IT Governance of Cloud Computing: Performance Measures using an IT Outsourcing Perspective

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Willem van Ketwich
Master of Information Systems

Melbourne School of Engineering

Department of Computing and Information Systems

The University of Melbourne

Australia

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Supervisors:
Dr. Rachelle BOSUA
Dr. Antonette MENDOZA

Abstract

With the advent of cloud computing and the success of the cloud computing industry, organisations are beginning to adopt this service model and technology at an increasing rate. As the rate and level of use increases, organisations are faced with how best to govern these investments and obtain maximum benefit from the services offered by providers. This includes measuring the performance of these services, the corresponding organisational performance and the associated business value generated. In investigating these areas, this study compares cloud computing and IT outsourcing. It is found that while cloud measures relate, to a great extent, to the operational level of an organisation, IT outsourcing measures are concerned more with the strategic level. This highlights that cloud computing lacks strategic measures and that measures from IT outsourcing may be adopted to fill this gap.

Declaration

I certify that:

This thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person where due reference is not made in the text.

The thesis is 8,348 words in length excluding text in images, table, bibliographies and appendices.

Signed _____ Dated _____

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1. Introduction

The rapid growth of cloud computing in recent years has led to the emergence of a multi-billion-dollar industry. According to IT analyst firm International Data Corporation (IDC), the cloud computing industry is expected to produce $1.1 trillion in business revenue by 2015 (Microsoft 2012). As cloud computing increases in prevalence, its use within the organisation is also increasing. A Deloitte survey of the CIO community found cloud computing adoption is rising and more organisations are looking at implementing cloud computing (Deloitte 2011).

The use of IT governance as a corporate mechanism promotes the alignment of IT with an organisation's business strategy. Additionally, IT governance aims to transform IT to meet the needs of the business and improve organisational performance (De Haes and Van Grembergen 2005; Mueller and Phillipson 2007). IT research firm Gartner reports that best results from cloud services are being seen by organisations through the use of very specific strategies that use cloud to accelerate the organisation's performance (Columbus 2012). To achieve this, IT governance offers mechanisms that help an organisation to strategically align IT with performance goals.

Concerns identified with cloud computing in the organisation include losing control of the IT architecture as well as security risks. The use of IT governance can help mitigate these risks for an organisation and give better transparency through the use of measures of processes and outcomes (Heier et al. 2012). As well as this, IT governance measures have been considered key to the success of IT for an organisation (PWC 2007)

The IT Governance Institute (ITGI) define IT governance as "… the leadership and organisational structures and processes that ensure that the organisation's IT sustains and extends the organisation's strategies and objectives" (ITGI 2012). They view IT governance in terms of strategic alignment, resource management, risk management, value delivery and performance measurement (ITGI 2003). In this study the areas of performance measurement, resource management and value delivery are used to frame the review and assist in the discussion of the issues relevant to the measuring of cloud computing performance for an organisation. In this light, performance measurement is discussed as well as Service Management and the resultant business value obtainable from these services.

Cloud computing has many varying definitions in literature and has included concepts such as service, hardware, software, scalability, virtualisation and grid computing (Böhm et al. 2011; Vaquero et al. 2009). The lack of agreed-upon terminology has hindered research into this area (Blaskovich and Mintchick 2010). For this study, cloud computing is defined from the National Institute of Standards and Technology (NIST) such that it involves "on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned" (NIST 2012). There are three service models of cloud in this definition that help categorise the type of service offered by a cloud service provider; (1) Software-as-a-Service (SaaS) which involves applications running on cloud infrastructure; (2) Platform-as-a-Service (PaaS) which involves the capability provided to the consumer to deploy onto cloud infrastructure and (3) Infrastructure-as-a-Service (IaaS) which involves the provisioning of processing, storage, networks and other fundamental resources (NIST 2012).

Cloud computing has been seen as a form of outsourcing but it remains to be seen whether existing theory and practice of IT outsourcing can successfully be applied to this burgeoning area. Measures of cloud computing exist but have been considered in isolation from existing literature of IT outsourcing. In reviewing performance measurement in the organisation with regard to cloud computing, the aim is to establish what measures can be used through governance mechanisms to more effectively govern cloud investments. In doing so, key literature is considered to assess what is currently known about measures in terms of cloud computing and how IT outsourcing measures can contribute to the governance of cloud computing.

This leads to the following research question:

- *What are the key performance measures that organisations require for effective governance of cloud computing investments?*

And the sub questions:

- *What are the key mechanisms that organisations require to measure performance from cloud computing investments?* and
- *How can IT outsourcing inform governance of cloud computing?*

2. Research Method

The research process consists of two main sections including a literature review in Section 3 and a comparison of cloud to IT outsourcing and a synthesis from the literature in Section 4. The literature review began with a search of the literature using the key terms of *cloud computing*, *performance measurement*, *metrics* and *IT governance*. The search was then expanded to the areas of *Service Management*, *Business Value* and *IT outsourcing* due to the relevance they carried to the former areas. Some older but still relevant papers were found through references to them in newer papers.

The synthesis compares and contrasts cloud computing and IT outsourcing to establish where cloud computing is situated in comparison to IT outsourcing. This also helps to identify what features are in common between cloud and IT outsourcing and helps to see where IT outsourcing can contribute to cloud computing. Following from this, measures of cloud and IT outsourcing are compared within the context of IT governance. This is done to determine where measures are situated in the organisation and what measures are most common at different organisational levels.

3. Literature Review

3.1 IT Governance and the Organisation

There are varying definitions of IT governance but it commonly involves the use of an IT governance framework such as IT Infrastructure Library (ITIL) or Control Objectives for Information and Related Technology (COBIT) (Petruch et al. 2011). COBIT is a toolset that defines processes for managing IT within the organisation. ITIL similarly defines practices for Service Management to align IT with the business.

Weill and Ross (2004, p.2) consider IT governance as the most important factor in generating business value from IT and define this as "specifying the decision rights and accountability framework to encourage desirable behaviour in using IT". In their view, enterprise strategy and the organisation harmonise with IT governance arrangements, mechanisms and decisions, which in turn harmonise with business performance goals including IT metrics and accountabilities. As part of the alignment process between business and IT, they suggest the use of IT management techniques such as approval processes, exception processes, Service Level Agreements (SLAs) and other methods to track business value from IT investments.

De Haes and Van Grembergen (2009) build on the idea of strategic alignment between business and IT using the Strategic Alignment Model (SAM) developed by Henderson and Venkatraman (1993). They view IT governance in terms of relational mechanisms, processes and structures and identify that IT governance is situated at the strategic (board) level, the management (C-suite) level and the operational (IT and business management) levels. Their major finding is that organisations with more mature IT governance practices are likely to obtain a higher degree of business/IT alignment. Among other processes, they find the use of the Balanced Scorecard (BSC) and Service Level Agreements (SLAs) as identified governance mechanisms.

3.1.1 IT Governance and Cloud Computing

As part of governance, and in order to manage processes and activities of cloud computing, Petruch et al. (2011) note that performance indicators in the form of Key Performance Indicators (KPI) and Key Goal Indicators (KGI) are commonly used through the use of a BSC technique. It is recognised that these KPIs and KGIs can also be used through a SLA in order to control the level of service in a contract with the cloud provider.

Heier et al. (2012) discuss KPIs in terms of outcome and process control metrics as a way of preventing 'losing control' of the organisation's IT architecture. These metrics are seen as a way of focusing management decision making, providing transparency to prevent opportunistic behaviour and mitigating discovered problems. Their focus on IT governance is described as a process-driven approach that provides a set of 'enabling mechanisms' in order to align IT with the business. In this light, governance is set within the context of business strategy and measured through the adoption of Luftman's Strategic Alignment Maturity (SAM) model (Sledgianowski et al. 2006). This takes into account aspects of communications, competency and value measurements, governance, partnership, scope and architecture and skills.

Farrell (2010) recommend conducting a gap analysis of cloud service and to map the service against security and compliance models resulting in a set of gaps to be addressed. Measures of governance are less specific with Farrell (2010), instead suggesting focal points for different models of cloud services. With respect to IaaS, it is highlighted that the organisation is responsible for all security and risk related issues. With PaaS, the focus should be on configuration management for hardware, resources, software development tools, middleware, database, messaging and queuing functions, and with SaaS to focus on SLAs.

3.1.2 Cloud Management Approaches

Cloud computing has been seen as an extreme form of IT outsourcing and a contrast to IT outsourcing (Clemons and Chen 2010; Dhar 2012). The meta-study conducted by Petruch et al. (2011) identifies that prior studies rarely address the topic of how organisations manage the relationship with cloud service providers. They note that a cloud computing relationship is similar to that of an IT outsourcing relationship. Additionally, that there is potential for research on whether common management approaches already used within the organisation for outsourcing could be extended for cloud computing use. They also note that the most significant benefits of managing cloud services through an IT department are IT know-how and the ability to manage SLAs.

Heier et al. (2012) consider management concerns from the perspective of the IT department, and predict that once the bulk of business computing has shifted to the cloud, IT will become a hollowed department only responsible for support and innovation services not mature enough for the cloud. This will make the IT department shift from "service delivery to service management – from in-house development to vendor management." (Heier et al. 2012, p.4986)

Contrasting the two views, it can be seen that while Heier et al. (2012) may consider the interests of the IT department and its future role, Petruch et al. (2011) take a more synergistic approach. This approach recognises how management of cloud relationships can be improved upon by existing organisational practices.

3.2 Performance Measurement

The measurement of organisational performance is well established in IS literature with the notion of the "Productivity Paradox" identified by Brynjolfsson (1993) that sees the lack of quantitative measures for the output and value created by IT. There have been attempts to operationalise measures across dimensions at the strategic level of the organisation. Venkatraman (1989) identifies six organisational strategy dimensions and measures their relationship with business performance. Performance is identified as both the aspects of growth and profitability of the organisation where the six strategic dimensions are the areas of aggressiveness, analysis, defensiveness, futurity, proactiveness and riskiness.

Chan (2000) in reviewing IT value, notes that managers evaluating IT investments should report on a number of performance dimensions at different points in time. Bakos (1987, p.12)

state “technology has an impact on organisational structure and process, thereby affecting organisational performance”. Barua et al. (1995, p.6) note that, in order to determine the performance of IT, it “can be measured at lower operational levels in an enterprise, at or near the site where the technology is implemented” and then be traced through the organisation to reveal higher level impacts on performance.

From this it can be seen that the performance of IT within the organisation is a product of the organisation itself including the structures and processes present to support it. Secondly, although measures and monitoring of IT are done at an operational level, the overall cumulative effects on the organisation are seen to be effectual at a higher strategic level where performance is related to other measures such as financial effects.

3.2.1 The Balanced Scorecard

The IT Governance Institute (2012) identify that measuring IT performance is a key concern and challenge to the enterprise. It has been identified that corporate performance measurement systems are positively correlated with the effectiveness of IT governance (Vaswani 2003). One way of measuring organisational performance is through the use of the Balanced Scorecard (BSC) of Kaplan and Norton (1996). This is a reporting tool intended to be used by managers to track and monitor actions and results of activities within the organisation. The BSC measures organisational performance across a variety of areas including finance, customers, internal processes and learning and growth. Through its use, performance is measured in a more meaningful and balanced approach than just financial performance of the organisation.

The IT Governance Institute (ITGI) identify that the means of value creation through IT has shifted from tangible to intangible assets, and as such cannot be measured through traditional financial means (ITGI 2003). Others have also noted that intangibility is a characteristic of IT services (Lovelock and Gummesson 2004). The ITGI (2003) suggest the use of the BSC as a way of measuring performance that surpasses conventional accounting. As part of this approach, the use of outcome measures and performance drivers are recommended. These metrics help to show cause and effect between strategy and action from comparing what has been done to how well it was done.

Kaplan and Norton (2004) indicate that for intangible assets, the creation of value is less direct than tangible assets and that financial outcome is affected through cause-and-effect

relationships. They also state that value is created through internal business processes where effective and strategically aligned internal processes determine how value is created and sustained. Further to this, they point to the measurement of intangible assets through the concept of 'strategic readiness'. This is where intangible assets such as IT services support the organisation's strategy in a way not dissimilar to liquidity. This way, the more ready these intangible assets are to support organisational strategy, the quicker they can contribute to generating financial benefit for the organisation.

The measurement of intangible IT assets to support organisational strategy appears to be paramount to the performance and success of these investments within the organisational context. Wilkin and Chenhall (2010) identify there are a number of Management Accounting papers that report how measurement could be used to inform strategy, that performance measurement enhances strategy and that both financial and non-financial information is important in formulating strategy. As a future research direction, they highlight that it would be useful to investigate what performance measurement approaches are most relevant to specific scenarios.

3.2.2 Measuring and Monitoring of Cloud Services

Various approaches have been taken toward the measurement and monitoring of cloud services within organisations. The vast majority of research into performance measures of cloud computing are concerned with technical aspects of cloud services and the related infrastructure. For example, numerous studies focus on the performance of Amazon's cloud services mainly from a technical and non-functional properties perspective (Garfinkel 2007; Jackson et al. 2011; Stantchev 2009). Iosup et al. (2011) focus on performance of cloud computing for scientific computing through evaluating scientific computing workloads in the cloud. They find that the performance of these services is not yet good enough for the requirements of scientific computing. Ghosh et al. (2012) focus on performance of IaaS, measuring the impact of workload on system characteristics and Expósito (2011) present an analysis of high performance computing in the cloud.

There is also research into monitoring services for cloud infrastructure. Katsaros et al. (2011) propose a hierarchical monitoring framework for cloud services and Kousiouris et al. (2011) present an approach to estimating resources in cloud environments. Machado and Stiller (2011) provide a design for offering guarantees for performance measures of SLAs.

Currently, limited research exists into the performance of cloud services and the impact on an organisation's overall performance. Although there has been some research into economic models in service computing (Chituc 2011), and even the use of the BSC for service performance (Liu 2011), there appears to be a lack of deeper understanding of organisational performance in relation to cloud computing investments.

3.2.3 Cloud Computing Performance Measures

Given cloud performance measures focus mainly on technical aspects, this includes aspects such as availability, throughput and response time in what is commonly termed Quality of Service (Qos) (Chituc 2011, Garfinkel 2007, Petruch et al. 2011, Katsaros et al. 2012, Goiri et al. 2012). As cloud services are usually delivered over the internet, these basic elements of measurement can be seen to be fundamental requirements of a cloud service and would equally apply to SaaS, PaaS and IaaS.

In terms of QoS, Goiri et al (2012) devised fine-grain guarantees on CPU performance at a technical level that give confidence to the QoS of SLAs for business activities. Kastaros et al. (2012) propose a cloud infrastructure solution for monitoring QoS that exploits existing open source Application Programming Interfaces (APIs) for cloud computing. Other monitoring solutions also exist such as the RESERVOIR project that supports infrastructure SLAs and aims to facilitate transparently provisioned and managed cloud services (Rochwerger et al. 2010)

In relation to IaaS specifically, measures such as CPUs utilised, memory size and storage capacity could be considered main concerns (Alhamad 2010). At the level of IaaS, the focus is more on basic computing building blocks that can be utilised to store and process an organisation's applications and data and thus these performance measures could be considered at a more rudimentary level.

With PaaS, a platform on which application developers can produce applications and also run applications such as databases and web servers is offered. Measures for this type of cloud focus more on aspects such as integration, scalability and server metrics (Alhamad 2010). Examples of PaaS are Google's App Engine, Microsoft's Azure and Salesforce's Force.com. At the level of cloud service of SaaS, measures become more qualitative and focus on the customer experience to a greater extent. This is seen in terms of experiential measures

(Skilton 2010, Garfinkel 2007) including rapport, responsiveness, reliability, flexibility, features (Benlian 2012), usability and customisability (Alhamad 2010).

3.3 IT Services, Service Management and Performance Measurement

To further investigate performance measures of cloud and to understand the context of the management of these services it is necessary to first look at Service Management and Business Value for cloud computing. In general terms, services have been seen as the application of competencies for the benefit of another where there is an exchange for value between provider and client (Spohrer et al. 2007). Within the scope of IT services, Bardhan et al. (2010) state that service-oriented systems involve the joining of business processes and technologies through autonomous, implementation-independent interfaces. These service-oriented systems are formed such that the alignment of business and technology facilitates cost advantages from the commoditisation of hardware, software and business processes (Bardhan et al. 2010). This is realised through technologies such as utility computing, virtualised resources, SaaS, and Application Service Provision (ASP), which have been described as a Service-Oriented Architecture (SOA) (Bardhan et al. 2010). This architecture is comprised of technologies which by some definitions could be seen as synonymous to that of cloud computing (Armbrust et al 2010; Buyya et al. 2009).

The management of performance of IT services is enabled though various governance frameworks such as COBIT and ITIL. With COBIT, for example, an objective relating to performance measurement is to *Define and manage service levels* (ITGI 2007). This requires a framework to be developed that uses metrics for Service Level Management. This also includes defining all IT services used, defining and agreeing to SLAs, monitoring and reporting on the performance of SLAs and regular review of SLAs. This is seen as helping keep continual alignment with business requirements and priorities and allow a common understanding between customers and providers of the IT services (ITGI 2003).

Financial performance at the organisational level has been measured using stock market returns to measure performance effects as well as the use of market value to determine a firm's IT capability (Wilkin and Chenhall 2010). In relation to IT services, financial performance measurement has been identified with respect to the negotiation and pricing of contracts between service providers and organisations. All IT services are seen to be subject to negotiation for the terms and conditions of their offering and followed by an execution

phase (Bardhan et al. 2010). At the execution phase of a contract, both parties are vulnerable to a variety of risks including opportunistic, technical, market and competitive risks.

Opportunistic behaviour in relation to cloud computing has been viewed from a risk profile perspective as well as from a legal perspective (Clemons and Chen 2011; Bradshaw et al. 2011). However, information on decision making around this negotiation is required such that "It will be important to develop metrics, models, and methods that provide support for managerial decision making regarding IT services issues, especially IT services pricing, contract design, and shared organizational investment." (Bardhan et al. 2010, p. 34).

Heier et al. (2012) also identify that KPIs are useful for preventing opportunistic behaviour through increased transparency. Marston et al. (2011) further note that the area of pricing strategy as a research topic for cloud will most likely have to consider issues such as SLA contract design. This highlights the requirement for metrics that can be applied to SLAs at the negotiation stage in order to give managers a greater understanding and more bargaining power with cloud service providers.

3.4 Performance Measurement and Business Value

Kohli and Grover (2008) view business value as being categorised in terms of IT intermediate value, output value and financial value. In this perspective, IT capabilities result in better processes for intermediate value and output value is realised by better service to customers. They also recognise the 'embeddedness' of IT within organisational processes and that a chain exists between IT investment, the capabilities required and the creation of business value. Masli et al. (2011) refine this further to show a chain of contributions from IT investment to IT capability to business process performance measures to financial measures of business value. This is similar in many regards to the tracing of performance from lower to higher organisational levels as discussed in Barua et al. (1995).

Wilkin and Chenhall (2010) note that for IT governance, value delivery is difficult to assess at the different levels of the organisation, from business processes to the business unit level to the financial reporting level. They also note that similar to performance measurement, value delivery is an outcome that is dependent on sound practice of strategic alignment, risk management and resource management. This in turn leads to value delivery effectual through "strategic appreciation of a firm's activities" (Wilkin and Chenhall 2010, p.127). This

strategy is contextual to the organisation and can involve IT capability for competitive advantage (Rivard et al. 2006).

Grover and Kohli (2012) state that the co-creation of value is determined by four relational components, one of which is the use of effective governance. They identify that a governance layer exists at the firm level between a given firm and other firms that interact with it in the co-creation of value. They specify that this layer involves a control structure to reduce transaction costs and incentivise new creation of value typically through contracts and formal economic safeguards. At this inter-firm level, value creation is focused more on IT-enabled cost reduction than on IT-enabled capabilities. This layer could be considered to be extending the processes, relational mechanisms and structures of the organisation to a firm-collaborative level. Additionally, this extends the concept of measuring performance beyond the single organisation to that of performance in the multi-firm environment.

In relation to cloud computing specifically, Iyer and Henderson (2012) describe six benefit patterns of cloud computing for gaining competitive advantage. Among these is the ability to orchestrate dependencies, where companies that use cloud can form temporary alliances with partners through the use of open Application Programming Interfaces (APIs) that enable interoperability between partners on a given platform. Consequently, value is co-created in a way described by Grover and Kohli (2012) where a control structure is provided by the cloud provider in the form of the APIs used in the cloud in order to mediate the relationship between firms. Figure 1 depicts the co-creation of value between firms, enabled through the use of APIs of a cloud service provider.

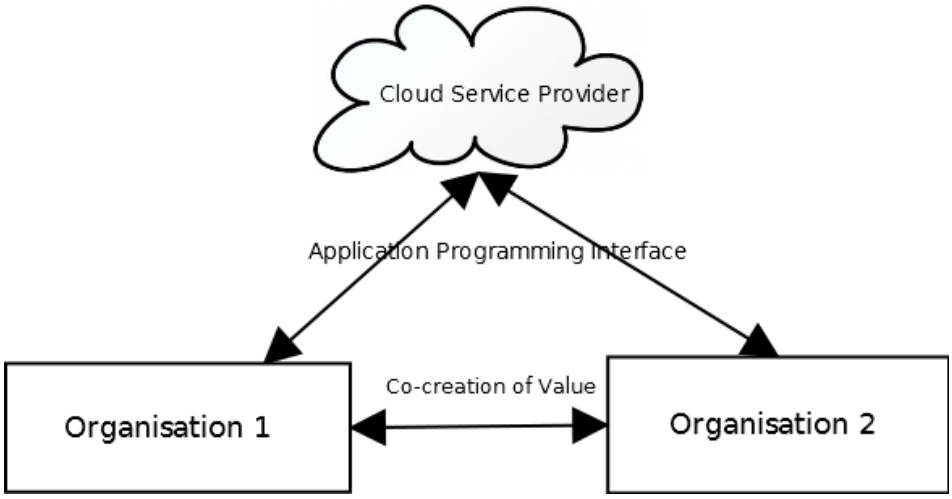

Figure 1 Co-creation of value between two organisations enabled through cloud services

Another form of value described by Iyer and Henderson (2012) is that of collective problem solving in which an organisation chooses from cloud-based process libraries of configurable but standardised SaaS software. This has the advantage of using software and processes already developed for other clients for what are perceived as common functions. The result is the avoidance of costly customised software and reduced building of new processes. This form of business value could be recognised to be a result of the commoditisation of processes within the organisation as earlier described by Davenport (2005). This is where sets of activities are standardised for a variety of reasons including making it possible to compare measures of performance as well as making it easier to allow outsourcing of process capabilities. The measuring of the performance of processes within an organisation using cloud services could therefore have more meaning as a result of this standardisation where meaningful benchmarks can be established.

3.5 IT Outsourcing

Considering the added value that can be gained from IT outsourcing literature in relation to performance measures, and due to the fact that there are similarities between the two types of services, it is important to draw on IT outsourcing to help determine where it can inform cloud computing. A formal definition of IT outsourcing used as a basis of this discussion is:

"delegating or transferring some or all of the IT related decision making rights, business processes, internal activities, and services to external providers, who develop, manage, and administer these activities in accordance with agreed upon deliverables, performance standards and outputs, as set forth in the contractual agreement" (Dhar and Balakrishnan 2006, p. 59)

The use of a contractual agreement in this delegation of services is often done through SLA mechanisms that define what is expected for what is being paid. This includes details of aspects such as accountabilities of each party, the work to be performed by each party, reporting requirements, metrics to be used and incentives/disincentives to both motivate good performance and mitigate poor performance (Cullen 2009)

Lacity et al. (2009) identify the main reasons an organisation outsource are to reduce costs, enable access to resources, and to allow internal resources to be focused on more strategic work. Dhar (2012) additionally identifies motivations such as faster development cycles, performance and quality assurance and creative and structured leases intended to reduce risk.

Variants of IT outsourcing are seen as Offshore Outsourcing, Business Process Outsourcing (BPO), and ASP (Lacity et al. 2009). Offshore Outsourcing is where IT work is outsourced overseas instead of done domestically. BPO is outsourcing of business processes within a function of an organisation. ASP is a business model whereby a supplier hosts and rents applications to clients over a network. Of these variants, ASP could be considered the closest to the cloud service provision model, particularly SaaS, although there are distinct differences between the two that could be seen to differentiate the way they are treated in practice and how existing theory relates to them.

3.5.1 IT Outsourcing and Cloud Computing

Blaskovich and Mintchik (2011) discuss cloud computing in the context of IT outsourcing and establish that cloud is especially relevant to IT outsourcing researchers due to the business benefits provided and the view of it as a solution to accounting challenges. They consider that although cloud computing has had the effect of levelling the competitive field through flexible access to technology, in comparison to IT outsourcing it also accentuates challenges associated with third party processing of information and business risks such as disruption of service and data recoverability. In addition they suggest that future research could address determining effective SLAs for cloud, as also noted by Bardhan et al. (2010). They also state that it remains to be seen "whether the conclusions of prior ITO research remain valid in the context of cloud computing or if the technological switch is so dramatic that prior findings should be reconsidered in their entirety" (Blaskovich and Mintchik 2011, p.25). This would suggest possible merit in cautious analysis and application of existing knowledge in IT outsourcing to the burgeoning field of cloud computing.

3.5.2 IT Outsourcing Performance Measures

Performance measures of IT outsourcing to a large extent involve the use of strategic and financial measures that indicate the importance that is placed on outsourcing decisions. Cullen et al. (2008) present a framework for assessing IT outsourcing success that comprises of the areas of value for money, improved financial results, improved operations and strategic outcomes. This framework attempts to take into account that an organisation's IT outsourcing goals may change over time and from organisation to organisation. This framework views the outsourcing relationship from a much higher level within the organisation than the measures seen with cloud computing and views the goals and outcomes of the investment to a greater extent than the current operating performance.

Misra (2004) present a top-down framework of outsourcing metrics for IT services that flows from business strategy analysis to outsourcer selection to selection of outsourcing metrics giving a high-level view of how metrics fit within the business strategy of the organisation. Misra (2004) categorise metrics in terms of productivity/output, quality, responsiveness, efficiency as well as risk management, reporting and incentives/rewards. These categories could be seen to be on a more managerial and operational level within the organisation and help identify areas to evaluate more short-term results from outsourcing whilst keeping this within the context of the organisation's overall business strategy.

Analysis of performance measures in DiRomauldo and Gurbaxani (1998) of the outsourcing contract is divided into the strategic areas of IS improvement, business impact and commercial exploitation. These are seen as the main strategic intents for outsourcing and so the measures defined are specific for each strategy. The measures of IS improvement and business impact are similar in some regards to the BSC area of internal processes and commercial exploitation is similar to the area of financial performance of the BSC. Of these strategic areas, the IS improvement measures could be seen as most similar to the identified performance measures of cloud, with a focus on IS costs, IS quality, IS productivity and IS user satisfaction.

A study of large-scale IS outsourcing agreements is conducted in Smith et al. (1998) from a financial perspective. From this, financial metrics of the firm were established based on publicly available financial data. The resultant metrics gave a financial performance view of the firm that reflected outsourcing decisions the firm had made. Similar studies on large-scale cloud adoption would possibly be of use in order to determine the financial characteristics of organisations entering into agreements with cloud service providers.

Jiang and Qureshi (2006) conduct a literature review of outsourcing and identify a gap in the lack of objective metrics for evaluation of outsourcing results. They produce a model of aspects that can be measured with financial data as the outcome of an outsourcing action. These measures comprise of the areas cost reductions, productivity growth, profitability increase, firm value improvement and risk control. Once again, these measures observe the service from a much higher and less technical level within the organisation than those observed with cloud computing.

3.6 Key areas covered in the Literature

In summary, Table 1 indicates key sources from literature for each topic discussed.

Table 1 Literature Review focus areas and main contributing authors

Focus Area	References
General IT Governance	De Haes and Van Grembergen (2009), Farrell, (2010), Heier et al. (2012), Petruch et al. (2011), Weill and Ross (2004), Wilkin and Chenhall (2010)
Performance Measurement	Brynjolfsson (1993), Chan (2000), Bakos (1987), Barua et al. (1995), De Haes and Van Grembergen (2009), Kaplan and Norton (1996), Kaplan and Norton (2004), Venkatraman (1989), Wilkin and Chenhall (2010)
Service Management	Bardhan et al. (2010), Bradshaw et al. (2011), Buyya et al. (2009), Marston et al. (2011), Spohrer (2007), Wilkin and Chenhall (2010)
Business Value	Davenport (2005), Grover and Kohli (2012), Iyer and Henderson (2012), Kohli and Grover (2008), Masli et al. (2011), Wilkin and Chenhall (2010)
IT Outsourcing	Bardhan et al. (2010), Blaskovich and Mintchik (2011), Cullen (2009), Dhar (2012), Dhar and Balakrishnan (2006), DiRomauldo and Gurbaxani (1998), Jiang and Qureshi (2006), Lacity et al. (2009), Misra (2004), Smith et al. (1998)

3.7 Gaps in the Literature

Petruch et al. (2010) note that cloud computing relationships are similar to governance of IT outsourcing relationships and identify that studies rarely address whether existing approaches within the organisation extend to management of cloud computing. Blaskovich and Mintchik (2011) identify that it remains to be seen whether conclusions of prior IT outsourcing research remain valid within the context of cloud computing and that characteristics of effective SLAs remain unclear for cloud computing. Bardhan et al. (2010) highlight the importance to develop metrics, models, and methods to support managerial decision making regarding IT services.

Considering the main research question of: '*What are the key performance measures organisations require for effective governance of cloud computing investments?'* and from what has been reviewed, a gap can therefore be seen to exist in determining performance measures at different levels of the organisation with respect to cloud computing. This includes but is not limited to the strategic, managerial and operational levels. This additionally includes determining where the existing body of IT outsourcing literature can be used to help fill this gap.

4. Synthesis and Discussion

4.1 Comparison of Cloud and IT Outsourcing

In order to determine where IT outsourcing can inform and contribute to our understanding of cloud computing, a comparison of the literature was first performed to determine the similarities and differences between IT outsourcing and cloud. Following from this, a synthesis of performance measures and where IT outsourcing can contribute to cloud was conducted as well as identifying measures relevant to different levels within the organisation. It was found that while cloud computing measures are more often focused at the operational level within the organisation, IT outsourcing measures were more concerned with the strategic level.

Table 2 below identifies the various characteristics of different services. Different service models are shown in the row across the top and different characteristics along the left-hand column. A tick indicates a given service model offers a specific characteristic. For example, both ASP and SaaS offer provisioning of software. The main similarities and differences from the table will be elaborated on in the following two sub-sections.

Table 2 Characteristics of various service provider models

Service Model / Characteristic	IT Outsourcing		Cloud Computing		
	Business Process Outsourcing (BPO)	Application Service Provision (ASP)	Infrastructure-as-a-Service (IaaS)	Platform-as-a-Service (PaaS)	Software-as-a-Service (SaaS)
Economies of scale (Kern et al. 2002; Benlian and Hess 2010; Skilton 2010)	✓	✓	✓	✓	✓
Forms of service and use of Service Level Agreements (Kern et al. 2002; Bradshaw et al. 2011)	✓	✓	✓	✓	✓
Subscription Based Business Model (NIST 2012)			✓	✓	✓
Multitenant Elasticity (NIST 2012)			✓	✓	✓
Provisioning of Infrastructure (NIST 2012)			✓		
Provisioning of Platform (NIST 2012)				✓	
Provisioning of Software (Lacity et al. 2009; NIST 2012)		✓			✓

4.1.1 Similarities between Cloud Computing and IT Outsourcing

One main similarity between IT outsourcing and cloud computing is that they are both forms of service and can be thought of through both the IT Service Management (ITSM) and

Service Science orientations. ITSM involves the management of the implementation and quality of services to meet the businesses needs with a focus on the relationship with the customer (van Bon 2007). In the Service Science frame of thinking, companies co-create their offerings with customers and there is a focus on loosely coupled systems that are reusable (Bardhan et al. 2010). Services and service thinking also involves a high degree of involvement by people in both the delivery and usage of IT services (Bardhan et al. 2010). In addition, the quality of services delivered becomes an important measure of what is being delivered to the customer in areas such as rapport, responsiveness, reliability and features of the service (Benlian 2011).

In relation to cloud computing, this service component is seen with the requirement for high usability of the services offered whilst hiding the implementation details to the end user (Vaquero 2009). In IT outsourcing, this service component is seen through the requirement for close relationships between clients and providers where effective and flexible partnerships are based on trust, commitment, and mutual interest (Lee 2003).

Another similarity is that IT outsourcing and cloud service providers define their product services through the use of SLAs. These define the relationship between the provider and the client as well as provide a guarantee for the availability and performance levels of the services (Kern et al. 2002; Bradshaw et al. 2011). These contractual arrangements also help to regulate and govern the relationship between the parties.

The relationship between a client and a service provider can be seen as another common aspect of IT outsourcing and cloud computing, however the complexity and nature of this relationship may vary greatly between service types. For example, a large IT outsourcing deal between IBM and Kodak valued at $1 billion in 1989 was viewed as legitimising IT outsourcing where Kodak was seen as entering a ‘strategic alliance’ with IBM and others (Dibbern et al. 2004). This contrasts with Continental AG, a leading automotive supplier who recently identified 29 internal IT services that are likely candidates for cloud computing with various cloud service providers (Loebbecke et al. 2012). This indicates more of a mix-and-match approach to cloud services from organisations than with IT outsourcing. This also leads to different dynamics with these providers and different approaches to governing these relationships.

Variations in provider relationships not only exist between service types but also in the size of organisations that utilise cloud services. Whereas most cloud service providers offer standardised SLAs and Terms of Service for the majority of customers, large commercial or government cloud contracts are likely to be negotiated and tailored to meet the requirements of the customer, such as Moller-Maersk who negotiated cloud email services with Microsoft (Bradshaw et al. 2011).

Kern et al. (2002) note that a significant benefit of the ASP model is similar to that of traditional IT outsourcing in that they both deliver economies of scale that a customer could not realise on their own. Benlian and Hess (2010) contradict this, however, and posit that in retrospect as ASP was based on single-tenant architecture, vendors could not share IT infrastructure and application code efficiently across customers causing low economies of scale.

This apparent contradiction may have emerged from the fact that what was considered an economy of scale a decade ago is not necessarily still so given advances in technology. Cloud computing appears to allow for economies of scale through an increased number of users using shared resources (Skilton 2010), and along with the use of statistical multiplexing can offer services at costs lower than a medium-sized data centre (Armbrust et al. 2010).

4.1.2 Differences between Cloud Computing and IT Outsourcing

Cloud computing has been considered a paradigm shift in IT outsourcing to an asset-free provision of technological resources (Dhar 2012). This is seen as having emerged from outsourcing customer's requirements for more efficient, economical, and flexible delivery of IT services from their outsourcing partners. In order to meet this requirement companies such as Amazon, Microsoft and Google have leveraged their large computing and storage infrastructures in order to deliver services with innovative business models that are now in competition with traditional outsourcing providers (Dhar 2012).

Business Process Outsourcing (BPO) could be considered the least similar to cloud computing. When BPO involves the use of human services to complete a task by which outsourced application development is done, it usually involves the development of highly customised software applications for an organisation (Dhar 2012). In contrast to BPO is ASP which has elements of software customisation and in greater contrast is cloud computing which is usually comprised of standardised but configurable software (Ju et al. 2010).

As mentioned previously, ASP is the closest match to cloud computing, particularly SaaS, although the business model is different to that of cloud for three reasons discussed. Firstly, cloud computing uses a subscription based business model that involves a 'measured service' such that customers are charged on a pay-per-use basis (NIST 2012). In comparison, ASP usually comprises of a licencing payment model charged on a per-user basis (Ju et al. 2010).

Additionally, many IT outsourcing efforts require initial up-front costs in entering an agreement with a provider as a Capital Expenditure. Cloud service provision in contrast is seen as an ongoing Operational Expenditure where installation costs are absorbed into the rental fees (Dhar 2012). This leads to a lower barrier to entry to access these services and more granular costs with cloud computing (Ju et al. 2010).

Finally, cloud computing uses a multitenant architecture that allows for rapid elasticity. This means that computing resources are pooled over multiple customers to allow for greater utilisation of resources and can handle large changes in demand at short notice (NIST 2012). The multitenant architecture ultimately leads to greater economies of scale and lower operational costs. Application Service Providers in comparison are not concerned about providing shared services to multiple tenants (Ju et al. 2010)

4.2 Discussion of Cloud and IT Outsourcing Measures

In assessing where IT outsourcing can contribute to cloud computing an analysis of the performance measures identified in Section 3 was undertaken. It was seen that although cloud performance metrics are more detailed in technical and operational aspects of performance, they appear to be lacking in higher level measures such as strategic intent and financial impact to the organisation. This may be due to the reduced level of partnership and negotiation that is inherent with cloud service providers, where contractual agreements such as SLAs and terms of service are usually standardised (Bradshaw et al. 2011).

In addition, as large IT outsourcing contracts can involve a significant amount of customised work, it would make sense to measure progress of this work against whether it is achieving the organisation's business strategy. In contrast, cloud services are usually offered on a pay-per-use model and although this may allow for better measuring of the financial cost of the service it is arguably a more myopic investment strategy and may additionally make it more difficult to measure whether the service is meeting the business objectives of the organisation.

The measures in IT outsourcing can be used to give more perspective to the relevance and context of cloud services within the organisation and where they are positioned to help align with the organisation's strategy. Although some cloud services may be a small component of the overall IT architecture of an organisation, others, such as implementation of enterprise-wide Service-oriented architecture (SOA) in a cloud environment may be a major transition for an organisation.

4.3 Performance Measures within the Governance Context

From the literature search in Section 3 on performance measures for both cloud computing and IT outsourcing, a study of where measures are placed within the organisational structure was performed, as summarised in Table 3. While many studies have identified measures, this study cumulates measures and places them at different levels within the organisation.

Key important measures were chosen for both cloud computing and IT outsourcing. Once chosen, they were classified into four organisational levels. These levels were identified as the inter-firm, strategic, managerial and operational levels. The inter-firm governance level has been adapted from Grover and Kohli (2012) where measures are between the firm and other firms. Strategic, managerial and operational levels have been loosely adapted from De Haes and Van Grembergen (2009). These levels help identify where value is created with the different services and to help establish where IT outsourcing can contribute to cloud computing.

Each measure or measure type identified from a paper was allocated to one of the levels depending on where it was thought the specific measure would be measured within the organisation and depending on the context that the measure was used within the given paper. Inter-firm measures were considered those that measured the organisation's interaction with other firms. Strategic and financial measures were allocated to the strategic level as these measures relate more to the direction an organisation takes. Managerial measures were considered to be those that involved processes and actions that an organisation would take to act upon the strategy of the organisation. Operational measures were deemed to be those that involved lower-level functionality and activities and at the level where value is created within the organisation.

Table 3 shows the number of times each measure was identified at a given level. A full review of each measure and the corresponding papers is listed in Appendix A. Although

some of the measures could be seen to fit within more than one level, effort has been made to determine the correct level from the context of each paper the measure came from. The numbers listed next to each measure refer to the number of papers that have identified a measure. For example, the measure of Availability listed for cloud computing at the Operational level has the number [7] which specifies seven papers have identified Availability as a measure.

Table 3 Performance measures for cloud and IT outsourcing at various organisational levels

Governance Level		Cloud Computing	IT Outsourcing
I.	**Inter-firm (2)**	Market Disruption Rate [1]	Market Share/Ratios [2]
II.	**Strategic (1)**	Compliance [1] Legal Issues [2] Intellectual Property [1] Pricing / Costs [4] Privacy/Confidentiality [2] Revenue Efficiencies [1] Trans border information flow [2]	Alignment of IT with Business [1] Business Transformation [1] Core Competencies [1] Financial Costs & Cost Reduction [4] Firm Value [1] Revenue Growth [2] Improved Financial Results [1] Productivity [4] Profit & Profitability [3] Return on Assets [1] Reporting Metrics [1] Revenue [1] Risk Control [2] Strategic IT Initiatives [1] Strategic Outcomes [1] Transforming Internal IT Organisation [1] Value for Money [1]
III.	**Managerial (1)**	Auditing [1] Confidentiality [1] Data Ownership [1] Education for Users [1] Monitoring [2] Security [3] Support [3]	Acquisition of IT Skills [1] Business Process Performance [1] Cash Management [1] Delivery and Enablement [1] Delivery of end-to-end Solution [1] Incentives/Rewards [1] Management and Operations [1]
IV.	**Operational (1)**	Availability [7] Capacity [2] Customer/Employee Satisfaction [1] Data Storage [2] Experience with Service [2] Features of Service [1] Flexibility/Customisability of Service [2] Integration with Services[1] Intelligent Automation [1] Processing [2] QoS [1] Query Variance [2] Rapport [1] Reliability [3] Response Time [2] Responsiveness [5] Servers / Environments Supported [1] Scalability [1] Throughput [4] Usability of Service [1] Utilisation [1]	Customer/User Satisfaction [1] Efficiency [1] Improved Operations [1] Integration [1] Quality/ IT Service Quality [3] Speed /Responsiveness of IT activities [2]

Governance Levels:
(1) De Haes and Van Grembergen (2009) **(2)** Grover and Kohli (2012)

4.4 Informing Better Governance of Cloud Computing

From Table 3 in Section 4.3 it can be seen that the vast majority of measures for cloud computing appear at the operational level, whereas for IT outsourcing the greater proportion appear at the strategic level. The most commonly reported measures of cloud computing at the operational level were availability, responsiveness and throughput with 7, 5 and 4 papers noting these measures respectively. For IT outsourcing, measures at the strategic level were more dispersed but included four references to financial costs and cost reduction, four papers reporting productivity and three reporting profit and profitability measures. The measure of pricing/costs is also important at the strategic level of cloud computing with four papers noting this measure. The only two measures found at the inter-firm level were to do with the effect of and position of the market relative to the firm. More research into inter-firm measures could possibly show financial measures or measures of value co-creation with other firms as a result of the use of cloud services.

At the operational level, there are twenty six measures for cloud computing and six for IT outsourcing. At the strategic level, there are seventeen measures identified for IT outsourcing and only seven identified for cloud computing. While measures of cost are common between cloud and IT outsourcing at the strategic level, measures of IT outsourcing such as profitability and productivity could be incorporated to improve the financial value of cloud computing at this level. At the managerial level, IT outsourcing measures could also be applied to cloud such as incentives/rewards to incentivise the use of cloud within the organisation.

The difference in the number of measures at the strategic level highlights that measurement in the cloud computing literature is focused more on the immediate operational value obtainable from the service as opposed to how the service fits within the overall strategy and direction of the organisation. The reason for this difference could be due to many factors, not the least being the pay-per-use business model adopted by cloud services which helps frame it more as a short-term solution for an organisation rather than a strategic decision. In addition, greater focus on automation and self-service inherent with cloud computing reduce human interaction with these services and could possibly lead to less of a long-term strategic relationship developing between the organisation and the cloud service provider.

Some of the IT outsourcing measures, particularly at the strategic level, could possibly be adapted to cloud computing to view the performance of cloud services as a more integrated

and holistic service within the organisation. Although difficult to trace, the adaptation of IT outsourcing measures to cloud could help measure value at the operational level which could then in turn be measured at the strategic level of the organisation through financial and strategic measures to determine cause and effect within the organisation.

Also noticeable from the two types of services is that measures pertaining to cloud computing are more often related to the performance of the cloud service provider whereas IT outsourcing measures focus more on the performance of the organisation as a result of IT outsourcing. This may be due to the more involved and tailored nature of IT outsourcing to the requirements of the individual organisation in contrast to cloud services which are usually more standardised offerings. Whereas with IT outsourcing there is strong emphasis on the relationship with the outsourcing partner (Lee et al. 2003, Lacity et al. 2009), with cloud services, there could be seen to be more focus on the IT capability of the organisation to achieve the best returns of the service. From this perspective, IT outsourcing literature may be of further assistance in the understanding of relationships between the organisation and the cloud service provider.

4.5 Summary of Findings

From the literature review and the resultant synthesis, several points can be seen to have been established. In reviewing the performance measures of cloud, and in answering '*What are the key mechanisms that organisations require to measure performance from cloud computing investments?*' it is apparent that certain mechanisms are commonly used to govern and control cloud services. Two such mechanisms that appear are the Service Level Agreement and the Balanced Scorecard. These mechanisms can be seen as key in helping facilitate the measuring of the performance of cloud investments and the resultant organisational performance from the use of these services.

From the synthesis, it can be seen that although IT outsourcing is different from cloud computing, IT outsourcing shares similarities that enable aspects of it to be used in the measuring of performance within the organisation for cloud computing. While cloud measures are predominantly technical and appear mostly at the operational level, IT outsourcing measures are more financial and are most apparent at the strategic level of the organisation. Consequently, in answering '*How can IT outsourcing inform governance of cloud computing?*' it could be said that IT outsourcing can inform governance of cloud computing investments through the use of IT outsourcing's strategic performance measures.

These strategic measures, along with the operational measures identified for cloud can assist in better governing of cloud computing investments. In answering '*What are the key performance measures that organisations require for effective governance of cloud computing investments?*' throughput, availability and responsiveness are seen to be key performance measures of cloud computing. Profitability, cost reduction and productivity measures are key among IT outsourcing. These IT outsourcing measures could help in informing a more holistic view of the performance of cloud computing investments within the organisational context.

Based on what has been reviewed and analysed, there are a variety of directions that future research could take. What is evident is that there is a distinct need for empirical research into the metrics of cloud computing within the organisational context. This includes measures at the interface between the organisation and the cloud service provider through SLAs as well as measures with other firms that interact with the organisation through cloud services. Measures used between firms co-creating value in cloud environments could additionally help in determining effective governance at the inter-firm level.

5. Conclusion

This study brings new perspective on performance measures for organisations for cloud computing with specific focus on the strategic level in the organisation. This study is of value to academics in the sense that it enhances understanding of cloud computing from a governance and strategic view. For practitioners, this study contributes mechanisms and measures that can be applied to the governance of cloud investments.

6. Appendix A

Performance measures for cloud and IT outsourcing identified at various organisational levels

Governance Level		Cloud Computing	IT Outsourcing
I.	**Inter-firm (2)**	Market Disruption Rate (17)	Market Share/Ratios (8)(18)
II.	**Strategic (1)**	Compliance (18) Legal Issues (10)(19) Ownership of Intellectual Property (19) Pricing / Costs (3)(10)(16)(17) Privacy/Confidentiality (3)(19) Revenue Efficiencies (17) Trans border information flow (3)(19)	Alignment of IT with Business (9) Business Transformation (6) Core Competencies (9) Financial Costs & Cost Reduction (8)(9)(11)(18) Firm Value (11) Revenue Growth (11)(18) Improved Financial Results (7) Productivity (8)(11)(14)(18) Profit & Profitability (8)(11)(18) Return on Assets (8) Reporting Metrics (14) Revenue (8) Risk Control (11)(14) Strategic IT Initiatives (9) Strategic Outcomes (7) Transforming Internal IT Organisation (9) Value for Money (7)
III.	**Managerial (1)**	Auditing (15) Confidentiality (19) Data Ownership (18) Education for Users (15) Monitoring (3)(15) Security (3)(4)(15) Support (3)(15)	Acquisition of IT Skills (9) Business Process Performance (9) Cash Management (18) Delivery and Enablement (6) Delivery of end-to-end Solution (6) Incentives/Rewards (14) Management and Operations (6)
IV.	**Operational (1)**	Availability (3)(5)(10)(12)(15)(17)(19) Capacity (3)(15) Customer/Employee Satisfaction (16) Data Storage (3)(12) Experience with Service (10)(17) Features of Software (4) Flexibility/Customisability of Service(3)(4) Integration with Services(3) Intelligent Automation (17) Processing (3)(12) QoS (15) Query Variance (10)(16) Rapport of Software (4) Reliability (3)(4)(13) Response Time (3)(5) Responsiveness (3)(4)(12)(13)(17) Servers and Environments Supported (3) Scalability (3) Throughput (5)(10)(12)(13) Usability of Service (3) Utilisation (17)	Customer/User Satisfaction (8) Efficiency (14) Improved Operations (7) Integration (6) Quality/ IT Service Quality (8)(9)(14) Speed and Responsiveness of IT activities (9)(14)

Governance Levels:
(1) De Haes and Van Grembergen (2009) **(2)** Grover and Kohli (2012)
Measures:
(3) Alhamad (2010) **(4)** Benlian et al. (2011) **(5)** Chituc (2011) **(6)** Currie (2003) **(7)** Cullen et al. (2008) **(8)** DiRomauldo and Gurbaxani (1998) **(9)** Fitoussi and Gurbaxani (2012) **(10)** Garfinkel (2007) **(11)** Jiang and Qureshi (2006) **(12)** Kratzke (2012) **(13)** Kumaran et al. (2007) **(14)** Misra (2004) **(15)** Petruch et al. (2011) **(16)** Rader (2012) **(17)** Skilton (2012) **(18)** Smith et al. (1998) **(19)** Spivey et al. (2009)

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