Auditing in enterprise system environment: a synthesis

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Abstract

Purpose – The purpose of this article is to provide a selective and comprehensive literature review based on previous research within auditing and enterprise systems (ES). This is done to identify research gaps, propose directions for future research and guide researchers and practitioners on how to better synthesize these two areas. Interaction between ES and auditing is in need of more academic research and practical investigation, which may lead to the development of better solutions, guidelines and frameworks.

Design/methodology/approach – A total of 31 academic studies from 2000 to 2010 were included in this study. After reading these studies, different areas had been selected and were addressed in five categories: the future of audit in ES environment, modern audit tools and techniques, changes of auditors' role, differences in perceptions between financial auditors and IT auditors, ERP and compliance with regulations.

Findings – ES implementation results in audit process reengineering and increases the need of continuous monitoring of transactions. The presence of IT auditors becomes critical, while financial auditors are asked to enhance their skills in order to be able to conduct effective audit tests. Modern audit tools and techniques must be used so that internal control processes will be appropriate for an ES.

Research limitations/implications – It is not an exhaustive list and some relevant publications might have been overlooked. Much literature has been scanned by reading the title only. In order to conduct a comprehensive review the topical focus was kept relatively narrow on auditing and ES.

Practical implications – Researchers and practitioners must take into consideration the interaction between ES and auditing in order to advance research in this area. Companies must understand the changes that occur in the audit procedure due to ES implementation, so that they will design efficient audit tests and auditors must enhance their knowledge in order to be able to conduct these tests effectively.

Originality/value – This study uncovers and classifies current research within auditing and ES (focusing mostly on ERP systems).

Keywords ES, ERP, Internal-external auditing, Continuous auditing, IS (IT) auditors-financial auditors, IS (IT) Audit, Internal-external control, External auditing, Internal auditing

Paper type Literature review

1. Introduction

Many business changes have occurred throughout the history and a major one has been related to Enterprise Systems (ES) and their primary form Enterprise Resource Planning Systems (ERPs). These systems have transformed the way business data is collected, stored, disseminated and used (Sutton, 2006). Enterprise resource planning systems are defined as "information system packages that integrate information and

information-based processes within and across functional areas in an organization" (Kumar and Hillegersberg, 2000). An ERP system is an enterprise system that affects many all the departments of a company. Thus, understanding each department and its concerns is important (Gallegos, 2005). ERP system appears to be the system used by the majority of large clients serviced by audit firms. Thus, ERP systems are the dominant system environment for auditors servicing public clients, although the clients of audit firms use a variety of systems to monitor accounting transactions (Brazel, 2005). Yen *et al.* (2006) and Coppers & Lybrand (2002) also mention that auditing personnel must properly deal with the change caused by the ERP system.

The profession of auditing is a rich resource for enterprises because the audit activity monitors the adequacy and effectiveness of management's control framework and contributes to the integrity of corporate governance, risk evaluation, and financial, operating and IT systems (Burnaby and Hass, 2009).

The traditional audit model has undergone significant change during the last decade. The change in the financial audit's focus is attributed to market pressures, including saturation, competitive pricing and increased training and technology (Eilifsen *et al.*, 2001). Auditing has taken on risk management focus, and audit engagement teams increasingly include information system specialists also (Winograd *et al.*, 2000). Although enterprise systems increase the complexity of accounting and auditing processes, they offer opportunities for improvements as far as these processes are concerned (Spathis, 2006).

Auditing can be classified into two types: internal auditing and external auditing. Internal auditing can be defined as a method independent and objective validation. Not only it increases the value and improves the operation and performance of an organization, but also facilitates the effects of related processes to achieve an organization's goals. Spathis and Constantinides (2004) also, found that the implementation of an ERP system is usually followed by an increase in internal audit procedures. This is because inadequate internal controls in an ERP system environment may cause problems, such as unauthorized access to the system and computer fraud (Bae and Ashcroft, 2004). On the other hand, external auditing is conducted outside the organization. Organizations hire the services of external auditors who are usually accountants.

It is important to note that in an enterprise system environment traditional procedures for obtaining audit evidence may not be appropriate or sufficient, as evidence comes mainly in an electronic form. Electronic audit evidence can be defined as any information created, transmitted, processed, maintained or accessed electronically and used by the auditor to evaluate financial statement assertions and to support the content of the audit report (Rezaee and Reinstein, 1998).

Computer aided auditing is beneficial, but it also has some disadvantages. Besides changing the operation and process of auditing, computer aided auditing involves the distribution of various files in different locations, making auditing even more difficult and complicated especially for those who do not have sufficient knowledge of the technology. In addition, many ERP systems involve journal recording. This means that those not involved in the operation department may not be able to identify the personnel responsible for some data they may need. Another drawback may be that personnel from IT department can also modify the data and information since they have access to the database. This could lead a company to economic losses, which may not be identified right away (Chang *et al.*, 2008). Auditors' main concern has to do with

the security of financial data, because when data security processes are missing, integrity is threatened. Overall, the implementation of enterprise systems presents new challenges, risks and opportunities to accounting professionals (Sutton, 2000). Furthermore, an ES raises serious concerns for auditing practitioners and has a major impact not only on financial auditors, but also on IT auditors (Munter, 2002).

Despite their acclaimed advantages, ERP systems pose potentially heightened business, security and audit risks primarily due to automated procedures among business process and integrated databases (Hunton *et al.*, 2004). Statement on Auditing Standards (SAS) No 94 (AICPA, 2001) calls for auditors to understand the computerized procedures used to prepare an entity's financial statements and related disclosures. More specifically, SAS No.94 requires auditors to consider how the client's information technology (IT) infrastructure affects the audit strategy, to design audit tests, to determine the extent to which computerized internal controls are operating effectively, and to possess requisite skills to evaluate and test IT systems or obtain help from specialists who have such skills. ERP systems are complex audit environments and therefore auditors need to expand their technological knowledge and skills in order to perform effective and efficient audits (POB, 2000). It seems that there is a need of computer or IT auditors for auditing an enterprise system and evaluating the automated controls built into the system. The presence of IT auditors is necessary when the audit process takes place in a dominant or significant IT environment.

At this point it is worthwhile to note that the most important implications that arise for the audit function due to enterprise systems implementation are as follows: First, auditors need to handle electronic audit evidence effectively, second there is need of more internal controls for the enterprise system and the security of the electronic data and third there is a need of IT audit professionals.

Few literature reviews have been written concerning auditing and information systems. The most recent is the one of Kuhn and Sutton (2010), which focuses particularly on continuous auditing and ERP systems. Curtis *et al.* (2009) also, published a review focusing on auditors' training and proficiency in relation to information systems and Madani (2009) analyzed the role of internal auditors in ERP-based organizations. Thus, our study is the first literature review that focuses on auditing and enterprise systems as a whole.

The purpose of this study is to uncover, classify and interpret current research within enterprise systems and auditing, and also to examine how and to which extent the implementation of ES in organizations affects audit procedures. This will be done to identify research gaps and directions for future research and to guide researchers and practitioners investigating and making decisions on how to better synthesize these two areas. This study also tries to examine how and to which extent the implementation of ES in the organizations affects auditors' roles.

Our study is organized as follows: At first, we present the approach used for article identification and collection. Then, we analyze the bibliography and review. Finally, we draw some conclusions, we state some limitations and we propose directions for future research.

2. Survey search approach
The survey search approach can be divided into four essential phases: databases online search, first results, final results and classification of results, as displayed in Figure 1.
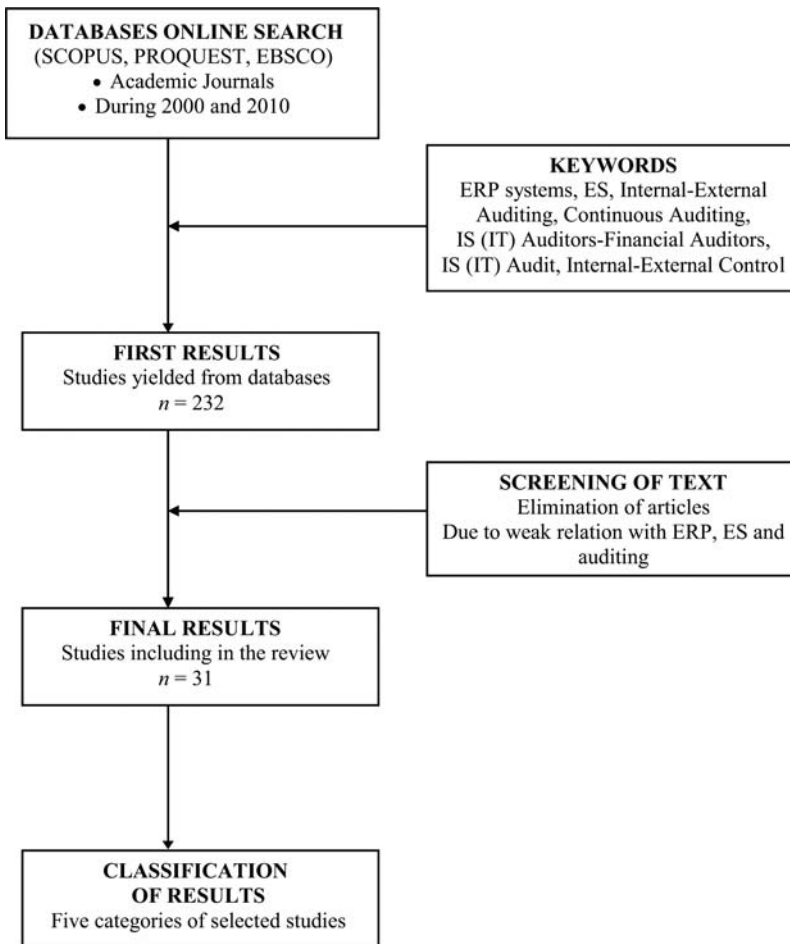
Figure 1.
Steps of survey search
approach

In phase 1, we selected articles through web search facilities (databases) offered by some major publishers, such as "ProQuest", "Scopus" and "Ebsco".

The criteria for choosing articles for our study are as follows:

- First of all, the article must have been published in a peer review, archival journal.

- Second, to avoid never ending search of articles, "December 2010" was selected as the cut-off date.

- Third, articles were searched by using specific keywords, such as "ERP systems, ES, Internal-External Auditing, Continuous Auditing, IS (IT) Auditors-Financial Auditors, Internal-External Control". The reason why is that our purpose concerning previous research was to summarize the effects that ES have on the audit procedures, on the auditor's (internal-external) role and on the future form of the audit function as a whole. The exceptions are those articles that are

explicitly dealing with "ERP (or ES) and auditing" but for some reasons the authors decided not to use the above keywords in the title and abstract. Consequently, it is possible that there exist more of such articles, which are not reviewed in the present study.

· Fourth, no restrictions were imposed in the field of the surveyed journal. This should allow a comprehensive set of viewpoints on ERP and auditing by different fields.

· Fifth, we included academic studies from 2000 to 2010. This was because from 2000 until today there is a tremendous increase in the use of ES. Studies before 2000 referred to IT or IS in general and not to ES or ERPs in particular.

According to these criteria, an attempt has been made to collect all the available journal articles. Different combinations of the above keywords produced 160 articles. Also, we checked the references of the articles and we clicked on the option "related articles" and thus, a further 72 studies were added to our first results. Thus, initial survey produced originally a sample of 232 articles (phase 2).

The review and classification process was carefully and independently verified by the co-authors. After reading the articles, we eliminated those that had a loose relation with ERP (or ES) and auditing. A total of 31 articles were eventually included in the final sample (phase 3). The complete list of the articles (year of publication, journal title, authors, paper type, research method and sample size) which were finally included in our study is provided in Table I.

Distribution of articles by journal title is displayed in Table II.

In phase 4, we classified the final sample of articles as follows:

· using the articles' abstracts, the one co-author defined large classes of subjects in order to structure this large amount of literature;

· these classes of subjects were then verified and double checked by the other co-author; and

· the authors classified these subjects into five main categories.

The different areas that have been selected are successively addressed in the following sections of this study:

· the future of audit in an ES environment;

· modern audit tools and techniques;

· auditor's role and expertise in an ES environment;

· financial auditors and IT auditors – differences in risk assessment, roles and perceptions; and

· ERP and compliance with regulations.

Indeed, many overlapping items can be found among these main categories and further categories emerged, but nevertheless this study tries to provide a consistent framework for classifying the considered published articles.

Year	Journal title	Author	Paper type	Research method	Sample size
2000	*Australian Accounting Review*	Best	TR	Analysis	–
2001	*The International Journal of Digital Accounting Research*	Grabski et al.	ER	Case study	1 Organization
2002	*Journal of Information Systems*	Wright and Wright	ER	Survey	30 Information system auditors
2003	*Advances in Accounting*	Vendrzyk and Bagranoff	ER	Field study	20 Senior managers and partners
2003	*The Journal of Corporate Accounting and Finance*	Goldberg and Godwin	TR	Literature review	
2003	*Information Systems Control Journal*	Cerullo and Cerullo	ER	Case study	1 Firm
2004	*Information Systems Control Journal*	Bae and Ashcroft	TR	Analysis	–
2004	*Journal of Information Systems*	Hunton et al.	ER	Survey	83 Financial auditors and 82 IS audit specialists
2004	*Journal of Emerging Technologies in Accounting*	Vasarhelyi et al.	TR	Analysis Theory	–
2004	*Managerial Auditing Journal*	Yang and Guan	TR	Analysis	
2004	*International Journal of Auditing*	Messier et al.	ER	Survey	6 Public accounting firms
2004	*Business Process Management Journal*	Spathis and Constandinides	ER	Survey	26 Firms
2005	*Managerial Auditing Journal*	Brazel	ER	Survey	73 Audit seniors
2005	*Information Management and Computer Security*	Brown and Nasuti	TR	Literature review analysis Viewpoints	–
2005	*Journal of Information Systems*	Debreceny et al.	TR & ER	Survey	6 ERP providers
2006	*Journal of Emerging Technologies in Accounting*	Kuhn and Sutton	ER	Case study	1 Firm
2006	*International Journal of Accounting Information Systems*	Alles et al.	TR & ER	Case study	1 Firm
2007	*Journal of Enterprise Information Management*	Maurizio et al.	TR	Literature review Viewpoints Analysis	
2007	*Contemporary Accounting Research*	Brazel and Agoglia	TR & ER	Survey	74 Practicing auditors

(*continued*)

Table I.
Research on auditing in
Enterprise System
environment

Table I.

Year	Journal title	Author	Paper type	Research method	Sample size
2007	*International Journal of Accounting Information Systems*	Grabski and Leech	TR & ER	Survey	35 Internal auditors & 33 CIOs
2008	*Journal of Information Systems*	Alles *et al.*	TR & ER	Case study	2 Firms
2008	*Information Systems Management*	Chang *et al.*	TR & ER	Case study	2 Firms
2008	*The Accounting Review*	Hunton *et al.*	ER	Experiment	72 Managers
2008	*International Journal of Management and Enterprise Development*	Huang *et al.*	ER	Survey	77 IT, financial accounting & auditing executives
2008	*Knowledge-based Systems*	Lee	TR & ER	Case study	1 Firm
2009	*Journal of Digital Forensics, Security and Law*	Best *et al.*	TR & ER	Analysis-Case study	1 Firm
2009	*Journal of Accounting and Organizational Change*	Madani	TR	Literature review Theory	–
2009	*Managerial Auditing Journal*	Burnaby and Hass	TR	Literature review Analysis Theory	–
2009	*Journal of Enterprise Information Management*	Chen	ER	Case study	1 Firm
2009	*Decision Support Systems*	Huang *et al.*	TR & ER	Case study	1 Firm
2010	*Journal of Information Systems*	Kuhn and Sutton	TR	Literature review Analysis	–

Note: ER = Empirical Research in organizations; TR = Theoretical Research (literature reviews, viewpoints, analysis, theories)

Journal title	n	%
Journal of Information Systems	5	16.2
Managerial Auditing Journal	3	9.8
Information Systems Control Journal	2	6.5
International Journal of Accounting Information Systems	2	6.5
Journal of Emerging Technologies in Accounting	2	6.5
Journal of Enterprise Information Management	2	6.5
Advances in Accounting	1	3.2
Australian Accounting Review	1	3.2
Business Process Management Journal	1	3.2
Contemporary Accounting Research	1	3.2
Decision Support Systems	1	3.2
Information Management and Computer Security	1	3.2
Information Systems Management	1	3.2
International Journal of Auditing	1	3.2
International Journal of Management and Enterprise Development	1	3.2
Journal of Accounting and Organizational Change	1	3.2
Journal of Digital Forensics, Security and Law	1	3.2
Knowledge-based Systems	1	3.2
The Accounting Review	1	3.2
The International Journal of Digital Accounting Research	1	3.2
The Journal of Corporate Accounting and Finance	1	3.2
Total	31	100

3. Bibliography analysis
In the present study we focused on the auditing function as a whole and how it is being
transformed due to ES implementation. In this section we analyze studies referred to
each one of the five categories mentioned in the previous section.

3.1 The future of audit in an ES environment
Many researchers have started discussing the transformation of the audit function due
to the introduction of ES. These systems present new challenges and risks and as a
result the mechanism of the audit-control and the audit-control procedures change.
Internal audit seems to be an important factor as far as an ES implementation is
concerned. Although enterprise systems seem to increase the overall control risks,
researchers claim that these systems have adequate and efficient control processes and
security tools into their applications (Wright and Wright, 2002; Hunton *et al.*, 2004).
Researchers claim that complexity of such systems and decentralized decision-making
processes can lead to many risks (Grabski *et al.*, 2001). Bae and Ashcroft (2004) pointed
out that although ERPs are complex systems due to their capabilities, they could
provide companies with major data processing benefits.

ERPs are known for their extraordinary nature and numerous implementation risks.
Control function must be well organized over the entire life cycle of an ES, including
implementation. Literature shows that it costs 50 to 100 times more to add functionality or
to correct an error in the post-implementation phase than it would have cost to provide the
proper functionality during the implementation process (Goldberg and Godwin, 2003).

The first major topic that occurs in an ES or an ERP environment is the
transparency of the data and the information integrity. For example, personnel from

the IT department (or from other departments) can modify the figures since they have access to the database (Bae and Ashcroft, 2004). This could lead a company to economic loss, which might not be identified immediately (Chang *et al.*, 2008). There are recent studies that show that continuous auditing techniques and continuous monitoring can help organizations and auditors detect fraudulent activities (Kuhn and Sutton, 2006; Alles *et al.*, 2006; Alles *et al.*, 2008). Kuhn and Sutton (2006) tried to examine the methods of fraud utilized by the management of a big telecommunications company in the USA, in order to design a continuous assurance strategy which could have detected such fraudulent behavior earlier.

In order to secure audit results and the validity of the data, formal policies and designs for the auditing process are necessary, especially in computerized environments. In 2006, Alles *et al.* presented a study in which they describe the lessons they have learned from an implementation of the monitoring and control layer for continuous monitoring of business process controls (CMBPC) in the US internal audit department of Siemens Corporation. Their main conclusion was that standardization of audit procedures and audit judgment is greatly underestimated. They pointed out that reengineering of audit processes is inevitable due to the necessity to separate standard and non-standard parts of the program. They stated that in order for modern audit techniques and processes to be effective in an ES environment, it is necessary that a high integration level of the system is reached.

The last decade there were a lot of accounting scandals, and therefore internal control and auditing became the focus of attention. Huang *et al.* (2008) built an internal control framework with five dimensions and 19 detailed factors and they used it in a survey of Taiwanese public companies which had an ERP system. They found that the five most important internal control factors were:

(1) establishment of IT organizations and their relations;

(2) integration of financial information;

(3) development of IT strategic plans;

(4) management of information quality; and

(5) monitoring of operating procedures.

From the literature it seems that there is a relation between organizational development and ES implementation. An in-depth case study in a Taiwanese IC design house was conducted by Chen (2009). The study showed that to leverage the value of the enterprise resource planning system, the implementation should take into consideration the firm's growth, the unique industrial characteristics, the influences from the business group, and the alignment of the internal control and audit function, corporate governance and information technology governance.

There are also studies that compare computerized and non-computerized business process environments, in terms of risks and errors that may occur due to computerization. It is mentioned generally that in computerized environments there are more risks and this is also the reason why formal policies are necessary in such environments (Alles *et al.*, 2006). Messier *et al.* (2004) conducted a survey in the six largest public accounting firms in Norway. The purpose of their survey was to examine if information technology (IT) affects the audit procedures used by auditors in detecting misstatements and if the causes of misstatements detected through audit

tests are different for computerized or non-computerized business processes. The results showed that (considering the effect of IT) tests of detail and attention directing procedures were just as likely to identify the misstatements in both computerized and non-computerized business processes. The authors mention that the primary reason auditors did not rely on IT controls was their belief that substantive testing was more efficient or effective. They found that there is an increase in the cause of misstatements resulting from missing and poorly designed controls and audit tests. They also found that appropriate controls were judged to be missing more often in computerized business processes rather than in non-computerized business processes. Comparing their results with previous research they concluded that control problems increased generally in the last decade, but these problems are more prevalent in computerized business processes. They mentioned that due to an increase in IT, there has been some degradation in the control environment and increase in the workload of accounting staff. They concluded stating that one consequence appears to be a shift in the audit procedures to detect misstatements with the use of more tests of detail. Spathis and Constantinides (2004) also conducted a research in Greek companies that have implemented an ERP system trying to examine the impact that the system had on the enterprise procedures. They found that the implementation of an ERP system is usually followed by an increase in internal audit procedures. As a result the enterprise can reach a higher level of integration in business processes and improved quality of reports.

Yang and Guan (2004) stated that the introduction of data processing equipment has many impacts on the traditional manual accounting systems and that IT systems require that the recording and processing procedures be concentrated in departments that are separate from the origin of the data. They also mentioned that computerization has reduced significantly the time available for the review of transactions before their entry into the accounting records. As a result, in poorly controlled systems the opportunity for uncovering errors before they have impact on operation has been reduced, which highlights the increased importance of improved internal control procedures. Finally, they pointed out that computerization and automation could potentially eliminate the audit trails by which individual records can be traced to final reports or to the original transaction.

Another important study concerning control procedures and the factors which affect them, was the one that was conducted by Grabski and Leech (2007). They pointed out that ERP implementation projects are but another example of an information system development project that needs to be controlled, and that the implementation of an ERP system is significantly different than a traditional system implementation. They focused on the fact that – as previous research showed – single modes of control are not sufficient, and that a portfolio of control modes is needed and should be utilized. This was explained through the theory of complimentarity. Chief Information Officers (CIOs) and Internal Auditors were selected to be the participants in this study. A questionnaire was created and distributed to them. The questionnaire was specifically expanded and significantly modified to include the controls identified as important in the literature and it also included questions specific to internal audit activities during the implementation phase. One of the main findings of this study was that groups of complementary controls need to be employed in the implementation of ERP systems in order to achieve successful implementation.

In addition, for companies that have implemented an ES it is very important to design formal policies-procedures, appropriate for auditing sufficiently and effectively such company environments. At this point, we should mention that the successive use of a system and the output quality of the system depends on the efficiency of the internal audit system and the internal audit processes (Lee, 2008). Wright and Wright (2002) conducted a semi-structured interview study with 30 experienced information systems auditors who specialized in assessing risks for ERP systems. The participants indicated that in order to provide assurance on ERP systems, a focus on testing the processes rather than system output is of great importance.

Control procedures are very important in order for data distribution and process to be reliable and for audit procedures to be successful. The latter is due to the fact that in computerized environments, many errors may go unidentified, unless efficient internal controls are present. Formal and accurate audit policies are necessary after an ES implementation. Continuous auditing and monitoring of automated business transactions by the internal audit function is growing, as businesses try to improve internal control (Spathis and Constantinides, 2004; Hunton *et al.*, 2008). Main objectives concerning the future of auditing in an ES environment are presented in Table III.

3.2 Modern audit tools and techniques

Researchers have discussed the different techniques that auditors can use in order to test the efficiency and the effectiveness of internal control procedures. Best (2000) mentioned that one of ERP's advantages (specifically SAP's) are the strong features that may be set up to control access to transactions and data. Auditors use computer-assisted audit techniques and tools (CAATTs) to help them in auditing an enterprise system. It is of great importance that the internal auditors assure that the enterprise system, which a company implements, is well controlled and secure. Modern tools are needed, so that all control tests will be performed effectively. The current definition of internal auditing adopted by the Institute of Internal Auditors Board of Directors in June 1999 expanded the scope of internal auditing to include consulting activities and value-added services for evaluation and improvement of the effectiveness of risk management and governance processes and internal control procedures. This requires internal auditors to continuously develop new skills and learn how to use new audit tools and modern technologies (Burnaby and Hass, 2009).

Main objectives	Authors
Transparency of data and information integrity seem to be threatened	Bae and Ashcroft (2004); Chang *et al.* (2008)
There is an increase of misstatements when there are no efficient control procedures	Messier *et al.* (2004)
There is a great need of increased and improved control processes (reengineering of audit function)	Yang and Guan (2004); Spathis and Constantinides (2004); Grabski and Leech (2007)
Continuous monitoring of automated business transactions seems to be the future of auditing	Alles *et al.* (2006); Kuhn and Sutton (2006); Alles *et al.* (2008)

Table III.
The future of auditing in an ES environment

It seems that auditors tend to apply continuous auditing techniques when accounting information is reported and stored in an electronic form. Continuous auditing tools tend to support both internal and external auditing processes. Enterprise systems offer functionalities for continuous monitoring of controls and detection of fraudulent activities (Best *et al.*, 2009). There are different methodologies for approaching auditing in ES environments, such as the Embedded Audit Module (EAM) which is software built into an information system, or the Monitoring Control Layer (MCL), which is separate software that operates independently and is linked into the information system (Kuhn and Sutton, 2006). The EAM approach – its benefits, disadvantages, technologies and processes – have been analyzed by the researchers for many years (Debreceny *et al.*, 2005; Alles *et al.*, 2006; Huang *et al.*, 2009).

The CAATTs can be classified into tools for substantive tests and tools for control tests. Huang *et al.* (2009) aimed to develop the Business Process Gap Detecting Mechanism (BPGAP-Detecting Mechanism), in order to detect the business process gap IS processes and internal control flows. In their conclusions they state that "there are various computer-assisted audit technologies and tools that can assist the auditor in acquiring knowledge of IS. However, most of them can only perform substantive tests. To construct a general system to perform the entire control test for IS is rather difficult since various IS have different data structures and IS process flows".

The embedded audit module (EAM) can be characterized as a substantive test tool and the BPGAP-Detecting Mechanism as a control test tool. Huang *et al.* (2009) mention that the disadvantage of the EAM is that it must be tightly coupled with the ES, in order to be effective and therefore it is difficult to construct a general EAM that can be customized to diverse ES. On the other hand the BPGAP-Detecting Mechanism is more flexible because it is separate from enterprise systems. This mechanism relies only on read-only access and the extraction of controls data from enterprise systems. So they conclude that this mechanism ensures that controls data extracted by BPGAP-Detecting Mechanism cannot be manipulated by the firm personnel, before or after extraction. Finally, they support that this mechanism improves both audit quality and software quality.

EAMs seem to be useful for ES as an added tool, which helps a company improve its audit process. The potential of exploiting the perceived benefits of EAMs in an ERP environment was examined by Debreceny *et al.* (2005). Their research was designed to assess the level and nature of support for EAMs by ERP providers. A set of ten model EAM scenarios were developed within a fraud prevention and detection environment. The scenarios were exposed to six ERP solution providers. The research revealed that support for EAMs within the selected ERP systems was highly limited and partial. It also showed that technical expertise was necessary to create EAMs of each ES system that was investigated.

The implementation of ES leads to automated and integrated re-engineered processes and as a result redundancies and inefficiencies are eliminated. Continuous assurance systems are built upon an organization's underlying IT systems, providing information access throughout an organization. This integration results in significant changes concerning the auditing function (objectives, process, timing, tools and outcomes) (Vasarhelyi *et al.*, 2004). Alternative continuous auditing system architecture to the EAM architecture is the MCL (Monitoring and Control Layer) which is appropriate to cater to different circumstances (Kuhn and Sutton, 2010). The

MCL approach has also been analyzed by researchers (Vasarhelyi *et al.*, 2004; Alles *et al.*, 2006; Kuhn and Sutton, 2006). The basic elements of the MCL architecture are: data capture layer, data filtering layer, relational storage, measurement standards layer, inference engine, analytic layer, alarms and alerting layer and the reporting platform (Vasarhelyi *et al.*, 2004).

Researchers have also discussed audit trails in the literature. Changes in configuration, security and master records, and financial transactions are edited with date/timestamps, user identification and workstation identification which are collected in various audit trails. In general audit trails can be defined as "records of user activity" (Best *et al.*, 2009). Audit trails are part of enterprise systems and often they have their own reporting facilities. As far as continuous auditing is concerned, they can be used for monitoring user activity and thus, they can de either part of EAM or MCL approaches. Best *et al.* (2009) highlighted the potential vulnerability to vendor fraud that may occur from inefficient segregation of duties and the need of for automated continuous fraud detection solutions. In their study they demonstrated how an ERP system (mySAP) could be used for audit trail analysis in detecting financial frauds.

In ES environments substantive tests and control tests should complement each other with the support of the appropriate CAATTs. Continuous auditing and its tools seem to be the future of auditing in such complex environments. Main objectives related to CAATTs are displayed in Table IV.

3.3 Auditor's role and expertise in an ES environment

ES are new and complicated audit environments and therefore internal auditors need to improve their technological knowledge and skills in order to perform effective and efficient audits (POB, 2000). Specifically the POB (2000, p. 171) states:

> Increasingly, auditors will find it necessary to understand fully the risks associated with new and advanced business information systems, and the controls that are needed to respond to those risks. Auditors also will find that they must expand their technological knowledge and skills, devise more affective audit approaches by taking advantage of technology, and design different types of audit tests to respond to new business processes. Highly skilled technology specialists will become even more essential members of audit engagement teams.

In this section we analyze the skills and the experience that an auditor must have, to be able to conduct successful audits in an ERP or an ES environment. Bae and Ashcroft

Main objectives	Authors
New audit tools and modern techniques are necessary	Vasarhelyi *et al.* (2004); Burnaby and Hass (2009)
Continuous auditing techniques increase	Best *et al.* (2009); Kuhn and Sutton (2010)
EAM and MCL are basic methodologies for approaching auditing in ES environments	Kuhn and Sutton (2006)
Auditors must be able and know how to use these tools, techniques and methodologies	Burnaby and Hass (2009)
In ES environments substantive tests and control tests should complement each other	Huang *et al.* (2009)

Table IV.
Modern audit tools and techniques (CAATTs)

(2004) published a study focusing on accounting and auditing implications related to ERP systems implementation. More specifically, they discussed information technology implications based on the SAP system. They mentioned that if accountants and auditors learn to work with ERP software, then they would be able to assist companies in improving the management of their operations. For example, when older practices of internal control are no longer appropriate, the auditor can assist a company in designing new advanced controls and tests to achieve efficient audits in an ERP system environment.

Many researchers support that the experience that an auditor has in auditing ES, is more important and essential than the experience in auditing in general, when the audit process takes place in an organization which has implemented such a system. This was supported by Brazel (2005) whose purpose was to develop, assess and provide uses for a measure of perceived ERP systems expertise. He was motivated from the "Theory of Planned Behavior" (Ajzen, 1991), which suggests that auditors who perceive that they have higher levels of ERP systems expertise should perceive that they have more behavioral control in ERP settings. Behavioral control refers to the perception of the ease or difficulty of performing the behavior of interest, for example auditing in an ERP environment. He supported that perceived auditor ERP systems expertise may be an important determinant of auditor behavior and audit quality in ERP environments. He developed a multiple-item scale which included measures of auditors' perceptions of their experience levels with auditing ERPs, their time spent auditing ERPs and how early in their careers they began auditing such systems. The multiple-item scale developed in this study was assessed for reliability and construct validity with 73 practicing audit seniors from four international and two national public accounting firms. Participants had an average of 3.68 years of audit experience (AUDEXP). Brazel (2005) supports that the measure can be used to capture perceived auditor ERP systems expertise as part of an experimental study interested in determining its effects upon auditor performance, audit quality, audit perceptions etc. Furthermore, he mentions that it may be preferable to assign a less experienced auditor with ERP systems background to an ERP systems audit environment than a more experienced senior auditor who may lack this area of expertise. The measure has the propensity to dichotomize auditors into distinct groups perceiving either low or high ERP systems expertise for experimental research and also to provide significant variation in participant responses for use in survey studies. Interestingly, the results of Brazel's study suggest that auditor perceptions of ERP systems expertise are not significantly related to general AUDEXP. Therefore, he suggested that it might not be prudent to assume that auditor perceptions of ERP systems expertise automatically increase together with the longevity of their audit careers. The results of Brazel (2005) are similar with those of another study which showed that for auditors in an ERP environment, it is more important that they know how to use the information provided by the system than have increased audit experience (Chang *et al.*, 2008).

Moreover, Brazel and Agoglia (2007) pointed out that in complex Accounting Information System (AIS) environments, both auditors' AIS expertise and their evaluations of CAS (computer-assistance specialist) evidence play a significant role in determining audit quality. They stated that although complex AIS (such as ERPs) and CAS have become basic factors for audit engagements, little prior research has examined how they affect auditor judgments. There are few studies which contributed

to the literature by examining the moderating effect of auditor AIS expertise on control risk assessment and the nature, staffing, timing, extent and effectiveness of planned substantive testing. AIS expertise plays an important role in complex AIS environments and appears to be more important when CAS competence deficiencies are present (Brazel and Agoglia, 2007).

Enterprise systems present new challenges to the internal audit function. Researchers claim that there are new relationships that an ES requires to exist between the internal auditors and five associated groups:

(1) software vendors;

(2) information systems;

(3) IT managers;

(4) ES users; and

(5) consultants.

ES gives internal auditors an enabling technology to advise management on the implications of ES for risk-intelligence and this leads to a hybrid position of an internal auditor within an organization (Madani, 2009).

At this point, we should mention that AIS expertise plays an important role in complex AIS environments, in order to achieve successful auditing. As Brazel (2005) states "it may be preferable to assign a less experienced auditor with an ERP systems background in an ERP systems audit environment than a more senior auditor who may lack this domain of experience".

We can conclude that the information provided by an ES during auditing plays an important role. Auditors must know how to comprehend with information systems and must be able to detect errors and fraud in such environments. Overall, the literature indicates that financial auditors need a higher level of technology skills to be able to deal with enterprise systems and to supervise computer auditors to ensure the accuracy of their work. In Table V we present main objectives concerning auditor's role and expertise in an ES environment.

3.4 Financial auditors and IT auditors – differences in risk assessment, roles and perceptions

In enterprise system environments financial auditors need the assistance of IT auditors. IT auditors audit the enterprise system environment and submit a report to the financial auditors presenting their findings about the system. This report states whether the system is reliable (if there are weaknesses in the internal controls and explain their impact on the financial statements) and whether the financial auditors can

Main objectives	Authors
Auditors must enhance their knowledge and skills in order to perform efficient audits in ES or ERP environments	Bae and Ashcroft (2004)
Auditors take on consulting activities	Madani (2009)
Experience in auditing IS in general or ES in particular seems to be critical	Brazel (2005); Chang *et al.* (2008)

Table V.
Auditor's role and expertise in ES environment

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depend on the output of the system. IT auditors can improve the effectiveness and the efficiency of the financial statement audits. Financial and IT auditors should cooperate and work together as one team (Vendrzyk and Bagranoff, 2003). In the literature there has begun a discussion about the differences in perceptions between financial auditors and IT auditors, concerning the auditing process in an ES environment.

Vendrzyk and Bagranoff (2003) described and contrasted IS and financial auditor's perceptions of the current and future role of IS auditing within the five largest accounting/professional services organizations in the USA. The primary objective of this study was to examine whether there are differences between IS and financial auditors' perceptions of the growing role of IS auditing. They investigated the perceptions among auditors about the evolution of the IS audit function, by focusing on the two major roles of the IS audit practice:

(1) its relationship to the financial audit; and

(2) the expected growth in the IS audit practice itself.

They concentrated on the largest accounting/professional services firms to better examine state-of-the-art auditing/assurance practices. In general they found that IS and financial auditors have different perceptions about the current and future relationship between IS and financial audit and differ in their opinions concerning clients' expectations for future audit services. More specifically, the results showed that financial auditors are more likely to indicate that the financial audit will continue to dominate the IS audit. IS auditors see a growing IS dominance over the financial audit. The researchers claimed that although financial auditors perceive the audit of general controls to be more important than IS auditors do, both groups believe that IS audit's focus on control evaluation includes a mix of general application controls with a growing focus on risk assessment. In evaluating the expected growth of the IS audit practice itself, financial auditors are more likely to interpret audit services and the need for services provided in terms of the financial audit, while IS auditors are more likely to take a broader view.

Finally, the researchers stated that as firms struggle with the significant changes occurring in their environment due to IS, understanding differences in the perspective of these two groups is critically important to accounting researchers, practitioners and educators. They supported that more research is needed to understand these differences and determine which is the best way to overcome them, so that financial and IS auditors would work together in order to improve audit practice.

The purpose of another study (Hunton *et al.*, 2004) was to examine the extent to which financial auditors recognize differences in the nature and extent of unique business and audit risks associated with ERP systems, as compared to traditional computerized (non-ERP) systems. They also investigated financial auditors' level of confidence in assessing such risks and their propensity to seek consultation with IS audit specialists in their firm. A total of 83 financial auditors and 82 IS audit specialists participated in an experiment in which "system type" was manipulated as either ERP or non-ERP. All participants were CPAs. The results showed that financial auditors were significantly less concerned than IS audit specialists with the following heightened risks of the ERP environment in the experimental case: business interruption, network security, database security, application security, process interdependency and overall control risk. Additionally, financial auditors did not

recognize the heightened risks of a seeded control weakness. Financial auditors were also highly confident in their ability to evaluate risks in both ERP and non-ERP environment; however IS audit specialists were less confident in financial auditors' abilities to recognize and assess risks related to ERP systems.

Nevertheless, another study showed that auditors seem to be more sensitive to the competence of CAS and assess control risk higher when provided with positive control testing from a CAS with low (versus high) competence. Also, in the AIS setting with increased risk, auditors with higher AIS expertise tend to assess control risk as higher than those with lower AIS expertise (Brazel and Agoglia, 2007).

Expectations of both groups (IS auditors and financial auditors) concerning the impact of IS audit findings on the scope of financial audit are difficult to assess. Research shows that computer audit specialists can recognize and assess much better audit risks in an ERP environment than financial auditors can. In addition, financial auditors are confident that they can assess risks in both ERP and non-ERP environment. However IS audit specialists are less confident in financial auditors' abilities to recognize risks related to ERP systems. Finally, in the literature it is mentioned that auditors are not capable of recognizing heightened inherent and control risks and that auditors with higher perceived ERP systems expertise are better able to plan substantive procedures to deal with ERP system related risks.

Overall, we can conclude that auditors, who possess higher AIS expertise, tend to assess control risk higher, compared to auditors with less AIS experience. This shows that financial auditors lack in recognizing the control risk importance in complex AIS environments and that they may be overconfident about their assessment results or their capabilities. Table VI displays main objectives concerning the category analyzed in this section.

3.5 ERP and compliance with regulations

In this section we analyze ERPs and their compliance with the Sarbanes-Oxley (Sarbox or SOX). The Sarbanes-Oxley Act (SOA) includes 11 sections, ranging from additional corporate board responsibilities to criminal penalties and required the Securities and Exchange Commission (SEC) to implement rulings on requirements to comply with the new law. The Act started as a reaction to a number of significant corporate and accounting scandals associated with big organizations (WorldCom Company was one of them).

Statement on Auditing Standards (SAS) No. 94 and American Institute of Certified Public Accountants (AICPA, 2001) calls for auditors to understand the computerized procedures used to prepare an entity's financial statements and related disclosures.

Main objectives	Authors
Financial auditors need the assistance of IT auditors and they are asked to cooperate with them effectively and work with them together as one team	Vendrzyk and Bagranoff (2003); Hunton *et al.* (2004)
Financial auditors and IT auditors tend to assess risks associated with ES in a different way	Vendrzyk and Bagranoff (2003); Hunton *et al.* (2004); Brazel and Agoglia (2007)

Table VI.
Financial auditors and IT auditors

More specifically, SAS No.94 requires auditors to consider how the client's information technology (IT) infrastructure affects the audit strategy, to design audit tests, to determine the extent to which computerized internal controls are operating effectively, and to possess requisite skills to evaluate and test IT systems or obtain help from specialists who have such skills. Cerullo and Cerullo (2003) classified computer-assisted audit techniques in three main categories:

(1) auditing around the computer;

(2) auditing with the computer; and

(3) auditing through the computer.

They stated that SAS No. 94 provides explicit guidance when a significant amount of financial information supporting one or more financial statement assertions is automated by complex electronic IT. They continued mentioning that under these circumstances, the auditor must assess control risk by performing audit tests and tests of controls, regardless of firm size. Auditing through the computer techniques, such as data, parallel simulation or embedded audit module, should be used to test controls when a firm has complex IT systems. The test data technique is appropriate for auditors with little IT experience (Cerullo and Cerullo, 2003). With the introduction and implementation of the Sarbanes-Oxley Act (SOA), enterprise systems are seen as an opportunity for corporations in order to achieve SOA compliance (Maurizio *et al.*, 2007).

The evolution of technology and the use of computers in business practice result in more information technology (IT) auditing and internal control standards and guidelines to assist auditors in their roles and responsibilities (Spathis and Constantinides, 2004). There are publications that focus on the discussion of the IT audit standards issued by the AICPA (American Institute of Certified Public Accountants) and ISACA (The International Federation of Accountants and the Information Systems Audit and Control Association) and their significance for the auditing profession. Auditors should understand clearly these pronouncements, standards and guidelines when performing an IT audit and it is certain that in the future we will see more announcements in this area. Specifically, Yang and Guan (2004) focus on the discussion of the IT audit standards issued by the AICPA and the ISACA. They state:

As the use of computers in business data processing gets more widespread and the integration of IT in business processes gets more intricate, we expect to see more pronouncements of IT audit standards in the future. Auditors should well understand these pronouncements, standards and guidelines when performing an IT audit.

Additionally, Brown and Nasuti (2005) conducted a study-report in order to provide background information for senior and middle management in IT organizations who may be in the implementation phase of compliance for Sarbanes-Oxley (SOX), and moreover to accountants, internal auditors and academics who wish to evaluate the impact of SOX on the IT organization. They concluded that competencies in several related core disciplines, including project management, change management and software integration should be the first priority for SOX implementation. Moreover, they supported that enterprise architecting and related areas such as security and outsourcing can be managed more adequately and effectively with the appropriate competencies.

Maurizio *et al.* (2007) published a study which reviewed factors and methods used to integrate multiple ERP systems to comply with the Sarbanes-Oxley Act (SOA) in an

Enterprise Application Integration Environment (EAI) focusing on the SAP business warehouse application. They examined earlier research, surveys, actual processes and documentation defined in the SAP system, as well as information gathered by developers, auditors and compliance experts.

Today, with the introduction and implementation of the SOA, enterprise systems are seen as an opportunity for corporations to be able to achieve SOA compliance. Based on their research, Maurizio *et al.* (2007) suggested that to comply with the SOA it is advisable to look at the area of EAI for assistance. They explained that compliance with SOA is not an easy task and needs the use of an EAI concept to become possible. The reason why is that the challenge of configuring a landscape to comply with the SOA without EAI means that most of the links would be interfaces which is the opposite of integration. They stated that the Business Warehouse systems (BW) have been available for over five years and the progress to offer additional functionality to address SOA requirements is an ongoing activity. In their opinion, landscapes need to be simplified from multiple systems environments to as few servers as possible. They also found that the authorization functionality in the Online Application Process (OLAP) environment is not as enhanced as it is in an Online Transactional Processor (OLTP) system, and this is due to the differences in the two systems' approaches to data. Data in an OLTP system is used for daily postings and processing, while data in an OLAP system is used mainly for reporting and viewing. The introduction of SOA changed that area and they supported that additional authorization processes need to be applied to reflect that change. The ability to post from BW to R/3 has made the use of authorizations in BW a must. They mentioned that there are many applications based items that have been affected by SOA, such as risk management, balanced scorecard, business planning, management of internal controls, BW based consolidations, core SAP, etc. and that these applications are much more mature and consistent with the needs of the organizations and auditing requirements.

Chang *et al.* (2008) published a study that aimed to achieve three purposes: The first was to explore the crucial control items of the purchasing and expenditure cycle in meeting the conditions of SOA 404. The second was to develop a computer auditing system based on the recognized control items and requirements of SOA 404 and the third was to validate the applicability of the system using an ISO/IEC 9126 model in meeting organizational needs. The development of the computer auditing system in this study showed eight proposed activity constructs and 34 control items in the purchasing and expenditure cycle, which are necessary for system development. The researchers established then this system on two chosen public firms to validate the applicability of the system. The interview results agreed on the usefulness of the system to facilitate their company's internal control procedures. It was found that the system could provide management and external auditors with the ability to identify incorrect financial statements and fraud. The computer auditing system complied with SOA 404. Furthermore, it improved the correctness of the auditing activities, and thus increased the reliability of the company's investment and management environment.

Continuous auditing tools are becoming basic factors of overall corporate governance and compliance with regulations. Continuous auditing applications are being used to support GRC (Governance, Risk Management and Compliance) activities across business processes, departments and information technology platforms (Kuhn and Sutton, 2010). Overall, auditing function supports ERP systems and thus it helps

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businesses to comply with regulations. The main objectives concerning ERPs and compliance with regulations are provided in Table VII.

4. Discussion

Since the use of computers in data processing and the implementation of enterprise systems have become so widespread, the auditing process is being transformed and auditors are asked to conduct efficient audits in ES environments. It is well known that information systems have a great impact on information management and business process redesign (BPR). When implementing information systems, enterprises re-engineer their business processes in order to obtain a competitive advantage. And as long as ES have impact in almost all business processes, they have impact on the auditing process as well. From our literature review it is obvious that ES significantly change the auditing procedure and the internal control of an organization. Standardization of auditing policies-procedures seems to be of great significance (Alles *et al.*, 2006). However, most of the companies don't have formal policies for auditing ES environments and this might cause problems within an organization. Researchers claim that companies that implement an ES must also design and implement formal and accurate control procedures which will be of assistance in auditing such a system.

There are studies that focused on the risks and challenges that occur for the audit function due to information systems implementation. In ES environments several risks occur and a major one is the risk related with fraud (Best *et al.*, 2009). Control procedures are very important in order for data distribution and process to be reliable and for audit procedures to be successful. The latter is due to the fact that in computerized environments, many errors may become unidentified, unless efficient internal controls are present.

Once these risks and challenges occur, auditors are asked to deal with them effectively. It seems that auditors must use modern audit tools and techniques in order to ensure the transparency of data and timely detection of fraud. Continuous auditing and its tools (EAM and MCL) help businesses prevent and detect fraud more effectively and in an early stage (Kuhn and Sutton, 2006; Alles *et al.*, 2006; Alles *et al.*, 2008). Thus, continuous monitoring of business transactions seems to be the future of auditing. Furthermore, researchers argue that in order to provide assurance on ERP systems, a

Main objectives	Authors
Technology results in more IT auditing and control standards and guidelines	Spathis and Constantinides (2004)
Auditors should understand well these guidelines when performing IT audits	Yang and Guan (2004)
SOA has affected several applications, such as risk management and management of internal control	Maurizio (2007)
CAATs are becoming basic factors of corporate governance and compliance with regulations	Kuhn and Sutton (2010)
ES are seen as an opportunity for corporations to achieve SOA compliance	Maurizio *et al.* (2007)

Table VII.
ERP and compliance with regulations

focus on testing the processes rather than system output is of great importance (Wright and Wright, 2002). Also, it seems that audit tools which support substantive tests and control tests should complement each other, in order for auditors to perform effective audits in computerized environments. Substantive tests can detect errors of the data and control tests help us know what causes these errors (Huang *et al.*, 2009).

As mentioned already before, ES implementation changes not only the audit process, but also the auditors' role. Auditors are asked to enhance their knowledge as far as the information systems are concerned, in order to be able to complete successful IS environment controls and audit tests. Previous studies support that it is more important for auditing in an ES environment, that the auditors know how to use the information provided by the system, and less important the general audit experience that they have (POB, 2000; Brazel, 2005; Chang *et al.*, 2008). The information provided by an ERP system during auditing plays an important role and this is the reason why the presence of an ERP-experienced auditor is significant.

In the bibliography analysis section, we also reviewed studies which were dealing explicitly with the relation and differences between IS auditors and financial auditors. It seems that expectations of both IS auditors and financial auditors concerning the impact of IS audit findings on the scope of financial audit are difficult to evaluate. Computer audit specialists can recognize and assess much better audit risks in an ES environment than financial auditors can. In addition, financial auditors are confident in that they can assess risks in both ES and non-ES environment successfully. However, IS audit specialists are less confident in financial auditors' abilities to evaluate or even recognize risks related to ES. Finally, in the literature it is mentioned that auditors are not capable of recognizing heightened inherent and control risks and that auditors with higher perceived ES expertise are better able to plan substantive procedures to audit such systems environments (Vendrzyk and Bagranoff, 2003; Hunton *et al.*, 2004; Brazel, 2005; Brazel and Agoglia, 2007). We also point out that IS auditors and financial auditors should cooperate and work together as one team. Further research is needed to examine the differences in perceptions and the conflicts between financial auditors and IS auditors (Vendrzyk and Bagranoff, 2003; Hunton *et al.*, 2004). Researchers also claim that auditors that possess higher AIS expertise, tend to evaluate control risk higher, compared to auditors with less AIS experience. This shows that financial auditors lack in recognizing the control risk importance in complex AIS environments and that they may be overconfident about their assessment results or their additional capabilities (Hunton *et al.*, 2004; Brazel and Agoglia, 2007).

Finally, researchers point out that the use of technology, computers and complex software packages in business practice results in more information technology auditing and internal control standards and guidelines to assist auditors in their roles and responsibilities (Yang and Guan, 2004). Overall, these standards and guidelines seem to improve the control function (internal – external) and we will see more additional announcements concerning ES and compliance with regulations in the future (Maurizio *et al.*, 2007; Chang *et al.*, 2008).

5. Conclusions

Enterprise systems and ERP systems seem to have significant effect on the auditing function, internal control procedures and auditors' role. In this section we summarize

the main conclusions of this study related to ES and audit function and we point out additional implications.

Next, we present the main conclusions of the study:

- In ES environments there is strong demand for increased control procedures, because in computerized contexts many errors may go unidentified when there are no sufficient audit processes. Standardization and formalizability of auditing policies and procedures are necessary (Alles *et al.*, 2006).

- In ES environments several risks occur and the most important are related to the transparency of data, information integrity, transaction errors and fraud (Bae and Ashcroft, 2004; Best *et al.*, 2009; Kuhn and Sutton, 2010).

- Continuous auditing and monitoring of business transactions seem to be the future of auditing function. Continuous auditing and its tools (EAM and MCL) help business detect and prevent errors and fraud more effectively and in an early stage (Kuhn and Sutton, 2006; Alles *et al.*, 2006; Alles *et al.*, 2008).

- Auditors' role changes along with the audit process and auditors are asked to enhance their skills and knowledge in order to be able to: complete successful IS environment controls and audit tests; and be of assistance for an organization to achieve compliance with standards and guidelines.

- Financial auditors need the assistance of IT auditors and they are asked to cooperate with them effectively and work with them together as one team (Vendrzyk and Bagranoff, 2003; Hunton *et al.*, 2004).

- The use of technology and computers in business practice results in more information technology auditing and internal control standards and guidelines to assist auditors in their roles and responsibilities (Yang and Guan, 2004). These standards and guidelines improve the control function (internal and external) (Maurizio *et al.*, 2007; Chang *et al.*, 2008).

We should mention at this point, that several implications arise for the audit function due to enterprise systems implementation. Auditors need to enhance their skills and knowledge in order to be able to handle electronic audit evidence effectively. Furthermore, there is need of more internal controls for the enterprise system and the security of the electronic data, as potential risks related to fraud increase in ES environments. Finally, the presence of IS auditors becomes necessary and financial auditors are asked to cooperate with them efficiently and thus enterprises must find ways to overcome conflicts between these two groups.

6. Limitations

Although considerable attention was given to the method and design of the literature review some limitations exist. First, some relevant publications might have been overlooked. Much literature has been scanned by reading the title only. Although the title in most cases describes the content quite well this is not always so. In order to be able to conduct a comprehensive literature review the topical focus was kept relatively narrow on auditing and ES - ERP systems. This might be a regarded limitation since this literature review will not satisfy the need of readers looking for a review on accounting in general and Integrated Information Systems (IIS) as a whole- not only ERPs. Furthermore, in the bibliography analysis we included and analyzed five

categories. Indeed, further categories emerged (such as continuous auditing and on line auditing) but we decided not to analyze them. The reasons we decided not to include further categories are as follows: first, we feared that the study would become too long and second we chose to review five categories extensively, rather than adding further categories and analyzing them inadequately.

7. Directions for future research

In the previous section research on enterprise systems and auditing has been reviewed. Many suggestions for future research can be identified on the basis of the literature review. This section will draw attention to a limited number of research opportunities that seem to be the most promising areas of future research. Further research is needed concerning the relation and interaction between auditing and ES and the impact of ES on the auditing procedures and on the auditors' role.

From the literature review it is obvious that IS auditors and financial auditors differ in perspectives and this leads to potential organizational conflicts. More research is needed in order to understand these differences and determine how best to resolve them, so that financial and IS auditors work together as one team to improve audit practice.

Nevertheless, the audit expertise literature has shown that experience and training combine to create expertise in auditors. Still, more dimensions of ES expertise, such as ERP implementation knowledge, may be relevant to determining perceived auditor ES expertise. Future research investigating auditor interactions with ES may reveal such additional sources of expertise.

As far as audit tests are concerned, it is obvious that substantive tests and control tests are needed both in order for the audit function to be efficient and effective. More research is needed to examine how to better synthesize the usage of audit tools supporting substantive tests and the usage of tools supporting control tests. This will help in improving data transparency in an ES environment, preventing fraud and improving quality of audit reports.

Future research should further examine the ways in which the implementation of ES affects internal auditors' work and the potential audit risks, which may occur from that interaction. Furthermore, research is needed in order to identify which factors should be considered when an audit software solution is to be chosen in an ES environment. In addition, future research should further examine the skills that internal auditors must have and the training they must get so that they will be able to conduct effective and efficient audits in such an environment.

Next, we summarize the main directions for future research.

Future research is needed in order to:

- understand differences between IS and financial auditors and determine how best to resolve them;
- investigate auditor interactions with ES and reveal new sources of expertise;
- examine how to better synthesize the usage of audit tools supporting substantive tests and the usage of tools supporting control tests; and
- examine the ways in which the implementation of ES affects internal auditors' work and the potential audit risks which may occur from that interaction.

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