E-PROCUREMENT SYSTEM ADOPTION UNDER SUPPLY CHAIN MIGRATION: A CASE STUDY OF TAIWANESE NOTEBOOK COMPANY

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Abstract

This study examines the post adoption of technology and explores why technology may not be sustainable in organizations after its deployment. In contrast with previous studies, which emphasize technology improvement, users' post-adoptive behavior, and organization adaptation, this research offers a practice-based analysis and suggests that architectural innovations may bring about a fundamental transition in organizational practices and collaboration patterns. This transformation in organizational principles renders technology obsolescence, and precludes a superficial change in technological features. This case study analyzes an e-procurement system deployed from Taiwan to China and investigates why the initial success of technology use was not transferred to the later application. The technology use within supply chain migration provides a useful context to understand problems of technology sustainability. Important implications are provided to enhance the theoretical development of post technology adoption. Practical insights are discussed with regard to supply chain changes.

Keywords: Case Study, Technology Adoption, Practice-Based Analysis, E-Procurement Systems

1 INTRODUCTION

Enterprises often spend enormous resources in building and implementing information systems to streamline their supply chain, enhance customer services and enable process innovations. Although they could overcome people resistance, contain implementation risks, align technology with business processes, and promote technology diffusion, the information systems initially built to support organizational practices may not sustain the new challenges brought about by continual organizational growth within the fluid business environment. In many occasions, over time, technology may become outmoded, post-adoptive behavior altered, and business processes changed.

More importantly, the evolving technological environment may fundamentally modify organizational configuration as technological change renders an entirely new production model (Henderson & Clark 1990; Eisenhardt & Tabrizi 1995; Richard & Devinney 2005). In this situation, advancing technological features may fail to align with the underlying shift in the organizing principles and systems of governance (DeSanctis & Poole 1994; Zammuto et al. 2007). Technologies may therefore become obsolete even when they are constantly improved and upgraded. However, the current literature has not yet explored this technology obsolescence issue in detail.

For this reason, this study proposes the research question: Why may technology become unsustainable to support organizational practices, after successful implementation and use? Using qualitative methods, this study examines an adoption of e-procurement system designed to support a large-scale supply chain migration, from Taiwan to China. The findings suggest that technology can become obsolete not because of outmoded technology features but because of a fundamental shift in the collaboration pattern.

2 LITERATURE REVIEW

Is technology effective after it is adopted and used? Executives rarely consider this question. Most companies are more concerned with how to encourage technology acceptance (Lapointe & Rivard 2005), minimize implementation risks (Markus et al. 2000), and enlarge technology adoption and assimilation (Fichman 2000; Rai et al. 2009). Their major concern is using technology and ensuring that it functions effectively as anticipated. Few executives consider whether technology is still useful and relevant after it is adopted.

Technology visionaries suggest that migration of legacy systems is necessary so that technological application potential will not become obsolete and underutilized. Practically, such obsolescence is a result of technological evolution as newer technologies appear and older ones cease to be used (Wang 2010). Moreover, the difficulty in predicting timing and costs of technology migration match the unpredictability of technological obsolescence itself.

Scholars of post-adoptive behavior look beyond the ephemeral nature of technology capabilities, and examine the critical role of users in IT continuance (Karahanna et al. 1999; Bhattacherjee 2001). In this view, sustained technology must pay close attention to different stakeholder groups (e.g. end-users, implementers, and managers) and their individual differences (e.g. age, gender, and education). This is because the way stakeholders make sense of technology (e.g. compatibility, ease of use, task fit, and social impact) during the post adoption period inevitably affects their subsequent behavior in adopting technology (Jasperson et al. 2005; Ortiz de Guinea & Markus 2009). Post-adoptive behavior analyses essentially examine what influences the degree to which current stakeholders of installed technology applications learning, use, and extend the full range of features built into these applications. The emphasis is on technology features and users' sense-making (cognition). However, few analyses examine the IT continuance from organizational level.

Technology also becomes obsolete also due to organizational evolution (Pettigrew 1990). This is because organizational structure, business processes, corporate strategy, and people's roles and responsibilities may change over time (Scott-Morton 1991). In this case, technology adaptation may not keep abreast with organizational changes. Research on technology alignment also suggests that technology should renew constantly to reflect changes in organizational configurations (Sabherwal et al. 2001; Soh & Sia 2004).

Nevertheless, changing organizational forms and functions may not necessarily reflect the temporal shift in organizing principles, knowledge structures, and work practices (Orlikowski & Yates 2002). Meanwhile, the shift in institutional context could also invite architectural innovation and redefine production methods (Henderson & Clark 1990; Eisenhardt & Tabrizi 1995; Richard & Devinney 2005) which in turn reshape organizing principles and collaboration patterns. In these circumstances, technology designed to support the original forms and functions might fail to sustain new organizing principles resulting from the temporal shift. Hence, technologies become obsolete, not because systems are not updated in accordance with new business processes, but because of the incapacity to support new organizing principles and practices (Schultze & Orlikowski 2004).

For this reason, a theoretical gap exists in the current literature. An important research endeavor could investigate how technology fails to sustain shifting organizational practices within a dynamic business context over time. This question requires a practice-based view which focuses on shifting practices and examines institutional environments which induce those shifts in practices (Orlikowski 2000).

3 RESEARCH PERSPECTIVE: PRACTICE LENS

Practices can be understood as ongoing human activities informed by shared institutional meanings. Studies on technology adoption have considered that the perspective of practice theory can be applied to explain the relationship between organizations adopting a technology and carrying out organizational activities. Overall, two approaches contribute to this relationship.

The first approach is the point of view based on the embedded practices, as demonstrated in the early research of Barley (1986) and DeSanctis and Poole (1994). This approach views technology as a part of social structure, which influences organizational practice and the roles of actors in an organization when it adopts a technology. According to Barley (1986), the social practices are reproduced as technologies develop and adoption. Inventors are influenced by the societies they belong to, and in turn, they embed this social practice in their inventions. However, while technology is adopted by another group of actors, the embedded practice impacts the organizations or actors using the technology. Although this approach takes into account the social practice embedded within technology and its influence on the practices of organizations, it does not consider the continuously changing relationship between the institutional conditions and social practices (Bourdieu 1977; Giddens 1984).

Thus, the second approach focuses on shifts in practice, and believes that, while the practices embedded within technology are the norms provided by technology developers for users to engage in action, the actual environments for organizations are continuously changing, and thereby the organizational practices are not static.

More specifically, this approach divides the relationship between technology adoption and practice into two aspects. First, technology developers embed practices into technologies. Yet the embedded practices are only a set of behavioral or organizational models for actors considered applicable by the developers, which may include knowledge about how to precede a certain practice, resources required to complete the practice, and principles that should be followed during the practice. In other words, the real meaning of the embedded practices of technology is how technology developers expect organizations or actors to engage in practices based on their ideals.

On the other hand, however, for organizations or actors, the real practices always change with the institutional and organizational environment. The practices fixed within technology can no longer satisfy the needs of organizations or actors. Under the circumstances, organizations or actors tend to form another system of social practice, which enables them to endure changes in the environment.

Hence, no matter how delicately the practices are embedded within technology, to the organizations or actors, the embedded practices can not predict alterations in the institutional and organizational environments. Although developers can adapt the technology to match changes in the environment, through functional upgrades or customization, no fundamental changes can be made to the basic structure of technology. Consequently, from the perspective of shifting practices, the inapplicable technologies may not arise from the undeveloped functions of technology or from the different perceptions of users. This is because the practice embedded within a technology, as an ideal behavioral or organizational model, has a strong assumption in terms of the model it offers; the model not only assumes the status of the institutional and organizational environments to which the organizations or actors belong, but also presumes the scope of the practice. In this study, based on the approach of shifting practices, the study analyzes why an e-procurement system can not be sustaining adopted with a change in the institutional context, and demonstrate how this system become inapplicable when there is a migration in the supply chain activities.

4 RESEARCH METHODS

The qualitative methods this study uses reflect an interpretative stance, which seeks to explore temporal restructuring of organizational practices (Klein & Myers 1999). The aim is to assess critically the taken-for-granted organizational phenomenon and underlying assumptions. This research examines technology sustainability in the post adoption period and suggests an alternative to understanding technology obsolescence problems within a dynamic organizational context.

4.1 Research Setting

This research focuses on a national technological initiative, called “Project Vitamin” in Taiwan. The project objective is to implement e-procurement systems to help manufacturers maintain supply chains efficiency, from Taiwan to China. Project Vitamin includes 15 key Taiwanese personal and notebook computer makers. Project Vitamin also implements RosettaNet to establish a data exchange protocol and uses SupplyLink (a disguise name) – an international leading software – to support procurement practices including order management, delivery, supplier relationship management, and payment management.

The implementation and deployment of Project Vitamin was successful (1999-2003). The project did not encounter serious resistance and suppliers reported effective use of the system. However, the continual use of SupplyLink encountered great difficulties during 2004-2006, as most companies began to extend their supply chains to China. In the latter part of 2006, most suppliers only applied the system to coordinate administrative matters. SupplyLink, a system which promises to link up manufacturers and suppliers, began to ring hollow.

Hence, an interesting question: Why did SupplyLink become obsolete and fail to support migration of the existing supply chain? The study examines this problem from a practice-based perspective, requiring an analysis of procurement practices before and after migration, and identifies the transformation within the organization’s collaboration patterns. Through the practice lens, this work gathered and analyzed data in the following ways.

4.2 Data Collection and Analysis

The fieldwork for this study chose NoteCom (disguise name) and traced their procurement practices along the supply chain because the firm is a major stakeholder in Project Vitamin, among the 15 makers. Through a senior executive in NoteCom, I visited the MIS department and examined the implementation process and adoption issues. Knowing that the system, SupplyLink, would be transferred to mainland China by July-August 2005, I began tracing the transfer process with regards to the technology interface and adaptation problems. In tandem with tracing the technology transfer, I interviewed the sourcing and procurement staff to understand practices related to supplier selection, product categorization, and logistics (before the migration). Through the firm’s referrals, I visited their key suppliers to understand their daily procurement practices and later became acquainted with the R&D department to observe how components and suppliers are chosen within the product development process. By September-October 2005, I revisited the MIS department to obtain information about users’ post-adoptive behavior and business process modification. Subsequently, a vice president from the firm's Global Logistics Centre, who manages mainland China procurement operations, helped us understand the problems occurred in the China sites. Using face to face interview and teleconferences, I visited procurement people at China sites. This helped me appreciate the challenges of procurement operations in China and technology use problems. I also interviewed inventory specialists, and explored VMI (Vendor Management Inventory) practices employed in two major warehouses in China.

In addition to these formal interviews, I also conducted participatory observation and examined other field-based data. For example, I obtained government reports from MOEA (Ministry of Economic Affairs) and III (Institute for Information Industry) to understand the assessment of Project Vitamin (four whitepapers). As an observer, I also participated in NoteCom's procurement meetings, which helped me understand how BOM (Bill of Materials) is incorporated into the system, how procurement conflicts are resolved, and how cross-boundary collaboration occurs in situ.

The data analysis paralleled the data collection process in a reiterative way in three phases. The first phase involved mapping the project's chronicles, which traces the key events of technology implementation, user responses, and supply chain migration. While developing a good understanding of the project, this work began to investigate the procurement process in the second phase. Applying the practice lens, this work traced procurement activities, focusing on "design" (supplier selection), "buy" (material purchasing), and "delivery" (logistics). These three practices formed the core of supply chain procurement and signified the production model employed by NoteCom. In the third phase, this work analyzed data according to two periods: before and after supply chain migration (from Taiwan to China). This third phase identified that SupplyLink could not sustain NoteCom's procurement operations, not because of offshore migration, but because a major technological shift occurred in this period – an environmental change which induced supply chain migration. A third round of data gathering analyzed how such a technological trend may impact procurement operations, rendering a restructuring of design, buy, and delivery practices. With the analyses, this study examined problems within procurement practices and their influences on technology use.

5 RESEARCH FINDINGS

The findings include two phases, indicating changes in procurement practices. This arrangement elaborates major technological shifts in the institutional context and its subsequent impact on the collaboration pattern. The first section explains the case background; the second and third illustrate the shift in three procurement practices; the fourth section analyzes the impact of changing the collaboration pattern for technology use.

5.1 Case Background

NoteCom has provided ODM/OEM services to international buyers such as Acer, Dell, HPQ, IBM and Toshiba. By 1999, NoteCom participated in Project Vitamin and became a leading player. NoteCom spent 1.5 years (December 1999 – May 2001) for system implementation and another six months (May 2001 – December 2001) to ensure smooth adoption. In total, SupplyLink helped NoteCom connect more than 400 suppliers, coordinated procurement operations, boosted procurement efficiency and reduced administrative costs throughout 2001-2004. The heightened market competition required NoteCom to transfer its supply chain activities to mainland China, like many other manufacturers. Supply chain migration enlarged the production capacity scale and expanded the supplier base. NoteCom extended system capacities to consolidate procurement operations in both locations. The system was not unfamiliar to the MIS department and implementation took only two months to complete (July-August 2005). However, the system did not produce the former benefits for NoteCom's procurement operation. The purchasing staff found the system "inapplicable" for supporting their tasks in mainland China. A purchaser explained:

> *SupplyLink produced wrong purchasing orders. The purchasing orders were mismatched with our requests from production line requests. We could not modify the order because an*

altered order requires a series of changes for all materials. We ended up using telephone to confirm purchasing orders.

NoteCom subsequently adjusted the business processes and modified system functions. But these efforts were in vain. A senior executive noted his confusion:

In Taiwan, SupplyLink effectively supported our operation. We have transferred the exact manufacturing processes from Taiwan to China. The procurement model remains the same; the only difference is that the scale of operation in China is larger. It is not really a complex system for us, and we have customized the system to fit our operation in China. Why is SupplyLink not working? It doesn't make sense.

To make sense of this confusion, it is necessary to look at the macro-environment shift and its influence on procurement practices.

5.2 Period One: Before Supply Chain Migration (1999-2003)

Institutional context: Generally, notebook computer production required more sophisticated technical know-how than the desktop computer, as it needed to put all components into a much smaller space. Resolving magnetic interference, heat emission, and power consumption thus became important issues for the R&D department. For NoteCom, the average product development cycle was about six months, and much time was spent resolving technical interface problems.

During this period notebook computer construction consisted of seven main modules: CPU (Central Processing Unit), North Bridge, South Bridge, case (mechanical frame), motherboard (in which all electronic components are based), cooler module (e.g. fan), and peripheral devices. The first three modules formed the core product technology, which are circuitries embedded in micro-chipsets. The modules function as follows. The CPU oversees calculation and control, the "brain" of a notebook; North Bridge contains chipsets which process high-speed data transmission, memories, display and graphics; South Bridge holds chipsets for supporting data input and output (e.g. receiving data from the keyboard and sending data to monitor). These three core modules are connected in sequence, in top-down fashion: CPU is connected with North Bridge which connects to South Bridge. Specifications for the North Bridge chipsets are closely related to CPU, mainly produced by Intel during the early years.

The technical capability of notebook computer production was relatively immature, compared to that of the desktop computer. Although there was market potential, customer demands were relatively manageable. Most international buyers relied on Taiwanese makers to develop new product designs and arrange production capacities. For NoteCom, difficulties mainly involved finding capable suppliers to participate in the product development stage. The CPU experienced few problems, but how CPU connected with North Bridge chipsets and how effectively North Bridge chipsets could interface with South Bridge chipsets were major product design issues. NoteCom often invested enormous energies to resolve circuitry compatibility issues emerging from constructing CPU, North Bridge, and South Bridge.

Procurement practices: In this technical and business context, NoteCom's emphasis was on finding capable suppliers and collaborating with them to resolve technical design problems. Such problems were of major significance because NoteCom's design engineers needed to work closely with these suppliers to design circuitry layouts so that CPU and North Bridge chipsets could work smoothly. This kind of collaboration was not limited to trouble-shooting problems but might also involve a complete revamp of chipset design (hardware) and re-programming chipset drivers (software). More often, suppliers might have to engage in detailed interface design. For instance, a change in a specific chipset driver in North Bridge might affect other electronic components in South Bridge, calling for a redesign of cooler modules. As a whole, design engineers were concerned with design compatibility, in both hardware and software devices. As an R&D engineer noted:

In putting together a product prototype, we do not need a "cheap" supplier (i.e. offering low costs) but a "capable" supplier. The suppliers' technical capabilities determine whether the product will work or not. They need to know how to work with us, understand *our design, and react to engineering changes as problems emerge. Even when we select general materials suppliers, we also evaluate their technical capabilities. For example, you may have ten suppliers offering cooler modules; but their R&D capabilities may vary. On average, for each material, we take only three suppliers, and we choose them solely on the technical assessment report.*

After the R&D department selected "capable" suppliers, the list was sent to the purchasing department for price negotiation. Suppliers included in the AVL (Approved Vendor List) provided detailed component specifications which were then entered into the BOM (Bill of Materials) in NoteCom's material requirement planning systems. At this stage, NoteCom's engineers collaborated reciprocally with different supplier groups to ensure "manufacturability" – that is, to validate that the product design was not too ideal to manufacture. If incorporating more advanced features was necessary, such as adding handwriting devices, engineers assembled an army of suppliers to resolve a more sophisticated technical design. As a result, suppliers frequently visited R&D engineers to explain their new product technologies so that these components could be procured by the purchasing department. Under non-disclosure contracts, R&D engineers transferred technical know how to suppliers to ensure minimal design incompatibility. Procurement mainly involved sending R&D engineers regularly to suppliers' factories for knowledge sharing and competence inspection. One purchasing engineer remarked:

We have a minor role to play in procurement. R&D people tell us which suppliers are chosen. R&D people call the shots. They visit suppliers on an ongoing basis to assess their production capacity, work environment, quality control, operation management, materials distribution, technical services, etc. With the data, we rate the suppliers to anticipate responsibility allocation in case things do not work well.

Before migration, NotCom's manufacturing was largely based in Taiwan, where the computer industry is clustered in the north of Taiwan. To react to fluctuating demands from buyers, NoteCom set up a quick response production model, illustrated by a procurement manager as follows.

Initially a buyer may place an order with us. While filling this order, the buyer may transfer another order to us because another maker, one of our competitors, has some production problems. However, we do not have the materials to manufacture this additional order. So we place urgent requests to our suppliers to produce extra components, or ask them to source the materials from elsewhere. While filling the second order, the buyer might reduce the order due to unsatisfied sales in the market, while our suppliers keep fulfilling the urgent order. Since we cannot return the materials to suppliers, we have to ask them to send the materials to us for the next batch.

To respond to this flexible production, NoteCom developed a "purchasing via forecast and delivery by JIT (Just-in-Time)" model. In preparing production capacities, NoteCom worked closely with suppliers to forecast total material requirements. NoteCom allotted a one-month lead-time for general components and three months for specialized materials. Therefore, when the buyer placed an order, NoteCom's aim was to fulfill the order as soon as possible (before they reduced the order again). To smooth fluctuating material demand, NoteCom asked suppliers to look at the "big picture" and shift inventories to the suppliers' sites. This model also encouraged suppliers to establish production facilities nearby NoteCom's manufacturing base. Nevertheless, materials consumption was relatively predictable.

Hence, NoteCom could act as a production integrator as most materials could be delivered in days (or hours). To make this an effective model, NoteCom relied on suppliers for quality assurance and timely material supply. Since NoteCom had established mutual knowledge with its suppliers over time, such "purchasing via forecast and delivery by JIT" was very effective to secure production efficiency.

5.3 Period Two: After Supply Chain Migration (2004-2006)

Institutional context: 2003-2004 marked a major transition for notebook computer's product technology. This transition included two driving forces: notebook computers' rising demands and advancing product architecture. The market potential attracted major fabrication firms, such as Intel, AMD, VIA, and SIS, to invest R&D resources into developing microchips which are proprietary notebook computers. These chipsets were different from those of the earlier stage, designed mainly for desktop computers. The new CPU generations brought about standardized interface protocols (thus fewer problems incurred in integrating chipset drivers) and modular chipset designs.

As a result, microchip fabricators developed official design guidelines for notebook makers and suppliers. These guidelines made it easier for R&D engineers to consolidate CPU with North Bridge and South Bridge chipsets, which in turn reduced the complexity of solving problems related to memory chips, heat sink, radiation, power consumption, and PCB (Printed Circuit Board) layout. The fabricators also sent out FAEs (Field Application Engineers) to help makers and suppliers resolve chipset design problems. The implication was for standardized product architecture and R&D engineers shifted their concerns from design-for-manufacturability to system integration issues.

In the meantime, buyers' worries also shifted from product reliability to production volume, as the notebook computer market enlarged rapidly. This pressure pushed down to makers and suppliers. Makers were not only concerned with the speed of filling orders, but also with their capacity for producing large numbers of computers for the market.

Procurement practices: For NoteCom, the first impact of this environmental shift was product development. R&D engineers did not have to worry about compatibilities between different chipsets. The official deign guidelines helped them resolve these problems. As a side effect, the new generations of peripheral devices also followed the design guidelines published by microchip fabricators. As product architecture became standardized, R&D engineers did not have to employ specialized materials and components for product design. Nearly 80 percent of components became commodities.

In early product development, component replacement (e.g. a chipset) involved design changes, which required redesigning product architectures and endless teleconference calls with different component suppliers. Worse still, it re-launched architecture design, product prototype, and technical testing. A change in any component involved technical reformation and supplier knowledge exchange. With new generations of CPU, which integrated most chipsets and peripheral devices, component replacement meant finding an alternative supplier responsive to material delivery and ensuring product quality. As a result, supplier evaluation no more depended on technical capabilities but on price, quality, services, and delivery terms. A purchasing manager explained NoteCom's new practices in their supplier selection:

> *Every six months, we conduct a major supplier review. Our department gathers comments from R&D and production engineers to understand suppliers' past performance. This includes delivery agility, friendly prices, and market dynamic knowledgeability. We have a TQRDC (T: technical; Q: quality; R: responsiveness; D: delivery; C: cost) table to score their performance so as to reset out purchasing priorities for the next half year.*

The procurement engineers also took an active role in purchasing. After migration, total production capacity of the three China sites was four times larger than that of the Taiwan site. The key challenge was to expanding supplier bases with a larger production volume. As NoteCom moved to the Kun-shan industrial park (central China), most suppliers also followed. Except for a few suppliers who established production facilities nearby NoteCom, most Taiwanese suppliers based themselves outside of Kun-shan for tax avoidance issues or cost reduction reasons. Procurement engineers worked with incumbent suppliers as well as new suppliers – including migrated suppliers and newly developed Chinese suppliers. The centralized procurement organization soon became ineffective. By late 2004, NoteCom established a decentralized procurement organization and split the two procurement functions – with "sourcing" (qualifying suppliers and negotiating prices) controlled by the Taiwan office and "purchasing" (arranging deliveries and monitoring suppliers) delegated to individual factories. As most components became standardized commodities, the purchasing staff performed technical tests independently without calling R&D engineers and incurring product revamp.

The new procurement organization also altered NoteCom's delivery practices. The original JIT delivery model was insufficient for the expanded production scale. Especially the three factories in China had to cope with long-distance logistics for materials supply. For about 20 percent of materials, NoteCom's purchasing engineers applied "near delivery" and worked with suppliers surrounding Kun-shan city. Each supplier assigned a liaison officer to each NoteCom factory. Procurement staff sent purchasing orders to suppliers and liaison officers at the same time. As suppliers used NoteCom's factories for inventory, the liaison officers' job was to ensure optimal delivery of materials in each batch so that each factory could maintain material inventories for a one-day stock level.

For the remaining 80 percent of materials, NoteCom employed "far delivery" and outsourced inventory management to third-party logistics providers. This avoided complex domestic taxation and regulatory constraints. NoteCom collaborated with two third-party logistics providers to offer VMI (Vendor Management Inventory) services, called "hubs" by procurement engineers. NoteCom authorized the VMI staff to monitor the inventory. In this situation, NoteCom did not deal anymore with suppliers but interfaced with "hub" specialists to maintain a 5 percent stock level (ensuring 30-day non-stop fulfillment).

5.4 Collaboration Patterns and Technology Obsolescence

The investigation of supply chain migration provided important clues for understanding post technology use difficulties. By examining procurement practices, this study identified three major shifts in the collaboration model (see Table 1). First, NoteCom shifted its "design" practices from R&D-oriented to production-oriented supplier selection. In the R&D oriented model, NoteCom engineers selected capable suppliers and involved them in product development processes, including extensive knowledge sharing and cross-boundary collaboration to deal with compatibility problems among CPU and components.

	Period One (1999-2003) Before Migration	Period Two (2004-2006) After Migration
Institutional Context	*Technological shift*: Notebook computer product innovation was relatively immature, which is mainly transferred from desktop computers.	*Technological shift*: The architecture innovation in integrated CPU induced modular product and standardized components.
Collaboration Pattern		
Design: Product development practices	• R&D-oriented • Supplier selection based on technical capabilities	• Production-oriented • Supplier selection based on product quality and standards conformity
Buy: Purchase practices	• Selective procurement • Centralized organization	• Free market procurement • Decentralized organization
Delivery: Logistics practices	• JIT • Near range logistics	• VMI • Offshore logistics

Table 1. Practices Before and After Supply Chain Offshore Migration

This model assumed pre-selected suppliers, a preconfigured bill of materials (component databases), and a database designed to deal with complex system specifications. The definition of product specification for the system database involved reciprocal knowledge sharing between NoteCom R&D engineers and suppliers. However, this system became less useful when NoteCom needed to deal with constant changes and supplier base expansion, involving standardized product specification. In other words, SupplyLink dealt with data structure complexity while the new collaboration model required systems that could handle extensive database updates in enormous volume.

Secondly, NoteCom shifted its "buy" practices from centralized to decentralized (and distributed) material purchasing. The original model assumed a socially embedded relationship with suppliers. SupplyLink, under this model, presupposed stable transactions within which purchasing staff's role facilitated smooth transactions. However, the new collaboration model required purchasing staff to play a more active role in supplier selection and deal with sophisticated inventory control to cope with production uncertainties. SupplyLink became too rigid for purchasing engineers to interact with constantly changing suppliers, resulting from quality conformity assessment – rather than technical capability evaluation.

Thirdly, NoteCom shifted its "delivery" practices from JIT to the VMI logistics model. The JIT model assumed near-range logistics and frequent fulfillment capability. This is an end-to-end delivery requiring synchronous communication and tightly coupled operation (between production and logistics). For example, SupplyLink typically provided suppliers with a two-week production forecast and simultaneously informed the supplier of impending orders (for delivery in three days). This smoothed buyers' fluctuating additions and withdrawal of orders. Suppliers constantly monitored order status through SupplyLink to adjust their production and logistics. However, VMI required handing over inventory management functions to an intermediary. Suppliers only needed to monitor the inventory level to arrange their logistics activities. NoteCom no longer needed to inform suppliers put them on constant alert for production fluctuation. Hence, SupplyLink was unnecessary for VMI delivery and suppliers.

6 DISCUSSION AND CONCLUSION

In this study, the e-procurement system provided supply chain procurement practices; however, shifts in the institutional environment unexpectedly drove the product technology to undergo architectural innovation. This allowed the case company to develop a new collaboration model to respond to supply chain changes occurring in the environment. This situation not only rendered the original e-procurement system useless, but its continued operation negatively impeded routine procurement activities.

This case of technology obsolescence differs from the technology adoption discussed by past researchers. Past studies have found that organizations can constantly upgrade technical features (Bhattacherjee 2001), reassure post-adoptive behavior (Jasperson et al. 2005), and adapt technology to fit an organization to prevent technology from becoming outdated and ineffective (Majchrzak et al. 2000; Soh & Sia 2004). These studies emphasize that if businesses are able to continually improve technology, users, and the organization, then technology can be continuously employed. However, these studies have not yet observed how architectural innovation may bring about a fundamental shift in the organization's collaboration model and its situated practices (Henderson & Clark 1990; Schultze & Orlikowski 2004; Levina & Orlikowski 2009). Thus, in this case, even though the company strove to maintain continued progress in these three areas (technology, users, and organization), it was unable to prevent the e-procurement system from becoming obsolete.

This study emphasizes that in addition to technology, users, and the organization, enterprises adopting a certain technology must pay more attention to the institutional environment and shifting practices (Orlikowski 2000). From the practice perspective, even though the organizational actors may have the ability to execute practices, organizations are still exposed to impacts or constraints from the institutional environment. Institutional pressures that stem from the external environment require organizations to meet environmental demands to achieve legitimacy and ensure their organizational survival. Thus, from the practice perspective, the institutional environment is a major aspect of the organizing principles behind an organization's practices. Therefore, an organization's practices must adapt to the pace and scope of changes in the institutional environment. Using this argument to examine technology obsolescence, problems in technology adoption not only occur because technology, users, and the organization cannot continuously improve, but also because of traction existing between the institutional environment and practices. This study demonstrates the temporal effect of technology adoption at different periods.

The practical insight derived from this study calls attention to the change occurring in supply chain collaboration. Although this type of supply chain collaboration change was previously infrequent, in todays market environment it is quite prevalent. For example, in recent years, "NoteBook" has been repackaged into "NetBook" because of advancements in component technology. Methods in supply chain collaboration for "NetBook" may differ from "NoteBook". Thus, when the original collaboration practices in the e-procurement system are modeled in a particular way, can this old e-procurement system also be used in the supply chains of new products?

Previous studies have demonstrated that different products influence the arrangement and processes of a supply chain (Fisher 1997; Lee 2002). For example, linkages and operations within supply chains that manufacture functional products and those that manufacture innovational products will be different. A single-model supply chain would have difficulty supporting both traditional and innovative products at the same time. However, in this study, even though the same product, when changes occur in the product architecture, collaboration practices will vary greatly between before and after. Therefore, supply chains of the same product also have different collaboration models. E-procurement systems cannot be utilized to support new supply chains, because fundamental differences exist in collaboration practices in the areas of design, purchase, and delivery.

In theory, aside from complementing existing studies, this research provides a deeper understanding of the reasons behind technology obsolescence. These results also serve as a reminder to management to pay attention to the temporal effect of adopting a supply chain system. The core message of this study is that, although an organization may implement and use technology for the first few years, that technology might not always live happily within the organization, should the context shift.

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