Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Computer Science 16 (2013) 737 – 746

Procedia Computer Science

Conference on Systems Engineering Research (CSER'13)
Eds.: C.J.J. Paredis, C. Bishop, D. Bodner, Georgia Institute of Technology, Atlanta, GA, March 19-22, 2013.

Migrating To The Cloud: Lessons And Limitations Of 'Traditional' IS Success Models

Imran Khan Azeemi[a, b, c]*, Mike Lewis[b], Theo Tryfonas[c]

[a]Capgemini UK, No 1 Forge End, London, GU21 6DB,UK
[b]University of Bath, Bath, BA2 7AY, UK
cUniversity of Bristol, Tyndall Avenue, Bristol, BS8 1TH, UK

This work was supported by the Systems Centre and the EPSRC funded Industrial Doctorate Centre in Systems (Grant EP/G037353/1) and Capgemini."

Abstract

This paper uses the 'traditional' Information Systems (IS) success model literature (e.g. Grover, DeLone and McLean, Seddon, Alter etc.) as the starting point for developing a new model intended to support better outcomes when migrating/porting an IS functionality to a cloud. In simple terms 'cloud' refers to an IS functionality accessed (rented) by users through a thin client (web browser, mobile applications, etc.) while the software, hardware and data are stored on remote servers. Its popularity as an approach reflects claims that such 'shared resources' model (akin to a utility like the electricity grid) will allow organisation to access more advanced and flexible IS services at a lower aggregate cost. This paper argues that cloud migration requires organisations to consider a range of additional success factors, including how to accommodate new delivery modes (e.g. different pricing models) and manage new risks (e.g. data out side organisational firewalls, etc). Despite burgeoning interest in the topic, specific empirical research and, more importantly, specific practitioner guidance remains limited. This paper therefore concludes by presenting a preliminary conceptual model (informed by Systems Thinking) along with steps to operationalise it and suggests empirical options to test this model.

Selection and/or peer-review under responsibility of Georgia Institute of Technology

Key Words: Cloud Computing, Measuing Cloud Success, System Thinking, Success Model, Cloud Success Metrics , Information Systems, Complex Systems, High-Tech Technology Service Provider

* Corresponding author. Tel.: +44-870-366-0354; fax: +44-161-973-9016.
E-mail address: imran.a.khan@capgemini.com

1877-0509 © 2013 The Authors. Published by Elsevier B.V.
Selection and/or peer-review under responsibility of Georgia Institute of Technology
doi:10.1016/j.procs.2013.01.077

1. Introduction – (Motivation and Structure of the Paper)

System Thinking [1] is considered highly related to the IS [2]. An IS is network(s) of hardware and software that people and organisations use to collect, filter, process and distribute data [3, 4] which are typically understood to be 'successful' if they contribute to the achievement of organisational goals [5]. Establishing the success of an IS therefore requires a holistic [1] measurement process [6] informed by a range of metrics. There is a substantial body of literature that investigates the measurement of IS success, typically conceptualising the IS as a 'stand-alone' entity [7] or, more infrequently, recognising the importance of understanding IS performance in its broader context [8, 9]. These models have been refined and extended as underlying IS technology has evolved; for example DeLone and McLean's (D&M) updated model [10]; reflects the shift to client-server operating model. To date there has not been a corresponding 'update' to accommodate the additional challenges of migrating an IS to the cloud.

The theoretical benefits of cloud [11] have been discussed widely but, to date, there has been much less discussion of the pragmatic management issues it creates. Specifically because of a partial view of a whole system, support for decision makers deciding to migrate an IS to a cloud service is very limited [12, 13]. There has been some cloud performance research [14, 15, 16] - Braithwaite et. al. [12] for example, applied D&M [10] model to a variation of SaaS (storage service) for SMEs – but to date there has been no attempt to comprehensively identify additive implementation and, correspondingly, measurement challenges. Equally for the organisations providing cloud services, managing a 'multi-tenant' model necessitates a whole view of a system accommodating multiple collaborators who have their own business and technical preferences [17]. In seeking to develop a holistic multi-levelled success model for migrating to cloud, this paper is structured in 4 sections. In section 2, there is a classification of different cloud computing delivery and deployment models. This provides the basis for highlighting the specific additive management/measurement challenges. In section 3 there is a summary of the substantial body of research that has investigated the success of 'traditional' IS implementations [7, 9, 10, 18]. In section 4, an integrative model for reconciling these measurement lessons with the challenges of the cloud is proposed along with some high level operational steps. The paper concludes with suggestions for empirical validation of the model.

2. A C of cloud computing?

Cloud is primarily based on three existing technologies i.e. Internet [19], Virtualisation and Grid Computing [20]. Arguably the term 'cloud' was first coined in 2006 by Eric Schimdt, the Google CEO [19] but the fundamentals of this emerging model for delivering IS provision have been laid over many years. In the earliest days of commercial computing for example, mainframe computers were so expensive that allowing multiple users to share CPU time, thereby increasing utilization, was a common practice. The contemporary 'cloud' phenomenon however is directly linked to the widespread availability of high capacity, low cost networks, advanced software and hardware; in addition to the adoption of service-oriented architectures. Although there are numerous specific definitions [21, 22] – and indeed a range of different types of 'cloud' – for the purposes of this paper the US National Institute of Standards and Technology (NIST) definition provides a solid starting point [23]. NIST propose that cloud computing "is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" [23].

Cloud can be deployed and delivered in different ways. Deployment is more about how infrastructure is setup and delivery is more about how services are provided. An organisation can opt to deploy cloud as a Private Cloud, Community Cloud, Public Cloud or Hybrid Cloud. Private Cloud is preferred option for organisation with requirement of a very secure unshared Work System [9]. Although an external supplier may provide or manages it, cloud infrastructure is solely operated for a specific consumer organisation at on or off premises. For example ING DIRECT built a Private Cloud using Microsoft technologies. When a group of organisations have similar Work System or similar needs like compute power usage, or data sharing, they may opt for a Community Cloud. In a Community Cloud, infrastructure is shared between community organisations which may reside on or off premises. A third party organisation may manage it on behalf of the community. Nebula by NASA is such an example.

If cloud infrastructure is shared with a wider network of organisations, it is termed as Public Cloud. Capgemini Immediate, Microsoft Azure, Amazon AWS are some examples of Public Cloud. There are some organizations who need to keep some part of an IS on a Private Cloud and like to leverage other deployment models for other part of an

IS. Hybrid model provides capability to combine above stated different delivery models in a way that each cloud infrastructure remains unique. For example a government department of a Middle East country uses a private cloud with backup of a third party public cloud only for disaster recovery.

Computing resources deployed using either of above models can be delivered in different ways i.e. Infrastructure as a Service (IaaS), Platform as a Service (PaaS) or Software as a Service (SaaS). Delivery as an IaaS provide consumer organisations maximum control over processing, storage, networks, other related resources and their provisioning. Although a service provider manages underlying cloud infrastructure, a consumer can deploy and execute almost any operating system, any software, any IS and has some control over selecting a network component like firewalls. This greater control means consumers share maximum security and risk concerns. Amazon EC2 and Google's Google Compute Engine are some examples of IaaS. In PaaS, a service provider delivers a fully configured platform including underlying infrastructure, ready for a consumer for deploying an IS using provider's supported languages. Service Provider manages operating system, network and storage while providing control to consumer organisations to deploy and configure IS. For example Windows Azure and Salesforce's Heroku both support languages like .Net, Java, PHP and Python. As consumers have relatively lesser control, they share relatively lesser risks. When consumers are only interested in functionality they can opt for a SaaS. In SaaS, a Service Provider provides end applications and IS as a service running on a cloud infrastructure. Service Provider manages all aspects like software, hardware, network and other resources providing consumers some control over configuration. As a provider has maximum control over management, consumers share lesser risk to data and infrastructure. Microsoft Office 365, Salesforce.com CRM, Gmail, Amazon S3, Drop Box, Facebook are some example of a SaaS.

Although above deployment and delivery models are important aspects, these are following key unique cloud characteristics which servers benefits as well as pose challenges for migration.

- **On-demand self-service:** A service consumer is independent to self provision computing capabilities automatically at a given time. This can include server time, network, storage or even selection of platforms. On-Demand Services require details like consumer specific service demand patterns for definition and measurement of success. For example from consumers perspective it is important to have a good understanding of different demand peak patterns else consumers may end up in unused over provision of costly services. Amazon provides CloudWatch to alert consumer organisations if service provisioning needs increasing above their threshold. Service Providers need a holistic view of Service Demand to ensure there is no service outage
- **Broad network access:** Cloud requires service availability over the network to heterogeneous client's platform through standards mechanism. This implies location independence, clients may not need to know where data is computed or stored. For example Microsoft uses its Dublin data centre to serve clients in the Middle East. Broad Network Access also increases security concerns and risks. This is holding consumers from migrating IS to the cloud [24] as data may sit outside organisational firewall requiring a good understanding of context and IS together. Understanding the context requires a view of a whole system. It includes but not limited to concerns like physical security, personal security, Identity Management, application security, privacy, legal issues, business continuity, data recovery, log, audit trails, lack of control over data, lack of visibility of cloud infrastructure integrity and complexity of meeting compliance requirements. In cloud risk & security ownership and responsibilities are shared between service providers and consumers which depend on type of deployment and delivery models. Consumers need to have an understanding, like legal implications, about how a provider's infrastructure will maintain data integrity. For example a cloud Service Provider was forced by a government department to provide financial records of a bank (based in a different country) which was using its storage services. Consumers need to know under what context a service can be used and when not. For example a government body of a Middle East country has its own private cloud requiring not using a public cloud for day to day operations but can use public cloud for disaster recovery. From a Service Provider's perspective it is challenging to ensure security for multiple tenants while providing maximum possible control.
- **Resource pooling:** In a multiple client environment, a cloud service provider creates a pool of resources to serve multiple tenants which can be assigned or reassigned as needed. Resource Pooling is based on Multi Tenancy. In a Multi Tenant environment resources are shared by many organisations. Each may have their own business and technical preferences in adoption of cloud requiring resources logically separated. Context is an important aspect for keeping resources logically or physically separated. Context requires a complete picture as it can help to mitigate added complexity because a typical cloud service has multiple sub providers and diverse internal users.

For example Salesforce.com provides Force.com computing services which uses Multi-tenancy. Force.com uses Metadata (context specific information) which is processed by an engine at run time to provide a consumer's organisation specific behaviours. From consumer organisations perspective, it is important to understand impacts of resource sharing for concerns like compute process isolation, concurrency, data security cost, and stability of underlying virtual machines etc. As a result context is important for definition and selection of success metrics and depth of analysis. This also needs Quality Weights mechanism to reflect interest of different stakeholders in an IS on cloud as success measurement metrics "(may have) different (impacts) depending upon level (group, industry, society) of analysis" [10].

- **Rapid elasticity:** Economic uncertainty requires IS to release and scale out services rapidly with out user's intervention. Pay as you use model allows consumers to provision unlimited quantity automatically at any time. For example Amazon AWS allows a user to add a significant number of core processors to a compute process in progress with in couple of minutes. Providing elastic infrastructure and services requires a substantial setup cost. This leads providers to seek ways to achieve vendor lock In which is assisted by a lack of standards in the cloud world. This may result in an inability of consumers to take advantage of competitive prices offered by different providers. For example the University of Bristol has recently migrated their email system to mail service (a SaaS) provided by Google. A substantial cost was involved in mail conversion to Google's format. As this is a specific format, the university may require paying for conversion cost should they decide to migrate to a different provider like Microsoft. From a Provider's perspective it is challenging to catch up with other providers in a way that they can offer vendor neutral services. Different providers offer different price models at different times which make it a bit challenging to compare price. From a consumer perspective it is important to understand service usage pattern to calculate price. For example they need to decide whether it is good option to keep using Community Cloud for consistent high peaks or instead build their own private cloud.
- **Measured Service:** Above mentioned Pay per Use requires optimising resources which needs metering capability to inform consumer and provider service usage. This will allow both parties to monitor, control and report to make decisions about service provisioning and consumption. This metering can be done at any level of abstraction like core processor used, data usage, consumption time duration etc. For example on 11-09-2012 at 13:43, price of a Small (standard on demand instance) of Windows was $0.115 per hour for US East.
- **Flexible Service Granularity:** Service Granularity is another important aspect in cloud. When offering a service it is important to decide whether it will be a fine grained service like Public Data Sets on Amazon AWS or a coarse grained service like Amazon S3. If services are very fine grained then consumer organisations may need to use multiple providers for migrating their IS. It brings not only technical integration challenges; it also may need complex SLAs. From a providers perspective they need to decide about service granularity as per right target audience. A very coarse grain service may be less attractive to consumers because of unnecessary offerings and cost where as a very fine grained service may not attract consumers as they have to use multiple services to fulfil need.

  A concept related to Service Granularity in cloud is Scope of Service which defines boundary and usage of service in different Work Systems. For example it is important for metering service in different Work Systems. Traditional IS were dedicated to organisations without metering service usage and IT was seen as an overhead cost. Cloud offers Pay per Use models which require accurate metering as per usage in a certain Work System. For example Amazon AWS may offer a different price to a student researcher when using it for an academic research and a different for a consultancy research. Understanding of IS and Work System requires 'appreciation of components in terms of wholes' [1]. It is also important to understand ownership and liability of services. For example if a middle party such as Cloudmore is providing SharePoint Services offered by Microsoft then it becomes important: What is scope of Microsoft services? What is added by Cloudmore? Who will be responsible for service outage etc?

The above mentioned challenges are pressing organisation to measure IS success to make more informed decisions before migrating IS to the cloud. Although traditional IS success models served their purpose to inform decisions about legacy IS, above mentioned newly introduced challenges are beyond the scope of existing extents models for measuring success of migrating a traditional IS to a cloud.

3. What do existing IS success models tell us?

Given the importance of IS to organisations, there are hundreds of metrics and many models to measure IS success. We reviewed papers from 1992-2012 in journals including but not limited to MIS Quarterly, Information Resources Management Journal, Journal of Information Technology, Government Information Quarterly and IEEE conference papers. The process began with a key word searches using e-resources like Science Direct, Google Scholar, University of Bath Library System, University of Bristol Library System and JSTORE. More than 50 papers were identified for a detailed review. These papers included cases from multiple application domains (e.g. healthcare, education) and different geographical areas.

Literature suggests that early investigations of non-technical performance were focused on the attitudes, satisfaction and performance of users [25, 26, 27, 28] and since this early research even more finely detailed set of measures have been developed. Research into users has continued with, for example, Li [29] developing a 52-item User Information Satisfaction Instrument (built on the work of Saarinen) [30], Mirani and Lederer [31] proposing a 32-item based organisational benefit measurement tool, Doll and Torkzadeh [32] offering 30-items for measuring systems usage sub-metrics and Tarkzadeh et. al. [33] a 12-item tool for assessing individual impact. Arguably it wasn't until Bruwer [34] that a more comprehensive, multi-attribute model of post implementation success for a Computer Based Information System (CBIS) was proposed. Since then IS effectiveness has been explored by looking at the relationships between IS success variables [35]. Validation of the identified relationships between different variables led to the development of success measurement models.

Using citation analysis [36] it can be highlighted that these on-going success measurement research efforts can be categorised broadly into two streams based on IS characteristics for measuring IS success and the process of measuring IS success i.e. identifying purpose and context, etc. As an illustration first one is, the D&M [7] work which is seen as a major contribution to knowledge [8, 9, 23] synthesising many of the extant success metrics at that point. Their model, which as of August 2012 has been cited almost 5000 times (Google Scholar), is itself based on adaptations of communication theory [37]. The D&M [5] model provided a scheme for classifying the myriad success metrics into six categories using a "temporal and causal" model.

In this model any IS is endowed with certain system and information qualities and used by users resulting in individual and organisational impacts. This model was empirically investigated to validate multidimensional relationship between their proposed IS success categories. It has subsequently been adapted, refined, revisited and re-tested by numerous other researchers. For example Seddon and Kiew [38] replaced "use" with "usefulness" and added "user involvement" success metric. D&M also updated their original model to incorporate new success metrics and contemporary research related to application, validation and challenges [39, 40, 41, 42] to their original work. They also proposed four categories of context (individual, group, organisation and industry) along with a revised success dimensions (System Quality, Information Quality, Service Quality, Usage and Net Benefits.)

Although D&M focused on IS dimensions itself, Grover et al. [18] argued that IS systems measurement needed to be understood from a broader systems perspective where it is important to understand (a) who is measuring, (b) how to measure, (c) what has been measured (the unit of analysis) and (d) when it has been measured. Similarly, Seddon [8] proposed a two dimensional matrix for setting measurement processes in a context. This matrix was based on stakeholder and system dimensions. Both the stakeholder (informed by the work of Cameron and Whetten [43] and system dimensions [18] highlights the importance of understanding and measuring at various levels of analysis (e.g. stakeholders can be individuals, groups, firm, provider; systems can be aspects of an IT application, System Development Methodologies, IT functions in an organisation, etc.).

These traditional models were static like traditional IS, serving in a static context. Context can be defined as "any information that can be used to characterise the situation of an entity." [44]. Most of traditional system resided with in a data centre owned and maintained by organisations their selves or in cases maintained by a handful third party providers. Consumer organisations were aware of service context like computing environment, network capacity, computing cost, physical location etc. Pre defined static protocol were used for interaction. As a result IS were working in more controlled fashion. Support team could replicate issues as it is relatively easy to emulate environments. As IS was static, it is relatively easy to measure success using static metrics like cost, usage and supplier quality. Apart from these technical and financial context user context was static as well. Systems stakeholders were pre agreed who had defined usage scenarios. As a result observers used well defined metrics to measure success for a defined business and technical system boundary.

In terms of cloud context is dynamic. Depending on type of deployment and delivery model, consumer organisations may not be aware of computing environment, services interaction with other services at run time, actual service provider, compute process resource availability, network & service access dynamics etc. Cloud resource pooling uses multi tenancy, as a result stakeholders of systems varies at different point in time or their evaluation perspective changes impacting in using different evaluation criteria to measure same system. For example if NASA Nebula service starts serving to any Russian space agency, it may impact earlier stakeholders (tenants) perspective and their evaluation criteria. This may also impact on service scope, observers as observer's interest may change.

Earlier models for measuring IS success were either focused on IS context or IS characteristics, providing a partial view of a whole system. The dynamic nature of context in cloud needs a holistic approach to understand system as whole and additional metrics to measure success like dynamic costing, policy propagation to ensure service integration etc. Application of System Thinking leads to an integrated model as "it is a framework for seeing interrelationships rather than things (individual system components)" [45]

4. Towards a model of cloud success?

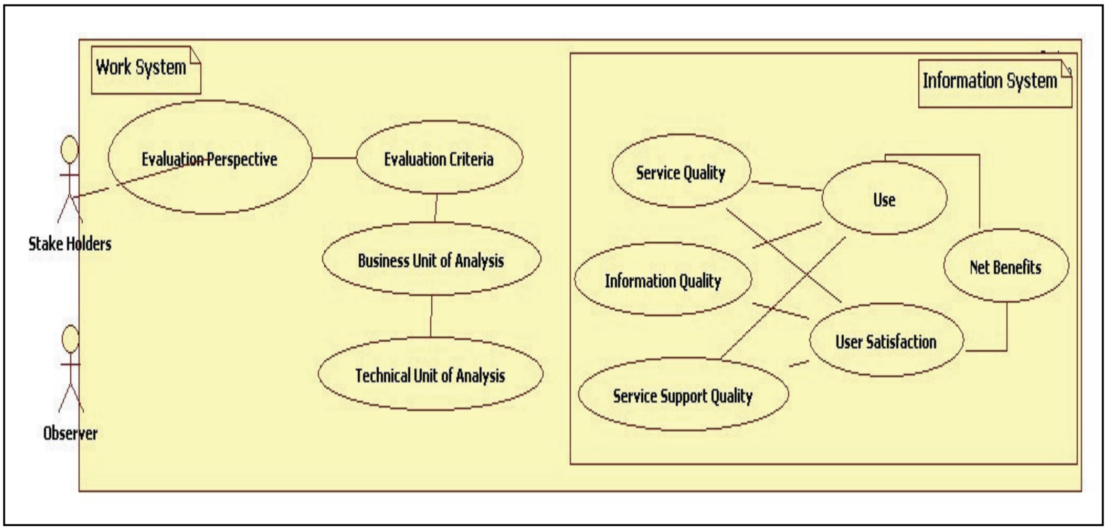

Figure 2: Proposed – A holistic Conceptual Model

This model provides a holistic view to measure IS success by combining key dimensions of IS context and IS characteristics. This model shows that an IS works with in a Work System. Measuring success of migrating an IS to cloud depends on understanding context of an IS i.e. stakeholder, observers, service boundary, scope of service and its relationship with in an over arching Work System as seen by stakeholders. This deployment and delivery neutral model provides a mechanism to explore system complexity at multiple levels i.e. Business, Work System, Information System and technology levels while providing a single view of a whole system. As a result a single model provides multiple views for different stakeholders to have a shared vision to inform migration decisions.

"Systemic thinking explores things as wholes' [1, pg 13] which involves, 'in the first instance, drawing tentative boundaries around stakeholders, focusing primarily on clients' [1, pg 7]. Following this principle this model focuses on drawing a Work System and an IS boundary informed by stakeholders. Stakehoders (for whose interest this evaluation is conducted) is a concept extending Seddon's concept [8]. This includes individuals, management, set of organisations, community, society, country or may be whole globe. As cloud offer multi tenancy, it is important to understand system from multiple tenants' perspective. From consumers' perspective, understanding stakeholders will help organisations to decide who can be other stakeholders to share provided infrastructure. Based on this organisations may migrate to a Public Cloud or may decide to proceed with a Private Cloud. From Service Providers perspective, understanding stakeholders will help service providers to offer right service to stakeholders. For example Amazon is offering service for gene to specific stakeholders.

Stakeholders and observers can use dynamic perspective based evaluation criteria to measure success of dynamic business/technical units. Understanding of evaluation perspective and evaluation criteria using this model will help to explore stakeholder's priorities which contribute to success of a system and ensure that decisions are based on underlying factual demands. Stakeholders may see new risk to over all system which may not be visible when looking at individual components levels, for example risk of miss-alignment of business and technical scope. To meet this specific challenge, Business Unit Analysis in the model sets scope from a business perspective where as Technical Unit Analysis from a technical perspective. But both are part of a whole model. All above mentioned units of this model are focused on exploring context and understanding work system. This sets up expectation from an IS to be success ful from a business perspective. How ever business expectation can not be achieved unless an IS exhibits certain technical characteristics.

In this model IS, showed as an inner system, addresses technical expectations from an IS to meet business expectations. This also addresses all technical challenges as a whole which helps to manage a balance between different requirements. For example Amazon offers service to use computing power when price is below a certain threshold. This means service quality is compromised to provide maximum Net Benefit. Similarly it can help to see how the increase of IS use will impact on Service Support Quality and Service Quality. It also helps to balance User Satisfaction and Net Benefits. For example a User may be more satisfied when process finishes as soon as possible in above example. How ever User Satisfaction was compromised to get maximum Net Benefits.

Apart from above big picture, this model also points to drill down in key system components with in an IS. This starts with Service Quality. In the cloud world what consumers see is a service. Pitt, Watson and Kavan observed "Commonly used measures of IS effectiveness focus on the products rather than the services of the IS function. Thus, there is a danger that IS researchers will measure IS effectiveness inaccurately" [46]. We propose to use word Service instead of original System used by D&M [10]. It measures the desired characteristics of cloud services like functionality, scalability, redundaness, resiliency, usefulness, usability, responsiveness, reliability and flexibility. Different aspects will be more important based on the context. For example for internal customers flexibility may be more important where as responsiveness may be more important for external customer.

Service Quality is of less use with out Information Quality. In this model Information Quality is as it is described in D&M model [10]. This captures the content issues of the cloud like service personalisation, relevancy. We consider security under this category to reflect the fact that it is important to secure content not service [47]. Economy of scale requires Resource Pooling which requires personalisation measures of the provided services to deliver correct contents. Service Quality and Information Quality contribute to Service Usage. Service Usage measures usage pattern by the end consumers including sub providers who consume dependent services. The Service Usage does not always represent User Satisfaction as User Satisfaction covers users (third parties as well as end users) entire experience from service discovery to end consumption. In the cloud world most of the services are dependent on underlying services made available from different providers. This makes user satisfaction a challenging task as it may be difficult to define service boundaries. User may not know how the underlying services are contributing to over all experience. Although metrics like "customer e-commerce satisfaction" [48, pg 7], "e-loyalty" [49] or customer attitudes [50] still apply to cloud, further metrics are required to measure user satisfaction.

Service Quality, Information Quality, Service Usage and User Satisfaction contribute towards Net Benefits. Net Benifits captures balance of positive and negative impacts on stakeholders as (expected) a result of migrating an IS to cloud. This varies from a group of people to whole economy depending on type of the service: Was G-Cloud initiative really successful? Has cloud enabled universities to provide services to wider audience? This is the most important of all categories as this summarises individual categories and benefits of these as aggregate. Net Benefits measures are context, objective and service dependent. These benefits can compose of variety of explicit and implicit benefits however in scope of an IS. For example as it was the case of e-commerce's country level impacts like readiness for e-commerce [51], it is the case with the cloud i.e. readiness for Cloud. [52]. Traditional Success measures like cost efficiency, increased sales, profits and ROI still holds but there are some additional ones for cloud like reduced time to market, ease of innovation.

4.1. Operational Guidelines

Following are high level steps to apply this model. Please be advised that there are no arrows in this model which is representing that steps 1 to 7 can be progressed in parallel but these must be run before step 8.

- Understand and agree on stakeholders: Stakeholder analysis can help to understand needs and motivation of measuring success of IS on cloud. It is important that all stakeholders hold almost same view of system under observation.
- Understanding and agreeing who is going to observe. For example whether an observer is going to be in-house IT department, a service provider, a third party individual or organisation, a government body etc?
- Understanding and agreeing Work System in which this IS works. It is quite possible that this Work System may support many other Work System but it needs to be scoped what is over arching Work System. Context in which IS System works also needs to be well under stood. At this step observers need to have a clear vision about business domain in which this work system works. For example Environment Agency (EA) is a public body (business domain) which helps protecting environment (Work System) using a GIS (Information System).
- Understanding and agreeing on Evaluation Perspective (for whose perspective/view point is effectiveness being evaluated?). Whether IS will be viewed from users point of view, managements point of view, IT department or whole organisation's point of view.
- Understand and agree on Evaluation Criteria. This concept is borrowed from Grover [18] work and its included types are normative, comparative and improvement. This step requires that Vision for an IS system is clear and well defined. IS System boundary is clearly defined not mixed with a Work System. It also needs to be established in this step that how data will be collected and analysed. For example if a comparative based evaluation criterion is selected then is there any organisation or number of organisations whose data is readily available to make comparison. In case of normative, are there well defined standards in place?
- Understand and agree on Business Unit of Analysis. For example whether scope of this measurement is limited to a business unit with in an organisation, an organisation, a community of organisation, country or globe?
- Understanding and agreeing on scope Technical Unit of Analysis. This is based on four categories proposed by Seddon [6] under system dimension of his matrix. For example whether scope of this measurement is to an aspect of IS application, An IS application, A portfolio of IS applications or all applications used with in a Business Unit of Analysis.
- Finally understanding and agreeing whether it is a Per-Implementation / Migration evaluation or Post-Implementation / Migration evaluation and agreeing on different metrics to be used for evaluation under different categories of IS success measures. For example Perceived Usefulness would be a good candidate for Pre-Implementation where as Usefulness would be a good candidate for Post-Implementation.

This model can help organisations to see a holistic view before migrating an IS to the cloud. From consumers perspective, this holistic view can help to see expected or actual IS characteristics along with their context to help stakeholders to foresee solution's business viability and making technical level choices. From a provider's perspective a key use of this model is understanding boundary of provided services and how it can be orchestrated to serve business partners / end consumers and in what context. For example Microsoft can see SharePoint scope for business partners like Cloudmore and end consumers. Whole picture can also help providers in identifying business demands and IS supply patterns to meet challenges of elasticity. Understanding evaluation perspective will help consumers to understand needs of different internal or external stakeholders. For example a finance department may have a perspective or saving cost using multi-tenancy where as sales department may have perspective to use it for elastic expansion. From providers' perspective, understanding Evaluation Criteria will help providers to address different perspectives. For example they may have to ensure more control of resources to consumer's IT department while ensuring less environmental impacts for a CSR department. This model may have a key impact on observers as this model can be used to understand scope of cloud service, who is interested in service in what way and how observers can measure impacts by appreciating context. For above example this model can help observers to collect IT, Sales and Finance departments' views to understand their role in Work System and how stakeholders see success. From providers' perspective this model can help observers to understand consumer organisations Work System and how they see them as successful providers.

5. Conclusion and future work

As per Sufi science every being is information and existence of every being is dependent on flow of information (Azeemi, 2005) [53]. Same is true for survival of any organization. Technological advancement has a high impact on IS. Each time technology advance, IS are migrated to take advantage of this advancement. In recent years technology has advanced to cloud. Organizations are once again hard pressed to migrate IS to the cloud to reap benefits and take advantage of this advancement. Given the dynamic nature of cloud to meet changing demands, a review of extent IS success model suggests limitation of these models to provide a holistic view to inform decision of migrating an IS in a cloud. Unavailability of this holistic view may cause a false observation as looking at IS itself only or focusing only on its context provides a partial view of a whole system. We argue that a holistic view appreciating context and providing focus on IS can help consumers and providers to make more informed decisions when migrating an IS to cloud. Using System Thinking, we have proposed a more holistic conceptual model based on D&M's model using Grover's flow and Seddon's two dimensional Context while appreciating (not focusing) on Work System [9] for measuring success of an IS migration to a cloud in pre and post migration scenarios.

A work, using case study approach, is in progress to empirically validate this model. There will be a case study from an education sector organisation who migrated there IS to a SaaS and a case study from a public sector organisation who are migrating IS to a cloud. In the first case organisation has already migrated IS so this will help understanding Post-migration success i.e. how this consumer organisation can inform that migration was a success. In later case migration is in process. This will inform Pre-migration success whether migration will be successful or not. For both cases we will evaluate impact of this model from observers and stakeholders point of view.

6. Acknowledgements

I am really thankful to many company and universities colleagues, for contributing to this paper. More specifically Mr. Khawaja Shams-ud-Din Azeemi from Azeemia Foundation , Mr. Scott Davies (Capgemini), Prof. Patrick Godfrey (UoBristol) and Proff Andrew Graves (UoBath) for their value able time and contribution.

References

1. Flood R. L., Rethinking The Fifth Discipline, 1997, pg 69
2. Checkland, P.B, Winter M.C., Brown D.H., A Role for Soft Systems Methodology in Information Systems Development. European Journal of Information Systems 4, 1995, 130–42.
3. Archibald, J.A. (May 1975). "Computer Science education for majors of other disciplines". AFIPS Joint Computer Conferences: p 906.
4. Jessup, Leonard M.; Joseph S. Valacich (2008). Information Systems Today (3rd ed.). Pearson Publishing. Pages ??? & Glossary p. 416
5. Thong J.Y.L, Yap C., Raman K.S, Engagement of External Expertise in Informatoin System Implementatino, Journal of Management Information Systems, Volume 11, Number 2, 1994, p 209-231
6. Beard Haley, Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Publishing , 2008, ISBN 978-1921523199
7. DeLone, W., McLean, E. Information systems success: The quest for the dependent variable, Info. Systems Research, 3, 1, 1992, p60
8. Seddon P. B., Staples S., Patnayakuni R., Bowtell M., Dimensions of Information Systems Success, Communication of the Association for Information Systems, Volumen 2, Article 20, November 1999
9. Alter S. response in Dimensions of Information Systems Success, Communication of the Association for Information Systems, Volume 2, Article 20, November 1999
10. DeLone, W., and McLean, E. The DeLone and McLean model of information systems success: A ten-year update. Journal of Management Information ystems, 19, 4 (2003), 9–30.
11. Tarafdar M. & Sufian Q., Examining tactical information technology business alignment. J. of C.Info.Systems, 50(4), 2010, pp.107-116.
12. Braithwaite F., Woodman M., Success Dimensions in Selecting Cloud software Services, IEEE 37th EUROMICRO Conference on Software Engineering and Advanced Applications, 2011
13. Woodman M., Success Dimensions in Selecting Cloud software Services, IEEE 37th EUROMICRO Conference on Software Engineering and Advanced Applications, 2011
14. Song J., Han F., Yan Z., Liu G., Zhu Z. : A SaaSify Tool for converting Traditional Web-based Application to SaaS Application: 2011 IEEE 4th International Conference on Cloud Computing
15. Etchevers X., Coupaye T., Boyer F., Palma N. : Self-configuration of distributed applications in the cloud: 2011 IEEE 4th International Conference on Cloud Computing
16. Hexiaoa H., Shimingb Z., Haijiana C. :Reengineering from Tradition to Cloud: A Case Study: Procedia Engineering 29 (2012), p 2638

17. Chang V, Gary Wills1, Robert John Walters, "Towards Business Integration as a Service 2.0", (ICEBE), 2011
18. Grover, G.; Jeong, S.R.; and Segars, A.H. Information systems effectiveness: The construct space and patterns of application. Information & Management, 31, 4 (1996), 177–191.
19. Sultan N., Bunt-kokhusis S. van de, Organisational Culture and Cloud Computing: Coping with a disruptive innovation, Technology Analysis & Strategic Management, Volume 24, Issue 2, 2012
20. Carr N., The Big Switch: Re-Wiring the World, from Edison to Google, New York & London, 2009
21. Voas, J., and J. Zhang. 2009. Cloud computing: New wine or just a new bottle? IT Professional. 11, no. 2:15–17
22. Grossman, R. 2009. The case for cloud computing. IT Professional 11, no. 2: 23–7
23. Mell P., Grance T., The NIST Definition of Cloud Computing, Computer Security Division, Information Technology Laboratory, National Institute of Standards and Technology, Gaithersburg, MD 20899-8930, September 2011
24. Intel IT Centre, What is holding back the Cloud?, May 2012,
25. Schewe C. D., "The MIS User: An Exploratory Behavioral Analysis," Acad. Management J., 19, 4, December 1976, 577-590.
26. Lucas H. C, JR., Why Information Systems Fail, Columbia University Press, New York, 1975.
27. Maish A. M., "A User's Behavior Toward His MIS," MIS Quart., 3, I (1979), 39-52.
28. Robey D., User attitudes and management information system use, Academy of Management Journal, 22 (1979), pp. 527–538
29. Li E.Y., Perceived importance of information system success factors: A meta analysis of group differences. Information & Management, 32, 1 (1997), 15–28.
30. Saarinen, T. An expanded instrument for evaluating information systems success. Information & Management, 31, 2 (1996), 103–118.
31. Mirani, R., Lederer, A.L. An instrument for assessing the organizational benefits of IS projects. Decision Sciences, 29, 4, 1998, p 803
32. Doll, W.J., Torkzadeh, G. Developing a multidimensional measure of systems use in an organizational context. Information & Management, 33, 4 (1998), 171–185.
33. Torkzadeh, G., and Doll, W.J. The development of a tool for measuring the perceived impact of information technology on work. Omega—The International Journal of Management Science, 27, 3 (1999), 327–339.
34. Bruwer P.J.S., A Descriptive Model of Success for Computer-Based Information Systems, Information & Management, 7, 1984, pg 63
35. Weill, P. , Olson, M.H., An assessment of the contingency theory of management information systems, Journal of MlS, 6(1), 1989, p 59
36. Ryan B., Scapens R., Theobald M., Research method and methodology in finance and accounting, II edition, Thomson , London, 2002
37. Shannon, C.E., and Weaver, W. The Mathematical Theory of Communication.Urbana: University of Illinois Press, 1949
38. Seddon, P.B., and Kiew, M.-Y. A partial test and development of the DeLone and McLean model of IS success., Proceedings of the International Conference on Information Systems. Atlanta, GA: Association for Information Systems, 1994, pp. 99–110.
39. Goodhue, D.L., and Thompson, R.L. Task-technology fit and individual performance. MIS Quarterly, 19, 2 (1995), 213–233.
40. Etezadi-Amoli, J., and Farhoomand, A.F. A structural model of end user computing satisfaction and user performance. Information & Management, 30, 2 (1996), 65–73.
41. Guimaraes, T., and Igbaria, M. Client/server system success: Exploring the human side, Decision Sciences, 28, 4 (1997), 851–875.
42. Rai, A.; Lang, S.S.; and Welker, R.B. Assessing the validity of IS success models: An empirical test and theoretical analysis. Information Systems Research, 13, 1 (2002), 50–69.
43. Cameron, Kim S.; Whetten, David A., Organizational effectiveness: A comparison of multiple models, N.Y: Academic Press, 1983
44. Dey A. K, Abowd G. D., Towards a Better Understanding of Context and Context-Awareness, Graphics, Visualization and Usability Center and College of Computing, Georgia Institute of Technology, Atlanta, GA, USA 30332-0280
45. Senge P. M, The Fifth Dicipline, 1994, pg 53
46. Pitt, L.F.; Watson, R.T.; Kavan, C.B. Service quality: A measure of information systems effectiveness. MIS Quarterly, 19, 2, 1995, p173
47. Kiviharju M., Content-Based Information Security (CBIS): Definitions, Requirements and Cryptographic Architecture, Defence Forces Technical Research Centre, Publication 21, 2010
48. Molla, A., and Licker, P.S. E-commerce systems success: An attempt to extend and respecify the DeLone and McLean model of IS success. Journal of Electronic Commerce Success, 2, 4 (2001), 1–11.
49. Reichheld, F.F. and Schefter, P., (2000), “E-Loyalty”, Harvard Business Review, Vol.78, No. 4, pp. 105-113.
50. Mehta, Abilasha 2000. Advertising attitudes and advertising effectiveness. Journal of Advertising Research 40:3 p. 67-72
51. Colecchia, A. (December 1999). Defining and Measuring Electronic Commerce: Towards the development of an OECD methodology. Paper presented at the Measurement of Electronic Commerce, Singapore.
52. Mulholland A. (Global C.T.O Capgemini), "The Cloud: Time for Delivery", 2011
53. Azeemi K. A., Muraqaba: Art & Science of Sufi Meditation, Plato Publishing, Inc. New York, ISBN-10 0975887548, Jan 2005