Leverage control in information infrastructure evolution: empirical evidences from a South country

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Abstract:

This study investigates the dynamics of control mechanisms that shape the evolution of the medical licensing system in Vietnam. Using data from an action research project conducted in Vietnam from 2012 to 2014, we found that control plays a crucial role in the evolution of the information infrastructure (II). This finding challenges the conventional wisdom that advocates for decentralizing or even completely devolving control over II. In our study, II is conceptualized as an assemblage of three key components: technology, resources, and legitimation. Therefore, favorable conditions for the evolution of II require that each actor is able to exert full control over the part of II that is inherently associated with them. This full control empowers participating actors with the ability to negotiate and protect their interests as the infrastructure grows

Keywords: information infrastructure; medical licensing; generative mechanism; innovation; scaling

1 INTRODUCTION

Today, thanks to the development of network and communication technologies, information systems (IS) are increasingly interconnected and thus become larger and more complex (Sommerville et al., 2012). Many researchers use the term information infrastructure (II) to refer to such large scale and complex systems and characterize them in five properties: shared, evolving, heterogeneous, open, and standardized (Hanseth & Monteiro, 1998). Project to build II often fails and drift away from initial goals. The complexities of II, lack of proper knowledge, improper organizational structure, and governance among many other social-technical factors have been reasons used to account for either total/partial failures (Heeks, 2002, 2006) or drifting from original goals of project's initiators (Ciborra, 2000; Hanseth & Braa, 2000). To tackle such challenges, a growing number of studies have been undertaken to identify favorable conditions that enable successful II growth (Grisot et al., 2014) and understand mechanisms that contingently drive the evolutional trajectory of information infrastructure (Henfridsson & Bygstad, 2013). More specifically, some studies try to solve the problem of imbalanced tensions between new and old elements of II, between stability and flexibility, and between control (centralized vs distributed) and autonomy (Rodon & Hanseth, 2015).

Apart from that, a substantial number of studies focus on understanding two constitutive components of II namely are governance (or control), architecture, and the interplay between them (Rodon & Hanseth, 2015; Tiwana et al., 2010). However, there are many calls for a decrease of control on II (Nielsen & Aanestad, 2006; Sanner et al., 2014). The argument of these calls comes from the fact that constitutive components of an II such as technical artefacts are often out of control of their designers. And balancing between control and autonomy is healthy for II evolution. Hence, balancing between control and autonomy or between centralized and decentralized control could mitigate the complexity of II and make the II become resilient, flexible, and adaptive to effectively response to any unpredictable future change. However, there are still many open issues associated with control which have not been addressed and explicated in the literature.

First, we argue that control, as an inherent attribute of II, is often not under complete control of any actors in II, thus adjusting (increasing or decreasing) it will not be trivial but requires substantial negotiation and arrangements.

Second, as control often comes along with privileges, it is hard for an actor to voluntarily give up its control on II.

Third, control in II is often seen as a black-box however it is important to unpack it to better understand the interplay among its constitutive elements and how it shapes the trajectory of II growth.

Four, while some scholars argue that decentralized control is an important factor contributing to the success of II evolution (Gregory et al., 2013; Nielsen & Aanestad, 2006; Sanner et al.,

2014), others argue that centralized control can support the scaling and adoption the two important generative mechanisms for successful evolution of II (Henfridsson & Bygstad, 2013).

Therefore, to better understand the role of control in the process of building and designing IIs, we undertook an action research that involved the development and implementation of a medical licensing system in Vietnam between 2012 and 2015. Our findings include three types of control that different actors can impose to shape II growth trajectory. We also discuss the interplay between them. We believe that understanding how control determines the trajectory of growth could be beneficial for managers and information technology professionals who are in charge of managing health information systems countries which have similar social-technical conditions. The remainder of this paper is organized as follows. A review of extant literature on II control and other related concepts is provided in section 2. Section 3 and section 4 present research methods and the case respectively. Analysis and conclusions are provided in section 5 and 6.

2 LITERATURE REVIEW

2.1 From information system to information infrastructure

The advancement in hardware, network technologies has transformed the way in which information systems are designed, built, and operating. Nowadays, IS has become larger in the scales and complex in their structures. IS more and more play the role of basic infrastructure such as water, electricity, road etc. Many researchers propose to view IS as II. For example, (Hanseth, 2002) characterize an II as shared, evolving, heterogeneous, open, and standardized system, in which:

- Shared: used by many users
- Evolving: keep changing to meet new requirements
- Heterogeneous: diverse composite of varying elements
- Open: everyone can take part in
- Standardized: elements communicated through standardized protocols

According to that perspective, II should be cultivated rather than being built from scratch (Hanseth, 2002; Hanseth & Lyytinen, 2008, 2010). Since its birth, the II perspective has been adopted widely by IS researchers in various domains. Ciborra and Hanseth (1998) employs this concept to analyze the process of designing II in business management. Henfridsson and Bygstad (2013) examines the case of building II in a Norwegian airlines company.

Many researchers also use this theoretical lens to understand the evolution trajectory of health II in both developed and developing countries (Aanestad & Jensen, 2011; Friedman et al., 2017; Horvath, 2017; Reich, 2019; Sahay et al., 2009). There are also calls on more research on IS in developing countries as these countries constantly face the problem of poor infrastructures and shortage of resources (financial, human). Designing and implementing successfully II could help these countries improve living conditions of people and achieve development goals. While building II is a challenge even in developed countries, finding appropriate strategies to accomplish that mission in poor countries is very critical.

2.2 Information infrastructure evolution: control or autonomy

Building successful II is a challenging task that concerns not only practitioners but only researchers. There are many studies attempted to answer the central question that is how II should be designed. Hanseth and Lyytinen (2010) proposes four design principles to deal with dynamic complexities of II. Jensen (2013) contextualized these principles to apply it the healthcare domain with the aim to build integrated health II. Hanseth (2010) suggests that II should be cultivated on existing installed base rather than built from scratch.

Henfridsson and Bygstad (2013) conduct an in-depth case study of a Norwegian airlines company to identify generative mechanisms that drive the evolution of II in this organization. Three mechanisms, which are innovation, adoption, and scaling, are derived from the case study provide a theoretical basic for a survey which encompasses 41 II cases published in leading information system journals such as Managing Information System Quarterly (MISQ), Information and Organization. They define innovation as a self-reinforcing process which new products and services are created based on recombination of existing ones. Adoption is relating to more users use the infrastructure and scaling is when infrastructure expands its reach by attracting new partners. Henfridsson and Bygstad (2013) uses the configuration perspective to find out which mechanisms exist in each case and how they are configured. The term "configuration" refers to the situation in which a plural of mechanisms interplays to shape the trajectory and outcome of each case.

AIS (Adoption-Innovation-Scaling) is the best configuration as all the cases that have this configuration are successful. The reason for this is as elaborated by Henfridsson and Bygstad (2013): "*The innovation and adoption mechanisms fed on each other, which created fertile ground for the scaling mechanism as combinatorial possibilities (innovation) increased and the provision of more users (adoption) leveraged the scope of the infrastructure*" (p.923).

The AS (Adoption-Scaling) configuration is surprising because 7/7 cases are successful while only two mechanisms (Adoption-Scaling) are actualized. This result contradicts the argument made in AIS configuration about the role of the innovation mechanism in triggering adoption and subsequently actualizing the scaling. The insignificant role of innovation in the II evolution can also be observed in other configurations such as I (Innovation) or AI (Adoption-Innovation) in which only 50% infrastructures succeed. This differs from what have been discussed in the extant literature when innovation often plays a critical role in the II evolution (Grisot et al., 2014; Henderson & Clark, 1990; Rodon & Hanseth; Sanner et al., 2014; Tuomi, 2002).

These configuration is not an end. Henfridsson and Bygstad (2013) believe there must exist other mechanisms and there must be fundamental differences in the contextual conditions that interact with the mechanisms and shape the outcomes of the II evolution. Through our engagement with the development and implementation of a number of systems of for healthcare sector in Vietnam, we have witnessed many contextual conditions and factors that contingently drive the infrastructure evolution. One factor that is worth attention is how various stakeholders exercised their control and how such a control affects the II growth. So far, the II literature seems to overly focus on the technical aspect of control and neglect other important aspects

such as legitimation and resources which, we believe, can help to further our insights of II evolution. For example, Nielsen and Aanestad (2006) discuss the case of Content Provider Access (CPA), a platform through which big telecom companies in Norway open their architecture and allow third-party providers to join in order to create and sell the digital content to end-users. Nielsen and Aanestad (2006) argues that by doing so, telecom companies could quickly grow the platform, reduce the risk and investment while still get revenues through charging commission. In other words, by balancing out the control and autonomy, i.e. reducing control in some areas while keeping control in others, those companies maintain their profits and stimulate faster evolution for their platform infrastructure.

Our experiences from the healthcare sector in Vietnam, which is still a communist nation, suggest the existence of many forms of strict control and centralization: technology, legitimation, and resource to name just a few. There are also observably intimating inter-links between these forms of control and the three generative mechanisms discussed in the literature (Innovation, Adoption, and Scaling). For example, governmental agencies can increase or decrease their control by mandating the use of a particular system. Donors can define a list of criteria for a new platform that all involved partners must follow. These conditions and settings are significantly different from those discussed by the extant literature. We believe that unpacking the dynamic of control in health infrastructure in developing countries could provide useful and powerful theoretical lens in understanding the power struggling and balancing processes that affect and shape the sustainability and evolution of IIs.

2.3 Health information in developing countries:

In recent years, developing countries have recognized the need for robust health information systems (HIS) to address public health challenges, strengthen healthcare systems, and improve population health outcomes (Braa et al., 2004b). A health information system refers to the collection, processing, storage, analysis, and dissemination of health-related data and information for decision-making, policymaking, and planning purposes (Braa & Sahay, 2012).

However, developing countries face numerous challenges in developing and implementing effective HIS, including limited resources, inadequate infrastructure, inadequate technical expertise, and political instability (Aanestad et al., 2014). Despite these challenges, there has been progress in the development and implementation of HIS in developing countries (Nguyen, 2010; Nguyen & Nielsen, 2017; Nguyen et al., 2017).

One of the key components of an effective HIS is the availability of reliable and timely data. In many developing countries, data is collected using paper-based systems, which can be time-consuming and prone to errors. To address this issue, many countries have implemented electronic health record (EHR) systems, which allow for the digitization of patient data, improved data accuracy, and real-time data access (Nguyen, 2010).

Despite the progress made in implementing HIS in developing countries, there are still numerous challenges to be addressed. One of the key challenges is the need for adequate funding and resources (Bossen & Piras, 2020). Many developing countries have limited budgets for healthcare, which can make it difficult to invest in expensive health information

technologies. Additionally, there may be a lack of technical expertise to develop and maintain these systems (Ostern et al., 2021).

Finally, there is a need to ensure that HIS are designed and implemented in a way that addresses the specific healthcare challenges facing developing countries. For example, many developing countries face high rates of infectious diseases, such as HIV/AIDS, malaria, and tuberculosis. HIS must therefore be designed to address the unique data needs of these diseases, such as tracking disease incidence and prevalence, monitoring treatment adherence, and ensuring timely reporting of cases (Friedman et al., 2017; Hussein Mahundi et al., 2019; Khiem & Kuo, 2022).

In sum, health information systems have the potential to improve healthcare delivery and outcomes in developing countries. However, there are numerous challenges to be addressed, including limited resources, inadequate technical expertise, data privacy and security concerns, and the need to address the unique healthcare challenges facing developing countries (Nguyen & Nielsen, 2017). Despite these challenges, progress has been made in the development and implementation of HIS in developing countries, and there is a growing recognition of the importance of these systems in improving population health outcomes (Nielsen & Sahay, 2022).

3 RESEARCH METHOD AND APPROACHES

3.1 Research method

Action research (Avison et al., 1999) was employed to carry out this study. The action research approach emphasizes solving a practical problem and generating knowledge at the same time (Davison et al., 2021). It thus well fits to our circumstance when we were interested in developing and implementing a software system for medical licensing as well as understanding the role of control in shaping the trajectory of large scale and complex systems.

A canonical action research consists of one or many cycles (Davison et al., 2021). Each cycle includes 5 phases: diagnosing, action planning, action taking, evaluation, and reflection. In this research, we conducted 3 cycles.

- Cycle 1: build a prototype of medical licensing and tested it in 5 provinces
- Cycle 2: scale the prototype to all provinces
- Cycle 3: integrate with another software

In each cycle, we also followed the 5 phases of canonical action research: diagnosing, action planning, action taking, evaluation, reflection.

3.2 Data collection

Data was collected through a variety of means. First, most important data source came from our daily interactions with the ongoing activities of the project which involved software development and implementation, meetings, capacity building etc. Second, formal and informal interviewers were conducted with informants who were staff at MoH, provincial health

departments, the donor. Third, document archive is another important source of data which included project reports, meeting minutes, and other legal documents such as law, decrees, and circulars.

It was a challenge to manage the collected data as they came from multiple sources and the collection process spanned over a long period of time. To systematically organize our data, key events (data) were sorted in chronological order and subsequently grouped by themes. Guided by the literature and research questions, three themes corresponding to the three types of control were used to process the data: technology, legitimation, and resource. Thereafter, we tried to pinpoint any possible links among these types and the control of these factors affects the II growth. Apart from that, we tried to examine the dynamics of control, how they are related to other mechanisms such as innovation, adoption, and scaling.

Part of the analysis process is the writing up of the case description which is presented in the following section.

4 THE CASE

In 2012, a doctor from Vietnam Administration of Medical Services (VAMS), Ministry of Health (MoH) (anonymously referred to as DoctorS) called one author of this paper to discuss about the possibility of reconfiguring District Health Information Software version 2 (DHIS2), a platform specially designed for healthcare, to build a centralized system that supports the medical licensing activities. A prototype was built in 1 week which was based on the DHIS2 platform. This was a very simple module with basic data entry forms. DoctorS liked the prototype so he quickly referred it to his friends working for licensing offices in provinces to get comments.

Coincidently, during a workshop organized by VAMS in Ho Chi Minh City in April 2012, the first author had a chance to meet again the doctor (now anonymously referred to as DoctorP) who attended several training classes on DHIS2 organized by one of the authors. At that time, DoctorP was the head of medical licensing office in Binh Duong province. He was eager to pilot the prototype in his province to compare it with the paper-based system. The prototype was tested with real applications submitted to the province. Thereafter, he sent back a list of comments to improve the prototype. Subsequently, the prototype was revised based on his comments. Eventually, the director of the health department approved the prototype and allowed to use it to process licensing applications.

The pilot in Binh Duong province lasted nearly one year and produced very good outcomes. The positive result of the pilot in Binh Duong province helped DoctorS successfully convince the director of VAMS to send a letter to six provinces (1 existing province and 5 new provinces) to pilot the system. These provinces were selected based on two criteria: one, the staff at the licensing offices had good rapport with DoctorS; two, the selected provinces must geographically represent the whole country. A team was organized to support the implementation of the system. At the same time, ADB agreed provide a small grant to pay salary for the team.

In 2013, there were two national workshops about medical licensing organized by VAMS. During these workshops, the team was allowed to introduce the system to all provincial licensing officers. Following the two conferences, the team was proactive in contacting all provincial health departments to remind them to input 100 applications to the system as requested by MoH through an official letter. Some provinces consented to the request and some refused to do that because of many reasons. Some were really busy with their routine work and did not have time to learn how to use the system. To convince the provinces that were using Excel for license processing, the team proactively supported them to automatically import their legacy data in Excel or Microsoft Word format to the system so they can start to use the online system.

The process, however, was not fully supported because at the same time ADB had a plan to buy a big system with many complicated modules etc. The new system was planned to replace the existing system that had been implemented nationwide. However, after strong considerations, ADB decided to keep the existing system intact to avoid the risk of replacing a working system by a completely new system (from now referred to as BigSystem). The new systems, thus, only focused on areas which the existing system did not cover.

The bidding process for BigSystem took much longer than expected. Eventually, a local company (hereinafter BigFirm) won the bid and subsequently was awarded a contract to build BigSystem. However, the contract stated very clearly that the local company must integrate their new modules with the existing licensing system; full or part substitution of full of the licensing module was prohibited. This requirement, despite hampering BigFirm a bit, helped to protect the licensing system from rival systems and sustain the infrastructure.

5 ANALYSIS AND DISCUSSION

In this section, we discuss how different sets of control in the infrastructure interplayed and how they shaped the evolutional trajectory of the licensing system. First, we find key stakeholders which had influential roles to the evolution of the infrastructure and subsequently unpack the control that these stakeholders had.

5.1 Key actors and their control over (part of) the infrastructure

5.1.1 The licensing team

From the empirical data, we can easily realize the vital role that the development and implementation team of the licensing system played in the process of actualization of this system. The team had initiated the infrastructure, nurtured it through uncountable small efforts. At certain points in time, the infrastructure could grow by itself but still needed lots of supports to become sustainable and irremovable. This process is very similar to the cultivation and bootstrapping proposed by (Hanseth & Lyytinen, 2008; Hanseth & Monteiro, 1998). So what was in control by this actor? As an external contractor hired to build a software system for the healthcare sector, the team does not seem to have control on anything. 63 provincial plus more than one thousand hospitals have been in a close contact with the team and depended on the team for technical support. The team, despite having certain influence on the end users, could not demand them to do or not do anything. The relationship between the team and the end users

was merely a kind of client-service provider. To some extent, the end users even had more control on the team than the team had on them.

However, the influence the team could impose on the end user was done through the software artefact that they created. This phenomenon is commonly known as inscribing behaviors in II or translation which involves a number of processes that inscribes a program of actions to the technological artefact that structures and frames user behaviors (Akrich & Latour, 1992). The translation process allowed the team to inscribe their control on the end users via the licensing system. One example is that the team had deliberately designed the licensing system using web technologies and a central database. This design forced the end users to use a web browser to access the system. Using a central database had prevented provincial health departments from creating fragmented databases and enabled a seamless data interchange across the country.

Obviously, the licensing team had control over technologies used in the infrastructure and through this control they imposed a program of actions on the end users. The technological dimension of control has an intimating relationship with the innovation mechanism discussed by Henfridsson and Bygstad (2013). This is a bilateral relationship because the control of technology allowed the team to introduce innovation(s) **of** and **in** the infrastructure (Grisot et al., 2014) and the infrastructure once actualized will reinforce the team's control by framing and shapping innovative applications **on** it.

5.1.2 VAMS (MoH)

Another stakeholder that had significant role in the formation and evolution of the licensing II is the health ministry department of VAMS. VAMS has a vast control on legal issues around health professionals and facilities licensing processes. It was the key actor involved in drafting the law on examination and treatment (LMET) and in issuing related circulars. In our case study, we can observe how VAMS controlled the evolution of the infrastructure through various legal artefacts. This means that VAMS could inscribe its program of actions through artefacts that were not necessarily technology, i.e. the legal documents acted as artefacts. A legal document can regulate as well as frame and structure behaviors of its users in the same way that technical artefacts do. However, in this analysis, we only focus on how the program of actions that VAMS inscribed in to various legal documents affect the infrastructure. In the two most important legal documents (the law and circular 41/2011/TT-BYT that guides the law), there was no inscription on how a software application would be used to support the licensing processes, checking the license duplication, and reporting of licensing activities. This lack of inscription did not favor the efforts by the donor in building an II infrastructure to support the licensing activities.

Conversely, an intentional program of actions were inscribed into the two public letters sent by VAMS to provincial health departments to request the pilot and input of 100 applications for testing. The two letters formed an important legal basic which the team used to convince provinces to use the system. Hanseth and Monteiro (1997) argue that the inscription can be either weak/flexible or strong/rigid and give the following examples: "*former are what can be called "tools," the hammer being a classic example, and the assembly line of Chaplin's "Modern times" a standard illustration of the latter*" (p.3). From our analysis, the inscriptions that VAMS assigned on the end users were varied. In the example of the law and the circular,

the inscription was too week, however, it was stronger in the case of the two official letters although it could have been better if one of the two official letters had imposed firmly that all licensing offices must officially use the licensing system for their work.

This strong inscription is conceptually similar to the centralized control that enabled and disabled the adoption of health information systems in Andhra Pradesh (AP), a state in Southern India (Sahay & Walsham, 2006). The centralized control was so powerful that although 23 districts in the state had adopted the system, the change of commissioner through election could result in a dismissal of the system. The conceptualization of legitimate control helped explain the paradox of the actual role that control plays in the II evolution. Control of legitimation is critical for adoption, thus centralized or tight control in this dimension could result in quicker adoptions which in turns would favor the II evolution. On the contrary, control of technology needs to be balanced to enable innovations.

5.1.3 ADB (the donor)

ADB was the donor that provided technical and financial supports to strengthen and develop human resources for the healthcare sector in Vietnam. Building a licensing information infrastructure was an important component that was geared toward the overall health human resources goal. ADB was thus an important stakeholder with a strong influence to the actualization of the licensing II in Vietnam via mostly financial means. The control that ADB had was the power of resources allocation (finance and expertise in both IT and medical licensing domain knowledge). This control had a strong impact on the trajectory and pace of the II growth. For example, the first grant had transformed a local and small innovation into a functional system that was adopted by many provinces and hospitals. The second grant was critical in providing necessary resources required for sustaining and maintaining the fragile infrastructure.

The resource control perspective in our analysis should be distinguished from the resource-based view concept (Wade & Hulland, 2004) that focuses on understating how specific parts of a firm including information systems affect the firm at large. However, our resource control concept is to some limit extent similar to the frugal approach discussed by Vassilakopoulou et al. (2015) , which highlights the ambiguity in making technical choices at early phases of the II growth. To cope with that, a number of small attempts were tried until a sound solution was found. During that process, affordable losses are acceptable. This is analogous to the approach that ADB employed when it provided small and separate grants to the team in supporting the building and maintaining the infrastructure.

5.2 Toward a control perspective on II evolution: control as a root configuration

So far, we have identified three key stakeholders involved in the evolution of the licensing infrastructure and various dimensions of control that the stakeholders possessed. Our findings have resolved the dilemma of centralized and decentralized control, answering the question which types of control enable successful II evolution. In this section, we provide some discussions on the findings in connection with the extant literature on II. Implications for research and practice are also provided.

First, Henfridsson and Bygstad (2013) note that innovation helps in actualizing adoption. Our empirical data show that this view is not sufficient. We argue that adoption would also be enabled through the control of legitimation. The program of actions which is inscribed into legal artefacts (the two letters in our case) mandates the adoption of the licensing system even in a very limited extent (pilot in 6 provinces and input of 100 applications). Furthermore, we contend the interaction between innovation and adoption (through which innovation enables adoption) described in the literature is overly simplistic. Our empirical data point out that in order for adoption to take place, the implementation team had made many efforts in diffusing the innovation to users at provinces and hospitals. However, their mediating role is often downplayed in the II evolution.

Second, the extant literature often discusses the early adoption of technological innovations in organizations (Chesbrough & Crowther, 2006; Dewar & Dutton, 1986; Wozniak, 1987). Wozniak (1987) emphasizes the role of human capital in decision making process based on educational background and information the decision makers have. We relate this theory to our case to discuss the first adoption of the licensing II (the case of Head of the licensing office in Binh Duong province). We argue that apart from available information about the innovative products, personal relationship and trust played an important role in such early adoption.

Third, recent literature on II highlights the need for long term and sustainable evolution of IIs (Ali & Bailur, 2007; Garde et al., 2007; Kimaro & Nhampossa, 2007; Kimaro, 2006). It is very common particularly in developing countries context that the introduction of an innovative system is stuck in the pilot phase with the scale that could not produce any useful values (Braa et al., 2004a). We go beyond this conceptualization and draw from our empirical data to highlight another risk that is associated with overlapping and competing efforts in building systems that could substitute each other. We argue this phenomenon might be harmful to II sustainability. For example, in our case study, the licensing system was initially planned as a temporal, situated, and improvised solution that was built to meet the immediate requirement. When the BigSystem was completed, it would replace the old system. However, the team had leverage their control of technology to delineate an integrated architecture in which both old and new system could coexist.

This finding contrasts with the established view on the need of balancing/relinquishing control to enable sustainable and successful II evolution. Also, we argue in many cases relinquishing control is unattainable in cases. For example, VAMS could not relinquish the control on legitimation, i.e. issuing legal documents. Another example is that ADB as a sponsor could not relinquish the control on financial resources.

6 CONCLUSION

Although medical licensing information systems are vital to regulate health services delivery in every country, they have rarely been discussed in the literature. Till date, most of researches about medical licensing focus on the economic aspect of a licensing system (Derbyshire, 1978; Gevitz, 1988; Goldblatt et al., 1975; Rayack, 1983) or debate around the curriculum or content

of medical licensing exams (Blake et al., 2000; Dillon et al., 2004; Dillon et al., 2002; Lee et al., 2001).

In this paper, we have used the control perspective to examine the empirical data from a case study of development and implementation of a licensing system. We also relate different facets of control to generative mechanisms to further unpack the interplay among control, innovation, and adoption. We extend several theoretical perspectives and concepts such as control, sustainability, and post implementation. Practically, this research played an important role in actualizing the medical licensing II in Vietnam. Up to now, the system has incorporated more than 300,000 health professionals (Ha & Nguyen, 2017; Nguyen et al., 2018; Nguyen & Braa, 2016; Nguyen et al., 2017).

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