2014

Agile enterprise architecture: a case of a cloud technology-enabled government enterprise transformation

Asif Qumer Gill
University of Technology

Steven Smith
Macquarie University

Ghassan Beydoun
University of Wollongong, beydoun@uow.edu.au

Vijayan Sugumaran
Oakland University

Publication Details

Gill, A., Smith, S., Beydoun, G. & Sugumaran, V. (2014). Agile enterprise architecture: a case of a cloud technology-enabled government enterprise transformation. Proceeding of the 19th Pacific Asia Conference on Information Systems (PACIS 2014) (pp. 1-11). United States: AISeL. 2014

Agile enterprise architecture: a case of a cloud technology-enabled government enterprise transformation

Abstract
Australian government enterprises have shown a significant interest in the cloud technology-enabled enterprise transformation. Australian government suggests the whole-of-a-government strategy to cloud adoption. The challenge is how best to realise this cloud adoption strategy for the cloud technology-enabled enterprise transformation? The cloud adoption strategy realisation requires concrete guidelines and a comprehensive practical framework. This paper proposes the use of an agile enterprise architecture framework to developing and implementing the adaptive cloud technology-enabled enterprise architecture in the Australian government context. The results of this paper indicate that a holistic strategic agile enterprise architecture approach seems appropriate to support the strategic whole-of-a-government approach to cloud technology-enabled government enterprise transformation.

Keywords
agile, enterprise, architecture, transformation, case, cloud, technology, enabled, government

Disciplines
Engineering | Science and Technology Studies

Publication Details
Gill, A., Smith, S., Beydoun, G. & Sugumaran, V. (2014). Agile enterprise architecture: a case of a cloud technology-enabled government enterprise transformation. Proceeding of the 19th Pacific Asia Conference on Information Systems (PACIS 2014) (pp. 1-11). United States: AISeL. 2014

AGILE ENTERPRISE ARCHITECTURE: A CASE OF A CLOUD TECHNOLOGY-ENABLED GOVERNMENT ENTERPRISE TRANSFORMATION

Asif Qumer Gill, University of Technology, Sydney, Australia, asif.gill@uts.edu.au

Stephen Smith, Macquarie University, Sydney, Australia, stephen.smith@mq.edu.au

Ghassan Beydoun, University of Wollongong, Wollongong, Australia, beydoun@uow.edu.au

Vijayan Sugumaran, Oakland University, Rochester, USA, sugumara@oakland.edu

Abstract

Australian government enterprises have shown a significant interest in the cloud technology-enabled enterprise transformation. Australian government suggests the whole-of-a-government strategy to cloud adoption. The challenge is how best to realise this cloud adoption strategy for the cloud technology-enabled enterprise transformation? The cloud adoption strategy realisation requires concrete guidelines and a comprehensive practical framework. This paper proposes the use of an agile enterprise architecture framework to developing and implementing the adaptive cloud technology-enabled enterprise architecture in the Australian government context. The results of this paper indicate that a holistic strategic agile enterprise architecture approach seems appropriate to support the strategic whole-of-a-government approach to cloud technology-enabled government enterprise transformation.

Keywords: Agile Enterprise Architecture, Enterprise Transformation, Whole-of-a-Government, Cloud Strategy

1 INTRODUCTION

Government enterprises operate in a highly complex, dynamic and regulated environment. Information technology (IT) is a core component of their operating environment and provides the necessary support to enable the delivery of sophisticated government services to citizens (Layne and Lee 2001). Government enterprises need the support of efficient and reliable IT systems and infrastructure for their day-to-day operations (Schelin 2003). IT also plays a vital role in the growth and transformation of services offered by government enterprises. The emergence of on-demand elastic cloud technology (Shroff 2010; Bakshi 2011) is laying the foundation to upend the conventional approach to government service delivery, which sometimes may be insufficient to support the unpredictable spike in the demand for IT resources for service delivery. It has been reported that "demand for electronic and web-based services is driving demand for data centres at unprecedented rates, and they are an increasingly important part of a nation's economy" (Smith et al. 2013, p.2). The core benefit of cloud technology is that it allows the rapid sourcing of computing storage, processing, network, and information systems as services to deal with the elastic IT demand during a period of peak activity (Mulholland 2010). Cloud technology enables the creation of a shared and flexible computing environment, which can allow government agencies to share cost and benefits (Gill and Bunker 2011).

Cloud technology seems to offer a number of benefits; and Australian government enterprises have shown a significant interest in the cloud technology-enabled enterprise transformation. However, the challenge is how best to approach cloud technology-enabled transformation at such a large scale? Australian government (2011, p.5) has a whole-of-a-government strategy to cloud adoption and suggests that "Agencies may choose cloud-based services where they demonstrate value for money and adequate security". While the cloud adoption strategy and intentions are clear, the question of how to best realise the cloud strategy needs to be carefully addressed. This paper addresses this issue and proposes the use of an agile or adaptive enterprise architecture driven approach to iteratively develop and implement the agile or adaptive cloud-enabled enterprise architecture for realising the whole-of-a-government cloud strategy in the Australian government context. This paper uses a theoretical practice-based adaptive enterprise architecture framework (Gill 2013) as a lens and demonstrates how to develop and implement the adaptive cloud-enabled enterprise architecture in the Australian government context.

This paper is organised as follows. Firstly, it discusses the research method. Secondly, it discusses the background and related work. Thirdly, it presents the adaptive enterprise architecture framework. Fourthly, it applies the adaptive enterprise architecture framework as a lens to the case of Australian government cloud adoption. Finally, it discusses the adaptive enterprise architecture approach before concluding in section 7.

2 RESEARCH METHOD

This paper applied a case study based qualitative research approach (Denzin and Lincoln 2000). A case study is an appropriate qualitative research methodology to study and explain a contemporary phenomenon within the practical context (Yin 1994). Firstly, based on the literature review (see Section 3), research problem and motivation have been identified. Here, the research problem is how best to realise the cloud adoption strategy for the cloud technology-enabled government enterprise transformation. Secondly, in order to address this problem, an agile or adaptive enterprise architecture approach has been proposed and used (see Section 4) to demonstrate how to relaise the whole-of-a-government cloud strategy in the Australian government case study context. The use of an agile or adaptive enterprise architecture approach in a single case could be considered a limitation when generalising the results of this study. However, this paper lays a foundation for further future case studies in this important area of architecture-driven cloud adoption in government enterprises. Despite one case study limitation, one of the main research contributions of this paper is the important demonstration of how to systematically and iteratively realise cloud adoption strategy in the context of large and complex government enterprises.

3 RESEARCH BACKGROUND AND RELATED WORK

3.1 IT in Government

IT in government was initially adopted to support the core management functions and decision making needs (Simon 1976). Further, IT was adopted in the operational layer of the government architecture to improve the performance and efficiency of the operational staff and transactional activities (e.g. financial transactions handling, front-end operations) with the intent to enhance overall government productivity (Zuboff 1988). The emergence of Internet in 1990s allowed the government agencies to further inject the adoption of technology at the citizen layer. The offering of government services through Internet was tagged as e-government or electronic government services. Government portals enabled citizens to interact with and use e-government services through public Internet technologies (Aldrich et al. 2002). Citizens now frequently consume e-government services (e.g. human services, financial services, education services, facility services, disaster management) that are offered by the government enterprises. Citizens are not only using the e-government services but also their demand is increasing for more e-government services. The demand for more e-government services is putting a lot of pressure on the IT capabilities of government enterprises (Datacentre Dynamics 2011).

3.2 IT Challenges in Government

The increasing demand for IT-enabled government (e-government) services and their integration across agencies is one of the biggest challenges to all governments. Governments not only need to introduce new services, they need to be more integrated, cost effective, efficient and accessible on a variety of platforms. In contrast these new services need to be cost efficient with fewer resources and reducing redundant activities, overheads and resources. While the citizens' awareness and demand for e-government services is rapidly increasing; traditional government IT systems and fixed infrastructure come under pressure and are often pushed to the point of failure. A scalable and shared IT environment is required to deal with the unpredictable spike for IT resources to support the dynamic ever increasing demand for e-government services. For instance, IT supports the necessary communication and coordination activities of different government agencies before, during and after the unpredictable crisis situations (Gill and Bunker 2012). It is difficult to forecast when exactly a disaster will strike and how much IT resources will be required to support the additional uncreditable IT needs for a multi-agency crisis management (Gill and Livingstone 2012). This escalates the need for a flexible and scalable cloud technology.

3.3 Cloud Technology

Cloud is a virtualised and distributed IT environment. US National Institute of Standards and Technology (Mell and Grance 2009, p.1) defines cloud as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models. The emerging cloud abstracts infrastructure complexities of servers, applications, data, and heterogeneous platforms." The concept of "cloud" is not new; however, the use and management of on-demand pool of cloud computing is a relatively new phenomenon for government enterprises. Cloud is a virtualized and distributed environment, which allows the management of a number of IT capabilities (e.g. development, deployment, support, data storage, processing, infrastructure, social media) of an enterprise (cloud service consumer) without having them any direct interaction with the physical IT environment (Zhang et al. 2010; Gill et al. 2011). It provides the cloud service models to organizations for hosting their IT components over the internet or an intranet.

With all its promises in cost cutting and improved access to IT technologies, migrating to the cloud remains a challenging endeavour with little methodological support. Some enterprises choose partial

migration of select applications or services to simplify their migration challenge. Even pursuing a partial migration to the cloud, still presents serious challenges in finding appropriate balance between performance and privacy versus cost cutting and other cloud benefits (Hajjat et al. 2010; Sun et al. 2011). The current state of support for migrating applications to the cloud often forces software engineers to abandon the use of existing development methodologies (Babar 2013). It is unlikely that a single methodology can offer the required support in cloud adoption. Rather it is likely that a general framework is required to enable developers to attune the migration project to their own context. This paper discusses a framework to support cloud adoption in government settings where methodological approaches are often mandated.

3.4 Cloud Technology and Government

Government enterprise of countries such as U.S., Canada, UK and many others are taking initiatives to embrace emerging cloud technology. For example, the federal government of the United States is actively pursuing the adoption of cloud technology and instituted the "Cloud First" policy to facilitate quick adoption and improve business flexibility as well as provide better interoperability between the back-end silo systems of the different departments (Kundra, 2011). Many agencies within the U.S. government such as the U.S. Army, Air Force, Navy, Department of Justice, Department of Agriculture and Department of Education have been early adopters of cloud based solutions (Perepa, 2013). The U.S. Federal Government is investing heavily in developing private clouds compared to public clouds. According to International Data Corporation (IDC), the Federal Government spending on cloud based solutions will reach $1.7 billion in FY2014 (IDC, 2013). Examples of crucial government services on cloud include IT consolidation, shared services between government agencies, and citizen services such as monitoring energy and water consumption, obtaining the status of service requests, access to medical records and informing citizens through the use of dashboards and scorecards on government initiatives. Similarly, the government of U.K. has also adopted a "Cloud First" policy for public sector IT and a number of other government services (Gov.UK, 2013). It has set up a framework called "G-Cloud" (Government Cloud) which is a programme to promote government-wide adoption of cloud computing. It supports CloudStore, an online marketplace where suppliers offer their services to government agencies (public sectors). These agencies can evaluate the services and buy them through this marketplace. Examples of cloud services offered are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), and Specialist Cloud Services (SCS) (Marshall, 2012). The Government of Canada (GC) offers a community cloud for pay, pension, CampusDirect, GC Intranet and Canada.gc.ca (Himmelsbach, 2010). Some of the goals of this community cloud are to use SaaS for internal collaboration (such as GCPedia, GCConnex and GCForum), PaaS for commoditized Web hosting and IaaS for virtual storage and computing services.

3.5 Cloud Technology and Australian Government

Similar to many other countries, Australian government is also showing significant interest in cloud technology. The focus and scope of this paper is limited to Australian government context. The emerging cloud technology provides both opportunities and challenges to Australian government enterprises. Australian government (2011) suggests the government-as-a-whole value for money and security risk-driven strategy to cloud adoption. Strategy is all about how the enterprise will maximise business value through continuous transformation and innovation. However, how best to realise this cloud adoption strategy for maximum business value is not an easy task and requires concrete guidelines and a comprehensive framework. This paper proposes to use an adaptive enterprise architecture driven holistic approach to strategic cloud technology adoption in the Australian government context. This paper consulted enterprise architecture body of knowledge and reviewed a number of enterprise architecture frameworks (see Section 4). Based on the analysis, the adaptive enterprise architecture framework (Gill 2013) has been selected to address the research question in hand. The adaptive enterprise architecture approach seems useful for establishing an agile enterprise architecture capability, which then can be used for iteratively developing, implementing and improving the cloud technology-

enabled adaptive enterprise architecture in the conquest for realising the Australian government cloud strategy. The next section discusses the adaptive enterprise architecture approach.

4 ADAPTIVE ENTERPRISE ARCHITECTURE

Cloud adoption demands a strategic change management approach. It requires a holistic government-wide multi-agency, top-down and strategic approach rather than looking at the individual local agency level isolated cloud adoption. Enterprise architecture is a strategic discipline that can be used in defining and realising the IT strategies and roadmaps (Ross et al. 2006). Architecture is defined as the "fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution" (ISO/IEC 42010 2007). The "system" concept, in the definition, is used here to define a government enterprise as a system. Enterprise architecture is a blueprint that can be used to describe the overall structural, behavioural, social, technological, and facility elements of a cloud technology-enabled government's operating environment that share common goals and principles (Gill 2013). It defines the integration and standardisation requirements for business processes and IT infrastructure (Ross et al. 2006).

The development and management of complex adaptive enterprise architecture is not an easy task. Traditional approaches to enterprise architecture development are criticized for not delivering the value early. Traditional enterprise architecture approaches may take few months to years to develop cloud technology-enabled fixed enterprise architecture for realising cloud adoption strategy. Organisations need an adaptive enterprise architecture capability for iteratively developing and managing the cloud technology-enabled adaptive enterprise architecture. An enterprise architecture is said to be an agile or adaptive enterprise architecture when it is responsive (scans, senses and reacts appropriately to expected and unexpected changes), flexible (adapts to expected or unexpected changes at any time), speedy (accommodates expected or unexpected changes rapidly), lean (focuses on reducing waste and cost without compromising on quality), and learning (focuses on enterprise fitness, improvement, transformation and innovation) (based on Qumer and Henderson-Sellers 2008).

There are a number of well-known enterprise architecture frameworks such as Zachman (1987), Federal Enterprise Architecture (FEA) (CIO Council 2001), The Open Group Architecture Framework (TOGAF) (Harrison 2011), and the adaptive enterprise architecture framework (Gill 2013) that can be used for developing adaptive enterprise architecture for cloud adoption. The challenge is which enterprise architecture framework is appropriate for developing and implementing the cloud technology-enabled adaptive enterprise architecture for realising the cloud strategy. The review of these well-known frameworks suggests that The Zachman framework only provides the architecture taxonomy and does not provide any concrete enterprise architecture guidelines and method. Federal Enterprise Architecture (FEA) is mainly focused on the implementation aspect of the enterprise architecture as opposed to the actual development of the enterprise architecture. The Open Group Architecture Framework (TOGAF) provides the most comprehensive architecture method and guidelines to develop the enterprise architecture. However, the challenge with TOGAF is two-fold: firstly, it is too heavy, slow and documentation driven and secondly, it is unlikely to be able to be used or adopted off-the-shelf for any specific organisation. Government organisations need to tailor their local enterprise architecture framework that suits their specific needs. Therefore, we propose here the use of the adaptive enterprise architecture framework (see Figure 1).

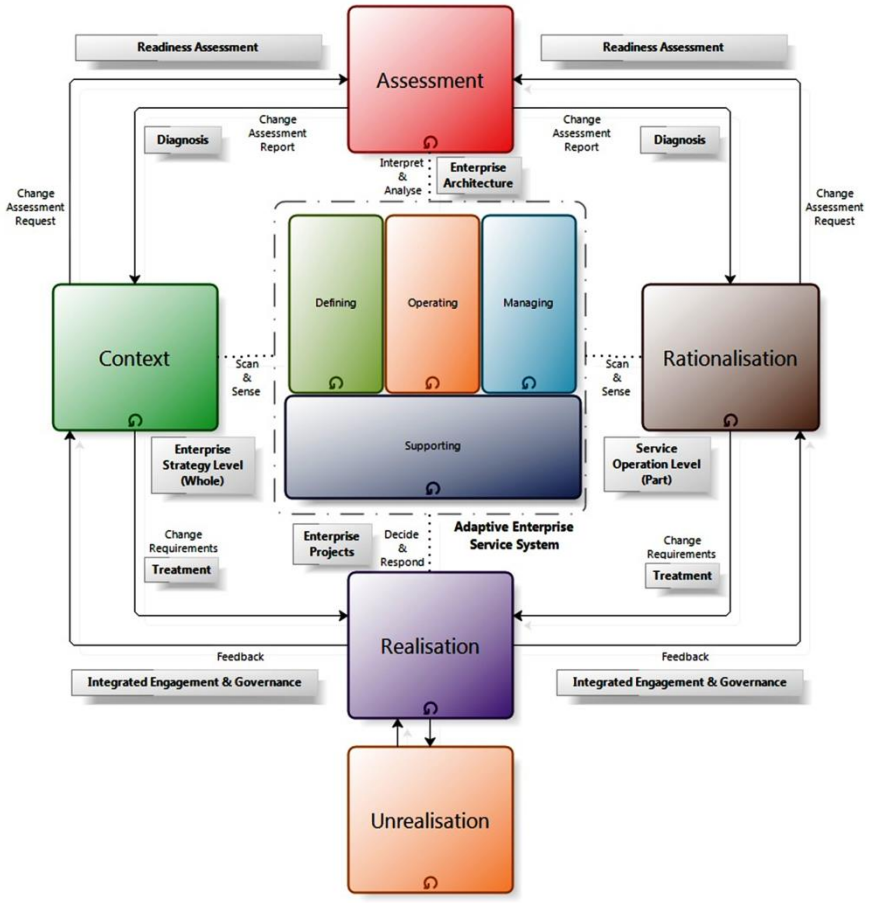

Figure 1. The Adaptive Enterprise Architecture Framework (Adapted from Gill 2013)

The adaptive enterprise architecture framework (a.k.a The Gill Framework) is not another prescriptive enterprise architecture framework. It is a meta-framework that can be used to support the tailoring of a situation-specific adaptive enterprise architecture capability or framework (Gill 2013). The adaptive enterprise architecture framework (see Figure 1) builds on the extensive multi-disciplinary action-design research in the well-known enterprise requirements, strategy, architecture, service, and project management disciplines (Gill 2013). This framework provides a support for developing and managing adaptive or agile enterprise architecture in a modern context including adaptive cloud technology-enabled enterprise architecture. This framework has its foundation on the new "adaptive enterprise service system" theory (Gill 2013). The adaptive enterprise service system theory extends the system of systems (Maier 1998), agility (Qumer and Henderson-Sellers 2008), and service science (Spohrer and Kwan 2009) approaches for defining, operating, managing, supporting and adapting a modern enterprise as an "adaptive enterprise service system". This framework has two main layers: (see Figure 1) outer layer and inner layer. The outer layer presents the five adapting capabilities (e.g. context awareness, assessment, rationalisation, realisation, and un-realisation) to guide the continuous adaptation of the adaptive enterprise architecture as an adaptive enterprise service system in response to internal and external changes. The inner layer assists in defining, operating, managing, and supporting the complex enterprise as an adaptive enterprise service system in response to changes or requirements reported by the outer layer.

5 AUSTRALIAN GOVERNMENT CLOUD ADOPTION CASE

The service-focused adaptive enterprise architecture framework seems appropriate for developing and implementing the service-focused Australian government cloud technology-enabled adaptive enterprise architecture. It provides an adaptive enterprise service system architecture driven approach that can be

used to define, operate, manage, support and adapt the Australian government cloud technology-enabled environment. It is divided into two layers: outer layer and inner layer.

5.1 Outer Layer

The outer layer presents the five enterprise architecture adaptation capabilities that can be used to guide the continuous adaptation of the government cloud environment: context, rationalisation, assessment, realisation and unrealisation (as noted in Figure 1)

5.1.1 Context awareness

It deals with the continuous scanning and sensing of the cloud service adoption opportunities for improvement or changes at the whole-of-a-government or enterprise level (horizontal). The context, in the outer layer, allows iteratively understanding and analysing the contextual information related to cloud technology-enabled government enterprise operating environment.

5.1.2 Rationalisation

It deals with the continuous scanning and sensing opportunities for improvement or changes at the individual government capability or service level (vertical). It involves analysing and identifying services (as per government cloud adaption strategy) that can be supported through cloud technology (e.g. software as a service (SaaS), infrastructure as a service (IaaS).

5.1.3 Assessment

It uses the adaptive enterprise architecture (e.g. cloud-enabled adaptive enterprise service system architecture) as a lens; and it interprets and analyses cloud adoption or change opportunities identified both at the context and rationalisation stages. Assessment focuses on the assessment of information presented in the context model in order to identify the current opportunities and government enterprise readiness for adopting the specific cloud services. Here, at this stage, one may choose to proceed with the adoption or de-adoption of cloud services based on their cloud readiness assessment results.

5.1.4 Realisation

It is about making decisions and taking action to actually realise the change recommendations in terms of specific cloud service adoption. It provides cloud adoption roadmap, integrated engagement, governance and cloud project portfolio support to assist with the overall management (e.g. cloud piloting, full scale cloud deployment) of the ongoing complex adoption and improvement of a government cloud environment (both from technological and economic perspectives). It includes actions related to consolidation of local and legacy government IT systems and their integration with the cloud environment.

5.1.5 Unrealisation

It refers to a situation when a cloud adoption opportunity is not realised and is deferred. It requires capturing cloud adoption opportunities that are not relevant at current stage, however, they could be reconsidered in future. It is important to capture why a cloud adoption opportunity is not relevant or realised.

5.2 Inner Layer

The inner layer of the framework (see Figure 1) is connected to the outer layer and presents a whole-of-a-government architecture as a living system of service systems (e.g. holistic view of the government organisations, agencies, units), which is called the adaptive enterprise service system architecture. The

adaptive enterprise service system architecture has four elements: defining, operating, managing and supporting.

5.2.1 Defining

This capability is required for first establishing the adaptive enterprise architecture capability of a government enterprise. This will require the selection and integration of industry best architecture practices, roles, tools and cloud reference architecture for establishing the situation-specific cloud technology-enabled adaptive enterprise architecture capability. It includes understanding the boundary and scope of government cloud architecture before commissioning any cloud architecture development and implementation work.

5.2.2 Operating

This capability (see Figure 2) is required to actually operate the adaptive enterprise architecture capability for developing and implementing the cloud-enabled adaptive enterprise architecture to realise the Australian government cloud strategy. It includes defining the cloud-enabled interaction, factory and facility architectures. Interaction architecture defines the complex dynamic interactions between internally and externally sourced cloud service systems. Factory architecture includes developing human focused business, information and social architectures; and IT (cloud) focused application (SaaS), platform (PaaS) and infrastructure (IaaS) architectures. It is operated as a trusted cloud service system factory that would have the capability to seamlessly mash-up and integrate the in-house built and externally sourced human and IT services (reusable and non-reusable) from different cloud partners and collaborators to develop the cloud service system solution architecture. Cloud service system factory approach to government cloud is important as it draws attention to the re-usability and service supply chain that includes sourcing of services to support the Australian whole-of-a-government cloud adoption strategy.

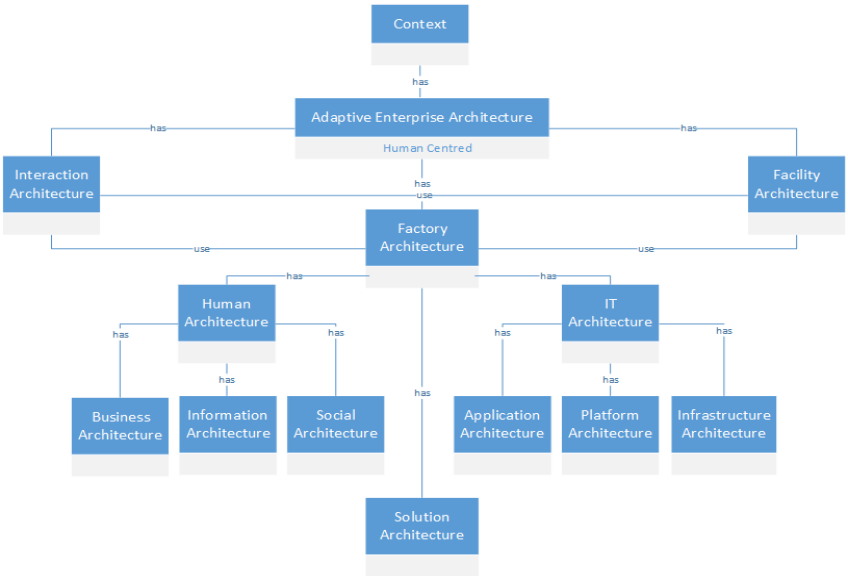

Figure 2. Operating Capability

5.2.3 Managing

This capability integrates the core management disciplines such as enterprise cloud requirements, strategy, architecture, and project and service management for managing the whole-of-a-government cloud adoption environment. Enterprise cloud requirements management is required to iteratively define the requirements for cloud services. Enterprise cloud strategy is required to inclemently provide and

adjust the overall strategic direction and initiatives (e.g. what and when government capabilities and services will be deployed in the cloud?). Enterprise cloud architecture management capability is required to develop and manage the cloud-enabled current, transition and future adaptive enterprise architecture. It is linked to up-stream enterprise cloud strategy and bottom-stream enterprise project and service management capabilities. Enterprise project management includes enterprise cloud portfolio, programs, projects and iterations. It is required to iteratively implement the cloud-enabled adaptive enterprise architecture. Enterprise cloud service management is required to provide the ongoing operation support once the cloud services are deployed in production environment by the enterprise cloud project management capability.

5.2.4 Supporting

Finally, Supporting capability is required to augment core management disciplines through cloud service supply chain, intelligence, asset library and method engineering. Outer and inner layers of the adaptive enterprise architecture framework provide an agile and integrated holistic service systems approach to deal with the complex government-as-a-whole cloud adoption strategy.

6 DISCUSSION

This paper proposed the use of an adaptive enterprise architecture driven approach to support the cloud adoption. It is critical that cloud adoption activities require a strategic approach as opposed to an individual project, agency and operational approach. Government enterprises need to first develop cloud strategy and roadmap at the enterprise level and then should use an adaptive enterprise architecture driven approach to realise the cloud strategy and roadmap. The architecture of the cloud environment needs to be first developed before actually implementing the cloud through the iteration execution of a cloud portfolio, which may include a number of cloud programmes, projects and iterations. In this paper, we argue that the government cloud adoption strategies can be realised by using an agile or adaptive enterprise architecture approach. The enterprise architecture is a strategic discipline that was first introduced by Zachman (1987) in the IBM Systems Journal. The Zachman framework is mainly known as the enterprise ontology. The enterprise architecture domain was further developed and The Open Group introduced a comprehensive framework in 1995, which is called The Open Group Architecture Framework (TOGAF). TOGAF provides a generic architecture method for developing different domain and organisation specific architectures. The TOGAF is criticized for its size, lack of agility and complexity. It needs to be agile and tailored to suit the local needs of an organisation. The adaptive enterprise architecture framework (Gill 2013) was first originated in 2006 in the context of agile system development and was then further developed to support the establishment of an agile or adaptive enterprise architecture capability. An adaptive enterprise architecture capability can be used to develop and implement the cloud-enabled adaptive enterprise architecture for cloud technology-enabled enterprise transformation. The adaptive enterprise architecture framework is not another architecture framework. It is a meta-framework that can be sued to combine best practices from different architecture frameworks for tailoring a government enterprise situation-specific architecture framework. It does not only provide the support for architecture framework tailoring but it also provides the mechanisms to continuously develop, implement, operate and adapt the adaptive enterprise architecture and related capabilities to meet the changing needs of an agile enterprise.

7 CONCLUSION

Cloud technology is fundamentally changing the way IT services are developed, sourced, deployed and managed in government enterprises. This paper highlighted that cloud technology adoption requires a holistic and strategic approach rather than looking at the individual local isolated cloud adoption at individual agency or department level. This paper demonstrated how to use an adaptive enterprise architecture driven approach as a lens to handle the complex case of the cloud technology-enabled Australian government enterprise transformation. The adaptive architecture approach discussed in this

paper offers an adaptive enterprise service system theory-based practical solution oriented comprehensive framework for the large scale adoption of cloud technology in Australian government. The benefit of using the adaptive enterprise architecture approach is that it provides a service oriented, holistic and systematic top-down strategic approach to continuous alignment and realisation in the context of incremental cloud adoption. One of the perceived disadvantages of using the adaptive enterprise architecture driven approach is that it requires government-wide integrated engagement and governance, which may be perceived as an overhead by the government agencies. In future, we intend to further extend our research and present the hybrid cloud architecture in the context of cloud and legacy government systems' integration.

REFERENCES

Aldrich, J., Bertot, J. C., and McClure, C. R. (2002). E-government: initiatives, developments, and issues. *Government Information Quarterly*, 19, pp.349−355.

Australian Government. (2011). Cloud Computing Strategic Direction Paper Version 1.1. Available: http://www.finance.gov.au/files/2013/04/final-_cloud_computing_strategy_version_1.1.pdf

Babar, M. A. (2013). Perspectives and reflections on cloud computing and internet technologies from NordiCloud 2012. *Proceedings of the Second Nordic Symposium on Cloud Computing, Internet Technologies*. Norway, ACM.

Bakshi, K. (2011). Considerations for cloud data centers: Framework, architecture and adoption. *IEEE Aerospace Conference*, IEEE Computer Society.

CIO Council. (2001). *A Practical Guide to Federal Enterprise Architecture*. Feb 2001.

Datacenter Dynamics. (2011). Global Industry Census. Market Growth. Available: http://www.datacenterdynamics.com/research/market-growth-2011-2012.

Denzin N.K., and Lincoln, Y.S. (2000). *Handbook of Qualitative Research*. London: Sage Publications.

Gill, A.Q. (2013). Towards the Development of an Adaptive Enterprise Service System Model, *ACMIS 2013 Proceedings*, Chicago, USA.

Gill, A.Q. and Bunker, D. (2012). Crowd Sourcing Challenges Assessment Index for Disaster Management" (July 29, 2012). *AMCIS 2012 Proceedings*, Seattle, USA.

Gill, A.Q. and Livingstone, R. (2012). Demanding times. *CIO*, Mar/Apr 2012.

Gill, A.Q. and Bunker, D. (2011). Conceptualization of a Context Aware Cloud Adaptation (CACA) Framework. *2011 IEEE Ninth International Conference on Dependable, Autonomic and Secure Computing (DASC)*, Sydney, Australia.

Gill, A.Q., Bunker, D., and Seltsikas, P. (2011). An Empirical Analysis of Cloud, Mobile, Social and Green Computing: Financial Services IT Strategy and Enterprise Architecture. *IEEE Ninth International Conference on Dependable, Autonomic and Secure Computing (DASC)*, Sydney, Australia.

Gov.UK. (2013). Government Adopts 'Cloud First' Policy for Public Sector IT. Cabinet Office, UK. Available at: https://www.gov.uk/government/news/government-adopts-cloud-first-policy-for-public-sector-it

Hajjat, M., Sun, X., Sung, Y.E., Maltz, D.A., Rao, S., Sripanidkulchai, K., and Tawarmalani, M. (2010). Cloudward bound: planning for beneficial migration of enterprise applications to the cloud. *Proceedings of the ACM SIGCOMM 2010 conference*, India.

Harrison, R. (2011). *TOGAF Foundation*. The Open Group.

Himmelsbach, V. (2010). Canada Clears up its Cloud Strategy. ITWorldCanada.com, Available at: http://www.networkworld.com/news/2010/021610-canada-clears-up-its-cloud.html?page=1.

IDC. (2013). Inaugural IDC Government Insights Report Examines Federal Government Spending on Cloud Based Solutions. Available at: http://www.idc.com/getdoc.jsp?containerId=prUS24218513.

ISO/IEC 42010 (2007). Defining architecture. Available: http://www.iso-architecture.org/ieee-1471/defining-architecture.html

Kundra, V. (2011). Federal Cloud Computing Strategy. Available at: http://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/federal-cloud-computing-strategy.pdf

Layne, K. and Lee, J. (2001). Developing fully functional E-government: A four stage model. *Government Information Quarterly*, 18(2), pp.122 – 136.

Maier, M.W. (1998). Architecting Principles for System of Systems. *Systems Engineering*, 1(4), pp.267-284. http://www.infoed.com/Open/PAPERS/systems.htm. Retrieved 2012-12-13.

Marshall, R. (2012). Government Launches G-Cloud Store with 257 Cloud Computing Suppliers. Available at: http://www.v3.co.uk/v3-uk/news/2153551/government-launches-cloud-store-257-cloud-computing-suppliers

Mell, P. and Grance, T. (2009). The NIST definition of cloud computing. Available: http://www.nist.gov/itl/cloud/upload/cloud-def-v15.pdf

Mulholland, A. (2010). *Enterprise cloud computing. A strategy guide for business and technology leaders.* Meghan-Kiffer Press. USA.

Perepa, S. (2013). Why the U.S. Government is Moving to Cloud Computing. Wired Innovation Insights, available: http://wirednext.ning.com/xn/detail/6544125:BlogPost:58430#axzz318naDO60.

Qumer, A. and Henderson-Sellers, B. (2008). An Evaluation of the Degree of Agility in Six Agile Methods and its Applicability for Method Engineering. *Journal of Information and Software Technology (IST)*, 50(4), pp.280-295.

Ross, J.W., Weill, P., and Robertson, D.C. (2006). *Enterprise Architecture As Strategy: Creating a Foundation for Business Execution.* Harvard Business Review Press, pages 256.

Schelin, S. H. (2003). *E-Government: An overview*. In G. David Garson (Ed.), Public information technology: Policy and management issues. Hershey, PA: Idea Group Publishing, pp. 120−137.

Shroff, G. (2010). *Enterprise cloud computing: technology, application and architecture*. Cambridge Press.

Simon, H. A. (1976). *Administrative behavior* (3rd ed.). New York, NY: The Free Press.

Smith, S. Gill, A.Q., Hasan, H., and Ghobadi, S. (2013). An Enterprise Architecture Driven Approach to Virtualisation, *PACIS 2013*.

Spohrer, J. & Kwan, S. K. (2009). Service Science, Management, Engineering, and Design (SSMED): An Emerging Discipline - Outline & References. *International Journal of Information Systems in the Service Sector*, 1(3).

Sun, Z., Shen, J., and Beydoun, G. (2011). P2CP: A New Cloud Storage Model to Enhance Performance of Cloud Services. *International Conference on Resource Management (CF-IRM2011)*, South Korea.

Zachman, J.A. (1987). A framework for information systems architecture. *IBM Systems Journal*, 26, p.276-292.

Zhang, S. Chen, X. Zhang, S. and X. Huo, X. (2010). Cloud computing research and development trend. *Second International Conference on Future Networks*.

Zuboff, S. (1988). *In the age of the smart machine: The future of work and power*. New York: Basic Books.