Cloud Adoption Decisions: Benefitting from an Integrated Perspective

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Abstract: The issue of businesses understanding "cloud adoption" exists, despite the diverse academic research on cloud adoption. The various approaches (business and technical), theories (Technology-Organization-Environment, Transaction cost theory, Resource based view) have resulted in a fragmented and piece-meal approach to understanding cloud adoption. The purpose of this article is to review and consolidate the diverse literature on cloud adoption. This can help organizations decide their cloud readiness and understand the business implications from multiple perspectives. The paper begins with a focused review of existing literature on cloud adoption. The articles in the literature are then systematically classified on various parameters such as the perspective used (business versus technical), the dominant theory used and the adoption factors that are identified. Two existing frameworks are also critiqued to highlight their strengths and limitations. Finally, a short check list based on the cumulative findings is prepared. The review reveals common themes in terms of examining cloud adoption. It shows that cloud adoption has been primarily examined from the innovative technology perspective using the Technology-Organization-Environment framework. The two other dominant approaches that come up include the economic/cost perspective driven by transaction cost theory and the use of multi-criteria decision framework. The article contributes by reviewing and consolidating the diverse literature on the topic of cloud adoption. The study organizes the recurrent themes in the reviewed articles in terms four important areas. Within each area, the study also provides some commonly asked questions that could help organizations understand their readiness to adopt cloud. This way, the article integrates different perspectives and provides organizations with a simple, holistic check list to examine business implications of moving to cloud.

Keywords: Cloud computing, technology adoption, diffusion of innovation, technology-organization-environment , transaction cost theory, cloud readiness

1. Introduction

In a research report released by the Global Technology and Telecommunications Team (2011), Morgan Stanley predicted that there will be a tremendous increase in workloads on public clouds and this migration would be one of the major drivers of technology spending by companies. Cloud computing has gathered a lot of interest within the practitioner as well as the academic community. Cloud computing refers to the use of shared computing resources by multiple organizations to fulfill their Information Technology (IT) requirements. Here, the actual hardware and the software are provided on a common platform called the cloud (Armbrust et al. 2010). In other words, cloud computing is a form of utility based computing, where companies use technology services and pay for them on a pay-per-use basis (Buyya et al. 2009). "Cloud computing" enables organizations to use technology as a source of strategic strength instead of mere business support.

Innovative technologies surge through because they are seen as solutions to business problems. However, every new breakthrough is accompanied by challenges of effective adoption, implementation and use. The same is true for cloud computing as well. Initially, cloud computing was seen as an innovation in computing because it presented a new realm of opportunities. Many companies began by questioning if cloud computing made sense from the business perspective and how they could use it in line with their business strategy. This coincided with call for research on understanding cloud computing adoption and implementation issues (Marston et al. 2011).

Since then, cloud computing has garnered interest and researchers are examining cloud adoption from both business as well as technical perspective using varied theories. Extensive research on the technical aspects of cloud computing like security and virtualization has been driven by the computer science/engineering field. However, Businesses looking to adopt cloud have multiple decisions to make. The decision making process starts with the understanding of how cloud computing fits with the organization's IT strategy and goals. As a result, it is important for Information Systems (IS) researchers to bring a holistic approach to understanding the issues in cloud computing (Marston et al. 2011). The entire process is complex and has important implications for organization's growth. Researchers in the IS area have been examining these issues using various theoretical frameworks/models in order to help organizations successfully adopt cloud.

One may argue that given the vast amount of academic research on cloud adoption, this issue cannot be worthy of any more consideration. Yet, businesses continue to struggle with cloud adoption challenges. A recent exploratory study on Small and Medium Enterprises (SMEs) who adopted cloud has revealed that companies do not rigorously determine their cloud adoption readiness (Carcary, Doherty & Conway 2014). Businesses are still having a hard time understanding cloud adoption issues. Diverse perspectives (business and technical) and theories (Technology-Organization-Environment, Transaction cost theory, Resource based view) have resulted in a fragmented approach to understanding cloud adoption. These perspectives are useful when understanding "cloud" as a phenomenon, but they are unable to provide businesses with a simple, integrated and holistic approach for cloud adoption. Every perspective has some common as well as unique insights. Can these varied insights be integrated into one framework to provide businesses with a useful roadmap to cloud adoption? This cumulative and synthesized approach to cloud adoption will be useful to the academic and practitioner community. This is the problem this paper looks to solve. The aim of this paper is to rigorously review the current literature on cloud adoption and identify common themes as well as important differences across various research studies. This will help integrate various perspectives and facilitate generation of a set of guiding questions for organizations considering cloud adoption.

In the following sections, the basics of cloud computing are explained to set the context. Then, the relevant literature in the area of cloud adoption and diffusion is reviewed. Next, the various perspectives/theories used to explain cloud adoption are critiqued. Finally, the various factors identified using the different perspectives are highlighted to understand their relevance for organizations looking to adopt cloud.

2. Cloud Computing Basics: The context

According to National Institute of Standards and Technology (NIST) (Mell & Grance 2011), "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."
Cloud computing has five important characteristics that differentiate it from other forms of shared computing (Mell & Grance 2011). They are:

- On-demand self-service: Any consumer can get the computing capabilities as needed, with none to minimal human intervention
- Accessibility: All cloud based services are available over the network and can be accessed using multiple network enabled devices
- Elasticity: Cloud computing resources expand or contract to closely match the actual requirements for an organization
- Pay-per-use: The services consumed on the cloud are measured and billed on an as-you-use basis without a huge upfront commitment
- Resource pooling: Resources owned by the vendor are pooled and allocated among multiple users giving efficiencies of scale

Within cloud, there are different service models depending on the level of computing resources that are used by the organization. They are as follows (Armbrust et al. 2010; Mell & Grance 2011):

- Software-as-a-Service (SaaS), where users within the organization access applications hosted on the cloud via the internet
- Platform-as-a-Service (PaaS), where infrastructure as well as a development platform is provided on which application development can be done by individual organization
- Infrastructure-as-a-Service (IaaS), where basic computing services are provided to the organization on a pay as you use basis

Depending on the ownership, the cloud infrastructure and the cloud computing resources (also known as "Cloud") are classified into the following types (Iyer & Henderson 2010; Mell & Grance 2011): public, private, community and hybrid. Public cloud consist of cloud computing services (applications, servers etc.) owned by a vendor and is available to any organization or general public. Private clouds are computing services that are operated for and belong to a single organization. In contrast, community clouds are owned by a group of

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organizations with shared goals. Hybrid clouds are an option where two kinds of clouds interoperate. Here, some resources reside on a public cloud while other critical resources reside on private or community cloud.

Cloud computing has its own set of advantages and disadvantages. The benefits of cloud computing include operational flexibility as well as the cost advantages of shared resources. Cloud computing has usage-based pricing which eliminates high capital expenses on technology and gives organizations the flexibility to scale up and down depending on their need (Grossman 2009). It also gives organizations the opportunity to explore areas such as analytics, collaboration etc. (McAfee 2011). However, there are significant concerns with respect to adoption of cloud computing. Concerns with respect to cloud computing include security of sensitive and critical data. Organizations on the cloud face issues such as loss of control over important data, outages, limited bandwidth for data-intensive applications as well as security breaches leading to loss of sensitive data (Marston et al. 2011; Subashini & Kavitha 2011). Cloud computing is still evolving and has its own set of inherent risks (Iyer et al. 2013). As a result, adopting the cloud requires careful deliberation and coherence in terms of organizational strategy and cloud offerings.

Considering the diversity of research in the area of cloud adoption, an integrated perspective, is needed to understand the cloud adoption decision making process. The paper begins this process by first reviewing the current literature in the cloud adoption area. In the next section, methodology followed to systematically review the literature on cloud adoption perspectives is discussed in detail.

3. Review Methodology

The methodology used for systematically identifying relevant articles in the cloud adoption area is described below:

The key words “cloud” + “adoption” were used as search terms in the EBSCO, Science Direct as well as ProQuest database. Within these databases, only articles in scholarly, peer-reviewed (where possible) academic journals were shortlisted. The search on EBSCO gave ninety-one articles, which finally narrowed down to twenty. The search on ProQuest added fifty-six articles to the list. The number of articles on Science Direct started with ninety-seven and after filtering came down to seventy-four journals. Thus the initial individual list for the three databases together was one hundred and fifty articles.

In addition, the search term was also used on the Google Scholar website to expand the search to include articles from conferences not indexed in the three databases. At this stage, duplicate articles among the three databases were also eliminated. The initial list consisted of ninety articles.

As the scope of the article is limited to the use of cloud in business context, a manual review was also conducted to carefully select articles that were relevant to cloud computing in the business domain only. On the basis of the title of the publication, the article as well as the abstract content, only articles relevant to understanding and informing the decision making process for organizations to move to cloud were selected. Papers at the individual adoption level (for example IT users, IT executives) were eliminated. Similarly, papers on cloud usage or cloud service selection (SaaS, PaaS or IaaS) were also not considered. At the end of this step, thirty-five papers were short listed for detailed analysis and review.

In the next round of review, the study classified each short listed article on two key parameters. One was the research perspective and the other was the core theory used in the research paper. Then, for each paper, the list of important factors influencing cloud adoption were identified and tabulated.

The following sections discuss some of the common perspectives/lenses used by the shortlisted articles.

4. Varying Perspectives

A detailed review of the shortlisted articles reveals some common themes across the different research studies.

4.1 The Technology-Organization-Environment Framework

The most widely used framework to examine adoption of cloud computing is the Technology-Organization-Environment (TOE) framework (Tornatzky, Fleischer and Chakrabarti 1990). According to this theory, the

process of technology adoption and diffusion is understood via the organizational, environmental and the technological context. The TOE framework is considered an extension of the Diffusion of Innovation (DoI) theory. As a result, most studies using the DoI and TOE framework divide the factors influencing cloud adoption into Technological, Organizational and Environmental factors. The review identified fifteen papers that fit under this category.

4.2 Technology Characteristics

Most studies examining cloud adoption using the TOE framework define technology context in terms of the characteristics of the innovative technology. Some of the common technology characteristics as derived from the Diffusion of Innovation (DoI) theory are as follows (Rogers & Shoemaker 1971; Rogers 1995; Tornatzky & Klein 1982):

- Relative Advantage: the advantage of using the innovation as compared to the current status quo
- Compatibility: the degree of comfort or overlap between the innovation and the needs, expectations or values of the adopter organization
- Complexity: the amount of difficulty an adopter associates with understanding and using the innovation
- Trialability: the availability of the innovation on a "trial" basis
- Observability: the extent to which the innovation results are seen externally

A brief review of the articles that use either TOE or DoI framework (or both) to understand cloud adoption is given in Table 1 below.

Table 1: Articles using the TOE/DoI framework

Articles	**Perspective**	**Theories used**	**Factors Identified**
(Alshamaila, Papagiannidis and Li 2013)	Business	TOE, DoI	Technological (Relative Advantage, Uncertainty, Geo-restriction, Compatibility, Complexity, Trialability) Organizational (Size, Top management support, Innovativeness, Prior IT Experience) Environmental (Competitive pressure, Industry, Market scope, Supplier efforts and External Computing Support)
(Borgman et al. 2013)	Business	TOE	Technological (Relative Advantage, Complexity and Compatibility) Organizational (Top Management Support, Firm Size and IT expertise of Business Users) Environmental context (competitive and regulatory environment) IT governance Structures (centralized, decentralized, or federal) IT governance process
(Gangwar, Date and Ramaswamy 2015)	Business	TOE and TAM	Technological (Relative Advantage, Compatibility, Complexity) Organizational (Readiness, Top management commitment, Training and Education) Environment (Competitive Pressure and Trading Partner Support) Others (Perceived Ease of Use and Perceived Usefulness)
(Hsu, Ray and Li-Hsieh. 2014)	Business	TOE and DoI	Technology (Perceived Benefits, Business Concerns) Organization (IT capability Environment (Not significant)

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Articles	Perspective	Theories used	Factors Identified
(Lian, Yen and Wang 2014)	Business	TOE and HOT-fit (Human-Organization-Technology fit)	Four dimensions (Technology, Human, Organizational, and Environmental) Top factors (Data Security, Perceived Technical Competence, Cost, Top Manager Support, Complexity, CIO Innovativeness, Compatibility, Adequate Resource and Perceived Industry Pressure)
(Low, Chen and Wu 2011)	Business	TOE	Technological (Relative Advantage, Complexity, Compatibility) Organization (Top Management Support, Firm Size, Technology Readiness) Environment (Competitive Pressure, and Trading Partner Pressure)
(Lumsden & Gutierrez 2013)	Business	TOE	Technological (Relative Advantage, Complexity and Compatibility), Organizational (Top Management Support, Firm Size and Technology Readiness) Environmental context (Competitive and Trading Partner Pressures)
(Morgan & Conboy 2013)	Business	TOE	Technological (Trialability, Relative Advantage, Compatibility, and Complexity) Organizational (Need for Collaboration and Openness, Increased Traceability and Auditability, IT managers' fear of 'losing control of their IT environment') Environmental (Security and Legal issues, Risk Averseness)
(Nedev 2014)	Business	TOE	Technical Factors (Relative Advantage, Complexity and Compatibility, Redundancy, Performance and Security) Organizational Factors (Top Management Support, Firm Size and Technological Readiness) Environmental Factors (Competitive and Trading Partners Pressure)

Articles	Perspective	Theories used	Factors Identified
(Nkhoma & Dang 2013)	Business	TOE	Perceived Technology Barriers (Security, Compatibility, Reliability and Availability, Extendibility of existing apps, Compliance policy) Perceived Environmental Barriers (Lack of IT Standards and Compliance Policy) Perceived Benefits (Business Scalability, Cost Flexibility, Market adaptability, Hidden complexity, Shared Best Practices) Adopter Style (New technologies' importance within the organization's body, Pace and Predominant Approach to adoption)
(Polyviou, Pouloudi & Pramatari 2014)	Business	TOE, DoI and Fashion Management Theory	Relative Advantage (cost, portability, it overhead reduction, collaboration ease, data redundancy), IT Fashion (fashion setter pressure, fashion setter exposure, progressiveness, adoption of previous innovations)
(Saedi & Iahad 2013)	Business-Technical	TOE and Actor Network Theory	Technology (Cost-savings, Relative advantages, Compatibility, Accessibility, Lack of Data Security/Privacy) Organization (Size, Size of IT Resources, Top Manager Intentions) Environment (Supplier Service-Level Agreement, Supplier Competencies, Government Support, Competitor Pressures, Friends and Family Members Advice, IT Specialist and Consultants Advice, Business Network Advice)
(Son & Lee 2011)	Business	TOE	Organizational Capability (Organization Learning Capacity, Organizational IT Capability) External Environment (Competitive Pressure, Expectation of Network Dominance) Characteristics of Cloud Computing (Perceived Benefits, Perceived Barriers)
(Wu et al. 2013)	Business	DOI, Information Processing View	Information Processing Requirements (Business Process Complexity, Entrepreneurial Culture) Information Processing Capacity (Compatibility and Application Functionality, Relative Advantage)

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Articles	Perspective	Theories used	Factors Identified
(Yeboah-Boateng & Essandoh 2014)	Business	TOE	Technological (Trialability of Cloud Services, Existence of Required IT Infrastructure and Resources, Compatibility with Existing Systems, Strength of In-built Security Systems, Learning Capability of Employees, Limited Technical Knowledge about Similar Technologies, Non-performance of Cloud Services to support Operations) Organizational (Top Management Support and Involvement, Resistance towards New Technologies, Conformity with Work Culture and Style, Impact of Organizational Structure and Size, First Adopters in Our Industry) Environmental (Adequate User and Technical Support from Provider, Choice of Skilled and Expert Cloud Vendors, Influence of Market Scope, The Nature of Industry, Relationship with Providers, Government and Competitors)

As seen in Table 1, some of the cloud technology characteristics that emerge across studies are relative advantage (cost, portability, IT overhead reduction, collaboration ease), complexity (strength of inbuilt systems), compatibility (with existing systems), reliability, availability (especially emphasizing areas of data redundancy and performance), focus on security and loss of data control issues.

4.3 Organizational Requirements

Organizational factors are extremely subjective to each organization's adoption context. For example, some organizations are interested in evaluating a technology in terms of its cost and compatibility and have the required expertise or complex knowledge to do so. Others, are interested in understanding how the technology works and are keen on evaluating its compatibility with existing systems/processes.

Some common organizational factors emerge from the TOE related studies. According to the review, these factors are top management support, firm size, technology readiness, IT expertise of business users, firm innovativeness (or resistance towards new technologies), size of IT Resources, organization's learning capacity, IT capability, conformity culture or style, organizational structure, organization's need to be the first adopters, need for collaboration and promotion of openness, increased traceability and auditability, IT managers' fear of 'losing control of their IT environment' and the importance placed on new technologies within the organizational environment. However, the most important organizational factors that repeat across various studies include top management support, firm size, skills of IT resources, employee buy-in and the innovative culture within the organization.

4.4 Environmental Characteristics

The competitive environment greatly impacts the strategic decisions an organization makes (Porter 1991). Environmental characteristics play an important role in an organization's decision to adopt and integrate any innovative technology (Kimberly & Evanisko 1981; Kwon & Zmud 1987). For example, an organization may need to integrate a specific technology because most competitors have implemented it and are gaining strategic advantage. Thus environment-related characteristics include the general competitiveness of the industry the organization is in (Utterback 1974), or maybe even the adoption level within the industry. This factor addresses strategic level issues with cloud adoption.

The review of TOE articles reveal some common environmental characteristics that are emphasized across studies. They are competitive pressures, trading partner pressures, industry pressure across different adopting groups, regulatory environment, security and legal issues, characteristics of the sector organization belonged

to (for example: risk averseness in the public sector), availability of technical support providers, choice of skilled and expert cloud vendors, market scope, relationship with cloud service providers, supplier competencies and government control. Out of these, the most important factors that emerge across all studies are industry adoption rates, competitor pressure, regulatory concerns, vendor expertise as well as availability.

All papers listed in Table 1 consider the technological, organizational as well as environmental characteristics. In addition, certain studies also use other theories (along with TOE and DoI) to highlight additional factors influencing adoption decisions. These theories are from various areas such as Technology Acceptance Model (TAM), fashion management theory, Human-Organization-Technology Fit (HOT), Actor Network Theory (ANT) and Information Processing View (IPV). For example, in a paper from the IPV perspective, factors influencing adoption decision are identified in terms of an organization's information processing requirement and capacity (Wu et al. 2013). It examines how organization's decision to adopt cloud depends on the business process complexity, the entrepreneurial culture, compatibility with its capacity and application functionality. The factors identified are similar to the ones identified by the organizational context within the TOE framework.

4.4.1 TOE View: A Critical Analysis

The TOE perspective is an important way to look at new technology adoption from three important macro levels. Cloud adoption success is directly related to the match or fit between organizational needs as well as cloud characteristics. This theory identifies the important aspects of both diverse perspectives. In that sense, the TOE theory examines cloud adoption in terms of understanding how good is the match between what the organization wants and what the technology can give. In addition, it uses the environment perspective to also reveal external success factors or pressure points that influence the decision to adopt cloud. This is important because often times, irrespective of the fit between technology and organizational needs, external pressures may influence the need to move on the adoption path.

However, this perspective lacks the ability to inform organizations on the cloud adoption "cost" aspect. Even though organizational factors such as top management commitment as well as technological factors such as relative advantage (in terms of cost/overhead reduction) are brought to the fore, the intricacies of cloud costing are missing. For example, what are the different kinds of costs that an organization needs to consider when examining cloud adoption? Are there significant sections to costing with respect to hardware, software, support? What about the cost of acquisition, network redundancy, data migration and lock-in?

This aspect is important because it reveals that not all costs for cloud adoption are same. This perspective is examined in detail by the next set of papers, under the "Cost Perspective".

5. Economics or Cost Perspective

The cost perspective is an important way to understand cloud computing. The review found eight papers that extensively rely on the cost/economic perspective to examine factors influencing cloud adoption. Table 2 indicates the summary details of the various papers from this perspective.

Table 2: Articles using the Economics/Cost perspective

Articles	Perspective	Theories Used	Factors Identified
(Armbrust et al. 2010)	Business-Technical	Cost and Cloud Economics	Technical Obstacles (Availability of Service, Data Lock-In , Data Confidentiality and Auditability) Business and Policy Obstacles (Reputation Fate Sharing , Software Licensing) Software complexity and Costs of (partial or full) Data Migration

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(Banerjee et al. 2013)	Business	Resource Based View (RBV) and the (Knowledge Based Theory) KBT	Firms Knowledge of IT Firms Appropriable resources, Knowledge and Resources of provider, Capability to acquire knowledge, Capability to assimilate and transform related information to knowledge, Capability to exploit the technology
(Benlian et al. 2009)	Business	Transaction Cost Theory, Resource Based View, Theory of Planned Behavior	Application Specificity, Application Adoption Uncertainty, Attitude toward SaaS adoption, Subjective Norm, Strategic Value, Application Inimitability
(Bhat 2013)	Business	Transaction Cost Economics and Institutional Factors	Asset Specificity, Uncertainty, Frequency, Institutional factors (Laws and regulations)
(Martens & Teuteberg 2012)	Business	Transaction Cost Theory, Production Costs Theory, Resource Based View, Agency Theory, Cooperative Sourcing model	Transaction Cost (Coordination Costs, Maintenance Costs, Agency Costs, Negotiation Costs, Adoption Costs, Allocation Costs) IT service Cost Expected Loss (Confidentiality Loss, Availability Loss, Integrity Loss)
(Nanath & Pillai 2013)	Business	Cost Benefit Analysis	Base cost estimation, Data pattern based cost estimation, Project specific cost estimation
(Nuseibeh 2011)	Business	Transaction Cost Theory, Resource Dependence Theory and Diffusion of Innovation theory	Transaction Cost Theory (Asset Specificity, Uncertainty) Resource dependence theory (Importance of resource, Control over resource) DOI (Relative Advantage, complexity, organizational innovativeness) Demand Uncertainty Security concerns
(Oredo & Njihia 2014)	Business	Resource Based View	Develop competencies in terms of organizational roles (Cloud Architect, Cloud Analyst, Vendor Manager, Training Manager, Security Manager, Provisioning

			Manager) Challenges identified include Availability, Reliability, Security, Data Lock-in, Regulatory/compliance Concerns, Integration, Customization, Vendor Management and Organizational Culture

The dominant theory under this perspective is the Transaction Cost Theory. In addition, some of the articles under this category also use theories such as Resource Based View of the firm, Agency Theory and Cost-Benefit Analysis. Some papers combine multiple theories including ones that are not from the economic/cost perspective to examine cloud adoption. Costs under this perspective are calculated using various factors such as base cost of the computing resources, the usage costs as well as specific cloud implementation costs, keeping the current infrastructure as is. Considering these costs, cloud adoption is said to be more suited to small-to-medium enterprises (SME) (Nanath & Pillai 2013).

According to papers using transaction cost theory, some of the factors related to the decision to adopt cloud are as follows:

- Asset specificity: is the degree of customization vs. standardization of the transaction. Highly customized applications (or assets) may be riskier in terms of vendor-lock in and may result in lower propensity to adopt cloud (Benlian, Hess & Buxmann 2009; Bhat 2013; Nuseibeh 2011).
- Uncertainty: refers to the degree of possible variation in the needs of the organization, which change the cloud computing requirements. Organizations with highly varying cloud computing requirements may not be comfortable with vendor's current offerings or the vendor's ability to respond to changes. This may result in organizations with higher level of uncertainty deciding to not adopt cloud (Benlian, Hess & Buxmann 2009; Nuseibeh 2011). In addition, uncertainty associated with cloud computing parameters such as security, service level, reliability and fate-sharing with other customers on the same cloud also result in a negative influence on decision to adopt cloud (Bhat 2013).
- Transaction frequency: refers to the volume and frequency of transactions. As this increases, organizations prefer to internalize the process to reduce the transaction cost with the external vendor (Bhat 2013). As a result, organizations with high volume and frequency of transaction prefer to not adopt cloud.
- Institutional factors: may include lack of suitable rules for cloud computing requirements, unclear understanding of jurisdiction of cloud contracts, lack of industry standards for cloud computing as well as presence of local data related regulations etc. All of these factors often negatively influence the organization's willingness to adopt cloud (Bhat 2013).

The resource based view (RBV) theory is also used with cost/economic factors to emphasize the organizational factors related to cloud computing adoption. These factors include allocation costs, costs of maintenance, confidentiality issues and integrity /availability loss (Martens & Teuteberg 2012). The RBV perspective also emphasizes the degree of importance of the information technology (IT) resources (Nuseibeh 2011), the degree of control over the IT resources (Benlian, Hess & Buxmann 2009; Nuseibeh 2011) and the application's strategic value as important influences on cloud adoption (Benlian, Hess & Buxmann 2009). Other factors included are internal expertise in the area of cloud computing, knowledge and resources of service provider, capability to acquire knowledge, capability to assimilate/transform cloud related information to knowledge and the firm's capability to exploit cloud computing also influence the decision to adopt cloud (Banerjee et al. 2013). Many of the factors in this perspective are also found in the TOE/DoI perspective studies. As a result, the salient factors that emerge from this perspective are degree of customization, uncertainty in terms of organizational requirements and calculating actual costs of cloud in comparison to the existing system.

5.1.1 Economics or Cost Perspective: A Critical Analysis

The cost perspective is an important way to look at cloud adoption because it examines the costs of adopting cloud from multiple angles. For example, the transaction cost perspective looks specifically at the various applications with respect to how customized or standardized they are because this will determine the migration as well as future lock in costs. In addition, transaction- heavy applications need better support and network redundancy, if hosted on cloud. This further increases cloud adoption costs. Industries that are heavily regulated such as healthcare or financial services need to closely manage data management/storage which also increases their cloud adoption costs.

The benefit of this perspective is that it expands the definition of "cost" mentioned under cloud adoption factors. It reveals various facets of cost, ranging from application specific to firm specific moving on to industry specific factors that organizations should examine when determining the feasibility. However, this perspective fails to examine the other important aspects of cloud adoption which relates to the organization's processes as well as people. As a result, it remains one dimensional.

6. Multi Criteria Decision Making (MCDM)

The literature search identified two papers that examine cloud adoption from a multi-criteria decision making perspective. These papers outline multiple criteria with alternatives and assign weights to them. These papers are listed in table 3 below.

Table 3: Articles using Multi-Criteria decision-making

Article	Perspective	Theories Used	Factors Identified
(Lee 2014)	Business	AHP, Literature Review	Financial Benefits (acquisition cost, ongoing maintenance cost, payment based on demand) Marketing Benefits (timely information, CRM application, green marketing, technology image) Management Risk (security and privacy, adaptability and agility, management control) Environmental Factors (vendors accountability, cloud technology reliability, content supplier systems, organizational readiness)
(Saripalli & Pingali 2011)	Business/Technical	Wide-band Delphi method	3 Decision Areas (DA) Cloud Switch, Cloud Type and Vendor Choice Suitability, Economic value (ROI/ROEI), Control, Usability, Reliability and Security

One study (Lee 2014) has found that financial benefits, marketing benefits, management risks and environmental factors are important in determining an organization's readiness to adopt cloud. This article has used the Delphi method to determine weights for the multiple criteria within each factor. The financial benefits factor emerges with the highest weightage in the decision process.

The other article (Saripalli & Pingali 2011) has also used the Delphi method to determine weights among two criteria (benefits and cost) to help decision making. The criteria used are suitability (in terms of network quality, legacy system integration and functionality), economic value (ROI/ROEI, operating costs, capital costs), control (integration and manageability), usability (launch time, simplicity, agility), reliability (recovery, trust, availability, compliance, elasticity) and security (confidentiality, trust, integrity, auditability etc.). In this article also, cost emerges to be the most weighted factors for determining cloud adoption. Both these articles reemphasize the financial factors, security as well as environmental factors that are discussed in the previous sections.

6.1.1 Multi Criteria Decision Making (MCDM): A Critical Analysis

The MCDM perspective is another approach to examining cloud adoption from multiple angles. This perspective's strength lies in its ability to combine factors from the cost perspective as well as the TOE perspective. As it combines various factors that influence cloud adoption, this perspective highlights importance of understanding financial benefits (such as costs as well as ROI), technical issues (like network dependency, security, redundancy) as well as environmental aspects (such as compliance and vendor issues). It also gives an insight into how all the factors that are relevant to cloud adoption are not equally important. Using weights, this approach distinguishes and gives a glimpse into the hierarchy among various cloud adoption factors. However, all the costs as well as factors in this perspective are already mentioned either in the TOE perspective or the cost perspective. As it attempts to combine different perspectives, it is unable to drill deeper into finer aspects of different factors. For example, organizational readiness is identified as an important factor, but the details of how to assess it are missing.

7. Other Perspectives

Some of the articles included in the review did not use any theory to understand factors underlying cloud adoption decisions. There are 3 such articles providing strategic directions for companies choosing to move to cloud. They contribute by giving strategic directions as well as prescriptive steps for organizations considering cloud computing (Iyer & Henderson 2010; McAfee 2011; Repschlaeger et al. 2012). These articles recommend looking at the organization's cloud computing requirements in terms of service, cloud management, costs, reliability, trustworthiness, security, governance, compliance and vendor characteristics. The methodology primarily used has been literature review of existing articles, both from a technical as well as a business perspective. In addition to the above articles, six other articles identified during the focused search phase, either use prior literature review or exploratory surveys to identify both benefits as well as concerns for organizations thinking about cloud adoption. For example, some of the benefits include financial savings, high/better performance and convenience benefits (Carcary, Doherty & Conway 2014; Géczy, Izumi & Hasida 2012; Gupta et al. 2013; Shimba 2010). Other articles identify common challenges to cloud adoption which include security concerns, lack of resources, reliability of service/service providers, integration issues, regulatory and compliance concerns (Carcary, Doherty & Conway 2014; Dillon et al. 2010; Géczy, Izumi & Hasida 2012; Gupta et al. 2013; Shimba 2010; Trigueros-preciado et al. 2013).

As a part of review, two research papers that provide a framework for organizations to assess if they were ready to adopt cloud have been identified. These frameworks are reviewed in the next section.

8. Frameworks in cloud adoption

Frameworks are useful tools because they indicate the relevant decision-making variables with respect to the context as well as how these variables interact to determine the final answer. Step-by-step analyses for determining and organization's compatibility with cloud computing adoption are identified in some frameworks. They help throw light on important issues as well as tough questions that organizations needed to ask in order to make the move to cloud.

Our review indicates two models or frameworks that consider multiple aspects of cloud adoption, both from the technical as well as business perspective. The closest conceptual model is the cloud adoption toolkit (Khajeh-Hosseini et al. 2012) which can help decision makers organize their thinking during cloud consideration. Another such framework is the three phase readiness framework which identifies (Loebbecke, Thomas & Ullrich 2012) the various steps in the process of adoption of cloud. Let us examine the frameworks in greater detail.

8.1 Three Phase Readiness Framework

In the three-phase cloud readiness framework (Loebbecke, Thomas & Ullrich 2012), the researchers identify three steps/phases to be followed by organizations interested in moving to cloud. This includes the identification phase, the screening phase and finally the categorization phase.

In the identification phase, organizations identify their IT services for cloud readiness as well as the cloud-readiness criteria relevant to their context. This phase also includes understanding the employees' buy-in to cloud computing. In the next phase, organizations evaluate all identified IT services against the determined criteria and aggregate values across various criteria for all services. In the final categorization phase, organizations set a threshold value and then compare the aggregated values for each service to designate the IT services under consideration as "likely cloud ready" or "not cloud ready".

8.2 Three Phase Readiness Framework: Critical Analysis

Some of the factors playing an important role in the readiness framework include core business/differentiating factors, importance/availability of services, standardization and simplicity of lifecycle, centralization, network connectivity requirements in terms of bandwidth and latency, identity management and compliance. The strength of this framework is that it gives steps that organizations can take, once they are ready to deploy cloud. However, this framework does not consider the role of external environmental variables in determining the need to adopt cloud. For example, how would vendor availability and offerings influence an organization's decision to adopt cloud?

8.3 Cloud Adoption Tool-Kit

The cloud adoption toolkit framework (Khajeh-Hosseini et al. 2012), provides a conceptual model for organizations looking to adopt cloud. The first step in this process of determining cloud-organization fit is technology suitability analysis. In this step, organizations examine if and how their technology requirements are fulfilled by cloud technology characteristics. The next step consists of doing a stake-holder analysis to evaluate the organizational fit in terms of resources as well as socio-political factors .Cost-modeling and energy consumption analysis is also done to understand estimates of operational cost as well as energy consumption costs of running the IT service on cloud. Finally, responsibility modeling is done to understand how responsibilities would be assigned under the cloud implementation scenario as well as the socio-political acceptability of interactions between various strategic departments in the organization. Only, after all these steps are completed, can the organizations actually determine the suitability of cloud adoption.

This framework is more robust because it examines multiple factors that need to be considered before companies can move to cloud. However, this framework does not consider the availability of vendor expertise in rendering cloud services in the particular industry. For an organization with lesser IT expertise, vendor expertise/availability can play a significant role in the cloud adoption decision. Also, cloud adoption differs from adoption of other technologies because it involves moving organization's data, people and processes on to resources owned by the vendor. As a result, vendor's expertise has significant implications for trust and security concerns. As the dependency on vendor increases, the organizations with lack of vendor availability in their industry may be wary of adopting cloud.

9. Cloud ready or not?

The extensive review provided in this study highlights various perspectives that are being used to understand cloud adoption. It also showcases the importance of looking at cloud adoption issues at multiple levels. This includes looking at cloud adoption decision from a strategic to a more tactical and operational level. For example, within the TOE framework, environmental factors examine how industry and competitor dynamics play a role in pushing organizations towards cloud adoption. Other factors such as complexity, redundancy and other technical aspects focus on day-today operations. Although, not mentioned specifically, strategic aspects of cloud adoption are emphasized via each perspective.

Each perspective is important but they do not necessarily consider all the relevant facets of cloud adoption. This is a gap because researchers and businesses looking at cloud adoption lack a "systematic" view or a "how-to" approach to deal with their organization's decision to move to cloud. Ideally, all the factors identified in the various studies play an important role in determining cloud readiness. For an organization considering cloud

adoption, this may seem like a daunting list. Similarly, as researchers look at actual adoption cases in the real world, what perspective should they consider? Alternatively, should they go into their research study with a laundry list of factors, not understanding the relative importance of each factor?

In order to answer this gap, this study has reviewed the extensive list of factors mentioned across all research studies to come up with a concise list of factors. These factors are those that have been highlighted by majority (if not all) of the studies under each perspective. We classify these factors under their relevant headings to help organizations as well as researchers focus on important internal as well as external areas for the organization. According to the classification, the emphasis areas for any organization considering cloud adoption falls under four categories. They are related to the technical aspects, organizational aspects, environmental aspects and cost aspects of decision making. Within each category, the organization needs to assess how it performs against some important criteria related to the category. The four areas are diagrammatically represented in Figure 1.

For each important area, some questions are formulated, grounded in the literature review findings. The questions are formulated directly from the list of factors that emerges post the review. For example, across the T-O-E studies, factors such as complexity, compatibility, reliability emerge as important from the "technology perspective". As much as these factors may make sense to the researcher, practitioners reading these factors may not be able to apply them directly to their context. So to help, questions are formulated such that answering these questions can help determine cloud adoption readiness for the organization.

For example, one factor uncovered using review across studies is "Complexity" under the "Technical Perspective". For an organization looking to move to cloud, this means that they need to understand how "complex" their current system are and if cloud will be able to support them. Even if organizations themselves are unable to answer this question, vendors helping with the transition should be able to answer this question satisfactorily.

The aim of this questionnaire is to serve as a quick check list that can help organizations compare their current system with the cloud based offering. These questions are formulated on the basis of the diverse literature reviewed in this study. In preparing this questionnaire, this study aims to consolidate findings across multiple studies into a concentrated bucket list. These questions are not aimed at being comprehensive, but more as a quick tool for organizations in the early stages of cloud adoption. The questions are listed in Table 4.

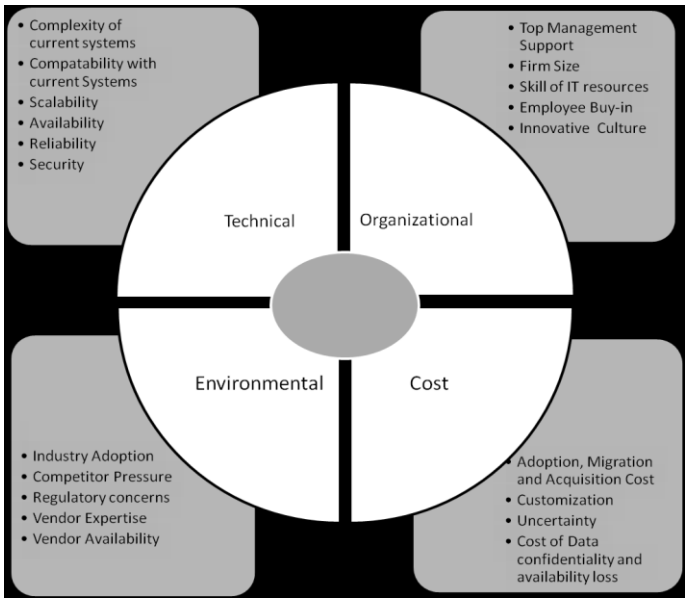

Figure 1: Four important focus areas for cloud adoption

Table 4: Check list of questions relevant to cloud adoption decision

Factors	Current System	Cloud based System
COST		

Adoption, Migration and Acquisition Cost	• What is the current cost of maintenance of the system? • Can we reduce the number of IT staff and what would be the cost savings?	• What is the cost of set up, subscription and maintenance of the cloud system? • What is benefit of instant and up-to-date access and can it be quantified (in terms of reduction in service time, increase in sales etc.)?
Customization	• How customized is the current application)	• Can the customized application be replicated on cloud and what will be the cost associated with it?
Uncertainty	• How frequently do the application requirements change?	• Can the cloud based application be changed quickly and what would be the cost of reconfiguration?
Cost of Data confidentiality and availability loss	• What are the current costs of maintaining data confidentiality and availability (in terms of network requirements)	• What could be the potential cost of data loss (both in terms of confidentiality and availability)
TECHNICAL	Current System	Cloud based System
Complexity of current systems	• Is the complexity of the current systems high? If yes, is maintenance taking too much of IT resource time?	• Will the cloud be able to support the complex systems in place?
Compatibility with current Systems	• Are the current systems very tightly integrated or modular?	• Will the cloud be able to seamlessly interface with the other legacy applications that are not on cloud?
Scalability	• How easily can the current system grow and scale with respect to the business needs?	• How easily can the cloud vendor scale the application for us?
Availability and Accessibility	• How critical is the application in terms of its need to be available and accessible? • What kind of redundancy measures does the current system have?	• Can the cloud based vendor assure meeting the current need in terms of system availability and accessibility?
Security	• What parts of the current security measures are physical and location based? • What is the expertise level of the current IT staff in terms of dealing with security threats?	• Will the cloud be able to replicate the security measures in place? • What kind of security mechanisms as well as expertise does this cloud vendor have?
ORGANIZATIONAL	Current System	Cloud based System
Top Management Support	• How well does the current system perform according to the current team of top executives? • How many of the top executives prefer the current system?	• How knowledgeable are the top executives in terms of the benefits and risks of moving to cloud? • Is there at least 1 top Executive ready to be the project sponsor?
Firm Size	• Does the current system adequately support the current firm size and its requirements?	• How huge would be the migration project according to the size of

Skill of IT resources	• How often do we need external support for our current application?	the company? • How skilled are our IT resources in dealing issues related to cloud based application?
Employee Buy-in	• How well versed are the users with the current system? • What is the level of technical expertise for the users for the current system? • How satisfied are the users with the current system?	• How drastically will the system work environment change for employees working on the cloud based system? • Will the cloud based application change any reporting structure within the organization?
Innovative Culture	• How often does the organization experiment with newer ways of doing things? • To what extent is the organization tolerant of failure?	• Will the cloud based work environment be seen as an innovative way of doing things?
ENVIRONMENTAL	Current System	Cloud based System
Industry Adoption	• How does the organization's current system compare to systems being used in the industry?	• How far has cloud based application use penetrated into the relevant industry?
Competitor Pressure	• How does the organization's current system compare to its leading competitors?	• Have the organization's important competitors already adopted cloud? Are they seeing benefits?
Regulatory concerns	• Do the current systems need to pass legal or regulatory audit requirements?	• Will the cloud based system pass all regulatory and audit checks?
Vendor Expertise/ Availability	• How heavily dependent are we on vendor expertise and availability for current system? • What are the terms and conditions in the service level agreement with the current vendor?	• How many cloud based vendors have expertise in the industry as well as the application relevant to the organization? • Do these vendors have references within the industry or in the particular application? • Is there a wide variety of vendors to choose from? • Can the current terms and conditions be replicated or assured by the cloud vendors?

10. Contribution

The most important contribution of this article is to consolidate the diverse literature on the topic of cloud adoption. Primarily, the detailed review highlights the diversity of perspectives used to understand factors influencing cloud adoption. Irrespective of the theoretical framework used, organizations need to examine cloud adoption in terms of four broad themes. These are technology suitability of cloud, cloud costs, organizational and environmental factors. Within each area, the study also highlights some quick questions to help organizations clarify how they fare on the various aspects of cloud adoption. This list of questions can help organizations focus on the few factors in terms of strategic considerations needed to move to cloud. The questionnaire also serves as a check list for organizations. The question/check list is not meant to replace detailed examination of cloud-organization fit. It is meant to provide a "quick" way to sift through the multiple factors relevant to decision making. This enables organizations to focus on relevant aspects of cloud adoption decision making.

11. Limitations

There are some limitations in the descriptive review style of research that has been conducted. For example, certain articles that are not indexed in the four databases are probably not included. Also, due to the focus on peer-reviewed academic research, a lot of practice based literature has not been included. Another significant limitation is that the study did not test/validate the questionnaire by talking to organizations that have implemented cloud or are considering cloud. As a result, the check list has limited reliability and validity.

12. Directions for Future Research

This article indicates how diverse perspectives to understand cloud organization fit can be consolidated via an integrated approach. Using four major themes, organizations can examine cloud offerings and its fit with business needs. As a result, this article has important implications for both research and practice.

Practitioners can use the quick check list to understand how they fare on various aspects of cloud-organization fit. They can also understand how various factors influence the chances of success with cloud adoption. From application to environment, various micro as well as macro level aspects are considered in the integrated perspective. In fact, the quick check list can serve as a roadmap to help organization navigate the four distinct aspects of cloud adoption using relevant questions.

For researchers that are looking to understand cloud adoption, future research could aim to validate, test and refine the questionnaire that is presented in this article. Rather than beginning with a laundry list of ideas, the integrated perspective offers researchers to start on a well-grounded, theoretical framework on various aspects of cloud adoption. Researchers can also examine how these perspectives would differ across varying cloud service offerings like SaaS, PaaS and IaaS. Future research can examine how certain perspectives such as cost and technical specification may become more important in adoption of a particular type of cloud offering, say PaaS. Businesses looking at SaaS adoption which is application based and user-facing may need to emphasize also on organizational factors that determine readiness.

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