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Abstract

IT usage is key issue in MIS research. However, a variety of models such as Technology Acceptance Model (TAM) have neglected the role of technology structure in studying IT usage. Alternatively, IT appropriation considers how IT is called into use in terms of IT technology structures. However, the practices of IT appropriation have not yet been convincingly demonstrated. This paper explores the issues of IT appropriation. Specifically, we conduct our study in the context of Server-Based Computing (SBC), due to its unique technology structures, where the issues of appropriation process of SBC becomes relevant and important. In this paper, the Adaptive Structuration Theory (AST) provides a conceptual framework that helps to capture the appropriation process. Drawing on a Taiwanese case study, three perspectives of SBC appropriation process are examined including the faithfulness of appropriation, the attitudes toward use, and the consensus on appropriation. The case findings suggest that incremental change, identity development and interaction are of critical importance in the SBC appropriation process. Our findings contribute to the literature on IT infrastructure deployment, innovation and cooperative behavior, and the social perspective of information management. The implications and future research directions are also discussed.

Keywords: Technology Structure, Server-based Computing, Adaptive Structuration Theory, Appropriation, IT usage

1. Introduction

Organizations have increasingly invested in deploying IT for administrative operations and critical business processes in their ability to deliver those IT service. Accordingly, there exists abundant empirical literature (e.g., Agarwal and Prasad, 1999; Fichman, 2004) regarding the processes, conditions and substantial impacts of IT adoption. This research stream emphasizes that IT usage is key dependent variable in MIS research (Karahanna et al., 1999). IT usage is viewed as not strictly encompassing hardware and software usage, but also the services that surround the technology and people and procedures that support their use (Taylor and Todd, 1995). Studying IT usage facilitates the effective adoption process, such as the sequence of activities and subsequent continued usage of an IT innovation.

From this perspective, a variety of models that incorporate attitudinal, social, and control factors have been advanced to explain IT usage, of which the Technology Acceptance Model (TAM) is the most well known (Taylor and Todd, 1995). Proposed by Davis (1989), TAM provides sound prediction of usage by linking behaviors to attitudes and beliefs (ease of use and usefulness) that are consistent in time, target, and context with the behavior of interest (Wixom and Todd, 2005). However, despite its predictive ability, TAM has neglected the influence of unique technological characteristics and technology structures.

Alternatively, in studying advanced information technologies (AIT), DeSanctis and Poole's (1994) Adaptive Structuration Theory (AST) focus on how IT is called into use in terms of IT's technology structure, rather than on IT usage only. AST is rapidly becoming an important theoretical paradigm for comprehending the impacts of advanced information technologies (DeSanctis and Poole, 1994; Salisbury et al., 2002). Based on AST, how IT is called into use, or appropriated, will mediate any influences that these technologies may have on the outcomes from their use. Appropriation is the process by which people adopt and adapt technologies, fitting them into their working practices (Dourish, 2003). In fact, assessment of appropriation processes is at the heart of the AST framework, by documenting exactly how technology structures are being invoked for, or constrained in use in, a specific appropriation (Majchrzak et al., 2000).

This paper explores the issue of IT appropriation. Specifically, we conduct our study in the context of server-based computing (SBC), due to its unique technological characteristics, where the issue of appropriation during its use becomes relevant and important. A large number of organizations are adopting the client/server technology to reduced development time, improve employee productivity, and increased customer service satisfaction (Amiri, 2002). However, there is much evidence that organization adoption of SBC has become one the more significant phenomena in the information technology field.

SBC is an advanced network architecture where applications are deployed, managed, supported and executed 100% on the server. According to analyst firm Forester reported in 2004, the server-based computing (SBC) market has matured, and more than 90% of Fortune 1,000 firms have deployed at least some applications on Citrix Systems MetaFrame XP Presentation Server and/or Microsoft Terminal Server (www.forrester.com). SBC gives firms a much better handle on IT security audits, so it makes it easier to comply with corporate governance laws. In addition, SBC leads to easier administration, a seamless and common experience for all users regardless of

where they log on, and a declining need to replace hardware.
Therefore, this paper explores the influence of SBC's technology structures on its appropriation process via the lens of AST. More specifically, this study intends to answer the following question: *how technology structures influence on the social interactions of deploying SBC?* This study analyzes the appropriation of SBC and presents findings from a detailed case study of a leader in Taiwanese Electronics Manufacturing Services Industry (EMSI), TIC (a pseudonym). The primary contribution of the paper is in extending our understanding of the impacts of the deep structures that exist within both the technological artifacts and the organizational context on IT appropriation.

2. AST and IT Appropriation

In studying AIT such as group decision support systems (GDSS), DeSanctis and Poole (1994) use the term appropriation, which address how IT is called into use in terms of design, use, and impact. That is, IT appropriations are not automatically determined by technology designs; rather, people actively select how *technology structures* are used, and adoption practices vary (DeSanctis and Poole, 1994). Technology structures include (1) *structural features* which are the specific types of rules and resources, or capabilities, offered by the system, and (2) AITs' *spirits* which refer to the general intent with regard to values and goals underlying given set of structural features (DeSanctis and Poole, 1994). Rooted on Giddens' (1979) structuration theory, appropriation can refer to the manner in which *technology structures* are adapted by a group for its own use through a process call structuration, wherein structures are continuously produced and reproduced (or confirmed) as the group's interaction process occurs (Gopal et al., 1993).
AST is that it expounds the nature of social structures within advanced information technologies and the key interaction process that figure in their use (DeSanctis and Poole, 1994). Essential to AST is the concept of appropriation, which is the mode of fashion in which users reproduce, or recreate for their use, an AIT (Poole and DeSanctis, 1992). Based on AST and Salisbury et al. (2002), three aspects of appropriations need to be taken into account. They are (1) faithfulness of appropriation, (2) attitudes toward use, and (3) Consensus on appropriation.
Appropriations may be faithful (the technology is used in a manner consistent with its general intent) or unfaithful. Attitudes toward use (e.g., beliefs about ease of use or usefulness) may be favorable or unfavorable. Also, consensus on appropriation (the extent to which group members agree about how to use the technology) may be high or low. Consensus on appropriation is the extent to which group participants perceive that they have agreed on how to adopt and use a technology (Salisbury et al., 2002). Poole and DeSanctis (1992) posited that appropriations differ in the degree to which they are stabilizing. Degree of stabilization is determined by extent of use, faithfulness of use, favorable attitudes toward the IT, and consensus about how to appropriate the IT. Table 1 summarizes the major issues, their definitions and some observation needs.

Table1: The three issues of appropriations

Appropriations		
Critical issues	Descriptions	Observations needed
Faithful or unfaithful	The technology is used in a manner consistent with its general intent.	How technology structure influences the general intent in using SBC?

Attitudes toward use	E.g., beliefs about ease of use or usefulness	How technology structure influences the beliefs about ease of use or usefulness in using SBC?
Consensus on appropriation	The extent to which group members agree about how to use the technology.	How technology structure influences the group members agree about how to use SBC?

3. Methodology

Contemporary MIS research has been dominated by a positivistic approach to research. We posit that methods such as questionnaire-based survey are not suitable to capture the complex of SBC appropriation. This study adopts an in-depth case research method for gathering evidence. The case research strategy allows the exploration of unforeseen phenomena and offers better insights into the inter-dependencies among the factors captured in the study (Benbasat et al., 1987). We believe case study research to be most appropriate in gaining in-depth knowledge of the practices of the SBC appropriation, in the holistic understanding as presented.

Established in early 1970s, TIC orients itself around two main businesses. Its Semiconductor Group offers IC packaging and testing services, through which it prepares clients' unpackaged microchips for shipment. This group is ranked among the top 5 in IC packaging & testing operation internationally. Its Finished Products Group offers contract manufacturing services, through which it builds electronic gear on behalf of other companies. Finished Products Group is among the top 50 Contract Electronics Manufacturing (CEM) worldwide. With corporate headquarters located in Taiwan, TIC provides electronics manufacturing services and IC packaging and testing services to more than 70 customers in Europe, North America and Asia Pacific. TIC today operates 30 automated SMT lines and 1250 wire bonders with 6,000 experienced employees and a total capital of approximately USD$17.5 millions by the end of 2001.

This study traces the TIC's SBC project from 2001 to 2005. Qualitative data were gathered from document archive, face-to-face unstructured interviews, and field-notes. In-depth interviews were conducted with staffs in charge of SBC project in TIC, managers of information services providers, and industrial experts as well. Respondents were asked to provide thorough descriptions of their experience of the whole appropriation process. They also provide the evolution of the case company's IT security governance strategy as well as the organization change related to the adoption of SBC.

All informants are selected and scrutinized carefully to ensure the quality of collected data. Accordingly, all informants are very familiar with the SBC appropriation in the organizational context. The face-to-face interviews were unstructured, with only a standard set of questions that were designed to help initiate and guide the interview process. The subjects discussed invariably stretched beyond these initial inquiries. Informants were encouraged to express themselves through their own experiences and terminology. All interviews were tape-recorded, and notes were taken during the interviews. Additional observations were noted immediately after each interview was completed. In the following section, we will first present empirical evidence and then discuss its theoretical implications in discussion section.

4. The Case

The Context of Prior SBC adoption

Before 1999, as many corporations, TIC implemented the client-server computing as its main IT architecture. At that time and even now, the client-server paradigm is the most widely accepted architecture for structuring applications that interoperate across a network. The client-server networking causes a paradigm shift computation to the clients and data decentralization. For example, a file server is a process that offers a service to clients, namely, it transfers files from the server to the client machine. Thus, a complex application is decomposed into a part that runs on a server and one which runs on the clients. Accordingly, a high-end client is the basic requirement in keeping the performance for the architecture. In this regard, TIC changed all their computers to IBM in 1997. In 2000, TIC's new office building was completed and also leaded to renew all network structure and facilities.

However, in TIC's headquarter, over 2000 PCs leads to many problems. First, for example, applications delivery has grown increasingly complicated and expensive, because of the increased worker mobility, global expansion, mergers and acquisitions, a shortage of IT professionals, greater choice of computing devices, and the rise of the Internet. Second, the TIC's MIS staffs recognize that, with the fast growth of Internet, managing information security is becoming an increasingly important part of their works. However, the system users may exudates the classified data easily under the client/server architecture. That is, under client-server architecture, TIC's information security strategy is somehow passive. As indicated by an informant:

> "We have antivirus and content security software for all PCs and we also remove CD-Roms and floppy disks, filter emails from all PCs. But, the device controls in all PCs are time consuming and troublesome. Even all employees need to sign a confidential contract for security reasons, we still cannot prevent employee to duplicate our data on purpose".

Third, the upgrading some applications such as Office, ERP and Notes may lead to an increasing need to replace hardware. For example, TIC had to replace or upgrade their IBM PCs purchased in 1997. A SAP R3 ERP system and a Manufacturing Execution System (MES) have adopted to reconfigure the company's business processes in 1999. However, over one half of client-side PCs still need to upgrade again to fit with the requirement in deploring the ERP system. Also, how to maintain the operation of over 2000 PCs is also a problem. As recalled by an informant:

> "We have many problems in managing our IT under Client-server architecture. In face, there are many constraints such as the high maintenance cost and low security control."

Indeed, Client-server networking need to face problems such as hardware upgrades, application deployment, technical support, and data storage. In this circumstance, easier administration, cost down and IT security audits become the most critical issues to taken into account for their IT policies. After learning from an SBC workshop, TIC started to consider SBC as an alternative architecture in replacing the client-server architecture in 2000.

The adoption of server-based computing

A thin-client product, Citrix Metaframe, was adopted to utilize Windows Terminal Server to deliver a high performance Windows NT 4 desktop to Windows terminals and PCs. The product is developed by Citrix Systems, Inc., which is a global leader with an over 70% of market of in sever-ware product in 2003. Citrix solutions deployed in 100% of Fortune 100 companies, 80% of Fortune 500 companies, and 97% of Fortune Global 100. There are over 120 thousands and fifty millions user (www.citrix.com).

At the meantime, top management recognized the importance of IT and fully supported the promoting of IT infrastructure to solve the problems of client-server architecture and/or improve the systems' performance. The MIS department of TIC was in charge of the planning and adopting for the SBC system and the decisions was fully supervised and supported by the vice president of TIC. After one year of study and prior testing on SBC, TIC has inaugurated their SBC project in 2001. In 2005, all departments in TIC, except RD department, are using SBC. Some special programs designed for RD department are still not compatible with SBC architecture. This will not lead to any serious problem. As noted by an MIS staff:

> "We are not worried about our RD department because the department is always highly secured. Their employees have the sense to keep the data confidently. Even under previous client-server architecture, our RD department has more restrictions than other departments…"

Target Setting and Deriving the Structural Features and Spirits of SBC

In this section, based on AST, we report SBC's technology structure including features and spirit of SBC. As mentioned, the structural features are they specific types of rules and resources, or capabilities offered by the system. In contrast to client server architecture, two structural features provided by SBC are particularly important including *centralized IT deploying* and c*ontinuity capability.* They govern exactly how IT related architectures (SBC) implemented to successfully accomplish activities in response to an enterprise's environmental and strategic imperatives.

Centralized IT deploying includes aspects of the deploying applications and information such as universal application access which bring any applications for anywhere and building a thorough and easy-to-use application. Deploying applications enterprise-wide is difficult and time consuming since IT administrators must, in many cases, physically install application software on every device. SBC's independent Computing Architecture technology provides the foundation for deploying applications and information onto any device. In this case, applications are deployed, managed, supported and executed 100% on a server. In addition, SBC provides resources integration, which builds a heterogeneous computing infrastructure and enhances the application lifecycle management.

The second important structural feature is "continuity capability". Features of simplifying manageability include way to enhance the business continuity capability such as disaster recovery site for data, applications and users. The intention of business continuity planning is to keep a business running during a natural, man-made, or technological disaster. More importantly, SBC provides a secure and reliable access infrastructure, and simplifying environments and application access. Administrators can lockdown specific files, directories and system areas as well as the entire system, improving the security on

Intranet or Internet.

Under these structural features, spirit as the general intent with regard to values of goals underlying a giving set of structural features. The spirit of SBC can be well addressed by a metaphor, SMART, which is the initial word by abbreviating Security, Management, Accessibility, Reliability and TOC. A detailed description of spirit of SBC is presented in Table 2. TIC's employees were encouraged to think SBC as "smart platform" to improve the corporation's IT performance.

Table 2: Dimensions for Characterizing the Spirit of SBC

Dimension	Description
Security	Data on the road Replicated databases
Management	Deployment, support, upgrades, version control, configurations
Accessibility	Application diversity, client diversity
Reliability	SCB provides business continuity capability, which can recovery site for data, applications and users.
Total Cost of Ownership	Total owned cost such as: direct costs (e.g., hardware and software, operations & administration) and Indirect costs (e.g., end user operations & downtime).

Figure 1 shows a framework of an AST analysis of the appropriation of SBC that we derived from the literature and is also the framework we adopt for guiding our study. The framework explores that (1) the structural features (centralized IT deploying and continuity capability) is designed to promote the SBC's spirits (SMART) encourage different form of social interactions, and (2) SBC adoption process will vary depending on the nature of SBC appropriation. Following this, we will examine TIC appropriation of SBC in terms of faithfulness, attitude, and consensus from all structural features. In the following sections, we will analyze each structural feature in terms of the faithfulness, attitude, and consensus of SBC appropriation.

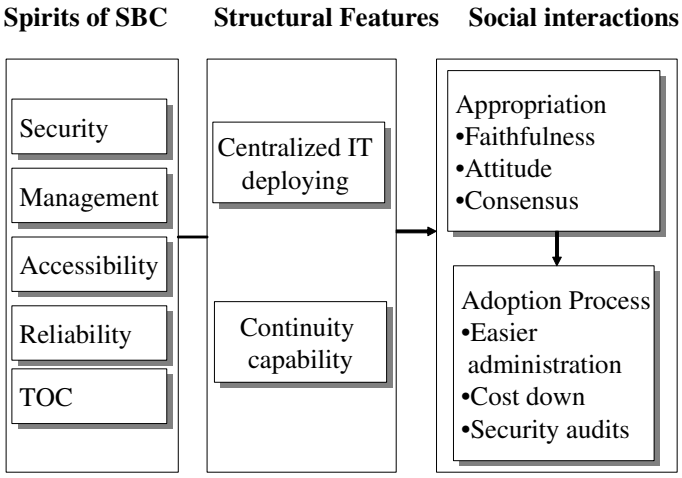

Figure 1. An AST analysis of the Appropriation of SBC

- **The Appropriation of centralized IT deploying**

The feature, centralized IT deploying, is designed to promote the SBC's spirits, such as

the deploying applications and information. In 2001, in considering the stability of thin client, TIC still used their IBM PCs. All PCs need to install client side software for IE browser, Notes, ERP to connect with server and to use application softwares. Now, the software upgrading needs only to test on the server side and users' authorities control. As mentioned earlier, SBC enhances the application lifecycle management. Until 2004, TIC replaced its old Pentium 100/133 PCs by low-end thin clients. In short, the centralized IT deploying feature is used in a manner consistent with its general intent. As indicated by informants:

> "The new SBC lets users access to an application without having to install the application on every computer. IT administrators install applications—and any updates to those applications—only on the MetaFrame XP server, instead of on each user's system. The cost-effectively deploy applications and low-end thin clients lead to a reduction of the total cost of application ownership."

TIC considered SBC would be very ease for their users and very useful in help them to the deploy applications and information. As indicated by an informant:

> "We realized that the human factors may have important impacts on SBC adoption. However, the most considerable advantage of SBC is that users will not perceive a significant change. Our users need only 5 minutes to learn the new system."

However, in the early stage of adopting SBC, centralized IT deploying feature has many problems, causing by the restrictions, un-sophistication and integrative capability of TIC's application systems. Occasionally, the server was crashed due to unknown reasons and the operating system was quite different as original systems, resulting many complaints from users. The SBC server was upgraded three times. The final version was upgraded in early 2005 by employing Win2000 Server SP4 + Citrix MataFrame XP Presentation Server. Finally, this version enhances the server farm (cluster) mechanism and improves the system reliability. Employees who were in charge of SBC adoption seemed overestimated the sophistication of SBC.

In considering attitude of appropriation of centralized IT deploying, we should distinguish two groups of employees: IT staffs and non-IT staffs. For IT staffs, they recognized the substantial benefits provided by the SBC architecture. For example, as summarized by an IT staffs:

> "Now, SBC's solutions for information aggregation let we consolidate and deploy data and applications. For IT administers, their work burdens have reduce significantly. We don't have to waste our time in those trivial jobs. SBC not only leads to cost-down, but also contributes to the promotion of IT professions".

However, non-IT employees may have different viewpoints. Before the adoption of SBC, users can install any software and manage PC by their own. In this case, users were likely to have a negative attitude toward centralized IT deploying feature. Meanwhile, they finally realized that, under this new architecture, their work burdens also reduced significantly and their attitude have change gradually. For example, as noted by an informant:

> "Prior to the launch of SBC, we need to scan viruses or maintain the data systems by ourselves. …Now, the responsibilities of these jobs are shifted to our MIS staffs. They need to secure our data. If there is any problem, what we have to do is to make a call to MIS department and they need to handle all computer problems."

- **The Appropriation of continuity capability**

By MetaFrame and Citrix Secure Gateway, SBC supports a high availability infrastructure that assists in providing a business continuity capability to ensure that customers, partners and employees quickly return to productivity in the event of a planned or unplanned business interruption. Data storage and replication technology provides real-time replication of file system and underlying application data. In addition, SBC provides a secure and reliable access infrastructure, and simplifying environments and application access. For example, That is, simplifying manageability of backup systems and environment can contribute to the value of information security. As indicated by an informant:

> "Our major target is information security. As you know that we are an IC testing corporation. The RD data is of crucial importance to our company and we cannot afford any risk from the attack of viruses or exudation of the classified data from our employees. SBC centralized our data and much easier for our management."

SBC's Data storage and replication technology provides real-time replication of file system and underlying application data. Since applications are deployed, managed, supported and executed 100% on a server, MIS employees considered SBC would be very ease for them to control the sever side and very useful in reducing the risk caused by users side. As indicated by an informant: "SBC can provide MIS to fully control the server, in turn, our users will find that they are under a safety environment." However, TIC didn't realize that Citrix alone cannot fully secure corporation information. For example, the system users may exudates the classified data easily via email. Accordingly, an anti-spam and anti-virus system, the Barracuda Spam Firewall developed by Barracuda Networks, was adopted to compensate Citrix's deficiency. The Spam Firewall handles a massive load (over 10 million daily emails) and sits just in front of your web mail gateway or e-mail gateway. As indicated by an informant:

> "TIC adopted SBC in 2001. At that time, SBC was not a prevailing architecture and Citrix's solutions did have some problems, which may leads to unknown occasional sever errors. These problems may lead to serious problems of users' performance. We learned some valuable information from Citrix Systems Inc. to improve the system stability. Now, along with the improvement of product and our techniques, the system is more reliable".

Basically, in terms of information security, all employees including mangers, AP developers and users, are all agree with SBC architecture. From mangers' perspective, they all agree with SBC architecture, but at the same time, they ask MIS to ensure a stable system. As indicated by an informant:

> "Two issues are significant affect our users' perceptions on SBC. First, there was almost four years that we didn't purchase any new PCs, resulting a

relatively low cost control of our IT deployment. Second, in 2003, there were many business servers attacked by worms such as Blaster, SQL Slammer and caused server damages. Our network was highly secured. Our users therefore recognized the benefits of our new architecture… These events accelerate the consensus building of SBC."

5. Case Findings and Conclusions

Drawing on an in-depth case study of the appropriation of SBC at TIC, we have seen the SBC provides different structural features which lead to different effects on the appropriation. The three dimensions – faithfulness of appropriation, attitudes toward use, and consensus on appropriation – are examined. Table 3 summarizes the case finings from two structure features in terms of three dimensions.

Table 3. Summaries of the case findings

Technology structures		
Critical issues	Centralized IT deploying	Continuity capability
Faithful or unfaithful	MIS employees are faithfully in using SBC, but non-MIS employees are unfaithfully because they cannot install any software and manage PC by their own.	All employees are faithfully in using SBC.
Attitudes toward use	For MIS employees, SBC is ease and the contributions are significant, but for non-MIS employees, their attitudes have changed from negatively to positively, due to the tradeoff between responsibility and convenience of using computer.	All employees have positive attitudes in using SBC.
Consensus on appropriation	The consensus is achieved incrementally. Incremental change, identity development and interactions are the main forces to pursue the consensuses.	The consensus is achieved at the beginning of adoption. In terms of information security, all employees including mangers, AP developers and users, are all agree with SBC architecture.

This study provided the much needed empirical insights into the notion that the technology structure and IT appropriation issues in system adopting process is just as important as the economic considerations of adoption. By employing an in-depth case study of the adoption of SBC from a Taiwanese high tech firm, we have demonstrated that practices SBC appropriations. We conclude that technology structures do matter and need carefully be examined in IT adoption and usage.

Our study contributes to the study of IT usage and appropriation research. We have identified how structural features influence on the faithfulness of appropriation, attitudes toward use, and consensus on appropriation. Our study clearly depicts that the structural features of an IT project influences it performance implicitly and should be taken into account in IT usage. Second, our findings suggest that critical forces need to be considered in pursuing the effectiveness of IT implementation. For example, we found that incremental change, identity development and interactions are the main forces to pursue the consensuses.

Our single case study has provided the rich insights of the practices of SBC appropriation. We

acknowledge the limitation of the case study method of this paper. However, our analysis could provide a vocabulary that researchers and practitioners could employ in the following the similar process, so that future appropriation research can be compared and benchmarked. For future studies on the subject, additional investigation is needed to ascertain the impacts of different stages on the effectiveness of appropriation. Alternatively, the critical success factors for each structural feature should also be derived and examined carefully.

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