Information Systems Frontiers (2020) 22:365–380
https://doi.org/10.1007/s10796-019-09918-w

Smart Institutional Intervention in the Adoption of Digital Infrastructure: The Case of Government Cloud Computing in Oman

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Published online: 26 April 2019
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Abstract
Cloud computing technology presents a case of centralised digital infrastructure that requires adherence to standards and planned approach for its adoption and implementation. There is little knowledge on how institutions could influence the successful migration to the cloud considering the known challenges of adopting technology infrastructure. This research questions: How can institutions positively influence the adoption of cloud computing services? It examines the case of adopting government cloud computing in Sultanate of Oman. It adopts concepts from institutional theory as a theoretical lens to synthesis and explains empirical results. The study shows the practices that exerted institutional forces and the role they play in the successful adoption and migration to cloud services. It reveals that not all institutional forces carry equal weight in their influence, and this depends on the context of adoption. In the case study, we found that both coercive and mimetic forces to be playing prominent roles in pushing the adoption and migration to the cloud forward easing potential resistance from normative forces. We conceptualise this as a smart intervention that took the context of adoption seriously into consideration and was tailored accordingly. Implications for research and practice are discussed.

Keywords Digital infrastructure · Cloud computing · Cloud adoption · Institutional theory · Isomorphic mechanisms

1 Introduction

Cloud Computing (CC) presents a new model of sourcing computing capabilities. It refers to a class of digital infrastructure where computing capabilities are offered as a service to organizations to utilize over the Internet on a pay per consumption model (Armbrust et al. 2010; Mell and Grance 2011b; Wang et al. 2016). It provides a unique hosting of information technology (IT) services outside organisational boundaries and offers standard uniform services for the entire organisation. The adoption of cloud computing services is rising as organisations seek ways to acquire IT resources faster, cheaper and with a shorter acquisition and implementation time (Gratner 2014; Meulen 2017).

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The adoption of cloud computing is rapidly growing, and its organisational spend continues to soar (Wilczek 2018). Many governments see cloud computing as a solution to the complex problems of developing large IT infrastructure (Gratner 2014). Interestingly, reports show that governments interest and spend on cloud computing is similar to other types of organisations and industries. For example, a Gartner's recent survey shows that companies spend on average 20.4% of their IT budgets on cloud computing while local governments spend 20.6% and national governments spend 22% of their IT budgets on cloud computing (Meulen 2017). With this high level of spending, it is important to understand how governments adopt and migrate to the cloud and how different institutional interventions could be devised to improve the chances of success.

Moreover, the digital infrastructure model of cloud computing is challenging the existing accumulated knowledge acquired from studying previous generations of infrastructure known as information Infrastructure or information systems (IS) infrastructure. Indeed, the adoption of the standard uniform technology of cloud computing (CC) together with its utility consumption model contrasts the accumulated knowledge on IS infrastructure adoption for the following reasons: 1) IS infrastructure research typically emphasises local adaptations and cultivations that take place when adopting large infrastructure (Hanseth and Monteiro

1997; Hanseth et al. 1996; Hanseth and Lyytinen 2010) and showed that they lead –in many cases- to fragmentation and lack of standardised infrastructure. 2) IS infrastructure research highlights the importance of bottom-up governance and design and argued for their criticality to IS infrastructure development (Hanseth and Lyytinen 2010; Sahay et al. 2009). Since CC constitutes a standardized solution to be shared with many other organisations and largely managed by its vendor(s), it is unlikely that single departments or organisations can fundamentally influence its design as IS infrastructure research suggests. This puts more weight on organisations to centrally manage the adoption and migration of its IT to CC services. While IS infrastructure research has produced important insight on the situated and heterogeneous nature of technology adoption and implementation, it has rarely considered how similarities and standardisation could be achieved despite the theoretical and practical importance of understanding this (Monteiro and Rolland 2012).

Hence, unlike the accumulated knowledge on IS infrastructure, cloud computing presents a class of digital infrastructure where the role of institutions and the possibilities of institutional interventions cannot be underplayed in the adoption and migration to CC services. Recently, IS infrastructure scholars recognised the gap in understanding institutional intervention and urged researchers to examine "what scope exists for proactive Information Infrastructure interventions" (Monteiro et al. 2014, p. vii). Scholars also highlighted that digital infrastructure, while a class of IS infrastructure, brings about "new dynamics …[that] necessitates …paying attention" to it and putting it at the centre of the IS research agenda (Tilson et al. 2010b). This research responds to these calls. It aims to understand the practices of institutional interventions that could influence government's adoption of cloud computing services. It specifically answers the question of: How can institutions positively influence the adoption of cloud computing services? To answer the research question, the study examines the adoption of cloud computing services in the government of Sultanate Oman. The study adopts an institutional perspective which provides a consistent conceptual for considering the role of context and institutions in systems adoption and implementation (Avgerou 2000; Currie and Guah 2007).

The findings reveal the institutional practices that influenced cloud adoption by government agencies. We conceptualise this as a 'smart intervention' where the context of adoption was taken seriously and allowed to shape the institutional intervention and adoption approach. Surprisingly, this smart intervention reveals that not all institutional forces are equal in their weight and importance. In the context of our study, the coercive and mimetic forces played more prominent roles in moving this large-scale government adoption forward towards a successful migration. The coercive forces provided incentives, rules and structure for the adoption which made it difficult for government agencies to decline participation. The mimetic forces played a propelling role that enabled government agencies to find and accept solutions and hence pushed the migration forward. The normative forces played a secondary role in easing resistance, but primary encouraged finding solutions to potential obstacles.

The study contributes to theory and practice in the following ways. Regarding theory, the research contributes to the understanding of cloud computing as a new class of infrastructure technology that requires centralisation and standardisation of services. The study adopts a macro view to provide an understanding of the institutional practices involved in encouraging the adoption of cloud services. It highlights the importance of considering the institutional context when orchestrating the institutional intervention that facilitates CC adoption. In doing so, the study responds to scholarly calls for moving IS infrastructure research beyond its current focus on micro practices (Iannacci 2010) and highlighting differences rather than similarities (Monteiro and Rolland 2012).

The study also contributes to institutional theory by showing that institutional forces do not necessarily hold equal weight in practice. This understanding of the institutional forces shows that institutional intervention has to take context into consideration. Regarding its contribution to practice, this research provides insights into the fostering conditions for successful adoption of cloud computing. It invites practitioners to devise smart interventions for cloud computing adoption that facilitate the acceptance of its centralised implementation and standards.

Following the introduction, the paper proceeds as follows. The second section presents a brief literature review of CC and IS infrastructure implementation in government. The third section presents the theoretical foundation of the research and the fourth section describes the research methods and introduces the case study. The fifth section offers an analysis of the case study and the last section provides further discussion and presents the research's conclusion and contribution.

2 Literature Review

This section consists of two parts. The first part presents a brief literature review of current CC research. The second part discusses the current knowledge in government technology adoption and in particular, IS Infrastructure.

2.1 Cloud Computing

Cloud computing could be defined 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" (NIST 2009). There are three types of services offered through CC. These types are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service

(IaaS) (Armbrust 2010; Creeger 2009; Durkee 2010b). Software as a Service (SaaS) refers to business systems that are delivered as a service using the Internet (Armbrust et al. 2010). Platform as a Service (PaaS) means that the users have a cloud environment in which they can develop their own applications and use software that they have developed (Armbrust et al. 2010). Infrastructure as a Service (IaaS) refers to the client simply leases the infrastructure that is needed for the application or business continuity requirements (Armbrust et al. 2010). IaaS usually offers the operating system on a server or servers including a specific computing power and storage capacity, while providing some control over the network such as choice of firewall and denial of service protection measures (Durkee 2010b). Once IaaS is stable and operating, PaaS and SaaS services can function better. Moreover, cloud computing could be categorised according to its ownership to three main types: public, private and hybrid. Public cloud customers have no control or view of the infrastructure and where it is hosted. Vendors facilitate sharing the computing infrastructure between their clients in different organisations to provide the service in a cost-efficient way. The private cloud works best for organisations who are concerned about the security of their data and who do not wish to share their data with other organisations. An organisation can own it itself or lease it from a vendor to serve only that organisation; the service covers the private network and the organisation's firewall. Two types of the private cloud can be identified: an on-premises cloud hosted internally within an organisation, and an off-premises cloud hosted outside the organisation but for its sole use (Petkovic 2010). Hybrid cloud is a combination of private and public clouds, where an organisation can host selected applications and services in the public cloud and keep other services in a private cloud. Governments cloud or G-Cloud is a private cloud owned by, government agencies and hosted either internally or externally depending on capabilities and the intended investment in IT infrastructure. Many countries have launched G-Cloud initiatives, including the UK and the US.

Cloud computing research could be classified based on research concern into four categories; technological issues, conceptualising CC, business issues and domains and applications (Senyo et al. 2018; Yang and Tate 2012). The majority of studies on CC focus on the technical aspects particularly in terms of architecture, virtualisation, security, data placement and storage (Chang and Ramachandran 2016; Goode et al. 2015; Güner and Sneiders 2014; Jouini and Rabai 2019; Mahmood et al. 2014; Oliveira et al. 2014; Sabi et al. 2016; Yuan et al. 2010, 2011). Studies that conceptualise CC are mainly definitional aims at providing general views in this area and descriptive account of features, benefits and obstacles (Armbrust et al. 2010). Research also describes the type of services, offerings and the business benefits of the cloud (Buyya et al. 2010; Creeger 2009; Youseff et al. 2008). Research on business issues describe the business values of CC from the vendor's perspective (Bhat 2013; Hoberg et al. 2012) and from the client's perspective whether organisations or individuals (Hoberg et al. 2012; Leimeister et al. 2010; Marston et al. 2011). It also examines privacy (Katzan 2010), risk (Svantesson and Clarke 2010), and security from regulation, market and policies point of view (Durkee 2010a; Schneider and Sunyaev 2014; Senarathna et al. 2016). Studies also examined determinants of CC adoption (Gangwar et al. 2015; Lee 2019; Sabi et al. 2018), adoption decision (Ray 2016), factors affecting intention to adopt and motivation of adoption (Sharma et al. 2016) and organisational readiness to adopt (Kauffman et al. 2018).

Studies that specifically focused on CC adoption has largely adopted a positivist approach producing lists of factors that affect its adoption including relative advantage, complexity, top management support, firm size, competitive pressure among others (Low et al. 2011; Oliveira et al. 2014; Senyo et al. 2018). Although this research is valuable in finding different factors that contribute to the success of CC, it falls short of providing detailed views on its adoption in organisations. Recent surveys of CC literature continue to highlight the dearth of case studies in this area of research and the need for more detailed studies that goes beyond positivistic approaches (Senyo et al. 2018; Wang et al. 2016).

2.2 Digital Infrastructure

The term information infrastructure (II) and information systems infrastructure are used interchangeably in the literature. Digital infrastructure is a new class of information systems infrastructure. It is defined as a group of technologies and human elements, networks, systems and process that contribute to the functioning of an information system (Tilson et al. (2010b). Hanseth and Lyytinen (2010) define IS infrastructure as:"a shared, open (and unbounded), heterogeneous and evolving socio-technical system (which we call installed base) consisting of a set of IT capabilities and their user, operations and design communities". IS infrastructure research has been conducted in the IS field from the 1990s with the advent and ubiquitous use of the Internet (Ciborra and Hanseth 1998; Hanseth et al. 1997; Hanseth et al. 1996). However, a recent survey showed that there is a significant need for IS research to focus on contemporary technology infrastructure (Tilson et al. 2010b). It also revealed the need to strengthen the theoretical grounding and understanding of digital infrastructure as a new form of IT (Tilson et al. 2010a).

Besides the conceptualization of IT infrastructure (Monteiro et al. 2014), information infrastructure studies have mainly focused on design (Pipek and Wulf 2009; Star et al. 1996) and standards making (Hanseth et al. 2006, 1997). In this regard, studies examined the tension between the local and global contexts in IT infrastructure design (Braa et al. 2007; Ribes and Finholt 2009; Ure et al. 2009). They also highlighted different tensions in the design of information infrastructure including the tension between standardisation and flexibilities (Hanseth et al.

2006), tension between top-down and bottom up governance (Constantinides and Barrett 2014), tension between local and global standardization (Silsand and Ellingsen 2014; Star and Ruhleder 1996). In addition, this research revealed the emergence of different organisational contradictions in the design and implementation of information infrastructure including what have been named a paradox of control (Nielsen and Aanestad 2006), a paradox of change (Braa et al. 2007) and paradox of bootstrapping (Hanseth and Aanestad 2003).

IS infrastructure research has been dominated by a micro perspective that focusses on the local issues related to the design and development of standards and the diverse use of IS infrastructure (Pipek and Wulf 2009). However valuable and insightful, this micro-level perspective has largely overlooked the important role played by institutions in large-scale projects (Iannacci 2010) and undermined the importance of proactive intervention (Monteiro and Rolland 2012). It has not paid sufficient attention to the practices of institutional interventions including -and not limited to- the deliberate actions that influence the adoption of IS infrastructure in general and digital infrastructure in particular. This is despite scholars' longstanding calls arguing for the inevitable role of institutions (King et al. 1994) and the repetitive invitations urging IS researchers to incorporate an institutional view in their research (Baptista et al. 2010; Currie 2009; Currie and Swanson 2009).

IS infrastructure studies have yet to examine the new generation of digital infrastructure such as cloud computing that requires the migration of IT services to a third party and using it as a service over the Internet.

3 Theoretical Foundation

This study adopts the concepts of institutional forces from institutional theory as a theoretical lens and sensitising device to understand the empirical data. Institutional theory (Meyer 1977; Tolbert and Zucker 1994; Teo et al. 2003; Scott 2008:37) provides a powerful explanation for the role and influence of the external and internal environment on organisations (Liang et al. 2007). According to institutional theory, an institution is defined as 'a social order or pattern that has attained a particular state or property' Jepperson (1991). Institutional theory argues that change in organisations are driven by an inevitable push towards what is known as homogenisation (DiMaggio and Powell 1991). This homogeneity of organisations is known as isomorphism and is argued to be infused by the desire for legitimacy and yielding to institutional forces (DiMaggio and Powell 1983). Isomorphism can be identified as a process that forces one unit in a population to be similar to other units that face the same set of environmental condition (Currie 2012).

DiMaggio and Powell (1983) explain the three types of institutional forces that infuse the homogeneity of organisations; namely coercive, mimetic, and normative forces. *Coercive* forces present "formal and external pressures exerted upon them by other organizations upon which they are dependent, and the cultural expectations in the society within which the organization's function" (DiMaggio and Powell 1983, p. 150). Coercive forces can be collections of rules, policies, procedures or collective agreements where the behaviour of every member of an institution is affected by the decisions of those who shape the institution's structure (Kondra and Hurst 2009). In this regard, government regulations, law and policies are examples of coercive forces. *Mimetic* forces present the tendency of organisations to imitate other organisations perceived to be legitimate. Mimetic forces occurs as a result of organisations attending to uncertainty responding to new problems, unclear goals, poorly understood technology or unclear solutions which invite them to search for a viable solution that has been already implemented or tested by others (DiMaggio and Powell 1983). *Normative* forces arise as a result of 'the collective struggle of members of an occupation to define the conditions and methods of their work, to control the production of future member professionals, and to establish a cognitive base and legitimisation for their occupational autonomy' (DiMaggio and Powell 1983, p. 152). This normative pressure considers particular types of behaviours that define goals and objectives as legitimate and designate appropriate ways to achieve them (Scott 2001). Normative forces significantly influence social actions by imposing constraints on social behaviours. These behaviours take the form of political signposting of what people are routinely expected to do (Scott 2008). Hoffman (1999) finds the three different forces to be interacting with each other rather than being independent (Table 1).

Institutional theory has been widely adopted in organisation studies and management literature (Kostova et al. 2008). It has also been advocated and adopted in information systems (Mignerat and Rivard 2009). IS studies adopted it to examine the adoption of technology on national level(Grimshaw and Miozzo 2006; King et al. 1994), government level (Currie 2012; Gozman and Currie 2014; King et al. 1994; Liang et al. 2007), industry and sector levels (Chiasson and Davidson 2005) or a single organisation (Davidson and Chismar 2007; Gosain 2004). The institutional forces have also been adopted in IS research (Gosain 2004) to examine the adoption of different technologies such as websites (Flanagin 2000), EDI (Teo et al. 2003) and ERP (Benders et al. 2006; Liang et al. 2007). It has also been used to examine supply chain (Lai et al. 2006), outsourcing (Ang and Cummings 1997) and compliance in IT security (Herath and Rao 2009; Hu et al. 2007). Recently, Monteiro et al. (2014)) argue that studying IS Infrastructure from institutional theory perspective "can be a major enhancement to examine what scope exists for proactive Information Infrastructure interventions, policy, and governance—and how these may vary under different Information Infrastructure forms and settings" (Monteiro et al. 2014, p. vii).

Table 1 Institutional isomorphic pressures

Institutional forces	Description
Coercive force	The result of both formal and informal pressure posed by one organisation on the other organisation upon which they are dependent and by cultural expectations in the society within which organisations function (DiMaggio and Powell 1983)
Normative force	the normal social action that considers particular types of processes or behaviours as legitimate (Scott 2001)
Mimetic force	Occur when new organisation technologies are poorly understood and when goals are not clear, and their environment creates uncertainty; the organisation then tend to model themselves on other organisations (DiMaggio and Powell 1983)

4 Research Methodology

4.1 Research Setting

The case study explores the national government cloud computing project in Oman (Oman G-Cloud). Sultanate of Oman is a country located in the Arabian Peninsula bordered by the United Arab Emirates, Saudi Arabia, and Yemen. Oman is part of the Gulf Cooperation Council (GCC) which also includes the following countries; Saudi Arabia, UAE, Qatar, Bahrain, and Kuwait (GCC 2015). GCC countries are unique in their stage of development. The United Nations Development Programme in Human Development Index considered GCC countries in 2015 as "very highly ranked" in human development placed right below-developed countries and well above other developing countries, and Oman is ranked 52nd in this index (UNDP 2015). Also, GCC countries share similar cultural, economic, social and political characters which can be different from other developing countries. GCC countries enjoy high income per capita and are not recipient of official development assistance but known as givers of such assistance (ODA).[1] This unique status of GCC countries allows them to be studied as a category in itself that sits in between developing and developed countries. Regarding Oman, the country is moving rapidly in international development indexes. For example, the last United Nation's E-government Survey in 2014 ranked Oman 48th in the E-government development index increasing 18 ranks from the 2010 survey.

Oman government cloud (G-Cloud) was initiated as part of the e-government vision that was launched in 2014. The G-Cloud project intended to provide services to the government agencies in Oman and to set up shared infrastructure including servers, network, storages and applications to all government agencies to meet all their IT infrastructure requirements. The rationale for the project was that having G-Cloud in place, government agencies can focus on their core business, reducing the IT budget, increasing their agility and providing the public e-Services at higher efficiency (ITA 2015). The project was owned by the Information Technology Authority of Oman (ITA), which is responsible for implementing national IT infrastructure projects (ITA 2018). ITA has decided to adopt the private cloud model in all government agencies to achieve its e-government objectives and integration. ITA. The private cloud is a model where the cloud infrastructure is operated exclusively for an organization. This model can be managed by the organization or a third party, and it can be within the organization premises or outside (Mell and Grance 2011a). With this model, the ITA has decided to build a government cloud using Open Source (OpenStack). This strategic decision to use open source was made in order to avoid the lock-in challenges of the off-the-shelf packages along with many other typical benefits of open source. On December 19, 2013, ITA signed an agreement with a provider; an international software development company, for the supply, design, delivery, implementation and operation of the G-Cloud for three years. During the time of data collection for this research, there were several projects to host different government services on the G-Cloud. One of these projects was the Ministry of Health (MoH) e-portal (MoH e-portal) which is the focus of this paper.

4.2 Research Methods

This study adopts a case study approach to gain a rich understanding of the phenomenon in its natural setting (Myers 1997; Walsham 1995). This approach is well suited to the research questions that require a detailed understanding of institutional influences. It follows a qualitative interpretive approach in order to gain rich insight and in-depth exploration of the phenomena (Myers 2010). It views people as social actors capable of creating and interpreting their own independent and inter-dependent meanings as they interact with the world around them (Orlikowski and Baroudi 1991; Saunders et al. 2007). The use of theory in this research offers a sensitising device to make sense of the collected data (Gregor 2006; Miles and Huberman 1994; Walsham 1995).

The level of analysis adopted in this research is the national level. The research reported here is part of a wider project to examine the implementation of government cloud in Sultanate of Oman. It focuses on the national project of CC led by the Information Technology Authority of Oman (ITA) and adopted by the Ministry of Health. This type of case study is

[1] For a list of ODA recipients see: https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/DAC_List_ODA_Recipients2018to2020_flows_En.pdf

considered as an embedded case study which has *multiple units of analysis* in a single case (Yin 2014).

Multiple sources of data collection were employed including face-to-face interviews, documents review, participation in chat groups and websites reviews. Thirty face-to-face interviews were conducted with senior managers, middle managers, technical staff and vendors both in Information Technology Authority of Oman (ITA) and the Ministry of Health (MoH). Interviews were conducted in the period between 29/07/2015 and 27/12/2015. All interviews were recorded and transcribed verbatim. Interviews lasted between 40 min and two hours with an average of one hour. Interviewees from management and technical levels were selected based on their involvement in the G-Cloud programme. Documents were also reviewed including government reports, vendors' reports and presentation slides, websites in addition to technical manuals and reports. The first author has also participated in a private, by invitation only, chat groups on WhatsApp (the online chat application) of professionals working on the project. This group discussed IS and government issues freely and anonymously in some cases, which presented an excellent opportunity for the researcher to observe these conversations. It was also an opportunity to ask questions and get feedback from many professionals. Data collection continued until saturation was reached and no further information was emerging from data sources (Marshall et al. 2013; Fossey et al. 2002; Saunders et al. 2007).

The data analysis processes were divided into two main stages: first cycle coding and second cycle coding (Miles et al. 2013). The first cycle involved reading all transcriptions and documents carefully and subject them to open coding. There are many approaches of first cycle coding and one of them is using NVivo to discover recurring themes which we used (Miles et al. 2013). The benefits of using research computer-based software for qualitative data analysis has been well discussed (Creswell 2009; Easterby-Smith et al. 2008b; Miles and Huberman 1994). A number of qualitative researchers advocate the use of software packages such as NVivo and Atlas/ti to help in developing consistent and transparent qualitative data analysis (Myers 2009; Robson 2002; Weitzman 2000). Flick (2008) recognised three main advantages of using computer software for analysing qualitative data. These benefits are that it takes less time than manual processes, it gives a consistency to the analytical processes that improves the validity of the research, and it improves data representation (Flick 2008).

Several codes emerged during the first cycle, which were grouped into categories and themes. When the theme of intervention emerged, the authors started reading on different strands of institutional theory. Institutional forces resonated well with the data. Hence, in the second cycle of coding, thematic analysis and coding were informed by the institutional forces derived from institutional theory (DiMaggio and Powell 1991). However, data was not forced into the three categories of institutional forces as the researchers continued to scrutinize data and attempt to create new categories. This effort has resulted in the observation that the coercive and mimetic forces were much more prominent in the data than normative forces reflecting that they had a stronger influence in the adoption of CC.

5 Research Findings

The findings show that the G-Cloud at MoH has faced different institutional forces. These institutional forces have pushed its adoption forward in the MoH. The following sections present the different institutional forces that influenced the adoption of cloud computing in the Ministry of Health (MoH).

5.1 Coercive Institutional Forces

The ITA followed different ways to embed the G-Cloud standards in government agencies and encourage them to migrate to the cloud and adopt these standards. They were keen to avoid pitfalls of other projects and ensure uniformity of the G-Cloud adoption and integrity of its standards. A senior manager in ITA summarised this view saying:

> Yes, the enforcement is coming from us, and we will not allow it unless we are making sure these controls are followed. But in the past because of these services are hosted on their premises or some service providers, we were not able to impose that. Many of them may not even follow these policies. So it will allow for us better enforcement ITA12

MoH has been subjected to different practices that exerted coercive pressure on it to adopt the G-Cloud. These practices are categorized as political power, centralized policies, financial resources, rules and regulations, compliance and standardizations. The political power of ITA made it possible for it to give priorities to projects that are consistent with the G-Cloud. One of the senior managers at the ITA explains:

> We are giving priorities to the e-transformation projects, many of the e-transformation projects are under development or on planning phase, so it makes it easy for the organizations and for ITA to build their application on the G-Cloud-enabled environment from the start.

In addition, ITA was mandated by the cabinet's office to achieve e-government, which granted it further power over government agencies and ministries including the MoH. Moreover, the ITA senior executives had a good relationship with the MoH senior managers. This helped the adoption of

G-Cloud as decisions made at ITA were taken for granted at the MoH executive level. Together, the political power of ITA and the established relationship with senior management of the MoH have influenced the decision of the MoH to join the G-Cloud. They also pushed the MoH staff to accept this decision as taken for granted fact. One of the IT management team in MoH states that:

> The decision was made by a senior manager in Ministry of Health and a senior manager in ITA to join the G-Cloud and the G-Cloud team in ITA, and the member of the evaluation team in e-tender have evaluated which company who will do the implementation of e-health portal along with hosting it in the G-Cloud.

The financial incentives that ITA offered have also played an important role in making MoH migration to the G-Cloud favourable. ITA has suggested to the MoH to the join the G-Cloud amidst the latter involvement in tendering and contractual arrangement with the supplier of the e-health portal and was practically difficult for MoH to switch path at that time. However, the financial incentives ITA offered the MoH made joining the G-Cloud a cheaper option for them which gave the MoH the necessary reason to change its contractual and tendering arrangement. An MoH IT manager explained:

> Joining the G-Cloud was mainly to save cost on the hardware. It was the time we were finalising the tender, and then the ITA was offering this solution, and it was offered for free; a deal that cannot be rejected MOH02

Also, a senior IT manager at the MoH stated:

> Well, when we had distributed the tender of e-Health project, the G-Cloud was not in the picture at all. After that, we knew that the ITA started to build the G-Cloud. We again asked the vendors to provide us with the financial cost if we move to the G-Cloud and how much it will cost us. We found out that the G-Cloud is much better financially MOH01.

The G-Cloud offered centralised services. Accepting to join the G-Cloud meant that the MoH digital infrastructure would be managed and controlled by a professional government agency. The view that this central service will have the human resources capable of managing different layers of digital infrastructure such as network and security and will be hence responsible for these aspects were positively seen as the MoH from any responsibility in this regard. One of the ITA's Project managers asserted this view saying:

> If I am in the G-Cloud, I am free of my responsibility... It will be the responsibility of the G-Cloud team to set the G-Cloud environment for the ministry; then the vendor was given access. So for me, as a Ministry, I do not have to worry about it. In a second scenario, which is hosting in the Ministry, I have to deploy a Ministry IT team, which I think does not have the capabilities to do that. So, we are also freeing the MOH from HR [expertise] requirements ITA07.

In addition, MoH has set up clear rules for agencies regarding where to host the applications and have provided series of talks to convince agencies of the importance of following these rules. An IT manager of the MoH explained:

> I think there are instructions from the ITA that any portal has to be hosted inside Oman, not outside the country. It has to be hosted in the G-Cloud, or it must be hosted internally. I consider it to be dangerous if it is not hosted internally inside Oman. I cannot imagine seeing my data to be managed or hosted by a cloud company outside Oman or by a private corporation. So it is fine as it is now, hosted by the ITA G-Cloud, as they have secured MPLS MOH04.

The MOH has also created centralised policy to control the content of their portal once moved to the cloud. It is worth noting that their previous website was static and fragmented. The MoH used to have a separate website for each of its many organisations, hospitals and departments where each had their own website design and content. A senior Manager in MoH elaborated on this by saying:

> Before I came into this place, we used to have a separate website of each organisation. As you know, the Ministry of Health is a wide organisation and has many hospitals and entities, and each of them had their website. They gave the wrong information and wrong statistics for each site. So we brought all of them together, and we called the portal like a house, and we are building for each department and each hospital their windows. So all the information we managed should come under one umbrella, and that is the concept we used as we do not allow any department or directorate to operate new website. We want them to be under one umbrella. MOH01

As the implementation stage progressed, the ITA team started introducing more standards to be applied to the e-Health portal. Some of these had been clearly communicated to the MoH team through different means—such as documents—while others, such as *security standards*, were introduced later. Figs. 1 and 2 summarizes the organisational practices that exerted coercive forces to adopt and migrate to the cloud.

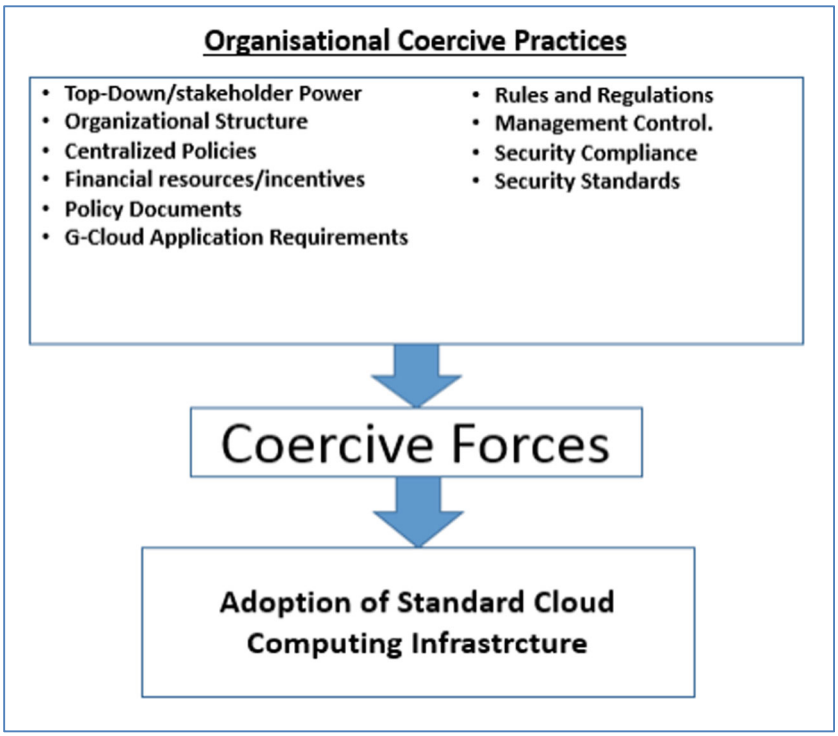

Fig. 1 Coercive Forces Contributing to the adoption of the G-Cloud

5.2 Normative Institutional Forces

Normative institutional forces also influenced the implementation of standard cloud solution for the e-Health portal. One of these stemmed from the ITA building *general knowledge* base for the MoH team who managed and implemented the e-Health portal. Different IT managers at the MoH stated:

> We understand it, and we encourage it MOH05
>
> I know the G-Cloud can provide you with high availability and can have an endless amount of space MOH02.
>
> The ITA held several seminars, and they invited us. MOH07

The MoH is a large government agency with over 240 sites all over Oman, and many of its IT staff members held the privileges needed to make changes to their application. But once

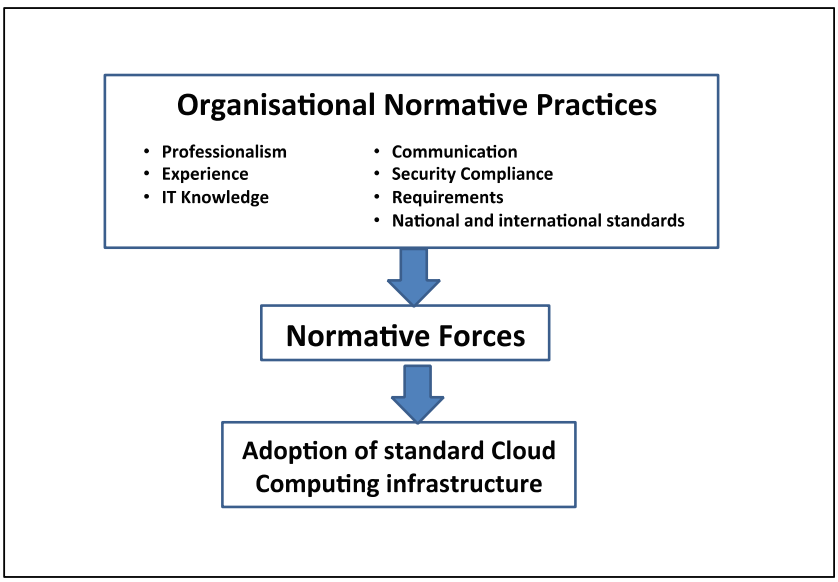

Fig. 2 Normative forces contributing to the adoption of the G-Cloud

the e-Health portal was hosted in the G-Cloud, making local changes was no longer possible. However, this use has not raised concerns and was seen as removing a burden from local units. During the implementation, departments such as networking and security had their concerns over the G-Cloud's implementation and had requested to ease the way of verifying requests. One of the MoH's managers stated that:

> The ITA wanted to impose their standards on our system, especially the security standards. For example, they had many concerns, and we asked them to give us many exceptions. Almost every action we took, nearly every click returned an error from the ITA because they had to analyse all the traffic to make sure it was not an attack, so they had to make an exception on their system to make it pass MOH02.

A project specialist also raised his concerns for the usability of the PKI system, which is an embedded standard throughout the G-Cloud in the MoH portal, by saying:

> We understand this has to be a hard effort and it might affect the usability of the portal, but then we had a long discussion, me and the DG of IT, so we thought about it, and we preferred to start from the beginning and mitigate that risk as a PKI team ITA07.

The e-Health portal project and the G-Cloud project were initiated at about the same times. The e-Health team had agreed with its vendor to use the agile methodology in the e-Health portal project where they could build a module, then go live with it, and this will be followed by iterative cycle of building and going live with other modules and keep adding to the system. This meant that some e-health modules could be activated as soon as they were completed, with no need to wait for the whole portal to be ready. The e-portal team wanted either the internal IT Infrastructure or the G-Cloud to be ready immediately so they could start their agile development cycles, but the G-Cloud team was not ready for the agile development approach. The e-health team's *requirements* pressured the G-Cloud team to have the G-Cloud ready for the e-health portal which has resulted in a temporary stage solution.

The G-Cloud vendor suggested a 'mini-cloud' to the e-Health implementation team as a quick cloud computing environment to allow the developers of e-Health portal to start their project. This was a temporary cloud environment for the e-Health development and testing stage that would be moved to the G-Cloud environment when it became ready. The reason for using the mini-cloud was that the G-Cloud project was still under development and was not ready for any services. The mini-cloud did not have the standards, controls, or features of the actual G-Cloud. The temporary mini-cloud was seen as an important infrastructure by the e-Health developers.

When the G-Cloud environment became ready, the G-Cloud team asked the e-Health team to move all 28 servers from the mini-cloud environment to the G-Cloud. This process took longer than the mini-cloud implementation process, as the G-Cloud came with embedded standards (MoHOman 2013). The vendor manager for e-Health Portal explains:

> The interesting thing is that when we started the MoH portal, ITA have just started the G-Cloud project, and they thought we would need the servers after ten months because they did not understand the agile methodology. It was the first time I believe they faced with an agile project. We told them we need the hardware now, as we will create the product backlogs, within one month we will finish the first sprint, and we need people to start accessing it. We have a sprint every month. So, what they did, they talked to the vendor, and came up with the concept called the mini cloud while doing the proper cloud project on the side and they did mini cloud. MOH08

A vendor staff member stated:

> To achieve our requirement; the ITA came up with the concept called the mini-cloud. So, while the ITA was doing the proper cloud project on the side, they did a mini-cloud for the MoH to cater for our requirement MOH08.

While the G-Cloud project came with standards that had been adopted from best practices, the ITA team also had requirements that needed to be embedded in the G-Cloud implementation. The ITA saw itself as a client who had demanded and asked the vendor to follow and implement its requirements in the G-Cloud project. Some of those requirements were the standards that had been agreed in the tender documents, while others had been imposed during the implementation of the project as *the client required*. One of the managers in the ITA explained that:

> We are following the security standards in ITA, and we are using the OeGav (Oman e-government framework), I would say, if anyone would like to start a cloud project, they should follow the standards on how to do that, which has been done by Gartner or others. These standards will guide you on what is happening in the market as of today, there might be some changes as we have experienced it, but the change is much better done now than getting into the cloud environment, and then it turns up as something else. That is why it should follow some international standard; then we should keep adding to it ITA05, 27/11/2015

Although the above statement highlights the client requirements, it also shows the role played by professionals—in this case, Gartner—in helping the ITA to create standard cloud infrastructure. From the consultants and from their IT experience, the ITA team gained the knowledge that helped them to include the requirements in the initial stages. It also enabled it to leave space to add future requirements if required. One of the managers in the ITA highlighted the different kinds of standards that the ITA team decided to adopt through their interactions with the consultants and explained why they were important by saying:

> First of all, the G-Cloud project needs to comply with many standards, such as security standards, virtual system standards, hypervisor standards, so every layer should comply with NEST standards. Even my RFP came from standard, so we are aligned with NEST standards such 583, 50083 and others, there is at least top ten standards from NEST. We should comply with NEST. Moreover, then the security standards, such HIPPA (Health Security Standards) and CCSK (Certificate of Cloud Security Knowledge) 3.0, so we implemented these standards so that our cloud will be trusted ITA06, 30/11/2015

The above statement shows how the ITA team was focussed on standards in G-Cloud from an early stage in its development. Figure 2 summarizes the organisational normative practices that exerted normative forces for the adoption and migration to the G-Cloud.

5.3 Mimetic Institutional Forces

Mimetic practices played a major part in the implementation of the e-health. Participants were convinced that the implementation of this standard infrastructure, however, might not suit their immediate needs, cannot be escaped, as they perceived it as a new trend that other countries and organisations adopt and hence they should also adopt otherwise they will be left behind. They believed that since 'others' implemented it, then they had to implement it as well so they are seen as going with "the new" and "catching up with the latest trends" and as a way of achieving levelled developments with "other [more advanced] countries". This view has surfaced in most interviews where interviewees referred to others as in other countries and the rest of the world portraying it as a general sweeping trend in advanced nations. For example, the network manager at MoH has expressed this view saying

> It is a new trend in hosting government network; I believe the whole world is going to the cloud MOH04.

Another manager of the e-health portal expressed this view saying:

> If you look at other countries experience you will find that they have one portal for the whole government and G-Cloud would help in this one portal MOH03.

The view that it has been successfully implemented by other countries has played an important role in pushing the implementation forward and overcoming disagreements and issues raised. They considered other countries implementation a legitimate reason for them to be part of the G-Cloud. The e-Health portal management team elaborated on that by saying:

> If you look at other countries' experience, you will find that they have one portal for the whole government, and the G-Cloud would help in this one portal MOH03, 09/08/2015

Moreover, the selection of the open-source cloud computing concept from a relevant best practice, an Estonian model, was a mimetic mechanism that led to the standardisation of the system. The ITA sought to find an example successfully implemented in another country as it was uncertain of what a G-Cloud application should look like or how it would operate. These uncertainties facilitated the application of software standards to the new G-Cloud solution. The Estonian model of implementing an Open Source G-Cloud motivated the Omani government as they believed that western culture, which many identify with advanced countries, was a good model to mimic. One of the senior managers in one of the government agencies stated Fig 3:

> The G-Cloud vendor since they are from an advanced country and probably since they are recommending the G-Cloud infrastructure ... That is why they are saying they will get better performance or the issue of performance we are having, the internet on the normal infrastructures, this will disappear when we move to the Cloud. I believe they are right, as they have given the sample for us, maybe they are better, why not try to move NCSI03, 17/11/2015

It also helped the migration to the cloud is that MOH is a proud organisation that seeks to be the first in implementing technical solutions. A Senior Manager in MoH added:

> We always work with the users and that what we did with Alshiffa system (The Health Management system in Oman). I can assure you that it is the only system in the world that 100% of doctors and nurses are using it is in Oman and that why we got the United Nations Award in the system. You can go and do your research, and you will see no country in the world that 100% are using health Management System. MOH05

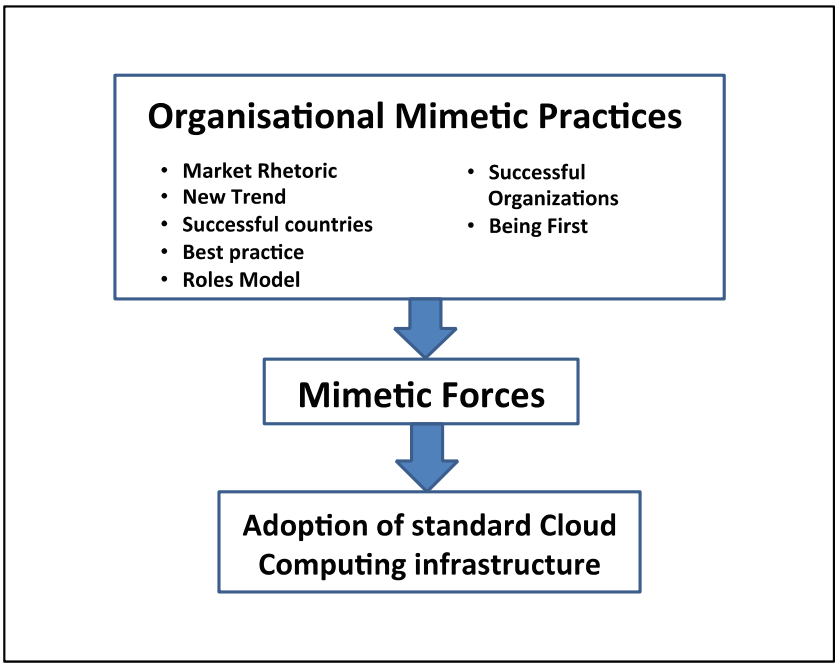

Fig. 3 Mimetic forces contributing to the adoption of the G-Cloud

Being the first implementation of G-Cloud has motivated MOH to move faster in the migration to CC. The ITA's project manager for the MoH added:

> All the policies that were prescribed by the ITA were put there. It was first as to have everything to be as per Public Key Infrastructure (PKI), and Mobile PKI for users who wanted to get access the username and password. We were the first who implemented the integration with MOC (Ministry of Commerce) and integration with ROP (Royal Oman Police) for all the G-to-B services through the ITA integration platform. We were also the first who used the cyber sources e-payment and so many things we used to do for the first time ITA07.

Mimetic institutional pressure playing a role in leading to the adoption of standard CC-based infrastructure through the G-Cloud. The practices mentioned above enabled the MoH to model itself on similar organisations within Oman and abroad in order to consider itself more legitimate or successful.

6 Discussion and Conclusion

Institutional intervention has been rarely considered in research into the adoption of IS infrastructure including digital infrastructure. This is partly because IS infrastructure research tended to provide micro-level analysis of the dynamics of its design and adoption. However, cloud computing presents a new generation of information infrastructure that demands an understanding of its adoption at a macro level and from an institutional intervention perspective. This is because it brings about a novel view of computing as a utility where organisations rent and pay per use. Hence, it comes with standard technology that organisations need to adopt and migrate to if they want to benefit from this new model of computing. This type of new digital technology invites better understanding of how organisations can intervene to influence the migration to the cloud. Our study questioned: How can institutions positively influence the adoption of cloud computing services? It examined the case of cloud computing adoption in the national government of Oman and in particular the adoption by the Ministry of Health e-Health.

The research findings reveal the different practices that exerted institutional forces and contributed to the adoption of standard cloud computing infrastructure. It showed that different artefacts were relied upon to exercises and support the institutional forces including policies, rules, regulations and embedded standards (De Vaujany et al. 2018; Lannacci 2014). Fig. 4 summarises these practices. It highlights that different organisational practices that exerted institutional forces to encourage the adoption of government cloud services and supported the migration of government agencies to the cloud computing model. The findings showed that these institutional forces play an important role in the adoption of a centralised digital infrastructure such as cloud computing. In the context of our study, the coercive and mimitic forces played more prominent roles in moving this large-scale government adoption forward towards a successful migration. The coercive forces provided incentives, rules and structure for the adoption which made it difficult for government agencies to decline participation. The mimetic forces played a propelling role that enabled government agencies to find and accept solutions and hence pushed the migration forward. The normative forces played a

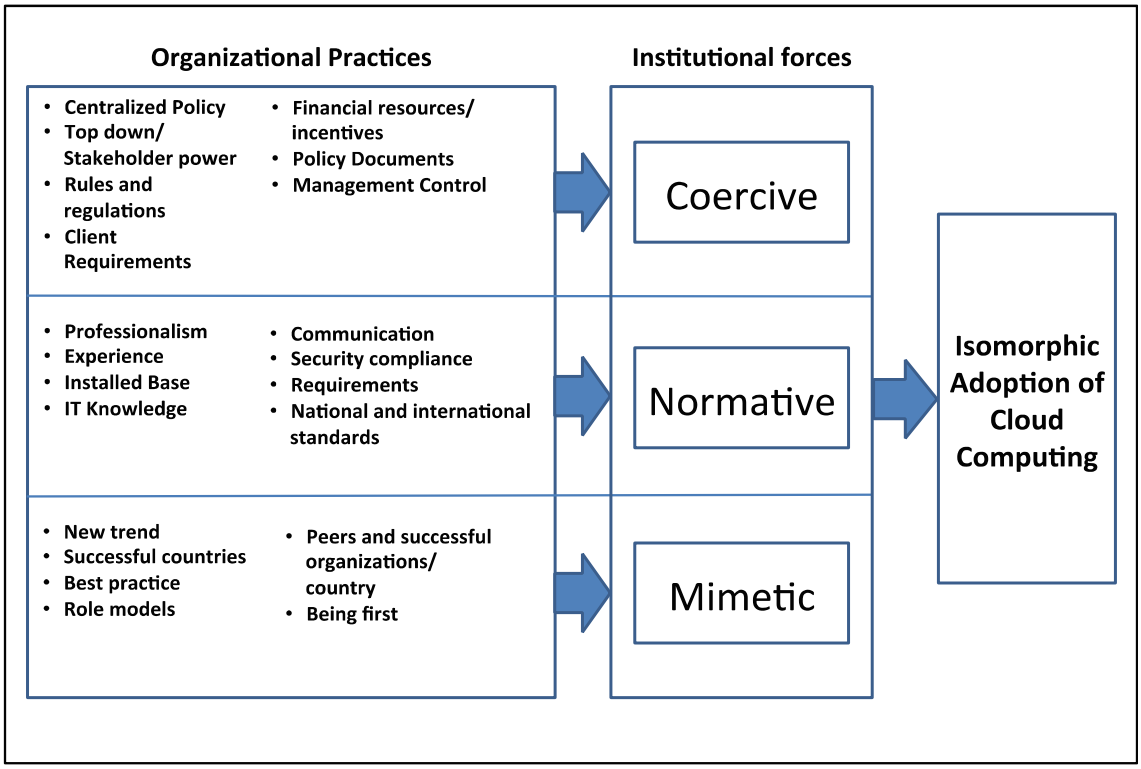

Fig. 4 Organisational practices and institutional forces contributing to the adoption of G-Cloud

secondary role in easing resistance but primary encouraged finding solutions to potential obstacles.

We conceptualise this institutional intervention as a 'smart intervention'. It is so as the context of adoption was taken seriously shaping the institutional intervention and adoption approach. This was manifested in the formal practices and the channelling of the informal practices towards organisational goals. Surprisingly, this smart intervention reveals that not all institutional forces are equal in their weight and importance. The study shows that the coercive and mimetic forces play a significant and primary role in the successful migration to the G-Cloud in MoH. While the normative forces led professionals to question some of the standards of G-Cloud, the mimetic forces propelled those professionals to quickly find solutions and compromises. This was particularly exhibited in the finding of the temporary stage solution of the mini-cloud to overcome the existence of different requirements and timetables. Indeed, our research shows that the normative forces could be overpowered by the coercive forces while the mimetic forces reduce resistance to the adoption of a standard cloud computing infrastructure and pushes organisations towards finding solutions and resolving obstacles. In the case study, the macro practices play a more pronounced role as institutional forces that could positively guide its adoption and reduce resistance at the micro-level.

Our finding differs from Currie (2012) work where institutional forces became conflicted with efforts to impose organizational change. While IT professionals in the MoH negotiated the standards, which were enforced from the G-Cloud team over the e-health portal, this has not resulted in resistance or adoption failures as in the National Health program that Currie (2012) studied. The zero-charge policy was a motive to join the G-Cloud alongside other financial incentives. Our research shows that the MoH was encouraged to adopt CC as a way of solving the complexities and saving cost. This was further enforced by the mimetic pressure of CC as a new trend that has been successfully implemented in other countries and large organisations. These findings differ from what previous research emphasised regarding the results of negotiation, contesting and resistance of standards implementations in IS infrastructure adoption (Hanseth and Lyytinen 2010; Sahay et al. 2009). Evidence of the problems and failures of centralized control in public sector IS infrastructure development from top-down are clear in the literature (Adler-Milstein et al. 2008; Currie and Guah 2007). However, our case study shows that the digital infrastructure comes with standards and its adoption can be achieved even on a large scale national level. This contrasting finding could be due to the nature of the cloud computing as a centralised technology governed by a top-down approach to its adoption and migration.

This study contributes to the understanding of digital infrastructure. It provides a macro-perspective of its adoption that is much needed in the literature. By adopting a macro view, this study provides an understanding of the institutional practices involved in encouraging the adoption and migration to cloud services. This macro view is timely and relevant to CC migration and has been largely missing from IS infrastructure

research that mainly focused on micro practices (Iannacci 2010) and identifying differences rather than similarities (Monteiro and Rolland 2012). While technology infrastructure research has maintained a micro organisational focus and has not paid attention to the possibility of intervention, this study shows that successful CC implementation requires institutional intervention. This responds to Monteiro et al. (2014), p ii) call for research on IT Infrastructure "to examine what scope exists for proactive Information Infrastructure interventions". It also responds to scholarly calls urging IS infrastructure researchers to considers the macro-practices in adoption (Iannacci 2010).

The study also provides detailed case study of the adoption of government cloud. It offers a case study of cloud computing in which there is a dearth of case study research despite the established views on its importance in giving insight into the experience of organisations (Walsham 1995). In doing so, the study responds to calls highlighting the lack of case studies in this area and the need for detailed case studies in examining organisational adoption of cloud computing beyond surveys (Senyo et al. 2018; Wang et al. 2016). The study also highlights the importance of considering the institutional context when orchestrating the institutional intervention that facilitates CC adoption and migration despite the universality of the technology.

This research also contributes to the adoption and application of institutional theory in IS by providing a comprehensive understanding of how various institutional forces impact digital infrastructure adoption. It identifies the practices that exerted institutional forces that play different roles in the implementation process. In doing so, it joins the few studies that link information infrastructure research with institutional theory (Brown and Thompson 2011; Iannacci 2010); an approach that has been well advocated and argues for (Currie 2009). It also contributes to institutional theory by showing that institutional forces might not carry equal weight in practice. This understanding of the institutional forces shows that institutional intervention has to take context into consideration and invites practitioners to devise smart interventions for cloud computing adoption that facilitate the acceptance of its universal standards. There are few previous studies of information infrastructure implementation at the macro level (Brown and Thompson 2011; Hanseth and Monteiro 1998; Iannacci 2010). Adopting the institutional perspective is important in view of the role that institutional forces play in information infrastructure implementation (Avgerou 2000; Currie and Guah 2007).

The findings of this study and their implications also make important contributions to practice. This study provides insights into the fostering conditions for successful adoption and migration to cloud computing. Although government organisations in IT infrastructure projects, many of these projects failed to achieve their objectives and/or were delivered after long delays (Currie 2012). This study provides government decision makers with useful insights into how institutional forces can help to achieve the implementation of new forms of information infrastructure solutions, such as cloud computing.

This study has focused only on the Infrastructure as a Service (IaaS) type of cloud computing. Future research could explore other types of services, such as PaaS and SaaS, and explore government agencies' adoption and migration to these services. Future research could also study the effect of the institutional forces on cloud computing implementation in developed countries. Future research could also study the influence of national culture on the acceptance of information infrastructure standards.

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Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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