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**Transformation of daily work practices as a consequence of information technology introduction:
The case of medical licensing system**

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Abstract: The potential of work transformation as a result of Information Technology (IT) introduction has been long recognized by scholars and practitioners in the information system field. However, the relationship between technology and work practices especially in large-scale, i.e. national, is still poorly understood and somewhat understudied. To fill that gap, we extend a conceptual framework in this paper relating to work transformation in modern institutions to develop more insights into the interplay between IT introduction and daily work practice in the healthcare sector on a massive scale. This extension is empirically based on a case study involving the development and implementation of a cloud-based medical licensing system in a developing country. Apart from analyzing the case using five dimensions of work practice transformation including time and space separation, the requirement of new trust system, institutional reflexivity, concerns for deskilling and opportunities for reskilling and empowerment, the paper discusses three additional dimensions which are transformation negotiation, transformation diffusion, and transformation flexibility.

Keywords: Work practice transformation, medical licensing system, information technology

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1. INTRODUCTION

The links between technology and organizational change have been a topic of debate amongst scholars and practitioners in various disciplines such as management, organizational study, and information systems (IS) field [1]. There are two contradicting perspectives about the role of technology in changing the organization. While he first overly emphasizes the enjoyment of workers with the high level of skills and job satisfaction, the second skeptically foresees a dark future of pervasive unemployment and deskilling [1]. Given its enduring nature, his debate is unlikely to cease. In the same manner, Aanestad et al. [2] contended that technology, work, organization, information and their relationships are the topics that have shaped the IS field from the beginning, however, these equally important topics are not treated in the same way. A bias was in favor of organization over work practices [2]. This bias also happened in both e-government and ICT for development (ICD4T) literature where the focus is overly on development [2]. Few other streams of research such as computer supported collaborative work (CSCW) are interested in getting insights into transformation at work level, however, they often focus on a small scale change, i.e. single organization [2].

To contribute to that debate, this paper examines an empirical case study which involves a development and implementation of a cloud-based software system to support medical licensing processes in Vietnam. The system started as a prototype and piloted in only one province thanks to personal relationships between the users and the designers. Based on initial success, the project gained political support from the Ministry of Health (MoH) and funding from an international donor. Subsequently, the system was scaled to other provinces and became a national system and endorsed by all licensing offices and hospitals in the country. that the rapid scaling of the new system represented a huge transformation of the work processes in licensing offices as well as in hospitals. To get the post-implementation perspective on the system presented in this paper, the data collection took place in two phases. In the first phase (2012-2014), data were collected during the participation in the construction and implementation of the system using methods such as observation, interview, and archival record analysis. In the second phase (2016), a questionnaire was sent to all licensing offices to understand the changes in work practices and users' attitudes toward the system. To support the analytical process on the empirical data, we employed and extended a theoretical framework developed by Barrett and Walsham. We applied this framework to the empirical data. Subsequently, three additional issues which are transformation negotiation,

transformation diffusion, and transformation flexibility have been identified and discussed to facilitate the understanding of the transformation of work practices in the healthcare sector.

In the next section, we review key theories and debates on the problem of IT introduction and work transformation. Research method and the case description are provided in section 3 and 4 respectively. We discuss the findings and several implications for theory and practice in section 5 before concluding the paper in section 6.

2. LITERATURE REVIEW

Information system research since its early days has focused on understanding the relationships between work, technology, and organization [2]. Braverman (1998) and Bell (1976) were among the first authors articulating the impact of technology on the transformation of work. Since then, contrasting images about this relationship are painted by different researchers [1, 21, and 22]. The first enduring debate might be the one between technology utopianism [3, 4] and techno-critics [5, 6]. Advocates of technology utopianism believe that technology would help create a new generation of highly skilled workers with the excellent level of job satisfaction. However, supporters of techno-critics are skeptical about that vision and argue that the negative impact of technology on the workforce is unavoidable. They worry that unemployment would become enormous problems because of deskilling.

Within the domain of information technology (IT), some researchers acknowledge the role of IT as a driver of organizational changes [7, 8]. However, these works are somewhat describing deterministic effect which assumes that IT could shape a uniform effect regardless the contextual conditions where the technology is introduced. This is in contrast to what is reported by Barley [9] where the introduction of the same scanner technology produces different outcomes in two hospitals. A similar argument is made by Robey and colleagues [10] when they investigated the organizational changes after introducing GIS technology in two district counties.

While these studies contribute valuable insights into the transformation of work practices under the influence of technology, they focus more on the organization and individual levels. To contribute to that theoretical gap of work practices transformation in large scale, Aanestad et al. report a case from India where an OSS software system is customized and implemented in all district hospitals of one state. A key finding from the study is that there is a recursive interplay between work and infrastructure (technology) in which the implementation of certain technologies enables work that was not possible before

and vice-versa. However, there is little research that examines large-scale transformation which involves multiple organizations as a consequence of cloud-based technology introduction.

This paper examines the process of the work practice transformation under the impact of IT implementation. Theoretically, we applied and adapted the conceptual framework developed by Barrett and Walsham [1] on the effect of IT on both institutional and individual levels. The framework is summarized in Table 1:

Globalizing Tendencies (Institutional Level)	IT can facilitate the separation of time and space
	IT as a type of disembedding mechanism
	IT may be an enabler of institutional reflexivity in changing risk environments
Self-identity (Individual Level)	Concerns for deskilling with IT adoption
	Concerns for existential anxiety with IT adoption
	Opportunities for reskilling and empowerment with IT adoption

Table 1: Conceptual scheme to understand IT and transformation by Barrett and Walsham (1999)

At the institutional level, IT facilitates the separation of time and space. In the past, time and space play the central role in shaping social relations. However, with the IT support, social relations could be established by both people present in time and space and those who are absent in time and space. For example, in the insurance industry, face-to-face meetings between brokers and underwriters are not necessary to perform the risk placement which could be done via global electronic data interchange (EDI) messages [1]. Furthermore, IT enables the disembedding mechanisms which lift the social relations out of the physical context of time-space. Also, as the time and space constraints are removed, there is a need to establish new ‘trust’ to the systems that work in addition or replace the trust established through physical presence. Finally, as facilitated by IT, the knowledge that shapes incumbent practices becomes mutable. Newly generated knowledge demands the reshaping of social relations and practices.

At the individual level, there is a great concern and anxiety of deskilling and unemployment. While this development is unavoidable, it keeps opening new opportunities for reskilling and empowerment which allow employees to develop new knowledge based on their past knowledge and experience about the rules, regulations, and needs of the work context they have been part of. When applying this conceptual scheme to our empirical data, we realized the need to extend it to capture other dynamics and specificities that arise from contextual conditions. We will discuss three additional dimensions of transformation:

- Transformation as a negotiation between system development and work practices
- Diffusion of transformation: work practice changes in province are transferred to other provinces
- Transformation flexibility: each province has its own adaptation and transformation due to contextual differences.

This extended framework will be used for our data analysis in section 5 after we discuss the research method and the case in the following sections.

3. RESEARCH APPROACH

Action research approach [11] was applied to undertake this study. Action research is a popular method that could help to solve practical problems and at the same time generate theoretical knowledge [12]. One of the authors took part in the day-to-day processes of designing and implementing the medical licensing system. The research which was carried out with consent from Ministry of Health (MoH) comprised 5 phases of a typical canonical action research. In the diagnosing phase, the urgent need to have a centralized and cloud-based system to assist the licensing process in Vietnam was identified. It was followed by a planning phase when MoH, the sponsor (Asia Development Bank - ADB), and the local team that was contracted to provide technical solutions for the first phase of the project agreed upon an action plan to build and pilot the software system in 6 provinces. During the action taking phase, the system was built and piloted in 6 provinces as planned. However, to respond to the emerging needs, the system was further extended to all other provinces and subsequently to all hospitals. As part of evaluating and reflecting phases, all involved parties decided to extend the contract to maintain and support the system for two years while carrying out a big and comprehensive tender to select a firm to build other modules of the health human resource management system.

Empirical data for this research were collected mainly by the first author through his daily interactions with the project. Other modes of data collection were also employed. Interviews were conducted with informants who were licensing officers at the provincial level, project managers, and end-users at various levels. Document analysis was another means to collect data. There were a variety of documents used in this research including formal documents such as laws, decrees, and circulars, and other project-related records such as reports, meeting minutes, design blueprints etc. To understand the transformation of work, it is important to compare the work processes before and after the introduction of the licensing

system. This comparison was carried out by a situation analysis performed along with the development of the licensing system and a post-implementation survey conducted by the research team. A questionnaire was distributed to licensing officers in all provincial health departments who were in-charge of medical licensing as part of their daily routine duty.

The analysis of data was done through the following steps. First, we identified the patterns of transformation through comparing the changes that happened to work processes of all licensing offices. Next, we used the theoretical framework proposed earlier to evaluate these patterns of changes. Finally, we extended the framework to conform empirical data of the case.

4. THE CASE

Located in Southeast Asia region, Vietnam is a low-income country with annual GDP per capital equivalent to approximately 2000 USD. As a tropical country, Vietnam faces high risks of deadly infectious diseases such as dengue fever, malaria, tuberculosis etc. The recent economic reform has significantly increased the people's income and thus drastically changed their nutrition regimes and life styles especially in urban areas. These changes, however, results in a surge of non-communicable diseases such as diabetes, hypertension, and heart problems. All these factors have tremendously overburdened the country's weak and vulnerable healthcare system. Overall, chronic problems such as fatal epidemics, hospital overloading and errors, bribery, and corruption, health professional neglects and incompetence are rampant and seemly out of control [13-17].

In an effort towards strengthening and upgrading the healthcare sector, a law on medical treatment and examination was passed by the Vietnam Assembly in 2009. The process of building the law involved support and wide participation of international aid agencies and other social civil institutions. To effectively implement the law, a computer-based information system was required as it could resolve the following issues related to medical health professionals management: a) Only qualified persons with sufficient training and internship are allowed to practice independently b) Continuous Medicine Education (CME) is a prerequisite for license lifetime validity c) To ensure that each medical practitioner has no more than one license.

The support from the international aid organization to health human resource development also included financial resources and expertise to build a software system. Originally, an international tender was planned to opt a qualified software firm for this task.

However, as the bidding process took too long and to fill the urgent need for licensing offices across the country, a local team was founded to build a prototype of licensing management system by adapting an open source platform specially designed for health care. The construction of this software system had followed the bootstrapping [18] and participation [19] approach, targeting firstly one provincial licensing office. The system was well received by the community of licensing officers in the country. Its implementation was rapidly expanded and reached national scale in a short time. The geographical expansion of the implementation went together with the enhanced functionality that the system could offer as well as server infrastructure and user training and support. The process is described in the next section.

4.1 Transformation in the first pilot province

The implementation in the first province was following a small and incremental approach. Basic functionality was provided at first to attract user engagement. New functionality was added in a piecemeal way and in the close participation of the users. Apart from being placed in the back office, the system was also placed at the reception desk for initial registration of applications. This design thus helped to integrate the process of receiving and processing licensing applications. Due to this, licensing officers were liberated from the daunting task of registering the application in the system. Instead, they could focus on application processing which would at the end shorten the processing time.

As applications were registered into the system, information of applicants became available for automatic receipt printing, which has significantly reduced the time for manually writing a receipt. The cloud-based deployment of the system has allowed the licensing officers working from everywhere at any time with a computer that has Internet connection. Instead of being confined to their physical office during the office hours, they could work from home at their convenience, i.e. early morning or late night.

4.2 Transformation in other 5 provinces

The positive feedbacks from the first pilot province had convinced health authorities to expand the implementation. The donor also provided funding for such expansion. Five more provinces actively joined this implementation. When the system was brought to the new province, the standardized processes which were formulated in the first province were transferred to these new provinces as well. To cope with diverse work practices in these new

provinces, a large part of the system was redesigned with generification and flexibility, which makes the system become more adaptive to local contexts. The important set of these features included highly customizable reporting templates and data entry forms. For example, the list of documents accompanying each licensing application was flexibly designed so that it could be defined according to the requirements of a particular province.

Despite being varied in their own practices, new provinces started to use the licensing system to assist their work which resulted in a drastic transformation of their daily work practices. Built-in reports with customizable parameters helped to reduce significantly time spent for processing an application. For example, writing and printing rejection letters was just a matter of one click rather than hours spent on composing and printing a letter as in the manual process.

4.3 Transformation during the national implementation

After the pilot in 6 provinces, the donor sent a group of consultants to the provinces to evaluate the implementation. Observing the positive results, the consultants made a recommendation to MoH and ADB to approve the system. In two national workshops about licensing management, the team managed to use the time slot allocated to them to introduce the system to all the provinces. Following that, the Vice Minister signed an official dispatch to all provincial health departments, requesting a limited national pilot with the registration of 150 applications in each province. At this point, the system became present on a national scale. The configurable settings built into the system made it easily transferable to other provinces. Still, there were various clashes between the system and the local practices.

A group of provinces which had used ISO to standardize their licensing processes demanded similar functionality from the licensing system. To respond to that need, the technical team extended the system by building a new set of functionality which allowed defining ISO stages, rules of transition between stages, assigning stages to corresponding licensing officers, etc. Thanks to the flexibility of this feature, provinces could choose one of the two processes or even run two processes in parallel. The ISO functionality was built to meet the demand of two provinces; however, later on, another province was also interested in using this functionality.

Another challenge that the technical team faced during the national implementation was converting legacy data in MS Office format (Excel, Word, Access etc.) to the central database system. The shortage of human resources was pervasive in all licensing offices and

the growing number of applications to be processed made the retrospective registration of old applications manually to become unattainable. To ease that process, the technical team developed a tool to automatically transfer data from legacy formats to the online system. This approach became successful when provinces decided to officially use the system to replace their manual processes because one of their biggest concerns had been solved. This was an unexpected success from the original plan of MoH which requested entering only 150 applications into the online system.

During the national implementation, work practices related to licensing were transformed on a large scale. There were many deviations from the standardized processes defined and revised in the pilot provinces. Some provinces used ISO processes functionality to process licensing applications. Other provinces exported data back to Excel to review and print license certificates, arguing that such an approach was the most convenient for them. Another significant change in work practices as results of the implementation of centralized database system was the change in the verification process of fraud applications. Some health professional cheated when submitting two applications to two different licensing offices. Previously, to deal with that, licensing officers had to send a letter to other provinces to verify suspicious cases. However, this was easily done thanks to the support of the duplicate check functionality from the online system.

4.4 Transformation when engaging hospitals into the licensing ecosystem

During the national expansion, the licensing officer in the first pilot province acted as a super user who shared her experience with other peer provinces and a source of innovation. Many provincial delegates had visited the first pilot province to learn about the improved processes with the support of the licensing system. It was also the province that proposed the idea of connecting hospitals into the licensing system so that hospital staff could help to screen and register applications into the system. The technical team had built necessary functionality to allow users from subordinate hospitals to take part in the licensing process by registering applications of health professionals working at the hospitals.

Since this approach helped licensing officers significantly reduce their workload, it was warmly welcomed by provinces. The implementation team played an essential role in spreading this approach to other provinces. The expansion process was also supported by the donor through organizing many training sessions. There were nearly 100 training classes organized across the country with bespoke curriculum for participants from hospitals and

licensing offices. Aside from that, on-the-job-training and an online helpdesk were also prepared to provide timely and adequate support to users.

At this stage, the transformation happened at three levels of the health system regarding the medical licensing activities. At the hospital level, staff responsible for human resources had to register applications into the system and after that transferred paper-based documents to provincial licensing offices for processing. At the provincial level, licensing officers now focused only on the processing part as the registration of applications was done by hospitals. This transformation also had an impact on health professionals as they did not have to go to licensing offices to hand-in applications like before.

This section discussed the transformation of work practices happened at all levels of the health system in different states of the scaling of the licensing system. In the next section, we analyzed our case using the framework proposed earlier.

5. ANALYSIS AND DISCUSSION

The successful introduction of an IT application to assist licensing management in Vietnam has resulted in a significant change in the routine daily work practices at both individual (licensees, licensors) and institutional levels (hospitals, licensing offices).

5.1 Institutional tendencies

5.1.1 Time and space separation

The introduction of the licensing system has facilitated the process of separation of time and space. Previously, licensing officers had to go to their offices during office hours to work. However, after the licensing system was deployed, this routine became more flexible. Because the licensing system is web-based, it can be accessed from anywhere at any time. It means that licensing officers did not have to come to their offices to do their work. When analyzing access logs of the system, we saw many accesses which were done outside office hours as well as during weekends. The positive effect of this separation process was that it offered licensing officers flexibility and freedom to carry out their work at their convenience.

5.1.2 Requiring new trust system

When emails and mobile phones become ubiquitous, modes of communication between governmental organizations also change drastically. Emails and mobile phones are substituting face-to-face meetings, faxes, and paper-based dispatches. These new forms of

communication require new trust systems. This also applies to the licensing system implementation. In this case, user accounts were used for both authentication and authorization. The licensing system was setup behind a secure socket layer (SSL) to increase security and protect confidential data.

5.1.3 Institutional reflexivity

IT is an enabler of knowledge generation, which again triggers reordering of social relations caused by such new knowledge. In the case of the licensing system, there have been many debates which were direct results of the introduction of the system. For example, MoH many times wanted to have summary reports on the number of health professionals divided by specialties such as internal medicine, surgery, pediatrics etc. However, there were no a standardized lists as very province defined their own list of scopes of practice that were not interchangeable and directly comparable with others. When data from provinces were put together, many discrepancies were discovered. Hence, both MoH and provinces realized the need to standardize the definitions of the scope of practices across provinces so that a national list that could be shared across licensing offices.

5.2 Self-identity

5.2.1 Concerns for deskilling and existential anxieties and with IT adoption

The penetration of IT technology in all aspects of day-to-day life leads to deskilling and existential anxieties to individuals. In our case, electronic government (e-government) is promoted by top politicians as a means to reduce the number of people working in the public sector. There have been many complaints about the too big but inefficient bureaucracy. As licensing applications could be entered from hospitals, the administrative staff of the licensing office could be made redundant and should be merged with other departments. As a result, some staff may lose their jobs. So in this case, deskilling is part of the government's plan to improve the efficiency of its bureaucracy.

5.2.2 Opportunities for reskilling and empowerment

However, IT introduction could also result in demand for emerging skills. There are always opportunities for reskilling and empowerment based on past experiences and knowledge about the context that ones have accumulated. In our case, although it was challenging to be reallocated other jobs in the public sectors, administrative staff could move

to the private sector and use their skills and experiences to join the labor market. There were possibilities for other more skilled jobs in the same settings such as data analysis and data mining on the medical licensing databases. This, however, required additional training and staff could be empowered for future career opportunities in the knowledge economics.

5.3 Work practice transformation in the context of HISs in developing countries

5.3.1 Transformation as a negotiation between system development and work practice

We argue in this paper that the transformation of work practices is not fully determined by the IT applications but a result of processes of negotiation between system design and work practices. As a design rule, IT system that supports the current work practices has a higher chance of success. However, if an IT system does not bring change to the current work practices, there are not many benefits when implementing such a system. Therefore, there must be a pragmatic balance between changes and IT system design. In the context of large-scale and complex systems [20], it is very challenging to attract first users due to the bootstrapping problem [18]. Designers of IT system must identify solutions that are low hanging fruits and the group of users that are most motivated and knowledgeable and enroll them into the systems. To do that, the system must be able to provide functionality that these users urgently need, the low hanging fruits.

In the case of the licensing system, the participation design in the first pilot province was indeed the negotiation process which identified what functionality should be built first and how it could affect the work practices in the province. The same process was applied when the system was scaled to the other five provinces. To cope with diverse requirements, the system was made generic with many configurable parameters. There is a dilemma here. Systems should be less invasive to grow quickly but significant changes are required to improve the efficiency of the work practice. This is a challenge that designers must address.

5.3.2 Diffusion of transformation: work practice changes in one province are transferred to other provinces

As analyzed earlier, work practices transformation can be negotiated between the provinces and system designers. However, the process standardized in the first pilot province was applied in many other provinces. The explanation could be from the historical factor. The pilot in the first province was lasting for nearly one year with full participation from end-users. This allowed the system and work processes to be revised and generalized and thereby

making it easy to adapt them to environments in other provinces. The diffusion of the new work practices was catalyzed by many visits of delegates from other provinces to the first pilot province. Apart from that, the implementation team also played an important role in spreading work practice changes. Through training and consultation, the team helped provinces understand the system and how to best align their current work practices to the computerized system. For example, many provinces switched to process applications directly on the software rather than print them out and do it manually. Through the use of review list functionality, licensing officers could easily filter and search applications, sort applications by the due date, and give priority to some applications which should be processed first.

5.3.3 Transformation flexibility: each province has its own adaptation and transformation

In the licensing system, there are many groups of users, i.e. provinces, with diverse requirements. In our case, the changes in these provinces after introducing the licensing system could be classified into three groups: minimalist, full-stack process, and ISO-oriented.

5.3.3.1 Minimalist

There was about a quarter of licensing offices using this approach. Receiving data entered by hospitals, licensing offices in this group used the export functionality in the system to dump monthly data to Excel files. As most of the licensing officers in these provinces were familiar with Excel, they could use it to review and print license certificates. This is considered as a minimalist approach when the interaction with the system was reduced to a minimum.

5.3.3.2 Full-stack process

Many provinces used the system in a standardized way comprising a number of steps: receiving applications, compiling a list of applications for committee review, approving applications and printing certificates. This process was streamlined from the pilot in the first province and gradually introduced to other provinces. In this approach, licensing officers performed most of their tasks in the system: searching an application, reviewing and making final decisions.

5.3.3.3 ISO-oriented

Few provinces demanded a full support for ISO processes. In these provinces, organization-wide processes were standardized based on ISO and certified by independent ISO certification bodies. Medical licensing was part of the whole processes so it needs to follow what had been pre-defined. The medical licensing system was extended to meet this requirement. The support from the system helped the licensing offices in these provinces to ensure the ISO processes were followed strictly. Therefore, there was a divergence in work practices transformation across provinces. Depending on the contextual conditions, changes were enacted differently from province to province.

6. CONCLUSION

In this paper, we applied and extended a conceptual framework relating to work transformation to develop more insights into the interplay between IT introduction and large-scale work practice transformation in the healthcare sector countrywide. Practically, the paper raises a number of issues for consideration by designers such as the balance between changes and scaling, the diversity of transformation, and the diffusion of change models. The framework of work transformation was extended mainly through using empirical data from the health care sector in Vietnam. Therefore, future research should focus on validating and extending this framework with more diverse empirical cases. For example, future work can identify additional dimensions of the transformation in other countries or in other domains rather than health care. Future research should also aim to operationalize each of the dimensions into a more detailed level. For example, it should answer questions such as what are the conditions that enable the process of diffusing work practice transformation and how to organize it effectively.

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