A Contingency Model for Assessing Cloud Composite Capabilities

Noel Carroll[1], Markus Helfert[2] and Theo Lynn[1]
[1]*Irish Centre for Cloud Computing and Commerce, Business School, Dublin City University, Dublin, Ireland*
[2]*School of Computing, Dublin City University, Dublin, Ireland*

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Abstract: Cloud computing present new economic and flexible business and technological models. The explosive uptake of cloud solutions has fuelled the growth of cloud service providers (CSP). However, recent development show that within the field of cloud computing there is often too much focus on technology solutions but little insight on cloud exploitation and service analytics from a business perspective. To support CSPs and cloud users, it is critical that sourcing decisions are informed to align cloud strategy and service capabilities. In this paper we present a contingency model which supports the assessment of cloud composite capabilities. While we develop an understanding of the research gaps which exists throughout academic and industry literature, the contribution of this paper is the introduction of our contingency model which forms the initial development of the Cloud Service Index (CSI). The CSI is a basis to assess cloud composite capabilities.

1 INTRODUCTION

Cloud computing focuses on the how IT enables greater business value through increased technological capacity and capabilities. As business subscribe or rent additional capabilities, IT capabilities are extended on an 'on-demand' basis from applications to additional storage. There are numerous definitions of cloud computing. One of the most accepted definitions comes from Mell and Grance (2009) at the National Institute of Standards and Technology (NIST). They define cloud computing as a "*model for enabling 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.*" This suggest that cloud computing allows users to utilise IT resources and capabilities when required. The fundamental benefits of cloud computing is its ability to share resources on-demand at considerably reduced costs. This has led to the explosive uptake of cloud computing. According to the latest Cisco report, "*cloud is now on the IT agenda for over 90% of companies, up from just over half of companies (52%) last year*" (Cisco CloudWatch Report, 2012). However, measuring the value of Cloud service capabilities through a systematic manner can become a very complex process, particularly for small-to-medium sized enterprises (SMEs).

In this paper, we discuss the initial work on developing a contingency model to assess cloud capabilities. Our research addresses the following research question: '**how can we measure the contributory business value of cloud service capabilities in SMEs?**' Examining the complexity and value of 'the cloud' offers immense opportunities through service analytics (i.e. measuring performance). Thus, understanding how cloud resource may be assessed for 'on-demand' services requires a contingency model to assist in the strategic alignment of business and IT resources.

2 LITERATURE REVIEW

The focus of our research focuses on is cloud computing in SMEs. We have examined how SMEs are considered the backbone of economies (Europa, 2012) and cloud computing presents them with a level playing field in terms of availing of IT resources and capabilities. However, considering the complexity of today's service environment,

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SMEs cannot afford to accept the status quo of service operations and therefore must have some clear business analytics objective to reach. Without clear metric objectives, organisations are almost destined for disaster since the allocation of resources may not have responded to the demand exerted from outside of the organisation. This places greater emphasis on the need to assess service capabilities in terms of quality and performance.

2.1 Cloud Value Co-creation

Value co-creation is concerned with the strategic and mutual approach to generating value between a service provider and a customer. Cloud computing comprises of four main layers within the cloud stack. These layers include Business Process-as-a-Service (BPaaS), Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), Infrastructure-as-a-Service (IaaS), and an overarching management layer which, in a real world scenario, would operate in most of the layers of service provision. We identify the need to assess the business value of each layer in the cloud stack and the relational dynamics of service metrics between each layer. According to Orand (2010), the main issue with IT is the inability to improve service provision due to a lack of 'proper' measurements. There is often a mismatch in IT personnel's ability to address the business needs as business demands more for IT support and functionality. Thus, the alignment of IT and business is often only experienced as an organisation matures (Luftman, 2003) to support evolving strategies. However, this is no longer the case in cloud computing. While there is often a lot of discussion surrounding business and IT capabilities, consider for a moment that business do not 'want' IT but rather, they want the 'service' which is provided by IT.

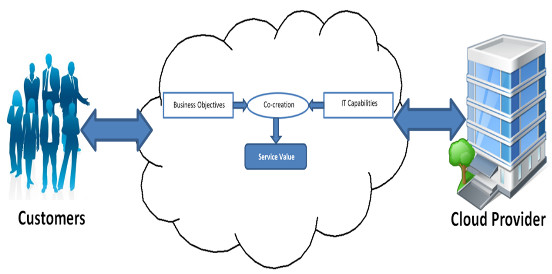

Figure 1: Cloud Value Co-creation.

We describe this as cloud value co-creation, i.e., the alignment of business objectives and IT capabilities to supports organisations ability to generate value (Figure 1). IT is a cost, and yet it enables business value. Thus, we are interested in the output of a service and the capabilities employed to reach the desired output. What is of immense interest here is the ability to assess cloud capabilities in delivering the desired output though service metrics. We consider the cloud to be a value co-creation environment to support service maturity.

This allows us to examine the generation and on-going realisation of mutual organisational-customer value through the affordance of additional IT capabilities provided by cloud computing initiatives.

2.2 Cloud Service Quality

Service quality can be measured and created through the utilisation of service capabilities. Within the cloud service environment, organisations rely on service quality through the successful alignment of business objectives and IT capabilities to co-create value. The concept of 'service' and 'quality' has received much attention across business and information systems literature. However, based on our analysis, we posit the need to evolve their meaning in a cloud computing context as we prescribe an alternative view through a 'sourcing maturity model'. For example, Kang and Bradley (2002; p. 153) define service quality as "*an abstract and elusive construct because of three features unique to the service delivery – intangibility, heterogeneity and inseparability of production and consumption*". This is particularly interesting when we consider the co-creation relationship between the service provider and user in generating business value within a cloud computing context.

Within a cloud computing context, service quality relies on the tangible resources which often rely on representative agents of resource provision rather than heterogeneous consumption. Therefore, we would attempt to define service quality in a cloud context as '*the orchestration of resources which contribute towards value co-creation actions that align the required IT and governance resources to support business objectives on-demand while satisfying customer requirements*'. This introduces a tangible relationship for service quality which is measurable within a cloud services. We argue that service quality must have a business value which is enabled through the alignment of IT and business architecture. This may be measured through performance metrics and service capability maturity.

2.3 Service Capabalitiy Maturity

There are five main maturity levels within the capability maturity model (CMM):

1. ***Initial***: undocumented starting point.
2. ***Repeatable***: documented process to allow the process to be repeated.
3. ***Defined***: confirmation of process becoming standardised.
4. ***Managed***: agreed metrics to evaluate the process performance.
5. ***Optimising***: managing the improvement of the process.

These levels provide a holistic view of process maturity. Within each phase there are key process areas which examine the goals, commitment, ability, measurement, and verification as they reach greater maturity. Ultimately, these steps were designed to improve performance through quantitative process-improvement objectives. However, one of the biggest criticisms of adopting CMM model is the cost and time associated (Herbsleb and Goldenson, 1996) with adopting it assessment activities (training and appraisal). Considering our focus lies with SMEs, we emphasise the need to develop an inexpensive and easily adoptable framework which is particularly interesting when applied to in a cloud context.

3 THE PROMISE OF MATURITY MODELS

Maturity models have been very prominent through information systems management literature. A maturity model may be described as *a systematic service assessment which provides a model to understand an organisations capability maturity of business processes*. A maturity model is specifically used to inform and support decisions and reduce risk in management strategies. A CMM comprises of five key factors which must be considered in the assessment including:

1. ***The Maturity Levels:*** presents a scale of one to five, where five is the ideal maturity state.
2. ***Key Process Areas:*** clusters specific business process or activities which are considered important to achieve a business goal.
3. ***Goals:*** goals of individual processes and to what extent they are realised indicates the capability and maturity of an organisation.
4. ***Common Features:*** describe the practices which implement a process centred on performance mechanisms.
5. ***Key practices:*** the infrastructure and practice which contribute to the process.

The main objective of developing a capability assessment is to provide some level of measurement which can generate data to support decision-making. These measurements can support managers determine a process status and its effectiveness when executed by their cloud strategy. There are a number of essential measurements which are associated with cloud and overlooked in the existing capability maturity models. We posit that their traditional approach of "a one size fits all" is no longer valid for the dynamic nature of cloud computing.

4 TOWARDS A CONTINGENCY MODEL

The concept of quality has long been on the management agenda and is still ranked amongst the more important factors which influence service performance and strategy. There is a clear relationship between 'quality' and 'value'. We have argued that the concept of quality taken from management science literature is no longer prevalent in a cloud computing context. To support our argument we try to redefine service and service quality through our contingency model and service composite capabilities and explain how quality is a co-creating activity between organisations that unpack and exchange service capabilities. Therefore this alters the responsibility for quality within a distributed cloud service ecosystem. We have categorised cloud metrics into BPaaS, SaaS, PaaS, and IaaS. Within each level, we can classify service metric depending on the managerial level:

1. **Strategic Cloud Service View:** resource allocation.
2. **Tactical Cloud Service View:** IT alignment of business processes.
3. **Operational Cloud Service View:** performance measures.

From each perspective, we consider it important to encapsulate the relationship between service and technology and how it co-creates value within an organisational context. Figure 2 illustrates a high level conceptual model which demonstrates the relationship between technological quality metrics and service quality metrics in the establishment of our Cloud Service Index (CSI). It also lists some examples of the broad technological and service categories which will be examined within the cloud service stack.

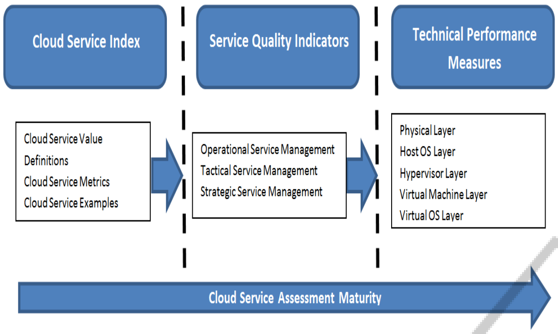

Figure 2: Establishing the Cloud Service Index.

In the cloud strategy, the primary difference between the CSI and service quality is the focus on value in the context of how cloud computing increases business value through sourcing additional service capabilities. The service quality indicators will examine cloud service provision in the context of subjective and objective quality criteria. The quality criteria will represent end-user perception and requirements analysis of service quality. In addition, the technical performance measures are primarily concerned with what the IT infrastructure provides through the requested functions and performance (i.e. execution). The CSI relates the quality factors of the cloud service to the business strategy and organisational goals. We define service quality as the difference between customer's perception of the expected benefit and the realised benefit which emerged from a service, or:

Cloud Service Quality = Expected Benefit – Realised Benefit

Therefore, quality is an attribute result of an emerging relationship between consumer expectation and service provision upon which we can build metrics to derive a value for quality. Within each of the service lifecycle phases, we are undertaking a layered analysis of the cloud stack (Figure 3) to identify specific metrics which include the following criteria:

1. Metrics must be actionable (i.e. influence what action managers must take);
2. Supports service trending which allows us to flag weak service performance;
3. Supports catalog data to examine processes and how they align with SLAs;
4. Have some industry baseline to benchmark against;
5. Reflect successes, problems, and failures to facilitate a 'learning' performance business intelligence system.

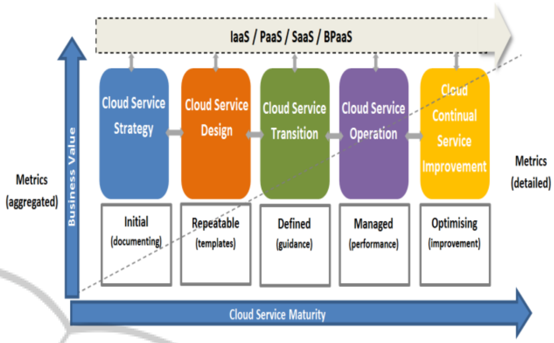

Figure 3: Cloud Service Index Model.

Having assessed the various cloud capabilities, our assessment focuses on presenting the results with regards the cloud service lifecycle in terms of process readiness:

1. *Strategy Readiness (SR)*: focuses on how the cloud will align with the organisational strategy while understanding the general demands to benefit from the promise of the cloud.
2. *Design Readiness (DR)*: balancing service requirements with service capabilities.
3. *Transition Readiness (TR)*: moving the service into operation through service provisions.
4. *Operation Readiness (OR)*: examining effective and efficient service operations to (re)align the cloud strategy.
5. *Continuous Improvement Readiness (CIR)*: monitors the governance and critical success factors (metrics and KPIs) to report on service capabilities throughout the cloud lifecycle.

We can model the service maturity through a snapshot where cloud service providers and users may view their readiness towards cloud solutions (see Figure 4). The model represents a conceptual view of service capabilities and customer experience. It offers an exemplary solution towards reporting cloud capabilities to SME managers. Each phase in the cloud lifecycle is scored (out of 5) to indicate it readiness to offer/avail of cloud solutions (0=not ready; 5=ready). In this example, we demonstrate how the OR and CIR presents us with an indication that these are areas of concern because the score below the value-added curve and therefore warrants immediate attention in these specific areas. This suggests that managers could investigate the suitability of cloud service capabilities to support these two phases and improve the service maturity.

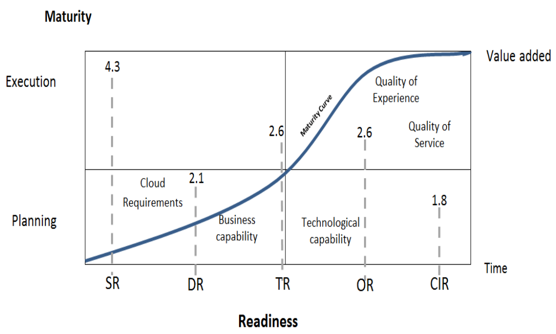

Figure 4: Example of Reporting through CSI.

5 CONCLUSIONS

This paper highlights that this is our initial step to establishing the CSI contingency model. There are many other challenges ahead. In terms of the CMM approach, we are positioned at the 'defined' phase where we are currently defining metrics to evaluate cloud process performance. We envisage that this work will address some of the key issues identified throughout cloud computing literature. The CSI will also indicate areas where organisations are strongest and examine which service functions may be of concern when compared to peer-organisations, i.e. benchmarking. We will also explore the visualisation of service brokerage through network analysis techniques to add greater transparency on value co-creation (for example, Carroll et al., 2012). Through the development of the CSI, we can assist organisations improve their cloud services through the assessment of their cloud capabilities, quality and performance using the contingency model.

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