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Using continuous auditing life cycle management to ensure continuous assurance

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The main purpose of this study is to develop a model of key steps for the successful implementation of continuous assurance software, and to reduce the impact of internal auditor technology on ensuring enterprise business assurance by monitoring business systems and their procedures, activities, transactions, and events in a real-time manner. The continuous auditing methodology effectively enhanced audit quality and reduced internal compliance cost for Mutli-Fab with across Taiwan and Chinese-based companies and ensure the continuous assurance in this case field study. Continuous auditing lifecycle management will consider continuous data retrieval, continuous data analysis, continuous data control, and continuous data monitor. This field study also provides useful findings and suggestions related to the insights and experiences learned.

Key words: Continuous assurance, electronic commerce, continuous audit web services, extensible markup language, business assurance.

INTRODUCTION

Since 1990, advancements in computing technology, such as Exchange Data Interface (EDI) and Electronic Funds Transfer (EFT) have greatly reduced supply chain costs and product lifecycles, eliminated redundant, overlapping operational procedures, and have decreased paper use (Vasarhelyi and Greenstein, 2000). In addition to these technological advancements, resource systems have gradually and steadily integrated internal information processing, and can now handle the bulk of large corporate transactions. To this end, these technological changes in the auditing environment have impacted traditional auditing techniques, which have forced auditors to use advanced, computerized methods for conducting procedure verification and for collecting evidence from electronic data (Bierstaker, 2001). In addition, audit trails have been converted from traditional paper documents to an electronic data format (Rezae, 2002). Due to the vigorous development of information technology (IT), some enterprises such as Wal-Mart, J. C. Penney, and Dollar General have utilized an electric format for their the production of periodic

financial information, as well as for the development of non-financial information. For example, CISCO systems Inc. is able to close an account within one hour (Daigle, 2002; Elliott, 2002).

Real-time demand for information has become a critical challenge for auditors to empirically develop new competitive strategies. Many scholars have taken advan-tage of IT advancement to propose various continuous auditing models to resolve the demands imposed on those auditors (Daigle and Lampe, 2002; Rezaee et al., 2002;Onions, 2003; Chen 2007; Yeh 2008; Alles et al., 2008;Kuhn and Sutton, 2010). Recently, data have become readily accessible between different systems due to the emergence of electronic commerce (EC). However, it is difficult to use the document format, HTML, to conduct several operations such as data output and comparisons (Alles et al., 2004). For this reason, a new document format, Extensible Markup Language (XML), which defines the information exchange standard by using document characteristics, has become widely used to resolve the inherited problems encountered when using HTML documents. The American Institute of Certified Public Accountants (AICPA) has cooperated with five major CPA firms to promote the Extensible Business Reporting Language (XBRL) for financial statements, and has established a general

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standard language which creates different financial statements to support companies, investment institutions, CPAs, bankers, Indus-trial analysts, and other competent authorities to prepare, announce, exchange, and analyze their financial data to support the development of real-time financial statements (Debreceny and GL, 2001; Alles et al., 2004).

Some scholars have already used XML and Web Services to design the framework of accounting information systems with continuous auditing web services (CAWS) (Murthy and Grommer, 2004). Such studies have demonstrated how to improve real-time financial statement support, how to communicate with external organizations based on real-time financial statements, and how to completely verify real-time requirements. Flowerday and von Solms (2005) have demonstrated that real-time financial statements require the utilization of information system integration, data integration, and the continuous auditing domain in the same time.

Objective/contribution

In this study, we propose a continuous auditing model that supports real-time financial reports on the Internet (O'Donnell and Smith-David, 2000; Sutton, 2000; Vasarhelyi and Greenstein, 2003; Hunton et al., 2003; DeWayne, 2009; Sutton, 2010). The model creates a three-layer framework of continuous auditing modules that will reduce enterprise compliance costs and enhance the quality of internal and external auditing. These three layers include the data retrieval, analysis, and presentation layers. The result of the auditing report will be passed on to the data presentation layer to complete the reliable/integrated real-time continuous auditing monitoring framework. The model integrates the unique attributes of XML and Web Services to provide external audit firms access to a continuous auditing data warehouse.

This field study case involves the following objectives:

1. Develop system architecture through the use of the data transaction, analysis, and presentation layers.
2. Determine the best mode for continuous assurance with a continuous auditing methodology.
3. Determine the communication between the enterprise assurance mechanism and the enterprise internal control framework.
4. Collect further clarification on the continuous assurance implementation model to formulate a novel management plan for external auditing firms.

The research team consisted of several faculty members, doctoral students and research assistants. They worked closely with senior internal auditors, the head of the internal information technology department, the head of the financial department and senior external auditors. The remainder of this paper is divided as follows: The

Literature describes the continuous assurance, continuous auditing, and related continuous auditing web services models. The methodology provides the framework for the continuous auditing web services (CAWS) model while the field report provides detail implementation of a CAWS model and field study findings. Also, the conclusion is provided. The empirical implications are also provided in detail. Finally, this study proposes future research and limitations.

Literature

The essential components of assurance consist of the continuous recording of business transactions, transact-tion monitoring, assurance, and reporting. Continuously guaranteed, real-time confirmation is a practical goal of assurance (Alles, 2002). Therefore, implementation procedures, such as continuous auditing and continuous auditing web services models, are reviewed.

Continuous assurance

Assurance is the opinion of a third party, regarding the state of a subject transaction, business process, risk, or overall financial performance of a business operation. The continuous assurance framework is the combination of activities performed by internal audit activity for independent evaluation. Continuous assurance allows for corrective action to be taken more quickly than in current scenarios (Bierstaker et al., 2001). Also, it requires that the assurance report be made available in real-time and contains all relevant information. Continuous assurance provides three levels of assurance, each of which has varying degrees of significance and types of actions required by the auditor:

Level 1: assurance regarding the reliability of the client's system and the security of data transmission, much like SysTrust (AICPA, 1999).
Level 2: an opinion regarding the fairness of the real-time financial statements provided by the client, based upon the continuous audit.
Level 3: assurance of a specific analysis between the client and third party, as outlined in the continuous audit agreement (e.g., debt covenant compliance).

Therefore, continuous assurance is a methodology used to analytically monitor corporate business processes and that takes advantage of the automation and integration of business processes provided by information technologies (Vasarhelyi et al., 2006).

Continuous auditing model

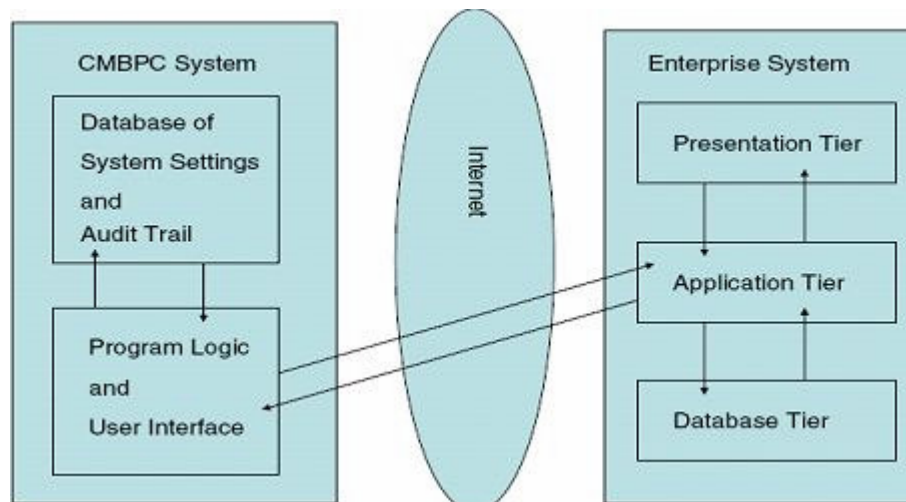The concept of continuous auditing was introduced more

Figure 1. Architecture of the generic CMBPC system.

than 20 years ago (Debreceny et al., 2003; Groomer and Murthy, 1989). The earliest continuous process auditing system (CPAS) was developed in the Bell Laboratories of AT and T, and was designed to either serve as a paperless pattern for internal auditing, or in various embedded auditing model (EAM) formats (Groomer and Murthy, 1989; Vasrhelyi and Halper, 1991). According to studies by the AICPA and the Canadian Institute of Certified Public Accountants (CICA), the most widely accepted continuous auditing definition is: "a methodology that enables the independent auditors to provide written assurance on a subject matter using a series of auditor's reports issued simultaneously with, or a short time after, the occurrence of events underlying the subject matter" (CICA/AICPA, 1999).

Rezaee et al. (2002) showed "a comprehensive electronic audit process that enables auditors to provide some degree of assurance on continuous information simultaneously with, or shortly after, the disclosure of the information." They proposed that a Client/Server network framework can be used not only as a conceptual framework for continuous auditing, but also can be employed as a structure to physically transfer data by the File Transfer Protocol (FTP) to different auditing workstations. Oninos (2003) proposed that the conceptual framework of continuous auditing is actually used to maintain integrity while monitoring data. Consequently, the keystroke method is suggested for data examination. Data examination utilizes common programs to monitor the database with any possible induction of fraudulence to prevent the use of potential applications with undesirable instructions. Use of real-time computer-aided tools to inspect the data from transactions and database applications and the auditing center (OLSAC) will be distributed according to the alert notice. Conducting searches for the data definition is done with assistance from Expert Systems. A series of predetermined regulations, such as the Alarm Notice or Red Header Flag

(Chen, 2004) can be utilized to accomplish the required level of auditing.

Alles et al. (2006) developed the conceptual model for designing a system to continuously audit business process (BP) controls, as depicted in Figure 1. The continuous monitoring of business process controls relies on automatic procedures to implement the continuous auditing system. The process of monitoring itself falls within the general continuous auditing framework, which is developed by obtaining assurance through continuously comparing actual observations (in this case the control settings) against the benchmarks developed by Vasarhelyi et al. (2004). The design of system architecture for continuous monitoring of BP controls is based on an independent system, usually referred to as the monitoring and control layer (MCL). The sub-system of an enterprise system is typically called the embedded audit module (EAM). The MCL system will not share premises with the enterprise system, and it relies on remote (read-only) access to the enterprise system at the application layer. The enterprise data retrieved by MCL are presumed to be absolutely safe and not susceptible to pre- or post-extraction manipulation from enterprise personnel. MCL can query the enterprise system through the application tier, using its application program interfaces (e.g., BAPIs in the case of SAP R/3). This approach is well supported by system vendors and enables the APIs to be well-documented. Analogously, an EAM could be implemented as a sub-module of the application (e.g., coded in ABAP in the case of SAP R/3). This data were reviewed against business rules defined by the Audit Action Sheets in the CA Analyzer to identify exceptions and report alarms to the appropriate compliance personnel in the CMBPC.

This integrated enterprise information systems has a three-tier architecture that consists of the presentation, application and database layers. Each of these layers is typically run on a separate computer system. While the database layer contains all enterprise data, all business

Table 1. Continuous audit model.

CA Criteria\Model	Woodroof and Searcy (2001)	Murthy and Groomer (2004)	Alles et al. (2006)
	Rule-based detection by digital agents	Continuous Audit Web Services(CAWS)	Monitoring and control layer(MCL)
Reliable system (confidentiality, integrity and availability)	Adapt and apply Sys Trust principles	Retrieve data relating to periodic adjustments and allowance	Embedded audit module(EAM)
	Auditor defined rules for digital agent	Like a continuous Systrust verification	SAP package system parameter
Internal control		System control audit review file (SCARF)	
	Level 1:security transmission	General audit software (ACL)	Audit action sheets (AAS)
Automated audit procedures	Level 2:Transactions and processes		Continuous Audit
	Level 3:Technical violation of 3rd party agreement Evergreen report		Analyzer (CA Analyzer)

logic is coded and executed in the application layer. This 3-tier enterprise system architecture creates the dilemma of whether MCL should interact with (or EAM should reside in) the application or database tier of the enterprise.

Continuous auditing model criteria

The continuous auditing system must match specific criteria to achieve continuous assurance in Table 1. The criteria must include the real-time basis system condition, internal control management and computer technology; the system supports an automated audit procedure and is executed at a fast pace in the client enterprise. We propose to evaluate the extant model base with continuous auditing criteria and to transform the model criteria. In this context, a reliable system consists of confidentiality, integrity, and availability of internal controls.

The internal control system must be evaluated and tested to ensure that it is working as intended. The process, control point, key player, and risk must be reviewed carefully. Many terms from GATG have been associated with the notion of providing ongoing audit procedures in real-time, or at least nearly real-time, including: continuous monitoring, continuous control assessment, and continuous risk assessment (GTAG, 2005; Alles et al., 2006). Therefore, the automated audit procedures provide most of the evidence necessary to opine on the subject of continuous monitoring, control, and risk assessment.

It is apparent that the approaches of the three modules differ slightly from each other. However, they all aim to function as reliable systems and to combine internal control systems and automated audit procedures. Some of the models use different technologies to achieve the same goal. For instance, detecting fraud and error may be accomplished with the digital agent, the CAAT, or the CA analyzer.

Related continuous auditing web services (CAWS) implementation research

Web Service is an application program logic which can be accessed using the Standard Internet Communication Protocol. Web Services can be discussed in conjunction with the element-oriented development. The process as a "black box" function can be repeatedly used as the elements, regardless of concern over how the services can practically be implemented. Web Services can be performed with the common network communication protocol and generic data formats, such as hypertext transmission protocol (HTTP) and extensible markup language (XML). Wolter (2001) defines XML Web services in terms of its three essential elements, as follows. First, XML Web services expose useful functionality to Web users through a standard Web protocol. In most cases, the protocol used is the simple object access protocol (SOAP). Second, XML Web services provide a way to describe their interfaces in enough detail to allow a user to build a client application to talk to them. This description is usually provided in an XML document, called a web services description language (WSDL) document. Third, XML Web services are

Table 2. Key issues in continuous auditing implementation.

CA architecture	Key issues in implementation in field study	Prior study
Capturing transactional data	1. Embedded Audit Module (EAM) as data could automatically be fed into several data marts	Rezaee et al., 2002
	2. keystroke level data examination	Woodroof and Searcy, 2001
Monitoring and analyzing	1. Audit processes separate, able to be formalized, and not able to be formalized program	Alles et al., 2006
	2. audit alarm, automatic confirmations, control tags, continuity equations, and time-series cross-sectional analytics	Alles et al., 2006
The communication of analysis outcome	1. Internal control as SysTrust	Woodroof and Searcy, 2001
	2. SCARF (System Controls and Review Facility)	Rezaee et al., 2002
	3. cost savings and expedience force the implementation	Alles et al., 2006
	4. assurance, evergreen opinions	Alles et al., 2006
	5. assists in verifying information integrity	Flowerday et al., 2005

registered so that potential users can find them easily. This is enabled through universal description, discovery and integration (UDDI).

Murthy and Groomer (2004) developed the continuous audit using the web services framework component, which uses continuous audit web services (CAWS), and can be envisioned in much the same manner as CATs (EAM and ITF). External auditors use CAWS to assist in gathering audit evidence to support an opinion on an audit client's financial statements. The external auditor can provide assurance services on any number of client objects (e.g., revenue streams, internal controls, etc.). Users (e.g., stockbrokers, analysts, investors, bankers, etc.) seeking this information and related assurance can use CAWS to access the objects and related assurance provided by an auditor. Each time CAWS is invoked, the auditor receives a fee for the service.

While the auditor has full access to client data in an opinion audit, the auditor must provide specific information products related to the client, with the client's permission. As Murthy and Groomer (2004) defined: CAWS must interface with the client's system to retrieve data relating to periodic adjustments and allowances. The CAWS process, in relation to such prorated adjustments, would likely include analytical procedures to verify the reasonableness and appropriateness of the adjustments.

Continuous auditing has not been implemented by internal auditors, and senior management has not fully accepted and funded the necessary technology. Successful implementation requires buy-in by all involved, and requires a phased approach that initially addresses the most critical business systems (Chan and Wright, 2007). Although each organization is different, there are a number of common activities that must be planned and managed carefully when developing and supporting the use of continuous auditing. The key issues covered by this study are arranged in the Table 2.

METHODOLOGY

As discussed above, continuous assurance is a methodology to analytically monitor corporate business processes through the analysis and monitoring of transaction data by establishing a set of rules pre-defined and based on internal control criterions. Hence, the research procedure developed in this study is rigorously based on continuous assurance, continuous auditing models, and related CAWS implementation literature that support real-time financial reports presented on the Internet and utilize design-science research guidelines (Hevner et al., 2005). First, we define the continuous assurance problem of relevance for the system model. Second, we build and classify the three-layer system framework from previous research. Third, we improve the system design evaluation based on the study of system implementation for troubleshooting the system model.

The field study and system model implementation process relied on the important assumption that a company requires a high level of automation in their business operations. Therefore, business policies are fully reflected by the process definition and are maintained in the enterprise information system based on the internal control management framework. The business process is controlled, stored, and maintained in the electronic format. Hence, we focused on creating and evaluating an innovative CAWS model to aid audit firms by improving audit report quality and reduce audit cost. The research includes the CAWS model description, analysis, implementation, and management of the audit model. Finally, based on our field study experience, we formulate a plan that can be used by external-auditing firms that want to implement a continuous-assurance model.

Continuous auditing web services model design

The system framework is divided into several parts that include the auditor server, the web service registry, the search service (UDDI), and the client server. The auditor server is installed with various software, such as the SQL 2005 database server, Audit Command Language (ACL), Secure Socket Layer (SSL) enterprises virtual network, and the Internet server (IIS). UDDI is established in the Information Control Center and is controlled by the host's procedures. It is composed of three parts that include the Service Provider, the Service Register, and the Service Requester. The Service Requester is used to maintain the registry, store the
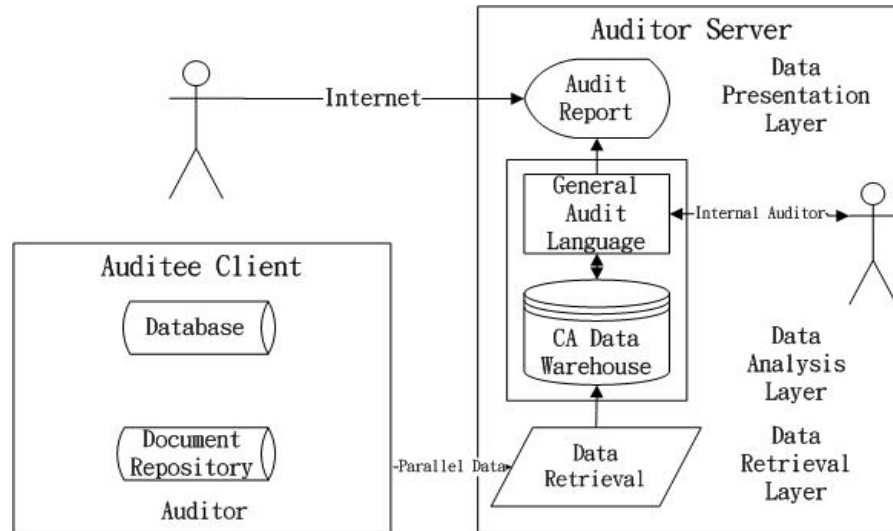
Figure 2. The conceptual model of CAWS system framework.

mechanism for general investors and financial institutions, and propagate the service items that it offers. Simple Object Access Protocol (SOAP) is a method for communicating between programs that has been formulated using XML syntax. Additionally, its document formats are stored in XML language form, including the audit report created by the continuous auditing system. Once accepted by the SOAP host, tasks such as decryption and content reading are conducted to make the data presentation layer pack the XML document into the SOAP packet. Such a repeated transfer procedure is able to transfer the relevant continuous auditing documents to Internet users. Detailed operations are shown below in Figure 2.

Data retrieval layer

The main purpose of the data retrieval layer is to use characteristics of the function database (store procedure) and ETL (Extract Transform Load) in the database management system (DBMS), or integrated test facilities (ITFs), to move data from the transaction procedures to another data storage area (that is data Mart) (Rezaee et al., 2002; Onions, 2003; Finnigan, 2003; Woodroof and Searcy, 2004). Groomer and Murthy (1989) call the EAM a subsystem of an enterprise system. By using such a method, the auditors should become familiar with the data procedure and column definition, so that the data can be smoothly collected. Therefore, this study improves the method of data collection, which is based on the procedures used by business systems, processes, activities, transactions, and events used to collect the relevant data within the domains of continuous auditing. The tools of database management systems (DBMS) are used to construct the data warehouse to accomplish the objectives of continuous auditing.

According to the principles of continuous auditing, the data retrieval layer ensures the data translation and conversion pre-definition by facilitating the auditors understanding of the relationship between components. In order to do so, the STAR framework is used as the principal design of the data warehouse to prove, convey, and contain data in an ERP system for the selling situation. The design can be introduced as follows. First, the customer collects the printed, inventory stock, invoice, goods-related, and/or electronic signature system data. All corresponding fields are defined for each business process. Data from the continuous auditing data warehouse must be verified for completeness,

accuracy, and timeliness. Field data are also collected that is based on the necessity of defining the process and/or procedure for conducting continuous auditing.

Data analysis layer

The data analysis layer is kernel keyed for an analytic procedure of an integrated and standardized enterprise system environment. The most appropriate approach to the three-layer architecture is to implement continuous auditing of data analysis layers about automatic analytic procedures. Since 1980, many researchers and primary accounting institutions have developed various computer assisted auditing software, such as the Decision Source System (DSS) or Expert System (KES), which can automatically select the relevant auditing procedures (Abdolmohammadi and Usoff, 2001). The main purpose of the automatic auditing procedure is to provide auditors with more reliable and rapid auditing functions. This allows them to avoid errors during routine auditing procedures, such as summarization, recalculation, and cross comparison (Lovata, 1990). General auditing software can provide auditors with a self-edited instruction sets or package functions provided by vendors and can improve the execution capability of auditing software.

After data have been collected and transformed, the completeness (fraud or error) and validity (operating standards) tests are conducted to process all transactions. Using the analysis procedure and independent testing for the computer assisted auditing technology, the real-time verification of invoice systems and account payable systems can thus be reached (Taylor, 2005). Therefore, the data analysis layer is not only the core of the continuous auditing process, but it is by nature an auditing tool. It should be automatic and determined in a real-time manner to check whether the control and implementation of the application system and financial report system is effective. Furthermore, the auditing tool will be able to rapidly mark specific differences or abnormal information, independently confirm the completeness of transaction data disposed by the operating system, understand loss and reduction of costs, improve the efficiency and effectiveness of the evaluation required by SOX Section 404, and control the inadequate quantitative analysis functions. Therefore, the main operations of such a layer include the effectiveness of controlling the client server and the confirmation of the continuous monitoring operation. The most frequently utilized auditing software tools

(Rezaee et al., 2002) are employed.

Data Presentation Layer

After collection and analysis, the auditors are presented with the results of data verification. Such an operation layer uses the web service function to upload the auditing report to the website to provide investors, financial institutions, or any interested group as a reference for review (Kogan et al., 1999; Murthy and Groomer, 2004).

System prototyping design and tools

It is critical that the prototype of CAWS conform to the standards of continuous auditing because its functions can be operated on the Internet. Thus it should differ from the definition of traditional HTML documents. As per the discussion above, web service should meet the following three conditions.

Web service uses the SOAP format to replace the Multipurpose Internet Mail Extensions (MIME) format.
Web service is not categorized as using the Hyper Transmission Protocol (HTTP).
Web service can be provided with required data that is defined by the explanatory data (metadata) from the auditing end.

To conform to these conditions of the system prototype, a completed mechanism and a supporting development standard (such as web service) is needed. In other words, the aforementioned mechanism can allow the system prototype to be tested, but it also can be operated under the continuous auditing functions for internal auditors. The development lists of the system prototype are shown below.

Web service / Operating system / Network Servers: MS.NET/MS Windows/IIS (Internet server)
Database: SQL Server 2005
User Site Tools: Java Client/ SOAP, WSDL and UDDI
Auditing Tools: CAAT/ACL

Field study

The research model creation follows the design-science research framework and demonstrates a well-executed evaluation method through the filed study as system implementation. In this way, the model framework enables the verified and supported empirical case to evaluate the model design.

Case introduction

This case company is not only in one of the most important technological industries in Taiwan, but also is a key vendor in the TFT-LCD supply chain. The case enterprise has over 5,000 employees worldwide, but its main factories are located in Taiwan, China and Malaysia. Furthermore, the case enterprise ranked in the top 150 Taiwanese manufacturing industries in 2008.
    In this case study, the internal auditor schedules the annual audit plan to review internal compliance at every process cycle in every site. However, some issues discussed in the monthly business management seminar, such as the difficulty the auditor faces in achieving high-quality and the auditor's annual travel to each site, incur unacceptably high costs. The more pressing question to be addressed is how to reduce the internal and external compliance from KPMG. The CEO decided to study continuous assurance and

to cooperate with KPMG to resolve such problems in 2007. Therefore, the three-layer CAWS model is based on the current information infrastructure. The more detailed system prototype is shown in Figure 3.

Data collections

Semi-structured interviews were conducted with the CPA partner and case enterprise managers, including the information technology department, the internal auditing department, and the external auditing firm. Following Yin (2003), we used an interview protocol. This protocol included an overview of the project, the field procedures (e.g., type of data to be collected, type of respondents) to be used and a series of case study questions. The use of a protocol enhanced the reliability of the data as it served to guide its collection. It also enables future researchers to replicate the study. All partners and managers interviewed had extensive knowledge of this case of XML-based continuous audit web services. Each interview began by defining a continuous auditing objective to ensure that the interviewers and interviewees shared a common understanding. The partners/managers were then asked to systematically walk through four stages: continuous auditing objective, data access and use (data transaction layer), continuous control assessment (data analysis layer) and reporting, and management results (data presentation layer). Questions and prompts for further information were asked throughout the interviews. All constructs were adapted from existing literature and underwent pre-testing to ensure construct validity in Appendix B. The data collection was undertaken over a 6-month period, commencing in 2008. All interviews were voice-recorded.

DATA ANALYSIS

Analysis was based on the interview transcripts, documentation, and observational notes from the nine participants, including an information technology manager, a financial manger, and an external computer auditor. The themes that emerged from the data are discussed below.

Data retrieval layer

There are many methods of implementing data retrieval from raw databases to continuous data warehouses, such as ITFs, ETL, or EAM. The field study developed the Java Client to deploy the program trigger of the electronic signature system and to transfer approved data into the continuous auditing data warehouse. The data retrieval layer was deployed in the enterprise resource system to collect relevant information about the business systems and processes, activities, transactions, and events (for example, customer profile management, quotation transactions, sale order processes, shipping order processes, invoice transactions, account receivable transactions, and journal and daily general ledger processes) in Figure 4. At last, the Java object was applied to package these functions and to provide relevant data of continuous auditing from different auditors' system hosts, such as the real-time business system deployed in IBM AIX.
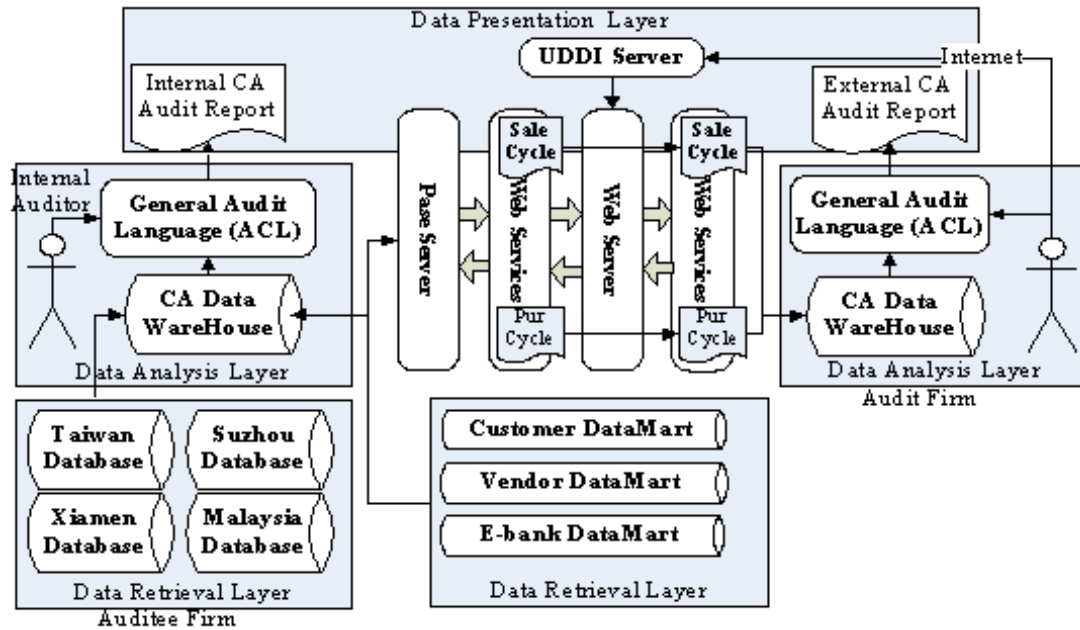
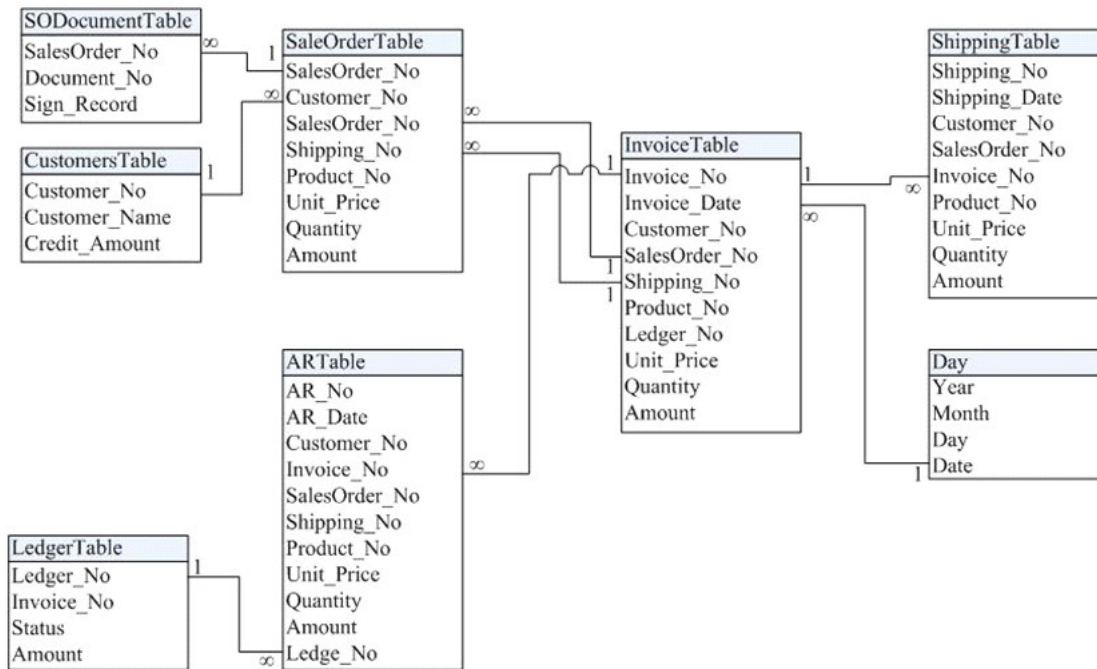**Figure 3.** CAWS system prototyping.

Figure 4. Continuous auditing data warehouse.

In the external auditing unit, the methods of data exchange are composed of XML for Microsoft SQL Server 2000 (SQLXML 3.0) packages. To this end, those managed types contain embedded SQLXML that can access Microsoft SQL Server 2000 and follow-up versions obtained from the XML function of the NET Framework. For example, these types that can implement the XML models are able to carry out the inquiry using the XML path language (XPath) to manipulate the data on server and use Updategrams or Diffgrams to perform data updates. On the basis of functions of SQLXML 1.0 and 2.0, SQLXML 3.0 has introduced the newer web service to the environment of SQL Server 2000. Based on the SQLXML 3.0, the pre-store procedures and XML
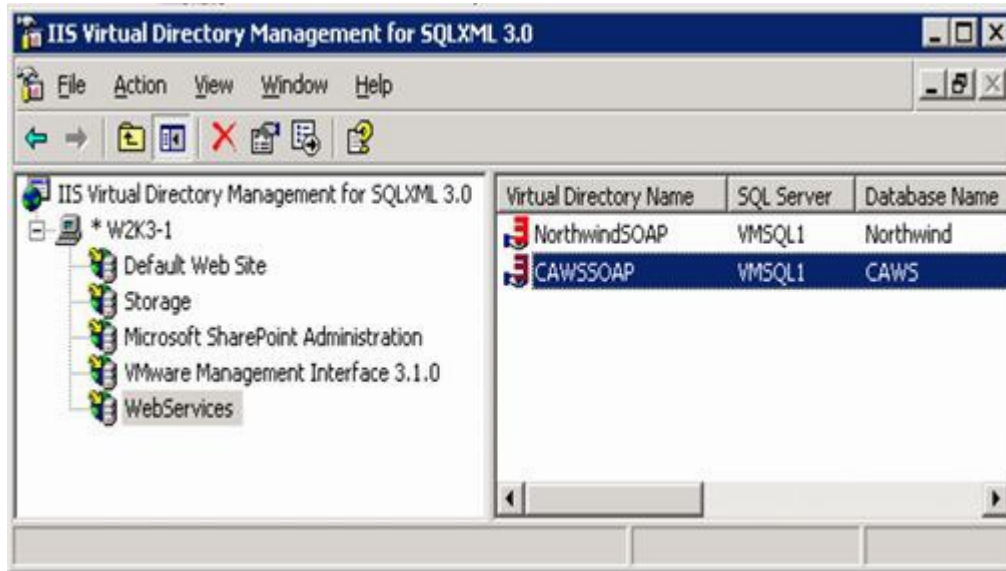
Figure 5. Setup of web services form.

models can access SOAP to provide the web service and to retrieve the data into the data warehouse of an external auditing unit. The setup of data retrieval for the external auditing unit is depicted below. The setup of data retrieval for the external auditing unit is depicted in Figure 5.

Although, the data retrieval layer is deployed in the enterprise resource system for the collection of relevant information about business systems and processes; activities, transactions, and events were packaged with reliable tools. The financial department users' response was that the electronic format data deduced by the EAM was clean and reparation, but some manual auditee data still required time to verify. Table 3 provides an overview of differences among the participants. The auditor and CPA show that the information collected should be factual, verified by the source, relevant, and useful to provide a sound basis for results. In searching for sources of information, auditors should start by deter-mining the application system, the necessary document as a data dictionary, the record layout, the system overview, and the business process. The data retrieval layer is also the key to ensuring the integrity of auditing data for the smooth application of continuous auditing techniques. The data integrity steps include detail system flowcharts or data flows, which examine the input and output documents, study the record layouts for data files, and examine transaction counts.

Data analysis layer

In Table 4, the client basic data, such as the client number, his or her name, the journal number in the purchase operation, the invoice number for the delivery operation,

the total account receivable, the detailed amount, the posting code, the date of delivery, the detailed amount and total amount in summary, the amount of detailed subjects in the daily ledger, the total amount of detailed subjects in the daily ledger, and the number of account receivables must be collected.

The Data Analysis Layer of this case study uses ACL as the tool for data analysis (www.acl.com). ACL provides the Client-Server framework, and makes use of the ODBC to directly link the retrieved data from the continuous auditing data warehouse. In addition, this layer uses the project auditing management to carry out the data verification obtained from the operating process cycle. Using the built-in features such as instruction analysis, stratified analysis, sampling and repeatability testing, this layer will be able to implement the automatic auditing procedure required by continuous auditing. More details are shown in Figure 6. The following models of automatic review for continuous auditing are also provided, based on the ACL syntax in appendix A.

The analysis layer implies the highly integrated enterprise system environment, the case study surveyed questionnaire have been show in Table 5. The data analysis layer implementation included steps that identify critical control points, identify control rules/exceptions, design a technology-assisted approach to test controls, and identify deficiencies, such as audit alarm, automatic confirmations, control tags, continuity equations, and time-series/cross-sectional analytics.

Data presentation layer

General auditing software has provided the auditing reports and results for review or print, and also can be

Table 3. Comparison of participant view in data retrieval layer.

Data transaction layer	Internal financial	Internal auditor	CPA
Reliable EAM for continuous auditing	Yes	Yes	Yes
Integrity EAM for continuous auditing	Yes	Yes	Yes
EAM reduces auditee data clean	Partial	Yes	Yes
EAM reduces auditee data preparation	Partial	Yes	Yes

Table 4. Empirical test of continuous auditing goals using sales transaction as an example.

Goal of continuous auditing	Goal description	Empirical transaction test
Existence	Recorded sales transaction is correct	Inspect whether or not the client who issues the invoice is actually existed in the customer information file. Check whether or not journal of sales entries contain the purchase order
Completeness	All occurred sales transaction were entered into the accounting ledger	Review the delivery note to see if the corresponding sale is existed the journal of sales invoice, sales transactions ledger
Accuracy	Entered amount is accurate	Re-calculate the total amount of income and map it with the posted figure
Timeliness	Sales transaction is recorded at the correct time	Compare with the date of sales transaction record and the date of delivery record
Posting and Summarization	Sales transaction is properly recorded in the main file of account receivable and has been correctly summarized	Summarize the total amount of daily transactions and review all the postings by tracing back to the general ledger and the main file of account receivable

utilized to properly offer the auditing evidence and generate a complete auditing record. These are automatically transferred through the auditing report to inform the analyzed results via e-mail. Furthermore, this layer produces embedded reports with the XML format, and publishes them on the official website to provide reference to investors, financial institutions or any other interested group (see Figure 7 for more details). Additionally, the XML format can be utilized to provide an external exchange of the auditing report via the Internet. In short, the data in the XML format is obtained based on the continuous auditing target, target description, auditing item, auditing result, and outline instruction and has practically tested all data content to further process the data exchange, as shown in Figure 8.

The presentation layer above implies that in the case of a highly integrated enterprise system environment, the participants should have been surveyed in regards to the data presentation layer. The continuous auditing shall consider the lifecycle management that consists of continuous data retrieval, analysis, monitoring and control.

Conclusion

Auditors have encountered the changed auditing environment due to the rapid development of IT in the modern business world. Accordingly, auditors have to use the needed information technology in the verification system to prove the data completeness, check the reliability that confirmed financial information from the auditing report, and also assess the quality of the verify-cation process (Wessmiller, 2002). This field study used a three-layer system prototyping that included the data transaction layer, data analysis layer, and data presen-tation layer to implement continuous auditing and support continuous assurance for the case enterprise. The model relied on an integrated set of automated information technology as CA data warehouse, Java Client, XML and

Figure 6. Automatic auditing procedure form.

Table 5. Comparison of participant view in the data analysis layer.

Item	Internal financial	Internal auditor	CPA
Q	critical control point or critical control rules		
A	Accuracy in sale prices	Customer overcredit control	Overdue account receivable
Q	exceptions		
A	Sale price change	Sale price change before approved	Exceed 90 days
Q	Able to be formalized by the automatic analytics procedure or not able to be formalized by the manual audit		
A	Yes,	Yes,	Yes,
	Sale order contains customer PO number	Recalculating AR amount	Sales journal entry and shipping document
Q	Audit alarm, automatic confirmations, control tags, continuity equations, time-series/cross-sectional analytics		
A	Yes,	Yes,	Yes,
	pre-condition by error happened	continuity equations, time-series/cross-sectional analytics	continuity equations, time-series/cross-sectional analytics
Q	Reduce the compliance cost/ reduce the auditing time/ increase the auditing reliable/ assist the information system integrated for reducing system error or fraud		
A	Yes, reducing the time cost by the pre-condition setting, assisting the ERP integrated.	Yes, reducing the internal auditing time, increase the auditing reliable	Yes, enhancing the time basis response by completely log in CA database

Figure 7. Data presentation layer form.

and Web Services and automated analytic tools by the ACL; it then implemented continuous auditing criteria, existence, completeness, accuracy, timeliness, posting and summarization based on business systems and processes, activities, transactions and events of the case enterprise scenario for supporting continuous assurance.

In the field study finding, continuous assurance produces a real-time, financial statement regarding the adequacy and effectiveness of control and integrity of information by the third party CPA firm. Internal auditing provides major key assurance services by performing objective examinations of evidence for the purpose of providing independent management control frameworks and practices, and information used for decision making and reporting. The financial department demand to establish a series of transaction controls into the information system for compliance by all relevant policies, procedures, and business processes control objectives. Meanwhile, the techniques management uses to continuously monitor controls are similar to those that may be performed in the continuous auditing requested by financial departments. Hence, continuous assurance can be provided when external auditors perform continuous auditing that is based on continuous internal audits of controls and evaluated based on the adequacy of top managers' continuous monitoring activities regarding business system and processes, activities, transactions and events.

In the implementation experience, there were four key steps to consider in regards to the continuous assurance implementation, including continuous auditing, data transaction, data analysis, and data presentation. The first step should consider the object definition of continuous auditing, business systems and processes/ activities/ transactions and the role of event monitoring, in addition to the alignment of business process and IT management. The second step should consider the data integrity including that reshaping detail system flowcharts/data flows, and examine the input and output document/ transaction counts, and study the table file layout in the data warehouse.

The third step should consider the automatic procedure, including the identification of critical control points/ control rules/exceptions, formal analytic procedures such as audit alarm, automatic confirmations, control tags, continuity equations, and time-series/cross-sectional analytics to reduce the compliance cost. At the same time, the data analysis is used to assist the information system that is integrated to reduce system error and fraud. The forth step should consider the reliability of continuous control and monitor the real-time financial statement environment created as a resulting of tracking, monitoring, control, and reporting. The data presentation is a process that manages the continuous control and continuous monitoring processes to ensure that enterprise policies and processes operate effectively under the continuous auditing methodology. In the overall view, continuous auditing shall consider the management

```
|---+--+--1---+----2---+----3---+----4---+----5---+----6---+----7---+----8---+----9---+----0---+----1---+---
1  <?xml version="1.0" encoding="utf-8"?>
2
3  <data>
4      <title>Continuous Audit Report</title>
5
6      <bills>
7          <name>Existence</name>
8          <describe>Sales transaction already written down really takes place</describe>
9          <point>Check whether the customer on invoice stores in customer information shelf</point>
10          <result>Exceptional</result>
11          <audit-list>
12              <outline>Finish the procedure analysis and independent test, the results are exceptional</outline>
13              <audit id="YX44083578">Omt file is not exist</audit>
14              <audit id="YX44083579">Data repeated</audit>
15          </audit-list>
16      </bills>
17      <bills>
18          <name>Accuracy</name>
19          <describe>Credit is correct in amount of money</describe>
20          <point>Calculate the total amount of money of incomes again, and collude and check with posting income</point>
21          <result>Exceptional</result>
22          <audit-list>
23              <outline>Finish the procedure analysis and independent test, the results are exceptional</outline>
24              <audit id="AR1-830231">Summary amount is error</audit>
25          </audit-list>
26      </bills>
27
28  </data>
```

Figure 8. Contents of XML format.

lifecycle that consisted of continuous data retrieval, continuous data analysis, continuous data monitor and continuous data control. The senior manager support is also a critical success factor in this field study.

During the initial period of the E-enterprise in this case, the enterprise had not yet considered the auditing standards to establish the definition of forms and columns. Therefore, the difficult situation of how to determine the retrieval column occurred during the data collection stage. Like the views of Vasarhelyi et al. (2006), based on the target of the continuous auditing to produce a real-time financial statement, the enterprise should have a multi-system with integrated data.

MANAGERIAL IMPLICATION

Enterprise software vendors traditionally provide limited continuous assurance capabilities with their system (except for SAP's audit information system module). Alles et al. (2006) studied the application of the SAP E-audit module, in which the auditor was instructed to perform a variety of reviews about the procedures on the SAP application. Visual Basic serves as a test environment for evaluating research questions regarding the continuous audit process. We are not aware, however, of any major

developments or any strategic decisions by a major ERP vendor to invest in the development of a continuous assurance package. The large accounting firm, KPMG, has been experimenting with continuous monitoring software, but it seems reluctant to discuss the package performance and returns on the investment. Another enterprise software vendor of ACL has been recently promoting its continuous controls monitoring solutions, such as one for the purchase-to-payment cycle program. Our experience has shown that the information technology tools for continuous auditing are a critical success factor for the implementation of continuous assurance. Therefore, information technologies, such as XML, web services, data warehousing, CAAT and EAM, are being easily applied to achieve continuous auditing at lower costs.

For the accounting practice today, internal auditors face many challenges in a range of areas, such as compliance and control, internal auditor value and independence, fraud, availability of skilled human resources and information technology. Specially, advances in information technologies have forced auditors to use advanced computerized methods to collect evidence from electronic data and automatic procedure verification. Continuous auditing will change the audit environment, including the nature of evidence, timing, and procedures. Internal auditors will develop and maintain the technical

competencies and enabling technology necessary to access, analyze and report the auditing data contained in disparate information systems by the continuous auditing web services model. In this way, enterprise continuous auditing performed by internal auditors who satisfy the demands for assurance control procedures will effectively integrate information and produce reliable audit reports.

The technology industry has been developed for twenty years in Taiwan, and most of the enterprise focus on cost control is concerned with how to create a greater competitive advantage through lower distribution costs in the multi-manufactory site of China, such as Foxconn, AUO, Asus. For the practices, the XML-based continuous auditing web services model integrates multi-site internal information processes and verifies transactions based on financial statement standards. This model is not only for the internal audit department, the finance department, or the IT department to reduce compliance cost and enhance internal/external audit quality, but can also assist different information systems and data integration to reduce system error or local fraud though the continuous auditing methodology in Multi-Fab located across Taiwan and China-based enterprise for effectively enhanced audit quality and reduced internal compliance cost.

FUTURE RESEARCH AND LIMITATION

Due to the demand for real-time financial information, this study develops a three-layer framework prototype of a continuous auditing system to make the real-time confirmation of operation move beyond a theory and a concept. During the verification procedure of this frame-work, suggestions for future research were oriented towards the following issues: how to trust and correctly evaluate the standards of the auditing report; how to display more real-time auditing reports; how to establish the standard of continuous auditing data warehouses; and how to set a standard for a continuous auditing report. In the future, we will still focus on extending the CAWS to implement enterprise customer relation management (CRM) and supply chain management (SCM) for automatic system linkage to data verification.

Practically speaking, the audited and auditing units use the conditions and terms of the contract to ensure the confidentiality of data review and disclosure of both parties. Continuous auditing is an acceptable concept in this industry. Recently, some technical issues of web service security have been discussed by many scholars, such as the calculation of web service charge standards and the transaction control of web services. Generally speaking, the CPA firm has not officially introduced such a solution. As a result, the verification procedure under this studied framework can be referenced as a new business model for CPAs and the external auditing industry.

Recently, the impacts of the financial crisis caused enterprises' risk management functions to be revoked.

The continuous auditing methodology does not only enable the complete understanding of internal control, regulations and business goals by the internal auditor, but also uses automatic analytical tools to control enterprise operation. It supports the real-time analytic test and risk assessment of error findings based on transaction data of business systems. However, conti-nuous auditing will reduce the complication of enterprise risk assessment in terms of availability, ability to integrate, and reliability of continuous assurance based on data transaction. The business assurances and risk-related issues will be future research topics.

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APPENDIX A: ACL SYNTAX

Existence 1:

Open % Invoice Table%
OPEN % Customer Table% SECONDARY
JOIN PKEY % Invoice Table. Invoice_No % FIELDS All SKEY % CustomerTable. Customer_No% Unmatched TO "ExistNO1 " OPEN PRESORT SECSORT
Open % Ledger Table%
OPEN % SaleOrderTable% SECONDARY
JOIN PKEY % Ledger Table. Sale NO % FIELDS All SKEY % Sale Order Table. SaleNO % Unmatched TO "ExistNO2 " OPEN PRESORT SECSORT

Existence 2:

OPEN %ShippingTable%
OPEN %InvoiceTable% SECONDARY
JOIN PKEY %InvoiceTable.CustomerNO % FIELDS All SKEY % Customer Table. Customer.No% Unmatched TO "ExistNO2 " OPEN PRESORT SECSORT

Completeness:

OPEN %ShippingTable%
OPEN %InvoiceTable% SECONDARY
JOIN PKEY %InvoiceTable.CustomerNO % FIELDS All SKEY %InvoiceTable.CustomerNO% matched TO "CompleteTable" OPEN PRESORT SECSORT
OPEN %Ledger %
OPEN %CompleteTempTable% SECONDARY
JOIN PKEY %LedgerTable.CustomerNO % FIELDS All SKEY %CompleteTempTable.CustomerNO% matched TO "Complete_END" OPEN PRESORT SECSORT

Accuracy:

OPEN %ARTable1%
OPEN %ARDetailTable% SECONDARY
Set folder /Result/DATACONFIRM
JOIN PKEY %ARTable.ARNO % FIELDS All SKEY %ARDetailTable.ARNO % WITH ALL Many TO "%Complete_JOIN" OPEN PRESORT SECSORT
COMMENT Check AR_Table.AMT with AR_Detail_Table.AMT Consistent
OPEN %Complete%_JOIN
SUMMARIZE ON %AR_Detail_Table.ARNO % SUBTOTAL %Detail_SUM_AMT % TO SUM_%cAR_SUM%

Timeliness:

Table1Date="SaleOrderTable.Date"

Table2Date="ShippingTable.Date"
DEL FIELD T1PKEY OK
DEFINE FIELD T1PKEY COMPUTED
"" if T1PKEY=""
"NO GOOD" if %TABLE1DATE%<>%TABLE2DATE%
"OK"

APPENDIX B: INTERVIEW PROTOCOL

Continuous auditing objectives

What is your definition of objectives for continuous auditing in this case?
Does the senior manager support the development of this case?
Do you define the degree for the management that performed its monitoring role in this case? Please give an example of your definition.
Do you identify and prioritize areas that should be addressed and types of continuous auditing that should be performed in this case? Please give an example of your explanation.
Do you identify key information systems and data sources in this case? Please give an example of your explanation.
Do you completely understand the processes and application systems for the following case business?

DATA ACCESS AND USE (DATA TRANSACTION LAYER)

We developed the embedded audit module (EAM) with Java Client for collecting the auditee data into the data warehouse. Do you think that the data assessment is reliable and integrated for your continuous auditing?
In this way, does it reduce your time in data cleaning and preparation?
For auditor firm, the auditee data that supported from data warehouse will be reliable and integrated through the Web Services data transformation or not?

CONTINUOUS CONTROL ASSESSMENT (DATA ANALYSIS LAYER)

What is your identification about critical control points or critical control rules in this case? Please give an example of your explanation.
Do you identify exceptions in this case? Please give an example of your explanation.
Do you identify the audit process that can be formalized separately by the automatic analytics procedure and non-formalized separately by the manual audit program? Please give an example of your explanation.
Do you design technology-aided approach to test controls and identify deficiencies in this case? Such as: audit alarm, automatic confirmations, control tags, continuity

equations, and time-series cross-sectional analytics.

Please give an example of your explanation.

Do you think continuous auditing implementation will reduce the cost saving or not? (Such as reducing the compliance cost or auditing time, increasing the auditing reliable issues, assisting the information system that integrated to reduce system error or fraud under continuous auditing criterion).

REPORT AND MANAGEMENT RESULTS (DATA PRESENTATION LAYER)

Do you think that this system will accurately develop the reliable system on a timely basis in this case?

Do you think that this system will naturally develop the continuous control and continuous monitor that can be used for continuous auditing?

The system is able to monitor and evaluate the effectiveness of the continuous auditing process — both the analysis (e.g. rules/indicators) and the results achieved.

Do you think that the audit report can evaluate and consider management's monitoring processes when performing continuous auditing in this case?