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The Adaptation and Routinization Processes of a Continuous Auditing System Implementation

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ABSTRACT

How to adopt computer-assisted auditing techniques (CAATTs) quickly and develop a continuous auditing system are the critical issues for the implementation of automated auditing techniques. In this research, we study the technological adaptation process of a case company, which continuously implemented four CAATTs projects in three years. We summarized and analyzed the routinization process of how the case company adapted their computer-aided audit procedures from an experimental action to daily usage. An approach based on organizational routines theories was adopted to study group learning and interactions among project members, and to understand how they integrated automated auditing techniques and mechanisms into the existing manual auditing procedures. The process also reveals the incremental progress of an emerging routine from CAATTs adoption to continuous auditing systems.

The research results show that the documentation of CAATTs projects and group learning among different functions contribute to the routinization of automated auditing procedures; the continuous auditing system based on the automated auditing program also contributes to routinely audited tasks. However, the improvisational nature of auditing activities, implicit characteristics within general auditing software, and rigidity of automatic auditing programs cause the resistance of internal auditors on CAATTs use, and also impede the emergence and flexibility of computer-aided auditing procedures.

Keywords

CAATTs, Continuous Auditing, Information System Control, Technological Adaptation, Organizational Routines.

INTRODUCTION

The popularity of Information technology in organizations, driven by the force of the global competitive information technology market, has created the era of automated auditing techniques (Bhimani, 1996; Elliott, 2002; Zhao, Yen, & Chang, 2004). It has been commonly accepted by scholars and practitioners that the use of computer assisted auditing techniques (CAATTs) can reduce auditing costs and improve efficiency, and also help auditors to focus on high-risk business activities (Braun & HE Davis, 2003; Debreceny, Lee, Neo, & Toh, 2005). However, Vasarhelyi et al. propose that the inadequate understanding of the nature of audit automation techniques is the greatest obstacle for organizations in adopting CAATTs (Alles, Kogan, & Vasarhelyi, 2009).

Automated auditing techniques can be roughly classified as CAATTs and continuous auditing. CAATTs are computer tools and techniques that an auditor (external or internal) uses as part of their audit procedures to process data of auditing (Mahzan and Lymer, 2010). They have been widely adopted by audit firms and internal auditors. In these years, a different kind of auditing technique, continuous auditing is emerging. Continuous auditing is defined as a type of auditing that produces auditing results simultaneously with, or a short period of time after, the occurrence of relevant events (Alles, Tostes, Vasarhelyi, & Luiz Riccio, 2006; Kogan, Sudit, & Vasarhelyi, 1999; Rezaee, Elam, & Sharbatoghlie, 2001; Vasarhelyi, 2002). Due to continuous auditing techniques adopting a more immediate approach to execute control testing and risk estimation, they are believed to enhance the quality of auditing evidences. However, in the Global Audit Information Network (GAIN) report of IIA (2009), "2009 IT Audit Benchmarking Study", only about a quarter of organizations who have adopted CAATTs use continuous auditing techniques; and although many organizations have tried to use CAATTs, most organizations still consider the use of CAATTs to be associated with high cost, implementation difficulties, and low short-term benefits. As a result, less than fifty percent of organizations use computer assisted auditing software for fraud detection and prevention (IIA, 2009).

Previous studies mostly focused on the individual characteristics of internal auditors and how they influence the results of CAATTs adoption (Huang, Hung, & Tsao, 2008; Janvrin, Lowe, & Bierstaker, 2008; Mahzan & Lymer). Fewer studies explore the drivers and resistance of CAATTs implementation on a group level. However, some scholars pointed out that perhaps the more fundamental problem is that people underestimate the impacts of automated auditing on auditing procedures and standards? In addition, promotions of continuous auditing usually emphasize the "redesign" of existing

auditing procedures, causing continuous auditing to be an unrealistic application having few impacts on current auditing procedures and methods. **Therefore, the incremental evolution process, which extends and integrates traditional auditing procedures with the experimental usage of CAATTs, might contribute to the adoption and development of continuous auditing.**

As a result, Alles et al (2009) state that dramatically reengineering existing audit procedures is not feasible. They suggest that the continuous usage of CAATTs might help explore how to adopt continuous auditing techniques. Therefore, continuous auditing techniques are not new technologies to replace CAATTs, but rather as extensions of CAATTs. To explore how to adopt continuous auditing techniques, scholars and practitioners might start from the study of CAATTs usage and consider how to integrate them with the daily activities of auditors.

As a result, we consider auditing activities as a kind of organizational routine, which will help us predict and analyze the patterns of organizational activities. Since the formation and evolution of organizational routines involves the learning process of organizations, the analysis of auditing practices will help us to understand how the usage of CAATTs becomes a part of daily activities and becomes the opportunity to change existing auditing procedures.

In summary, this study examines the interactions and group learning among CAATTs project members which are concerned with automating the traditionally manual procedures of auditing through integration with CAATTs. We examine how they start from the trial usage of CAATTs, and then proceed with experiments on continuous auditing and monitoring and finally work with CAATTs as emerging routines in auditing practices.

TECHNOLOGICAL ADAPTATION, ORGANIZATIONAL ROUTINES AND IMPROVISATION ACTIVITIES

Many scholars have explored the use of adaptation process technology, such as Rice & Roger (1980), who indicated that with the continuous use of technology users will discover and reinvent the application and usage of the same technology. The technological adaptation approach emphasizes the importance of follow-up modification after the adoption of technology, which will assist the effective use of technology and improve operational efficiency (Dutton & Thomas, 1984). The adaptation process is not only about affecting the usage of technology but also to changing the organizational structure and work practices (Van de Ven, 1986).

Kwon and Zmud (1987), based on the Change Model of Lewin (1980) proposed the Innovation Diffusion theory, which includes six stages: initiation, adoption, adaptation, acceptance, routinization and infusion. Through these stages, the wide use of the technology becomes part of the organizations routines (Cooper & Zmud, 1990). Despite The technological adaptation model of Kwon and Zmud constituting six stages, most studies focus on the prior stages of initiation, adoption, adaptation and acceptance. Fewer studies focus on the routinization and infusion stages, when users combine technology use with organizational routines and gain most benefits from the integration. Organizational routines, however, have been studied broadly by scholars of organizational behavior, who consider organizational routines are the results of organizational learning (Argote, 1999). The Changes of organizational routines, regardless of emerging routines or amendments of prior routines, are the accumulation of organizational learning process (Levitt & March, 1988; Nelson & Winter, 1982). In other words, current organizational routines are built by past learning, error correction, and continuous improvement. Managers have to appropriately execute the daily activities with repetitive procedures (routines) and creative tasks (innovations) for the tradeoffs between efficiency and flexibility (Feldman & Pentland, 2003).

The tasks of internal auditors consist of a series of repetitive procedures, among which include: audit planning, risk assessment, auditing procedure design, data collection and analysis, working papers and auditing report writing, and follow-up tracking. These auditing activities are organizational routines with specific patterns and interactions among people from different departments. To enhance the efficiency and quality of auditing, there are many principles and standards guiding the procedures of auditing activities, but the characteristics of improvisation, risk assessment and professional judgments are very important for the execution of auditing, which makes the tasks of auditors more complex than other organizational routines.

From the view of organizational routines theory, although CAATTs help organizations get the benefits of automation, accuracy, and quick analysis, some auditors might question that automated auditing is based on explicit audit procedures, whereas many unexpected situations with variant rules happen in the processes of auditing, thus making it unfeasible to define the complete auditing procedures which cover various scenarios in advance. So, one of the critical factors is to provide the flexibility to auditors (improvisational behavior) together with the explicit and precise procedures of automatic computer programs (predefined organizational routines).

RESEARCH DESIGN

In order to understand the adaptation process of enterprises using CAATTs, our research design adopts an exploratory study via a single case. The selected case company is referred to as 'Alpha Company' in this study. The period of analysis from 2006 to 2009 covers the time when Alpha Company decided to adopt CAATTs and their continuous use of CAATTs. Alpha Company developed the automatic auditing procedures for the four transaction cycles, and continues to fulfill the enhancement. Therefore, the technological adaptation process of Alpha Company could help us understand how companies adapt through the adoption and adaptation stages and the acceptance and routinization stages.

The sources of data come from interviews (see Table 1), internal documents (such as meeting minutes, audit plans, auditing procedures, analysis document of the continuous auditing systems, etc.) and public information (news, magazines, annual reports, etc.). The researchers interviewed the CAE and CIO and the members of CAATTs projects. To increase the accuracy of the interviewee's responses, and go back to the initial situation of use, the researchers first asked the interviewees the course of events for adoption and implementation of CAATTs, and followed up with the adaptation and routinization processes. The researchers used open questions and focused on emerging concepts and themes in the technological adaptation process.

In addition to the transcripts of interviews, the researchers also analyzed internal documents and public information, as the following shows, to understand the usage of CAATTs in Alpha Company.

Interviewee	Job Title	Frequency	Interview time
CAE	Chief Audit Executive	3	Dec, 2008/ Mar, 2009/ Feb, 2010
Internal audit staff	Senior Auditor	3	Oct, 2008/ Mar, 2009/ Feb, 2010
Internal audit staff	Financial auditor	1	Mar, 2009
CIO	Associate Manager	2	Dec, 2008/ Mar, 2009/ Feb, 2010
IT staff	Director	1	Mar, 2009
IT staff	Database Administrator	2	Dec, 2008 / Mar, 2009
Project consultants	Project Manager	3	Jul, 2008 / May, 2009/ Feb, 2010

Table 1. The interview activities and interviewee list

The initial use period: Pre-implementation phase

Alpha Company has a highly integrated information system; the management values the monitor and control of information processing activities. The IT staffs maintain the enterprise information system by themselves. The chief audit executive (CAE) of Alpha Company thought manual auditing is constrained by manpower and budget. For the purpose of increasing the effectiveness of the internal control system and decreasing the expenditure of auditing, the CAE started to implement the CAATTs project in 2006.

The internal auditors of Alpha Company have been trained in the use of CAATTs software; however, they still did not know how to use CAATTs in practice. So the CAE hired an external consulting team to assist the project and decrease the workload of the auditors during the implementation phase. The consultant thought it was not easy to discuss the computer auditing procedures only with CAATTs software, so he designed a series of documents as the analysis and design tools.

At the beginning of the initial period of use, the consultant arranged a kick-off meeting with the CAE and the chief information officer (CIO) to obtain the consensus of both. Although the CIO did not recognize the need for computer auditing, and also questioned the performance of the CAATTs software, after the explanations of the consultant and with the strong support of CAE, the CIO was willing to assist the project. The meeting was concluded with the following agreements: the audit items would be prepared by the auditors, whereas the IT staff would help auditors to understand the current system processes and provide the required data files, and the consulting team would be responsible for the design, testing and documentation of computer auditing programs.

The initial period of use: implementation phase

Initially, because of the lack of experience of the project members, the progress of project implementation was slow. The project meetings were chaired by the internal auditors, IT staff, and the consulting team. In these meetings, project members discussed together setting project plans, auditing scope, auditing items, risk assessment for each auditing item, and the feasibility of analysis using computer auditing procedures.

During these meetings, consultants found that the internal auditors were used to the pervious field detection and were not familiar with the process flow of the enterprise information systems and the embedded application controls. Therefore, some audit items were not applicable for computer auditing; some controls had been embedded in the information systems, but the internal auditors were not informed. So they required the assistance of IT staff to confirm the feasibility of the computer auditing procedures.

On the other hand, after analyzing these audit items, the consulting team recognized required data files from IT staff, and confirmed related data fields in these data files. However, it was difficult to communicate between IT staff and internal auditors, because IT staffs were not familiar with the auditing rules, and internal auditors were not familiar with the relationships of fields among multiple tables. The consultant played the important role of collaboration to explain the auditing objectives and technical illustrations to both. In addition, impacted by the heavy workload of IT staff, data confidentiality and authorization issues, and time-consumption associated with downloading and converting data from the mainframe, the schedule of the project resulted in serious delays.

After obtaining electronic data files, the consulting team used CAATTs software to execute the control test, data was filtered by auditing rules, and the abnormal transactions were extracted. The transaction data was sent to the internal auditors to confirm the reasonableness and reasons. If necessary, the internal auditors would modify the auditing rules and re-check several times for the extracted results. When the steps of analysis were confirmed as reasonable, the consulting team would write down the automatic procedures as computer programs. Meanwhile, the internal auditors would track the reasons of unusual records based on the analyzed results, and prepare the working paper for the auditing report. The consulting team wrote the analysis documentation according to the auditing procedures and the auditing objectives.

The initial period of use: post-implementation

The first CAATTs project needed 9 months to be completed because of the unfamiliarity with CAATTs by project members and the huge discrepancy in knowledge background among them; however, CAE and the auditors were satisfied with the achievements. The CAE confirmed that the automatic auditing programs can decrease the time and resource required for repeated auditing procedures and increase the efficiency of auditors with more coverage of data analysis. He also praised the consultants for the systematic analysis and documentation methods, and promoted this methodology as a guideline for following projects. He expected the auditors could apply the methodology and develop other automatic auditing procedures by themselves.

The period of continued use: pre-implementation phase

After the successful completion of the CAATTs project, the CAE wanted the scope of automatic auditing to be extended to multiple transactions cycles. He hoped the internal auditors could familiarize themselves with the development of computer auditing programs and be proficient with CAATTs software. Therefore, in addition to engaging the consulting teams to continue developing the other cycles, such as procurement, production and payroll cycles, the CAE requested the project members to take CAATTs training, and take active roles in the subsequent projects.

The period of continued use period: implementation phase

Since the internal auditors experienced the effects of CAATTs in their project, they knew what kinds of auditing items were applicable for computer auditing. So it was more efficient for the auditors to make a list of computer auditing items and to proceed with risk assessments. After an internal department meeting, they engaged the consultants with the IT staff for feasibility analysis in the first project meeting.

As the internal auditors were unable to grasp the updated status of business application controls, they still needed the assistance of IT staff to identify the appropriateness and feasibility of each computer auditing item. This step helped to remove these issues that were under control. So, the awareness of IT staff of internal control systems and acceptance with the values of CAATTs projects is very important for the implementation of projects. For example: IT staff with a supportive attitude not only explained the information flows and processing rules, but also enthusiastically pointed out the weak areas of current application controls. However, another IT staff serving as database administrator might focus on the efficiency of

database servers and the security issues of information, but would not be concerned with whether the data elements are applicable for the auditing items.

The involvement of the internal auditors and familiarity with CAATTs software still played an important role in the CAATTs projects. Based on the rotation system in Alpha Company, most auditors come from various business units. Some of them are determined not to be auditors in the long term, and some of them might only assist field auditing by collecting information; hence, they would not be active in CAATTs training. That is to say, some internal auditors keep a wait and see attitude for these projects.

The period of continued use: post-implementation phase

After the initial use of the CAATTs project on sales cycle and a following up with three projects on different transaction cycles, the auditing items developed in these projects covered the major areas of regular auditing activities in Alpha Company. The internal auditors began to use these automated auditing programs, which were developed by the consulting team, as pre-audit activities to help find out the abnormal transaction, and then conducted follow-up auditing.

The CAE was satisfied with the outcome of these CAATTs projects, but still recognized the necessity of self-reliance for internal auditors in implementing CAATTs projects. From the interviews, we find that the key for CAATTs implementation is not the insufficiency of computer skills for auditors, but the fact that they worry that the increase of automated auditing programs will become a heavy workload in terms of maintenance. The internal auditors hope the IT staff to undertake the maintenance and development of automated programs. On the other side, the CIO wanted the auditors to have the ability to use CAATTs tools and maintain autonomy, while the IT staffs focus on the enterprise information systems. The IT staff is only responsible for data file access authorization and database server maintenance. The consultant also believed that internal auditors should not only rely on reports generated by automated programs, although they still require the ability to use CAATTs for analysis conducted by themselves.

RESEARCH FINDINGS AND DISCUSSIONS

As mentioned in the section of literature review, whether or not computer auditing techniques can be utilized in organizations, the key issue is how to support and enhance current routines, and then convert them into new organizational routines. Figure 1 presents the development of computer auditing routines and related factors among the adaption process. The research findings and discussions is based on the drivers and resistance of routine adaptation, following with the emerging routines and related constraints.

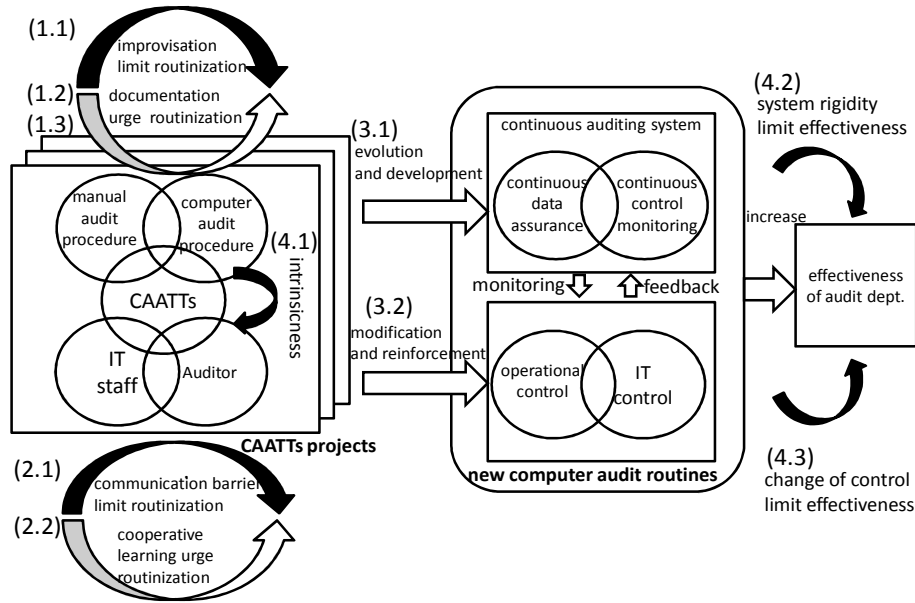


Figure 1. The research framework and findings

(1) The drivers and resistance of computer auditing routines

[Finding 1.1] The characteristics of improvisation in auditing activities will reduce the wiliness to use CAATs. The balance and complementary between human risk assessment and automated auditing are the key for the development of computer auditing routines.

In the case company, most of the auditors maintain the attitude of wait and see for CAATs adoption. The CAE thought maybe the internal auditors were not familiar with the software. However, even with training and compulsory use, some auditors were still negative about CAATs. After interviews, we found that the senior auditors value the knowledge and experiences garnered from field auditing. These help auditors identify problems and confirm the auditing scope. In other words, senior auditors emphasize the improvisational characteristics of risk assessment in auditing activities. Risk assessment is the response for the information from target areas with personal judgments or suggestions from other members. Decisions making activities for risk assessment are executed in timely pressure and limited information.

In auditing activities, risk assessment and determining the causes of abnormal data need impromptu decision-making with situational characteristics. The characteristics of structural analysis with predefined procedures for automated programs make it not easy to solve undefined situations (Searcy, Woodroof and Behn, 2002). Thus, the improvisational characteristics of auditing activities will reduce the wiliness to use CAATs. Alles et al (2009) also considered how to utilize the efficiency and accuracy of automated auditing programs, while maintaining the flexibility of result interpretation for auditors, retrieving data according to different situations, analyzing with real-time judgments are the bottlenecks for the use of a continuous auditing system.

On the other side, to lower the improvisational characteristics of auditing activities was also the motivation of the CAE to adopt CAATs. From the opinions of the CAE, the manual auditing methods are more dependent on the experiences of internal auditors, are not easy to learn for new comers, and sometimes the tasks are done in a muddled manner because of the of half-heartedness. However, from the thorough examination of computer auditing programs, there is the realization that the auditing scope is more comprehensive and reliable. Computer auditing programs help reduce the uncertainty of human decision-making and help the collaboration among auditors with efficiency and objectivity. In summary, the balance and complementary between human risk assessment and automated auditing are the key for the development of computer auditing routines.

[Finding 1.2] The characteristics of explicitness from computer auditing documentation will enhance the efficiency of the CAATs project, and the emergence of computer auditing routines

[Finding 1.3] The knowledge engineering features of computer auditing activities will help transform personal implicit knowledge into explicit knowledge shared by groups.

As most auditing activities have clear procedures, analysis procedures and reporting principles, using CAATs documentation to support auditing activities is similar to using manual auditing programs. The documentation helps integrate computer audit procedures with manual processes and also helps internal auditors understand the procedures of automated programs.

In addition to guiding the implementation of projects, the documentation, such as meeting minutes and analysis documents, also help project members clarify the implicit rules of fuzzy decisions into accurate procedures, which could be executed by computer programs. These analysis processes could be considered as the formalization process of knowledge engineering activities (Kamsu Fogueum et al., 2008).

Dowling and Leech (2007) also proposed the similar opinion: The key elements for auditing automation are how to clarify the vague knowledge hidden in manual auditing procedures and specify the knowledge as explicit rules. In other words, the analysis and design of automated auditing procedures, will transform the personal implicit knowledge, such as the operations and controls of each departments, the processing flow of enterprise information systems, etc., into explicit knowledge shared by groups after the project meetings. The explicit knowledge is easy to learn or imitate by new entrants (the emergence of new routines).

[Finding 2.1] The communication barriers caused by the differences in expertise limit the emergence of computer auditing routines.

[Finding 2.2] Cooperative learning among project members helps the emergence of computer auditing routines.

From the case company we find that: Because computer auditing activities are different from the traditional manual form of auditing, activities such as retrieval of electronic data, information system control tests, and examination of abnormal data require the assistance of IT staff. They cannot be done alone by internal auditors. However, the communication barriers caused by different expertise prohibit the implementation of CAATTs projects. For example, IT staffs tend to use the same platform and programming language with enterprise information systems, so auditors find it difficult to accept the software. Also, auditors are unfamiliar with tools with which automated programs and continuous auditing systems are developed and how maintenance should be conducted. Most IT staffs also do not understand the risk assessment and control testing procedures for auditing activities; thus, sometimes they will project a negative attitude toward CAATTs projects. In addition, the analysis needs the help of IT staff to confirm the causes of abnormal data. However, when the auditors recognize the areas of control weakness, they usually will be considered as the lack of control in information systems. The auditing results will add the workload of IT staff in terms of modifying the information system. Therefore, the IT staffs, who are the facilitators for CAATTs projects, embarrassedly become as the negligence holders. This reduces the willingness for IT staffs to participate in the CAATTs projects.

Though the knowledge gap among different experts causes barriers in communication, it also becomes the starting point for cooperative learning among project members. Through discussions and problem solving, individual skills and professional knowledge emerge and are infused into the organizational routines (Julian, 2008). For example, through the assistance of IT personnel, the auditors were able to quickly understand the logic of application controls, which is the key for effective risk assessment; the IT staff, for their part, used the opportunities to re-check the correctness and effectiveness of application controls by participation in the project. These helped to amend or reinforce the control mechanisms of operations.

In Alpha Company, we also found that the common training courses of CAATTs, which teaches auditors how to operate the software, are insufficient for auditors. However, after the implementation of several projects and continuous use, the project members accumulated the computer auditing techniques for various scenarios. In addition, with the assistance of consulting teams, project members with different professional backgrounds learned how to develop computer auditing procedures fitting the business contexts of Alpha Company.

This phenomenon supports the argument of Becker et al (2005), which clarifies the difference between organizational routines and personal skills by stating that collective nature is the distinctive feature for organizational routines. The projects, involving many departments, will help these functional communities, which work in different vertical divisions, gradually form a new community of computer auditing. Thus, the cooperative learning among project members help the emergence of computer auditing routines.

(2) The emergence of computer auditing routines

[Finding 3.1] The computer auditing programs developed in the CAATTs project are helpful for auditors transforming CAATTs applications into continuous auditing systems, and evolving them into emerging routines.

[Finding 3.2] The results of computer auditing with cause-effect analysis of abnormal data, contribute to updating and reinforcing control activities and operations.

From the case analysis, we found that the scripts of CAATTs software could be converted to the automated auditing system, which can be executed regularly. So the auditors could use the automated auditing system to assist regular auditing tasks, and these programs could be executed more frequently than manual auditing. Thus the auditors could timely and with less cost find the abnormal data. This improved the efficiency of auditors and made the auditors more willing to use CAATTs.

In addition, as the scope covered by the automated programs continued to extend, the auditors gradually changed their auditing procedures. They used the reports of the automated auditing system as the basics of risk assessment and activities arrangements. The use of the automated auditing system shortened the auditing periods, increasing auditing frequency. In Alpha Company they use the workflow system to provide real-time exception reports by definition. So the CAE and department managers can use the system to monitor the status of operations. The automated auditing system has become the continuous auditing system of Alpha Company.

Although Hammer (1990) proposed that the implementation of information systems should redesign or reengineer current processes to avoid a focus only on the automation of current operations, which would limit great potential benefits, the rules

of auditing activities are implicit and improvisational, so to redesign the overall auditing activities in advance is not easy. The hybrid approach of integrating manual and computer auditing is easier for promoting automated auditing in daily auditing activities (Alles et al., 2009).

From the above, the computer auditing programs developed in the CAATTs project are helpful for auditors transforming CAATTs applications into continuous auditing systems and evolving them as emerging routines. The results of computer auditing, with cause-effect analysis of abnormal data, contribute to updating and reinforcing control activities and operations.

(3) The Restrictions of computer auditing routines

[Finding 4.1] The implicit features of the automated auditing system restrict auditors in reviewing and understanding the meaning of auditing programs. These increase the rigidity of computer auditing programs.

[Finding 4.2] The rigidity of automated auditing systems limits the maintenance and expandability of the systems.

Despite what has been reported, we still cannot be too optimistic on the use of automated auditing systems. The limitation of CAATTs software and continuous auditing systems also emerged in the case company. For example: in the case company, CAATTs software could support the analysis of auditing activities, but manipulation by data fields did not easily indicate the logical relationships among data fields. In other words, for the internal auditors, who are not familiar with computer programs and data structures of databases, it is difficult to quickly grasp the semantic meaning of computer programs (Li, Huang & Lin, 2007). The implicit features of CAATTs manipulation and computer programs also hide the risk factors and the rule of auditing procedures. This will increase the difficulty of maintenance and expandability for computer auditing procedures and become the barriers for the integration with manual auditing procedures. Therefore, the rigidity of computer auditing programs restricts the improvisation of auditing activities.

In addition, as the auditing scenarios changed, the automated programs continued to be modified with more complexity and were more difficult to maintain. So the internal auditors argued with the IT staff as to who should be responsible for maintenance of the automated auditing system? Although automated auditing systems can be executed repetitively and rapidly, and improve the efficiency of regular auditing, the design and maintenance of automated auditing systems is more complicated than manual auditing procedures. This causes the resistance of internal auditors, who intend to avoid burden of system maintenance. As the auditor of the case company stated, "Our expertise is to focus on risk assessment and control test. We are not professional IT staff, so the burden of maintenance will decrease our performance."

As the statements indicated in findings 1.1, how to keep the flexibility of auditing activities with the automated auditing system is the key in terms of conducting computer auditing. In particular, the risk of companies will alter with changes in environments and organizations. The lack of semantic meanings in computer auditing programs hide the factors of risk assessment and the rules of the auditing procedures, therefore, it also has significant impacts on the benefits of continuous use for automated auditing systems.

[Finding 4.3] The change of operations and information systems will affect the long-term benefits of automated auditing systems

In the case company, the rules of application control were not recorded in detail in the documentation of internal control. In addition with the implicit features of computer programs, the operation risks will alter when operations or information systems changes. This will produce the weakness of control or even result in the loss of functions of automated audit systems.

Current automated auditing systems operate on the basis of data field manipulation and computer programs embedded within the structure of the database. Process redesign, organizational restructuring and the replacement or updating of information systems will cause the errors or dysfunction of systems and increase the burden of maintenance. For example, when the sales departments of the case company become separate business units, the location and data files of sales transactions change after the adjustments. This would lead to full revision of the overall computer auditing programs.

Alles et al. (2006, 2009) also proposed the similar opinions. Systems using general auditing software are based on the data oriented approach (named as CDA: Continuous Data Assurance), which makes it not easy to monitor the real-time status of controls. How to develop continuous monitoring systems with continuing changes in information systems and control activities remains a major bottleneck for continuous auditing systems.

CONCLUSION

Previous studies on CAATTs usage mostly focused on personal skills, attitudes and the support of top managers (Braun and Davis, 2003; Debreceeny et al., 2005; Huang et al., 2008; Mahzan and Lymer, 2010). Fewer studies explore the drivers and resistance of CAATTs implementation on a group level. In this study, we analyzed the technological adaptation process for CAATTs in a case company, which implemented four CAATTs within three years. We took the theoretical viewpoints of organizational routines to explore how the internal auditors integrated computer auditing procedures with manual auditing activities, and transform the CAATTs manipulation into the continuous auditing system. The technological adaptation process extends previous routines and leads to the emergence of new organizational routines.

From the case study and a discussion thereof, we conclude: Cooperative learning among project members and the documentation of projects contributes to the emergence of computer auditing routines; the continuous auditing system based on computer auditing programs also contribute to the emergence of routines. However, the improvisational characteristics of auditing activities, the implicit features of computer auditing programs, and the rigidity of continuous auditing systems causes the internal auditors to resist using CAATTs tools, and restricts the emergence of computer auditing routines and the flexibility of auditing activities.

The main contributions of this study are as follows: for the companies planning to adopt CAATTs or who have tried to use CAATTs, this study will help organizations comprehend the difficulties which they may face and how to overcome them. In addition, this study provides a solution on how to implement CAATTs projects, and transform them into continuous auditing systems. The study also revealed the interactions among continuous auditing systems, control mechanisms, information systems, auditing procedures and work adjustments of related personnel. These research results are in accordance with the suggestions provided by Brown et al. (2007): Case studies are necessary for the areas of continuous auditing. They help understand the key issues for building continuous auditing systems, and also the critical factors underpinning CAATTs implementation.

Concerning the arguments of previous studies relating to the ease of use of CAATTs and the importance of IT skills for internal auditors, we find that this contradiction is caused by the specialization of both tasks and knowledge. Although the general auditing software is easy to use for internal auditors, without the assistance of IT staffs, the auditors cannot successfully complete the analysis of electronic data extracted from enterprise information systems. In addition, the lack of semantic meaning in the software manipulation and computer auditing programs mainly restrict the accurate review and maintenance of automated auditing systems.

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