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符合沙氏法案 404 節連續性電腦稽核系統之建構與實證：以銷售及收款循環為例

The Development of a Computer Auditing System Sufficient for Sarbanes-Oxley Section 404: A Study on the Sales and Revenue Cycle of the ERP System

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摘 要

美國國會於 2002 年提出沙氏法案 (Sarbanes-Oxley Act, SOX）來規範公開發行公司必須建置與維持和財務報導有關之內部控制，藉以加強公司在內部控制及編製可靠財務報表之能力。本研究之主要研究目的為：(1) 探討符合 SOX404 之銷售及收款循環在電腦稽核系統上的重要查核項目；(2) 建構符合 SOX404 規範，並以企業資源規劃系統為基礎之銷售及收款循環重要查核項目之電腦稽核系統；(3) 以 ISO/IEC9126 模型為基礎，進行此稽核系統對於內部控制制度實施的有效性及稽查結果正確性之實證研究以確定符合 SOX404。本研究藉由紮根理論與專家問卷形成銷售及收款循環之查核項目，並使用這些查核項目進行系統實作與實驗設計研究。本研究成果可協助管理當局或稽核人員提升電腦稽核之成效。

【關鍵字】沙氏法案、電腦稽核、銷售及收款循環

Abstract

After the Sarbanes-Oxley (SOX) Act 404 enacted in 2002, public companies were required to comply and maintain internal control of financial reporting in order to strengthen the abilities of internal control and to ensure reliable financial reporting. The objectives of this research are : (1) Explore the important audit items in the sales and revenue cycle to match the principles of SOX404 on the computer audit system. (2) Construct the computer audit system based on the ERP system in the sales and revenue cycle to match the principles of SOX404. (3) Based on the ISO/IEC9126 model, this research verifies the quality of this computer audit system and the accuracy of the audit results. This research explores the control items of the sales and revenue cycle by Grounded Theory and expert questionnaire, as well as develops a computer auditing system using the results of the conceptual aspect followed by laboratory study experimentation to ensure the quality of the computer audit system and the accuracy of the audit results. The outcome of this study assists management and auditors to perform computer auditing.

【Keywords】Sarbanes-Oxley Act, computer auditing, sales and revenue cycle

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1. Introduction

The National Commission on Fraudulent Financial Reporting in the United States (US) emphasized the importance of internal control systems on corporate governance and reliability of financial reporting as early as 1987. The Committee of Sponsoring Organizations of the Treadway Commission defined internal control systems and practical measures. However, the frauds of Enron and WorldCom in the US exposed the weakness of implementing internal control in the US (Ettredge, Li, & Sun, 2006). In 2002, the US Congress passed the Sarbanes-Oxley Act (SOX) to regulate the deployment and maintenance of Internal Control over Financial Reporting (ICOFR) of public companies in order to enhance the capability of companies in internal control and production of reliable financial reports and re-build the trust of the public in the financial reporting of listed companies (U.S. House of Representatives, 2002). The most influential article on internal control in SOX is Section 404, which stipulates that management should assess and report the internal control of financial reporting, and submit their evaluation report on the effectiveness of the internal control of financial reporting and company-wide internal control.

With the rapid development of information technology (IT), digitalization has become the norm in today's corporate world. According to a survey by Market Intelligence and Consulting Institute (2007), there is growing demand for enterprise resource planning (ERP) systems from large companies. Over 90% of the manufacturing industry has implemented ERP systems. This shows that digitalization has become a basic element in maintaining market competitiveness. Digitalization has great impacts on the business environment and operational strategies of companies. As far as internal control is concerned, introducing digitalization should cover more than just financial departments. Relevant systems, personnel, and IT departments should all improve their internal control in order to avoid financial fraud (Walters, 2007).

The introduction of ERP systems made forms in management, finance, and sign-offs previously processed manually be handled by computer systems. A large amount of data is scattered across different files. Changes in the environment make it more difficult and complex for auditors to perform their tasks (Elder, Beasley, & Arens, 2008). Therefore, to resolve audit problems associated with ERP systems, auditors have to use computer-assisted audit techniques (CAATs) by effectively collating and assessing relevant information to issue reasonable and reliable audit reports (Debreceny, Lee, Neo, & Toh, 2005; Li, Huang, & Lin, 2007).

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Existing software tools to audit ERP systems, as generalized audit software, face some challenges and limitations (Lanza, 2005; Li et al., 2007). Lanza (2005) indicated that different audit environments call for different approaches, and it is difficult to maintain consistency in operations. When using generalized audit software, auditors have to write programs themselves. This highly technical task falls beyond the scope of auditing. The table compositions of different ERP systems from various vendors are different. Generalized audit software alone is not sufficient to assist auditors in understanding where they should start with various data. Moreover, the semantic gap between IT and auditing personnel results in the inability of generalized audit software to provide continuous system monitoring and warning for abnormal transactions (Li et al., 2007).

Due to market demand for real-time information, information provided by traditional audit periods cannot satisfy market needs. Continuous audits accurately reflect relevant events or situations in a timely manner supported automation technology and computer-assisted tools. Compared with traditional auditing, this can provide quicker and more accurate results (Allen, Hermanson, Kozloski, & Ramsay, 2006). Therefore, the appropriate use of Continuous Computer Assisted Auditing Techniques (CCAATs) can reduce audit risks and costs, and boost the efficiency of audit jobs (Coderre, 2005).

This study aims to construct a computer audit system in compliance with SOX Section 404. ERP audit and management requires overall planning of the scope of implementations and expected benefits. It defines the scope of this computer audit system as the eight steps in the cycle of sales and revenue. For most industries, the main sources of income are from this cycle. Therefore, it cannot be ignored in auditing and managing ERP. This study has the following research objectives:

(1) To explore the impact of inspection items in compliance with SOX Section 404 in the cycle of sales and revenue;
(2) To construct a computer audit system compliant with SOX Section 404 based on the cycle of sales and revenue of the ERP system of Data System; and
(3) To verify the quality of the computer audit system constructed by this study.

2. Literature Review

2.1 SOX Section 404 and Internal Control System

After the Enron scandal, the US Senate and House of Representatives passed the SOX Act in July 2002. It is the most important legislation supervising the securities market in the US since the Securities Exchange Act in the 1930s. SOX is also known as Corporate

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Governance Reform Law. It has following main objectives:
(1) To emphasize the responsibilities of companies and management teams;
(2) To enhance information disclosure;
(3) To strengthen the regulations on accounting and auditing; and
(4) To increase the penalties for law violations (U.S. House of Representatives, 2002).

The most influential section of SOX on internal control is Section 404. It includes three parts. The first requires management to establish, implement, and maintain an effective ICOFR. Second, management has to submit to the public an evaluation report on the effectiveness of the ICOFR each year. Finally, companies have to hire auditors to inspect their financial reports and issue evaluation reports on the ICOFR report, as well as opinions on the effectiveness of internal control of financial reporting (Securities and Exchange Commission, 2002).

According to the definition by Accounting Research and Development Foundation (1997), internal control is a management process. It is designed by management and approved by the Board of Directors to ensure the achievement of the following purposes:
(1) Reliable financial reporting;
(2) Efficient and effective operations; and
(3) Legal compliance.

The increasing application of IT systems in companies has resulted in internal control of IT throughout the system to ensure the accuracy, integrity, and accessibility of the IT systems in the transaction process (Edelstein, 2004). If internal control of IT fails to operate effectively, it will affect the overall operations of companies (ITGI, 2005). Therefore, auditors should understand the effectiveness of internal control flows during the inspection process in order to mitigate control risks (Allen et al., 2006). To sum up, to respond effectively to the requirements of SOX 404, management and auditors should pay more attention to internal control in the IT environment.

According to the Establishment of Internal Control Systems by Public Companies released by the Financial Supervisory Commission (Financial Supervisory Commission, 2005), internal control systems can be divided in accordance with the nature of businesses and transactional cycles. These include the control of sales and receipts, procurements and payments, production, wages and salaries, financing, fixed assets, investment cycles, and research and development cycles. As this study aims to construct a computer audit system centered on the cycle of sales and revenue, understanding the relevant operational procedures in the cycle helps ensure the robustness of system development. Table 1 summarizes the

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definitions of the procedures of this cycle from domestic and overseas scholars. It shows that workflows include order acceptance, shipping and delivery, invoice issuances, sales returns or discounts, receipts, and general ledgers.

Table 1 Summary of operational procedures for the cycle of sales and revenue

Representative Scholar / Operational Procedures	A	B	C	D	E	F	G	H	Total
Order Acceptance	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	11
Shipping and Delivery	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	11
Invoice Issuances	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	11
Sales Returns or Discounts	ˇ						ˇ		4
Receipts	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ	11
General Ledgers		ˇ	ˇ						3

Source: A: Boynton, Johnson, and Kell (2001); B: Hall (2004); C: Wilkinson, Cerullo, and Raval (2000) ; D: Whittington and Pany (2005); E: Boynton and Johnson (2005); F: Romney and Steinbart (2006); G: Arens, Elder, and Beasley (2005); H: Rittenberg and Schwieger (2005)

In the computer system environment, controlling system application is an important element of internal control. The purposes of these control designs are to appropriately record, process, and report all specific application processes such as wage processing and ordering. Application controls can be classified into three types according to their functions, namely, input controls, processing controls, and output controls (Elder et al., 2008; ITGI, 2006). The scope of each functional control includes relevant control procedures, such as authorization procedures, documentation, recording, and independent internal reviews. The computer audit system developed by this study is constructed by the three major functions covered by the application controls of the ERP system.

2.2 Computer Audit Practices and Techniques

Audits can be divided into internal and external audits, and can be used to inspect the internal control system (Boynton et al., 2001). The function of auditing is changing along with the transformation of the IT environment and the creation of SOX Section 404. Auditing has evolved from a passive tool to prevent frauds and has taken an active role in

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promoting profits. The scope of auditing has also extended from traditional financial activities to all operating activities. The audit trails of manually processed transactional proofs and documents are declining. These changes have prompted auditors to use computer-aided tools to resolve problems associated with the computerized environment and to upgrade their professional knowledge and experience in IT, a means of effectively collating and assessing relevant information and issue reasonable and reliable audit reports (Debreceny et al., 2005; Shaikh, 2005). The Information System and Audit Control Association (ISACA) (2003) mentions that auditors should understand CAATs and the corresponding applications, including the use of generalized audit software, test data generators, and integrated test facilities.

Recent studies aim to provide techniques (such as continuous audit system, system control and generalized audit software) to assist audits in inspecting the ERP systems (Brazel, 2005; Lanza, 2005; Li et al., 2007; Shaikh, 2005). Current software tools (e.g., generalized audit software) that audit ERP systems face many challenges and limitations. For example, generalized audit software is not compatible with complex ERP database systems (Li et al., 2007). Auditors often find it difficult to access audit data when they use generalized audit software for the first time (Braun & Davis, 2003). Auditors need to understand semantics regarding ERP data structure, relevant database hierarchy, and corporate workflows when they use generalized audit software. They also need to write programs for embedded audit rules (Frederick & Aleksandra, 2000). Table 2 lists the flaws of generalized audit software. Due to many technical barriers associated with generalized audit software, an ERP audit system that addresses the technical limitations of auditors can greatly reduce audit costs, as well as boost audit effectiveness and efficiency.

Table 2　List of shortcomings of generalized audit software

Shortcomings of Generalized Audit Software	A	B	C	D
1. The complexity of information technology and systems is beyond the overall comprehension of auditors.	●	●	●	
2. Special audit jobs require writing programs, which is outside the scope of work of auditors	●	●	●	●
3. Generalized audit software is not compatible with ERP database systems		●		
4. Total cost of developing generalized audit software is higher. The access of audit data is too time-consuming.	●			

Source: A: Lanza (2005); B: Li et al. (2007); C: Braun and Davis (2003); D: Frederick and Aleksandra (2000)

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The growing introduction of IT into companies and the rapid development of E-commerce have improved the convenience and the timeliness of access to corporate information, and changed the needs of corporate information users in terms of the nature of real-time accounting reports. The periodical audit-reporting pattern of the past does not meet the need for timely information reporting (Coderre, 2005). Continuous auditing can help auditors audit financial information in a timely manner. The audit reports generated with continuous computer audit systems can reduce audit costs and enhance the implementation of internal control of companies (Alles, Brennan, Kogan, & Vasarhelyi, 2006).

2.3 Usability Assessment of System Development

The main purpose of this study is to develop a computer audit system to assist auditors in handling complex and routine tasks. Usability is the key quality in developing systems. Systems with low usability often result in objections and discontent of users, such that they end up not being used (Anandhan, Dhandapani, Reza, & Namasivayam, 2006). Usability is a requirement for systems, and includes good presentations of design components, consistency of design styles, robustness of touring structures, the provision of accurate and timely system status, shortening of response time, stability of system operations, consideration of privacy and information security, and comprehensiveness of user services (Becker & Mottay, 2001; Ferre, Juristo, Windl, & Constantine, 2001).

System usability can be improved with usability tests, a means of enhancing the usability of products. Analyzing the application environment of products can identify the usability targets that the products have to attain and assess their usability levels. Furthermore, usability tests enable system developers to understand the real needs of users, so that the systems can match the capacities of users and identify system errors that may affect them. System developers can refer to information derived from usability tests for system improvements (Edwards, Moloney, Jacko, & Sainfort, 2008; Koubek, Benysh, Buck, Harvey, & Reynolds, 2003; Nielsen, 1992, 1993; Whiteside, Bennett, & Holtzblatt, 1988; Wixon & Wilson, 1997). System usability tests, like system development, should include questions in design and thinking in order to establish tasks in flows and executions. Relevant factors that may affect the execution of users, such as ease of learning, efficiency, ease of memorization, error rates, and satisfaction should also be incorporated (Anandhan et al., 2006; Yoon, Laffey, & Oh, 2008). Frequently used usability test methods are laboratory, field studies, expert reviews, and surveys, as well as the so-called cheap, accurate, reliable, efficient (CARE) testing (Anandhan et al., 2006; Dix, Finlay, Abowd, & Beale, 1993;

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Shneiderman, 1998; Zhou, Qin, & Chen, 2006).

3. Research Method and Design

This study uses the model structure of Gowin's Vee as the research foundation to construct systematically a computer audit system that complies with SOX Section 404 and then conducts an empirical test. The Gowin's Vee model manifests as a V-letter structure, with literature reviews and empirical studies provided at the end of the letter V. Researchers can sift through literature and collate papers based on their own understanding of the research issues in order to establish concepts on how to address these gaps. Data is collected, and interpretations on experimental results are made to establish an in-depth knowledge of the research issues (Novak & Gowin, 1984).

With regard to literature reviews, the present work applies the Grounded Theory in constructing the computer audit system and establishing the archetype of the audit items for the cycle of sales and revenue. Strauss and Corbin (1990) suggested that the Grounded Theory collects and analyzes data systematically to uncover, develop, and tentatively validate theories. Grounded Theory processes data to meet research requirements, followed by verifying and enhancing the content validity of audit issues in order to accommodate insufficiencies in literature and meet practical needs. This study has obtained expert opinions through questionnaires. It extracts the list of audit items for the cycle of sales and revenue in compliance with SOX Section 404 based on the method and validation processed proposed by Lawshe (1975). For the empirical study, we have constructed the computer audit system with system development and validated the practicality of the system with the CARE method. The CARE testing method is a suitable assessment method for system usability under a tight deadline, insufficient budgets, and scarce resources. This study selects the CARE method because it offers a specific definition of the steps for usability assessments (including question definitions and goals, list of preparatory tasks, scheduling, and implementation of assessment work, data collection, and analysis results). Compared with other usability tests (such as user tests and question-answer model), the CARE method requires less time and budget. Its credibility is also superior to the questionnaire survey method (Anandhan et al., 2006). Figure 1 shows the research flow of this study.

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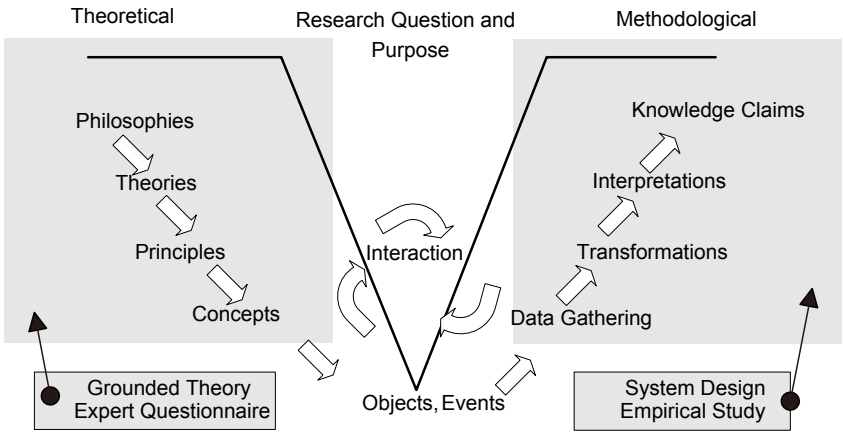


Figure 1 Research strategy structure and flow chart

4. Suggestions for Archetype of Computer Audit Systems

To construct the archetype of computer audit systems, the present work first divides literature relative to the audit of the cycle of sales and revenue, and applies the Grounded Theory methods in the initial summary and analysis of the audit lists for the cycle of sales and revenue. Afterwards, an expert questionnaire survey is performed to obtain opinions from professionals in relevant fields, a means of ensuring that the cycle of sales and revenue is compliant with the audited items required by SOX Section 404.

4.1 Processes of the Grounded Theory

As this study aims to construct a computer audit system compliant with SOX Section 404, the criteria for searches in literature review are keywords such as revenue cycle, computer auditing, internal control, and ERP. In addition, with the growing sophistication of computer audit techniques, this current research work focuses its focus on literature published no earlier than 2000. Data has been sourced from ProQuest, SDOS, and the National Central Library using these keywords, collated, and then summarized into 16 papers for in-depth examination and analysis. Classifications are then made to facilitate the coding based on the Grounded Theory.

4.1.1 Open Coding

This study performs conceptualized open coding based on the content of literature. Since our aim is to examine the important inspection or audit items for the cycle of sales and revenue on a computer audit system in compliance with SOX Section 404, any control items

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in relation to the cycle of sales and revenue mentioned or highlighted in literature are recorded and coded.

Example: Rittenberg and Schwieger (2005) in "Auditing: Concepts for a Changing Environment" suggest that "sales recorded only with valid customer order and independent shipping document" and "sales price comes from authorized sales price lest maintained on the computer and the Internet. It is possible to conceptualize this paragraph and set up the coding as credit limits, in consideration of credits, guarantee, and collateral quota (E1) of customers, and sale price that is lower than COGS (E6).

Coding results can be derived in this method. There are 210 conceptualized results. The present work converts the conceptualized results (codes) into 29 domains, which are the important audit or control items for the cycle of sales and revenue on the computer audit system.

4.1.2 Axial Coding

Axial coding in is based on the attribute domains of the 29 important audit or control items that influence the cycle of sales and receipts on the computer audit system. It resumes the analysis and comparison to bring forward the domain summary derived in the previous stage to a higher level of conceptualized dimension. This paper summarizes the 29 important audit or control items that influence the cycle of sales and revenue on the computer audit system into six major operations (i.e., order acceptance, shipment and delivery, invoice issuances, sales returns or discounts, receipts, and general ledgers). For example, [set-up of credit limits, consideration of customer credit, guarantee and collateral quotas], [continued shipments although exceeding credit limits], [repeated canceling of orders, frequent changes in pricing (within a certain period of time, customers place repeated orders)] are classified into "order acceptance."

By using the coding based on the Grounded Theory, this paper summarizes the key audit elements for the cycle of sales and revenue (Appendix 1).

4.2 Expert Questionnaires

After the initial summary of the computer audit key elements for the cycle of sales and revenue, this study has obtained opinions from professionals in related fields by issuing expert questionnaires, a means of ascertaining the content validity of the important audit elements. The questionnaires are released to 13 professionals, including accountants in accounting firms and auditors in companies listed on Taiwan Stock Exchange or Over-the-

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Counter (OTC) Exchange. Table 3 shows the background of these experts. As the number of experts is 13, the Content Validity Ratio (CVR) has to be greater than 0.542 to qualify as an audit item (Lawshe, 1975). The calculation of CVR is (n-N/2)/(N/2), where n is the number of the key factors deemed by the experts as important, but not absolutely relevant, and N is the number of experts. (Appendix 2 lists the analysis results of the CVR values for the expert questionnaires).

Table 3 List of shortcomings of generalized audit software

Field	Expert's Code	Organization	Experience and Title	Years of Experience
Accounting firms	E01	PricewaterhouseCoopers	Manager	9
	E02	PricewaterhouseCoopers	Manager	8
	E03	PricewaterhouseCoopers	Manager, Computer Audits	10
	E04	Ernst & Young	Accountant	10
Industries	E05	AGV Co. Ltd.	Finance Supervisor	18
	E06	Gsharp Corporation	Finance Manager	6
	E07	Hon Hai Precision Industry	Specialist, Accounting	7
	E08	Xue Xue Institute	Financial Manager	10
	E09	Tainan Enterprise	Engineer, IT system	11
	E10	Yuan's General Hospital	Deputy Director, Accounting Division	10
	E11	Chia Hou Automobiles	Manager	12
	E12	Taiwan Jhonsin Co. Ltd.	Finance Manager	12
	E13	National Tainan University of Arts	Accounting Director	22

As listed in Appendix 2, seven audit items are deemed by the experts as "not appropriate" for computer audit systems. Four audit items are expressed by experts as not having any influence on the audit items, as stipulated by SOX Section 404. After eliminating computer audit items that are unsuitable for system development and not in compliance with SOX Section 404, the new item on "control on whether the receipts and receivables are offset" is added, as suggested by experts. This paper assembles six major operations and 22 audit items for the cycle of sales and revenue, as shown in Figure 2.

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5. Development and Empirical Study of Archetypes of Computer Audit System

The computer audit system constructed by the present work is based on the ERP of Data System. It is a market leader in the domestic ERP industry, boasting 25% market share for the top 1,000 Taiwanese companies. The advantages of Data System are evidenced by the localization limitations of the ERP software (such as tax requirements and other regulations). Insufficiency in product localizations and overly high prices of international vendors pose a heavy burden to domestic small and medium enterprises (SMEs). Data System is the only domestic software company that provides products to small companies (with an annual revenue below NT$200 million), medium companies (with an annual revenue above NT$200 million), and large companies (with an annual revenue above NT$2 billion). The company boasts a comprehensive product line that is more competitive than international ones in the Taiwanese SME market. This study constructs the computer audit system based on the system structure developed by Chang, Wu, and Chang (2008), and makes appropriate modifications. With the System Development Life Cycle (SDLC), the present work completes the development of the computer audit system in four stages: (1) system planning and selection; (2) system analysis; (3) system design; and (4) system implementations and operations.

5.1 System Development

In the stage of system planning and selection, companies have to consider changes in external environments and limitations of internal resources in order to achieve operational targets and strategies. This requires analyzing present and future information needs, establishing an IT system structure on the general level, and prioritizing information needs based on certain criteria. Detailed plans and allocations of information resources should be developed accordingly for the systems (Lederer & Sethi, 1991). Regarding generalize audit software, auditors find the utilization threshold too high in the audit of the ERP system often due to their own insufficiency in IT techniques and compatibilities. This, combined with the shortcomings of generalized audit software, results in low utilization in the corporate world (Lanza, 2005). Therefore, a computer audit system customized to meet the specifications of a certain ERP system is highly expected and demanded by auditors or managers.

The system analysis stage mainly focuses on demands specified in the first stage for confirmation and analysis, a means of facilitating system development. The detailed and complete descriptions of the contents of user needs define the functions of new system. This study applies the research strategy of Gowin's Vee and confirms the appropriateness of the

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Grounded Theory and expert questionnaires with the use of 22 audit items for the cycle of sales and revenue. Therefore, at this stage, demand confirmation and analysis on these 22 audit items are conducted.

During system design, system designers have to assemble the "look and feel" of the system, from input and output screens to reports, databases, and calculation processes (Valacich, George, & Hoffer, 2001). Figure 2 illustrates the system design. This paper assembles 22 audit items for the cycle of sales and revenue, as confirmed by expert questionnaires. Table 4 explains the system analysis in these 22 audit items for the mismatches between invoice and ordered numbers.

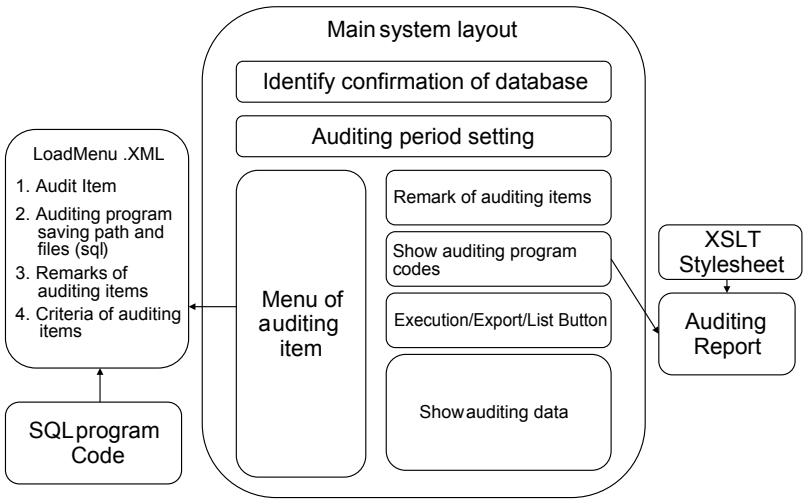


Figure 2 System structure planning

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Table 4 System analysis of audit programs

Operations	Receipts	Storage Paths and File Names	New\AC_01.sql
Name of Audit Items	Mismatch between invoice numbers and ordered numbers		
Remarks	Inconsistency between orders and invoice amounts during the audit period, to inspect whether databases or invoice amounts have been altered without authorization and check the risks		
Program Analysis	List from the data of the audited companies, i.e., (1) main files of invoices: (2) main files of orders during the audit period and then compare (1) and (2) and list the differences		
Input Parameters	Start and end dates of the audit periods		
Output Columns	Invoice numbers, order numbers and classifications, order amounts, sales amounts		
System Design-Inspection Programming Code			

```
SELECT TG.TG014   "Invoice number"
  , TD.TD001   "Order classification"
  , TD.TD002   "Order number
  , TD.TD012   "Order amount"
  , TH.TH013   "Sales amount"

FROM  COPTG TG
  , COPTH TH
  , COPTD TD
```

```
WHERE TG.TG001=TH.TH001
  AND TG.TG002=TH.TH002
  AND TH.TH014=TD.TD001
  AND TH.TH015=TD.TD002
  AND TH.TH016=TD.TD003
  AND TD.TD012<>TH.TH013
  AND TD.CREATE_DATE
BETWEEN :p_from_date and :p_to_date

ORDER by TG.TG014
```

After the success of the verification registration for this computer audit system, the system will execute the following:

(1) Read the contents of the LoadMenu.xml files in the same directory of the system as the selections of audit items.

(2) Read all relevant data in the ERP system to facilitate the operations of users. This leads to the selection of the items and periods to be audited. The system will display the details and risks of these items in the square box on the right. Modifications can be made, if necessary. When the operators confirm that all the parameter selections are correct, they can press the button “to audit” to initiate the audit job.

(3) When abnormal data are found during audit processes, the system will display the result in the square box on the right (i.e., the “to audit” button) to call the attention of

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operators. The system also records audited items and results made by auditors. The data is stored as XML files in the system. Until the auditors have completed all the audit items, they should press the button to print the inspection list in the execution zone. By referring to the Format.xslt files in the same directory of the system, the system will automatically open the browser to display the audit forms of this audit system (in HTML format).

5.2 Verifications of the Computer Audit System

After completing the system development, the CARE method proposed by Anandhan et al. (2006) is applied for the empirical study in order to understand the practicality of the system. This method defines usability assessment steps as problem definitions and targets, list of preparatory tasks, scheduling and implementations of assessment tasks, data collection, and analysis results. Figure 3 illustrates the assessment workflows based on the CARE method.

The explanation and result analysis of the CARE method are as follows.

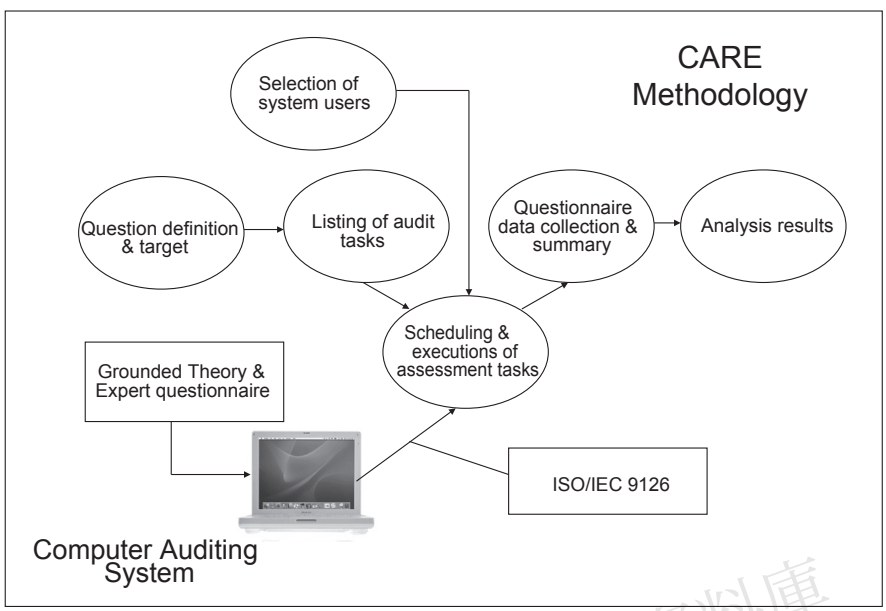


Figure 3 Empirical flows of computer audit system

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5.2.1 Question Definitions and Targets

The present work aims to conduct an empirical assessment to validate the quality of the computer audit system and the accuracy of the audit results. Therefore, we use the ISO/IEC 9126, a standard for software product assessment, as the structure to evaluate the computer audit system constructed by this research project. The ISO/IEC 9126 is an international standard for the quality of software products and measurements (ISO, 2001). Losavio, Chirinos, Matteo, Lévy, and Ramdane-Cherif (2007) indicated that software analysts will find it helpful to use ISO/IEC 9126 to appraise software engineering projects. Ossadnik and Lange (1999) also suggested that the ISO/IEC 9126 can effectively evaluate the quality of software products. Therefore, when it comes to measuring software quality, the ISO/IEC 9126 is an effective supporting tool. The quality characteristics it defines (including six attributes and 20 sub-attributes) can effectively help users understand the quality needs and evaluation criteria of software, as well as ensure the software can meet customer needs. The definitions of each ISO/IEC 9126 sub-attribute are summarized in Table 5.

Table 5 Definition of each ISO/IEC 9126 sub-attribute

Attributes	Sub-attributes	Definition
Functionality	Appropriateness	Specification of the task is precisely refined
	Accuracy	Capability of the software to provide the right results with the needed degree of precision
	Interoperability	Capability of the software to interact with one or more specified systems
	Compliance	Capability of the software to follow standards or regulations
	Safety	Capability of the software to avoid unauthorized access to programs or data
Reliability	Maturity	Capability of the software to prevent failures
	Fault Tolerance	Capability of the software to maintain a certain level of performance while software fault
	Recovery	Capability of the software to re-establish the level of performance and data
Usability	Understandability	Capability of the software to allow for user assessments to meet the logic and application of the software
	Ease of Learning	Capability of the software to allow users to learn it easily
	Operability	Capability of the software to allow users to use and control it easily

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Efficiency	Timeliness	Capability of the software to provide appropriate response time and processing time
	Resources Utilization	Resources utilization of the software while it is been continuously used
Maintenance	Analysis	Capability of the system analyze errors or analyze their causes
	Modification	Capability of the software to enable a specified modification
	Stability	Capability of the software to prevent unexpected effects derived from modifications of the software
	Testability	Capability of the software to be validated
Portability	Adaptability	Capability of the software transferred to other environments without modification
	Installations	Capability of the software install the system in different environments easily
	Replaceability	Capability of the software product to be used in place of another specified software product for the same purpose

5.2.2 Listing of Audit Tasks

The assessment project designs a number of audit tasks as the focus of the inspection of the cycle of sales and revenue. After completing system operations and tasks, system users should compare operational results and actual data. They are asked to answer the empirical assessment questionnaire for this ERP computer audit system. As a result, this paper establishes an understanding of the quality of the computer audit system and the accuracy of audit results.

5.2.3 Selection of System Users

As for the system users, we sought the participation of researchers who have taken computer audit classes, indicating that our respondents are potential users of ERP computer audit systems. We also invited professionals belonging to relevant areas. The observation results from student samples should be the same as the results from practitioners. In addition, the experience and professional expertise of industry practitioners should benefit the empirical assessment of this experiment. A total of 31 system users participated in this assessment project. Among them, 20 were graduate students, and the rest were undergraduates. Majority (54.8%) of participants have work experience. The mean for full-time work experience was 4.55 years, with a range of 2–10 years. Eleven (35.5%) users are currently working for the big four companies, namely, PricewaterhouseCoopers, Deloitte Touche Taiwan, Ernst & Young, and KPMG.

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5.2.4 Scheduling and Execution of Assessment Tasks

The implementation of the assessment project is carried out over five working days. System users operate the system and complete the questionnaires after they have completed the tasks. Before the assessment tasks, we invited five EMBA students with practical experience to conduct a pre-test to ensure the average time required to complete the tasks and identify any issues in association with the assessment tasks. Modifications have been employed before the formal project.

5.2.5 Questionnaire Data Collection and Summary

Paper-based (onsite) and electronic questionnaires (remote) are employed. Questionnaires are gathered immediately after the sample users have operated the system. After collecting the questionnaires, the raw data is inputted manually into Excel files. The data is stored to facilitate follow-up analysis.

5.2.6 Analysis Results

The Cronbach's Alpha (0.802) of the questionnaire data is greater than the acceptable value suggested by Hair, Anderson, Tatham, and Black (2006). Therefore, the questionnaire data are highly reliable, and results from assessment are stable and consistent. The data of all items are highly concentrated. Two items have 50% of the feedback centered on one scale. Thirteen items have 50% of the feedback centered on two scales. Five items have 50% of the feedback centered on three scales. Generally, if the data points gathered fall within three scales, it is within an acceptable range. Table 6 shows the descriptive statistical data of the system.

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Table 6 Descriptive statistical data of assessment questionnaire on ERP computer audit system

Construct	Items	No.	Minimum Value	Maximum Value	Total	Average	Standard Deviations
Functionality	Appropriateness	31	3	5	145	4.68	0.541
	Accuracy	31	4	5	142	4.58	0.502
	Interoperability	31	3	5	133	4.29	0.529
	Compliance	31	3	5	121	3.90	0.746
	Safety	31	2	5	129	4.16	1.186
Reliability	Maturity	31	4	5	132	4.26	0.445
	Fault Tolerance	31	3	5	129	4.16	0.454
	Recovery	31	3	5	132	4.26	0.893
Usability	Understandability	31	4	5	138	4.45	0.506
	Ease of Learning	31	3	5	131	4.23	0.560
	Operability	31	4	5	136	4.39	0.495
Efficiency	Timeliness	31	3	5	132	4.26	0.815
	Resources Utilization	31	1	4	87	2.81	1.108
Maintenance	Analysis	31	3	5	129	4.16	0.898
	Modification	31	3	5	129	4.16	0.898
	Stability	31	3	5	121	3.90	0.746
	Testability	31	3	5	119	3.84	0.688
Portability	Adaptability	31	3	5	125	4.03	0.605
	Installations	31	3	5	126	4.06	0.727
	Replaceablility	31	3	5	133	4.29	0.693

Among the functionality constructs, the attributes that received high ratings are [appropriateness] and [accuracy]. The computer audit system developed for this study can help users resolve related audit tasks and provide accurate results.

Among the reliability constructs, the attributes that received high ratings are [maturity]

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and [recovery]. This may be because the computer audit system does not incur any system errors during the implementation of audit tasks. There is no failure in access or system breakdown. Responses to the needs of users are quick and timely.

Among the constructs of usability, the attributes that received high ratings are [understandability] and [operability]. This may be because the computer audit system is easy to use. It allows users to understand quickly the functions and applications of the computer audit system. It also assists auditors in identifying easily any mistakes in a simple and analytical manner when completing the audit tasks.

Among the constructs of efficiency, the attribute that received high ratings is [timeliness]. This may be because the computer audit system generates results of the audit tasks swiftly, and is even quick in responding to the needs of users. This enables users to solve problems and complete audit tasks in a timely manner.

Among the constructs of maintenance, the attributes that received high ratings are [analysis] and [modifications]. This may be because the computer audit system does not incur any system problems during the experiment period. This computer audit system can be implemented immediately after completing the relevant information relevant environment. There is no need to waste any further resources for environmental modifications. Therefore, the ratings for these constructs are high.

Among the constructs of portability, the attributes that receive high ratings are [replaceablility] and [installations]. This may be because the computer audit system is easy to install and replace. As long as the relevant environment is set up, the computer audit system can be quickly installed in computers for audit tasks. Therefore, the ratings for replaceability and installations are rather high.

Some attributes received lower ratings, especially [resources utilization]. This might require long-term observation from users while the software has been continuously used. Moreover, despite [compliance], [stability], and [testability] receiving lower ratings than majority of attributes, which received an average score above four, the range of ratings assessed by users is distributed from three (normal) to five (very excellent). This evidence supports that these attributes of this system are recognized.

Generally, the attribute with the highest average score is the first item, [appropriateness: the present functions meet with the requirements], with an average score of 4.68. This may be because the computer audit system could effectively assist sampled users in their task needs and achieving of their audit tasks. The second attribute, [accuracy: the provision of accurate answers by the system] also has a high rating, with an average score of

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4.58, indicating that the computer audit system yields high accuracy in audit results and can provide correct results to assist users in their audit tasks. The finding also confirms the accuracy and validates the results of this computer audit system. In terms of software quality, the practitioners with professional expertise and students with relevant experience determine that the software quality is high. This means the computer audit system meets certain quality standards. When it comes to accuracy of audit results, the assessment questionnaires indicate that the accuracy is high by comparing computer generated results and relevant data after the completion of tasks. This means the system can assist users in reviewing and analyzing relevant audit tasks.

6. Conclusions and Suggestions

The present work constructs the computer audit system and conducts an empirical study based on Gowin's Vee research structure. Theoretically, we apply the Grounded Theory and distribute expert questionnaires to collate data and make modifications on the computer audit system. The audit issues required for the cycle of sales and revenue include six major operations and 22 audit elements. The audit issues derived in the stage are recognized by experts in the industries. They are highly reliable and compliant with SOX Section 404. The research result can serve as a reference for auditors in industries or accounting firms in the general audit of the cycle of sales and revenue. It can assist the audit of any potentially risky or fraudulent behavior. The proposed audit elements, after certain modifications, can also provide a reference to follow-up researchers in studying the cycle of sales and revenue as one of the major eight cycles in transactions.

The audit points formed in the first stage need to develop the computer audit system. For the methodology under Gowin's Vee structure, this study applies SDLC to develop the computer audit system. It then adopts the ISO/IEC 9126, a software assessment standard, and the CARE method to validate the quality of the system and accuracy of audit results. According to the empirical study, the computer audit system is with certain quality standard. The accuracy of the audit results is also highly rated.

Auditing ERP systems is but a small contribution in preventing fraud. In this rather limited field of work, auditors in the past were all accountants. They could not gain in-depth understanding of the structure of massive ERP database systems. Oftentimes, these manifest as misunderstandings between auditors and IT personnel. As a result, auditors could not obtain the abnormal data required. Acquiring abnormal data from complicated ERP databases is extremely time-consuming, which makes it impossible to analyze further the

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information, or even conduct audits on non-computer systems. The developed computer audit system can assist managers or auditors to comply with SOX Section 404, and allows auditors to focus more on result analysis and risk assessment. It provides a timely method to audit jobs and speed up the completion of audit tasks. Future research may conduct empirical tests of the designed computer audit system by comparing the audit results of using a traditional audit approach for specific research purposes.

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Appendix 1 Key audit elements for the cycle of sales and revenue

Constructs of Workflows	Item	Audit Items	Reference
Order Acceptance	1	Set-up credit limits by considering credit, guarantee, and collateral quotas of clients.	A, B, C, D, E, F, G, H, I, K, L, M, N, O, P
	2	Continued shipments although exceeding credit limits.	A, E, H, I, K, O, P
	3	Repeated cancellation of orders, frequent changes in pricing (within a certain period of time, customers place repeated orders)	B, E, G, I, J, K, N, O
	4	Sale prices lower than COGS	A, E, F, H, I, K, L, M, O
	5	Prices offered by salespeople lower than reserve prices	A, D, K, L, N, O
	6	Shipments not ready yet after deadlines	C, E, F, K, L, O, P
	7	Shipments earlier than ordering dates	B, G, H, K, L, P
	8	Orders in small quantities to avoid authorization	B, H, K, N, P
	9	Approval from appropriate levels of managers on orders	A, F, G, H, I, L, M, N, O, P
Shipping and Delivery	10	Whether shipped volumes, unit prices and product names are consistent with orders	A, B, D, E, F, G, I, K, L, N, O, P
	11	No orders but there are shipment records	D, E, N, P, L
Invoice Issuances	12	Percentage of returns in total sales during transactional periods	D, K, N
	13	Different product names and quantities in invoices and orders	B, C, D, E, F, G, H, I, L, M, N, O
	14	Invoices not issued despite shipments being made	A, C, H, K, L, M, P
Sales Returns or Discounts	15	Returned goods not recovered yet	A, D, G, N
	16	Unauthorized discounts	D, G, L, N

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Receipts	17	Mismatch between invoice amount and ordered amount	D, E, K, M, P
	18	Age analysis of receivables	C, F, H, K, L, N
	19	Shipment dates later than receivable dates	B, N, P
	20	Remittance notifications not consistent with receivables	B, D, E, G, H, O, P
	21	Receivables not yet entered the book	B, E, K, I, O
General Ledgers	22	Comparison whether the balance of receivables are consistent with the total balance	A, D, H, J, L, N
	23	Total asset turnovera	J
	24	Profitability by product (by customer)b	J
	25	Seasonality analysisc	J
	26	Sales return rate analysisd	J
	27	Liquidity of receivablese	J
	28	Credit expansionf	J
	29	Bad debt ratiog	J

Source: A: Wu (2007); B: Tsai and Feng (2004); C: Chen and Ke (2005); D: Ma (2006); E: Wu and Chang (2001); F: Li and Lin (2006); G: Yen (2002); H: Chi, Yu, Lin, Chiang (2002); I: Tsai and Lin (2006); J: Huang and Chuang (2005); K: Wu and Hong (2006); L: Arens et al. (2005); M: Rittenberg and Schwieger (2005); N: Whittington and Pany (2005); O: Romney and Steinbart, (2006); P: Boynton and Johnson (2005)

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Appendix 2 Experts' questionnaire statistics and content validity

Constructs of Operational Flows	Audit Items	Summation (No. of People)				CVR			
		Suitable for Computer Audits		Compliant with SOX Section 404		Suitable for Computer Audits		Compliant with SOX Section 404	
		Not suitable	Suitable	Not influence	With influence	Not suitable	Suitable	Not influence	With influence
Order Acceptance	1. Set-up of credit limits by considering credit, guarantee, and collateral quotas of clients	2	11	0	13	-0.69	0.69	-1	1
	2. Continued shipments although exceeding credit limits	0	13	1	12	-1	1	-0.84	0.84
	3. Repeated cancellation of orders, frequent changes in pricing (within a certain period of time, customers place repeated orders)	4	9	4	9	-0.38	0.38	-0.38	0.38
	4. Sale prices lower than COGS	2	11	2	11	-0.54	0.69	-0.69	0.69
	5. Prices offered by salespeople lower than reserve prices	3	10	3	10	-0.54	0.54	-0.54	0.54
	6.Shipments not ready yet after deadlines	1	12	2	11	-0.84	0.84	-0.38	0.69
	7. Shipments earlier than ordering dates	0	13	2	11	-1	1	-0.69	0.69
	8. Orders in small quantities to avoid authorization	2	11	0	13	-0.69	0.69	-1	1
	9. Approval from appropriate levels of managers on orders	0	13	0	13	-1	1	-1	1
Shipping and Delivery	1. Whether shipped volumes, unit prices and product names are consistent with orders	2	11	2	11	-0.54	0.69	-0.69	0.69
	2.No orders but there are shipment records	1	12	1	12	-0.85	0.85	-0.85	0.85

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Invoice Issuances	1. Percentage of returns in total sales during transactional periods	1	12	0	13	-0.85	0.85	-1	1
	2. Different product names and quantities in invoices and orders	2	11	2	11	-0.69	0.69	-0.69	0.69
	3. Invoices not issued despite shipments being made	2	11	0	13	-0.69	0.69	-1	1
Sales Returns and Discounts	1. Returned goods not recovered yet	2	11	1	12	-0.69	0.69	-0.85	0.85
	2. Unauthorized discounts	1	12	1	12	-0.85	0.85	-0.85	0.85
Receipts	1. Mismatch between the invoice amount and ordered amount	2	11	1	12	-0.69	0.69	-0.85	0.85

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Biographical Notes

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澳洲昆士蘭科技大學資訊系統管理博士，目前任職於國立中正大學會計與資訊科技研究所。現任中華民國電腦稽核協會編譯出版委員會主任委員、國際資訊系統學會台灣分會（TWAIS）副會長與國際華人資訊系統學會（ICISA）副會長。主要研究領域為企業資源規劃、組織 e 化效益評估、質性研究方法與應用、電腦稽核等。

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