there is an emergent body of knowledge vis-à-vis cloud computing from a business perspective that goes beyond the initial focus on the technology's adoption and implementation. However, as Table 1 shows, none of the existing literature reviews covers risk management for cloud-based business services innovation. Cloud-based business services providers are clearly in dire need of models that can help them, their business partners, and other stakeholders address the host of challenges they face during service innovation.

2.2. Risk management theory

Risk management uses various heuristics to link risks and resolutions. In this context, *risk* refers to the probability and impact of an adverse outcome (Aven & Renn, 2009; Graham, Weiner, & Benesh-Weiner, 1995); *resolution* refers to resources and efforts to avoid, transfer, prevent, mitigate, or assume the risks (Nogueira & Bhattacharya, 2000); and the *heuristics* link specific risks to one or more appropriate resolutions (Iversen, Mathiassen, & Nielsen, 2004). Fig. 2 illustrates this general risk management approach. At any point in time, an organization's managers identify and evaluate the risks that might occur, their likelihood, and their potential impact. They then explore and evaluate which resolutions, if applied, would avoid, transfer, prevent, mitigate, or help them assume the risks that might be encountered in the future.

As Table 2 shows, in the information systems and software context, Iversen et al. (2004) specify four approaches to risk management: risk list, risk-action list, risk-strategy model, and risk-strategy analysis. The risk list approach offers a prioritized list of risks, starting with the highest risk. The approach is easy to build, modify, and work with. However, its major drawbacks are that it provides neither risk resolutions nor strategic oversight. The risk-action list approach is thus superior in that it provides risk resolutions for each risk item. However, the risk-action list approach shares one common drawback with the risk list approach: it does not offer strategic oversight, which is crucial for flexibility and adaptability. While the risk-strategy model approach is hard to build and modify, it offers managers this strategic oversight. Moreover, in contrast to the risk-strategy analysis approach, it is easy for managers to use. We therefore chose to adopt this approach as the foundation for building our risk-strategy model.

3. Research method

With a focus on cloud computing, risk management, business services, and innovation, we used qualitative literature review followed by model development as our research method. Asking how managers of cloud-based business services innovation can manage risks, we began a

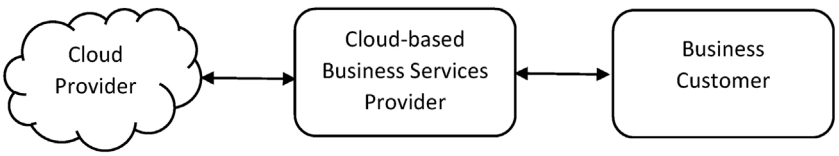

Fig. 1. Cloud-based Business Services Context.