IMPROVING THE SUCCESS OF CONTINUOUS AUDITING PROJECTS WITH A COMPREHENSIVE IMPLEMENTATION FRAMEWORK

Complete Research

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Abstract

The major aim of this paper is to create awareness of the demand for computer-assisted audit solutions within the European research community. The cause of this demand is twofold; on the one hand, regulatory pressure is increasing through both the reform of the audit sector in the European Union regarding mandatory audit firm rotation and tightened independence requirements. On the other hand, the speed and volume of data processing requires fast and qualitative audit results. These circumstances lead to the need to shift audit processes from traditional sample selection based on historical data to permanent monitoring and assurance of accounting-relevant processes and data– Continuous Auditing (CA). However, the implementation of CA systems is a recognized challenge for researchers and practitioners. Through the review of relevant literature regarding the issues and barriers of CA projects, sixteen critical success factors (CSFs) of CA were explored. These CSFs were condensed into one framework considering three different levels of business diffusion (strategy, processes, and systems) as well as stakeholders of CA projects (enterprise, project management, audit, and external environment). In terms of the conceptual level of the proposed framework, the authors of this paper chose a fictitious scenario and conducted an informed argument to evaluate the framework.

Keywords: Continuous Auditing, Implementation Framework, Accounting Information System

1 Introduction

In December 2013, European Commissioner BARNIER announced an agreement reached between the European Parliament and the *European Union* (EU) Member States on the reform of the audit sector in the EU (European Commission, 2013). In April 2014, the European Parliament enacted Regulation No. 537/2014 on specific requirements regarding statutory audit of public-interest entities (European Parliament, 2014a). Naturally, this regulation will have a tremendous impact on the organization of the audit market in Europe, because key measures include the mandatory rotation of audit firms, the promotion of market diversity, and enhanced supervision of the audit sector (European Commission, 2014). Moreover, the supplemental EU Directive 2014/56/EU contains extensive suggestions regarding the internal organization of statutory auditors and audit firms as well as the organization of the auditors' work (European Parliament, 2014b). Consequently, it can be assumed that the *Iron Triangle* of project management (Atkinson, 1999) will be exacerbated, because the time and budget of external audit projects will be reduced, and the quality of audit results needs to be ameliorated.

It is a well-known consensus among researchers and practitioners that *Information Technology* (IT) and appropriate *Information Systems* (IS) can increase the efficiency, efficacy, and quality of auditing (Braun and Davis, 2003; Rezaee et al., 2001). Nevertheless, technical evolution concomitantly affects both innovative *Accounting Information Systems* (AIS) and the challenges of the increasing complexity of data generation and its processing (Byrnes, Al-Awadhi, et al., 2012). Recently, the impact of the ever-growing size of data on auditing has been increasingly discussed among researchers and practitioners (Abbasi et al., 2012; Bhagat et al., 2014; Kiesow et al., 2014; Moffitt and Vasarhelyi, 2013). The breadth of this discussion spans from critical considerations about security and privacy (e.g. Rajan et al., 2012, Bojilov et al., 2013) to the question of how value and benefits can be generated from accounting-relevant data (Chew et al., 2013).

The main objective of an auditor is to gain a valid expression of the fairness and truth of financial statements according to national and international law and accounting principles (e.g. AICPA, 1972; IFAC, 2013). Regulatory pressure and technical evolution cause massive changes in the audit sector and require an IS solution that can permanently monitor accounting-relevant processes as well as ensure the assurance of accounting data—*Continuous Auditing* (CA). The current situation in the EU is comparable with the release of the Sarbanes-Oxley Act (SOX) in 2002, which stimulated an extensive debate among researchers and practitioners regarding the act's consequences for auditing and technology (e.g. Alles et al., 2005; Arnold et al., 2007; El-Masry and Reck, 2008). BROWN et al. (2007) concluded that SOX and the needs of external users for reliable financial disclosures that are released frequently are both factors contributing to the demand for CA. Nevertheless, although CA techniques have been widely discussed in literature throughout the last two decades, market-ready CA solutions for external auditors are still lacking. In 2012, the *American Institute of Certified Public Accountants* (AICPA) stated that CA "*consists of many diverse elements and may be implemented at various levels of sophistication*" (Byrnes, Ames, et al., 2012, p. 3). The implementation of CA is strongly affected by an organization's data, controls, and processes, in other words, the organization's architecture (Byrnes, Al-Awadhi, et al., 2012). Thus, the implementation of CA is a long-term, complex task (Byrnes, Ames, et al., 2012) and needs to be thoroughly explored and planned. Consequentially, the *Research Question* (RQ) in the context of this paper is

RQ: *How should the implementation of Continuous Auditing on an organizational level be planned?*

To answer this question and to enhance the evaluation of CA projects following implementation, the authors of this paper explored the issues and "lessons learned" from CA projects in the past and condensed the results into a structured implementation framework. Furthermore, the aim of the paper is to augment the awareness of the European community of the need for and to accelerate the development

of CA solutions. Therefore, the paper at hand is structured as follows. Critical success factors of CA projects are analyzed in Section 2 by reviewing relevant literature. Next, the research approach is described in Section 3. An implementation framework is proposed in Section 4. Section 5 contains the evaluation of the framework using a fictitious scenario. In Section 6, the results of the evaluation are summarized and discussed. This section contains an outlook which emphasizes the need for further work in this research area. Finally, the conclusions are presented in Section 7.

2 Reviewing the "Lessons Learned" of Continuous Auditing

Since GROOMER and MURTHY (1989) proposed the *Embedded Audit Module* (EAM) approach in 1989, concepts of CA systems as well as their limitations and implementation issues have been widely discussed in the literature. For the presentation of an implementation framework for CA systems, which is the main purpose of this paper, it was necessary to review this literature and to derive the "lessons learned" from past CA projects.

The first holistic concept of a CA system based on EAM was investigated by VASARHELYI and HALPER in 1991 (*Continuous Process Audit Methodology*, CPAM). Important issues for CA implementation were highlighted in this study, such as the auditor's knowledge, startup costs, and resistance to changing existing organizational structure (Vasarhelyi and Halper, 1991). WOODROOF and SEARCY (2001) developed a conceptual model of CA and examined a five-stage implementation method within the debt covenant compliance domain. As a result, they determined stringent criteria that must be fulfilled in order to enable the proposed CA concept, for instance, motivation of the involved parties, expertise of participants, and security and reliability issues. In 2004, VASARHELYI et al. proposed a 4-level-based model of CA as well as the concept of the *Monitoring and Control Layer* (MCL). As a conclusion, VASARHELYI et al. (2004) predicted the "*paradigm shift by auditors*", which is manifested by the "*creation of a new system of continuous analytic monitoring that will completely transform the audit environment* […]". Nevertheless, the authors pointed out barriers to adopting CA, such as the necessary reengineering of audit processes, concerns with independence, and the relationship between internal and external auditing. In a case study design with six *Enterprise Resource Planning* (ERP) vendors, DEBRECENY et al. (2005) pointed out that the ERP systems investigated only partly enabled the support of EAM. Additionally, they shed light on different implementation issues, for instance, ownership and control, trust in the client's IT staff, and customer acceptance.

From 2002 to 2007, ALLES et al. undertook two pilot CA projects in cooperation with major firms. In 2008, they articulated their work and condensed the lessons learned into a single document (Alles et al., 2008). Major issues found include the overlap of operational monitoring by management, and, hence, the compromising of auditor independence. Further issues concerned the importance of communication and the reengineering of existing audit procedures. From a technical perspective, the disregard of controls if the subject matter is covered by another control later in the process ("*compensating controls*"), and overwhelming system alerts due to CA ("*alarm floods*") were discussed. Finally, protectionism and adjustments to existing audit procedures were presented a second time. KUHN and SUTTON (2010) discussed the current CA techniques, namely, EAM, EAM ghosting, and MCL, as well as their specific limitations and external auditors' concerns (system and design maintenance, legal liability, and client independence). Additionally, six third-party CA solutions were analyzed considering audit-relevant functionality, such as risk management, ERP compatibility, and reporting.

By conducting expert interviews, SUN (2012) investigated the process of technological adaptation for *Computer-assisted Audit Tools and Techniques* (CAATTs). In detail, the incremental progress of an emerging progression from CAATT adoption to CA from an experimental perspective to daily usage was explored within a case study. By analyzing the results, SUN explained essential issues for the implementation of CA. Beyond cost and technical considerations, SUN pointed out that, first, the documentation of CA projects is important for integrating manual auditing procedures as well as for the maintenance of computer programs. Second, communication among the team members and the will-

ingness for cooperative learning and collaboration is crucial. Further requirements of CA projects are the skill, knowledge, and training of the participants. Additionally, the auditing environment, which contains computer procedures for testing as well as application controls inter alia, is proposed as a critical issue for CA projects. Finally, the restructuring of processes and the replacement and updating of systems affect both the correctness of systems and the effort to maintain them.

In a survey of internal audit staff members and managers from nine organizations, VASAHELYI et al. (2012) determined that almost every organization within the survey had implemented initial or emerging level CA. Crucial issues for their individual CA projects included lack of management support, lack of employee knowledge and auditor skills, and protectionism of data owners due to data integrity and security concerns. In this survey, costs were not identified as a main issue for the implementation of CA technology because the interviewees recognized the scale effects of computer-assisted mass data analysis. In summary, VASAHELYI et al. concluded that there is a need for the development of CA technology.

Using case studies, SHIN et al. (2013) delved into the implementation of CA systems in the financial and manufacturing industries and brought problems in this context to light (e.g. the speed of advancements in IT environments, access rights). In 2014, SINGH et al. presented the comparison of three CA systems regarding, inter alia, their architecture, implementation, and functionality. They conclude that as "*business and ERP landscapes continue to evolve and advance, any CA/CM solution will need to evolve to higher levels of maturity and in new directions"* (Singh et al., 2014).

Beyond simply the academic literature, the practitioners' perspective, which is condensed in the publications of professional organizations, was also revisited. This is important inasmuch as the CA debate has high practical relevance (Rezaee et al., 2001). As the first professional organizations, the *Canadian Institute of Chartered Accountants* (CICA) and the *American Institute of Certified Public Accountants* (AICPA) published the Continuous Auditing Research Report in 1999. This report was updated by the AICPA in October 2012—more than twelve years later. In this White Paper, the AICPA stated that "*the general view is that not much is currently being done with CA/CM*" and "*this is particularly evident in the area of external auditing, although there has been some limited progress in the internal audit area*" (Byrnes, Ames, et al., 2012). The AICPA highlights the fact that the implementation of CA requires understanding and support at the top management or board level. A lack of understanding by top management or at the board level can predicate the failure of CA projects on lower levels. Another recognized barrier is protectionism by data owners, which could lead to unwillingness to grant access to internal or external auditors (Byrnes, Ames, et al., 2012). In a supplemental paper, which was released in November 2012, the AICPA highlights the importance of auditor education in technology and analytic methods, the socio-technical environment, and, again, management support. The AICPA states that "*comprehensive strategic planning joining technical with human issues is also a necessary ingredient in helping to ensure a successful transition to the future audit*" (Byrnes, Al-Awadhi, et al., 2012). Further issues are related to timing restrictions of the audit, statistic considerations, and adjustments to audit concepts (e.g. materiality and the independence of the auditor) and procedures. Finally, the AICPA concludes that audit quality can be increased if organizations automate data, controls, and processes according to technological functionalities. In 2002, the professional organization *Information Systems Audit and Control Association* (ISACA) proposed noteworthy issues for CA and concluded that "*They [organizations] should start with easily auditable data that has significant value to users, such as investors and the equity markets, and structure an engagement to allow an IS auditor to report in a timeframe that provides value to users of data*" and, furthermore, that "*continuous auditing engagements require significant reliance on controls and the use of control-based testing, which can be achieved through traditional controls testing*". Finally, the ISACA states that the implementation of CA is feasible, although it is considered to be complicated (ISACA Standards Board, 2002).

3 Research Approach

Overall, the authors of this paper strive for the design of *Information Systems* (IS) based solutions for the needs of internal audit departments, external audit firms, and IT management in BDCE. The aim of the authors is the development of artifacts which serve human purposes according to the definition of *Design Science Research* (DSR) (March and Smith, 1995, p. 253). This theory is characterized by the usage of "*principles of form and function, methods, and justificatory theoretical knowledge*" for the development of IS (Gregor, 2006, p. 628). The authors of this paper are aware that the employment of the *Action Research* approach (AR) would also be suitable. However, DSR, unlike AR, proposes "*a more technical and distinct approach to evaluation and research evaluation*" (Papas et al., 2012, p. 151), which is understood to be a crucial step of the iterative IS research cycle (Hevner et al., 2004, pp. 85, 88). The authors considered several specific DSR approaches (e.g. Nunamaker et al. 1990-91, Peffers et al. 2008, Sein et al. 2011). Ultimately, the DSR approach according to ÖSTERLE et al. (2011, p. 9) was selected, as this approach emphasizes the iterative process of design-oriented IS research. Following this approach, the previous work of the authors was ordered according to four distinct phases, which are *analysis*, *design*, *evaluation*, *diffusion*, as shown as follows.

First, the challenges and issues of CA projects that were conducted in that last two decades were derived from literature (*analysis*). Subsequently, the critical success factors were investigated and arranged into an implementation framework, which constitutes the artifact of this research paper (*design*). Afterwards, the presented framework was descriptively evaluated by using a scenario (Hevner et al., 2004, p. 86) based on a fictitious implementation of a CA system using EAM, MCL, and additional CAATTs (*evaluation*). Finally, the *diffusion* of this work was attempted through the presentation of the framework within a conference. As mentioned above, DSR is an iterative process. Figure 1 presents the four basic phases of DSR as a spiral with an iterative aspect. The authors maintain that the rigor of this approach increases with every iteration. The result of these considerations is presented in Figure 1.

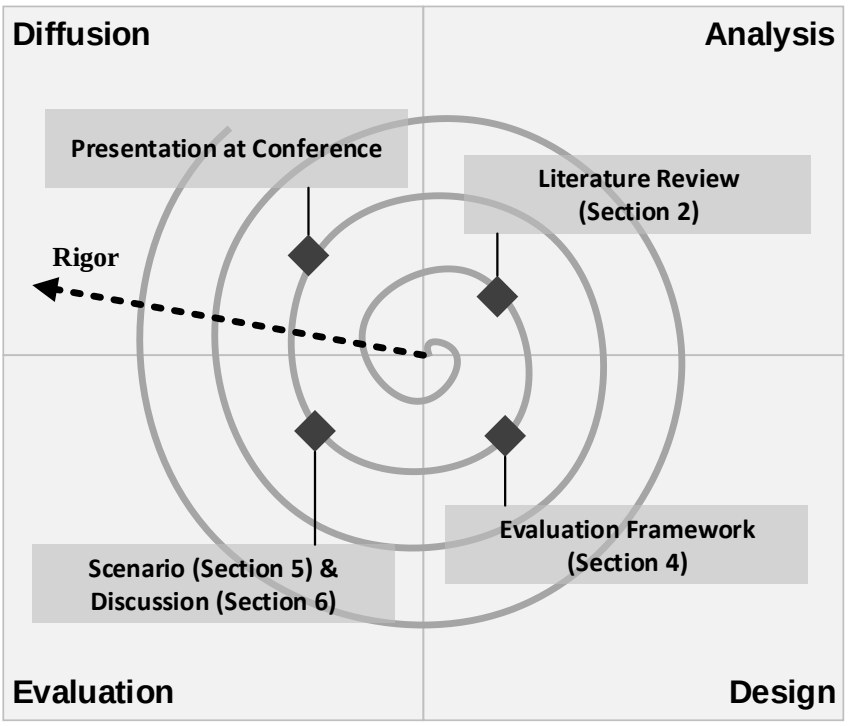

Figure 1. Iterative Research Approach (cf. ÖSTERLE et al., 2011)

4 Designing an Implementation Framework

According to the iterative research approach mentioned in Section 3, the first step was the analysis of the challenges, or, in short, the "lessons learned" of previous CA projects. This information sets the baseline for the investigation of *critical success factors* (CSFs) of CA projects in terms of the suggestions of EU Directive 2014/56/EU. Moreover, previous considerations reasoned that the implementation of CA is comparable to a transformation process affecting major parts of the organization's architecture (e.g. accounting processes, AIS, and control environment). Through the analysis of similar problems in IS research, the authors recognized that the implementation of CA can be understood as a specification of the *Business Engineering* (BE) approach according to ÖSTERLE et al. (1995). BE is defined as the "*method and model-based design theory for businesses in the information age*" (Thomas and Scheer, 2006). BE incorporates this transformation, which results in the segmentation of projects into individual subprojects, which are in turn segmented on the levels *strategy*, *processes*, and *systems* (Österle and Blessing, 2003). Inspired by the BE approach, the general idea of the framework to follow is the arrangement of the CSFs from a textual presentation into a framework with three different layers, which correspond to the aforementioned levels. Additionally, because the aforementioned CSFs of CA projects affect various stakeholders, the framework parses them into the four stakeholder perspectives: *enterprise*, *project management*, *audit department*, and *external effects*. The result is a conceptual model according to HEVNER et al. (2004, p.83) and is presented in the upcoming Figure 2.

The European Parliament stated in its Directive 2014/56/EU that "*the primary responsibility for delivering financial information should rest with the management of the audited entities*" (European Parliament, 2014, paragraph (5)). Accordingly, the support of the auditee's management ((1) *Management Support*) is considered crucial in the literature, because further factors depend, either directly or indirectly, on this prerequisite. In preparation for subsequent activities, the management should be aware of the consequences of CA and strive for the alignment between business and audit. Therefore, this CSF is settled at the strategic level and affects both the enterprise and the CA project itself. The activities of the auditee's management are strongly related to the acceptance of the customers, which are namely the client's business staff. (2) *Customer acceptance* is considered crucial for two reasons: First, if implemented, CA enables the permanent monitoring of the employees' work. This could result in fear and, hence, in insufficient output. Second, audit activities are often perceived as imposition, which could inspire a negative attitude towards audit activities. However, the integration of (continuous) audit activities into business processes demands the cooperation and acceptance of the clients. Therefore, this enterprise-specific CSF is placed at the strategic level.

It is an acknowledged opinion among researchers and practitioners that CA is able to increase the efficiency of the (external) audit (e.g. Groomer and Murthy, 1989; Vasarhelyi et al., 2004; Byrnes, Ames, et al., 2012). Nevertheless for the time being, appropriate studies which prove this opinion are lacking, particularly, because of the perception of CA as a costly undertaking with lengthy payback periods (Byrnes, Ames, et al., 2012). Hence, reasonable planning and monitoring of the (3) *Cost-Benefit Tradeoff* of CA projects have to be aligned to the strategic level of project management.

In literature, the (4) *Adjustment of Audit Procedures*, (5) *Auditor's Independence*, and (6) *Education of Auditors* (i.e. technical skills, business knowledge, and training) are considered crucial to the success of CA projects (e.g. Alles et al., 2008; Debreceny et al., 2005; Singh et al., 2014; Vasarhelyi et al., 2012). Considering audit procedures (4), the implementation of CA techniques affects the timing restrictions of audit. On the one hand, if CA is implemented and a system is permanently monitored using a predefined rule set, "*audit can rely purely on exception reporting and the auditor is called in only when exceptions arise*" (Vasarhelyi and Halper, 1991), which enables the audit on a daily basis, which in turn contributes to an increasing quality of audit. On the other hand, ALLES et al. (2008) emphasized the issue of time-lags in audit: If an exception occurs in the processing, the auditor has to

react immediately to avoid latency in the business process. This issue has to be considered in the design of the CA technique and covered by appropriate audit procedures.

In terms of the audit procedures, the EU Directive suggests:

- "*(h) a statutory auditor or an audit firm shall use appropriate systems, resources and procedures to ensure continuity and regularity in the carrying out of his, her or its statutory audit activities;*" (European Parliament, 2014, Article 24 (h)) and
- "*(i) a statutory auditor or an audit firm shall also establish appropriate and effective organisational and administrative arrangements for dealing with and recording incidents which have, or may have, serious consequences for the integrity of his, her or its statutory audit activities;*" (European Parliament, 2014, Article 24 (i)).

Furthermore, a major concern of the EU Parliament is the independence of statutory auditors and audit firms. Therefore, the EU Directive highlights the independence of auditors in several places (e.g. Article 22 and Article 22b). Likewise, the EU Parliament suggests the continuing education of auditors and, moreover, that failure to respect the continuing education requirements should be subject to appropriate sanctions (European Parliament, 2014, Article 13). Thus, CSFs (4), (5), and (6) are placed at the strategic level of CA projects. CSF (6) includes project management skills as well as technical skills and is therefore related to both the Project perspective and Audit perspective.

At the level of Processes and Controls, the success of CA projects depends highly on (7) *Communication and Teamwork*, which include the collaboration of all participants of the CA project (enterprise management and staff, project management, and auditors) and overcoming the communication barriers caused by different expertise (Sun, 2012) and segregation of duties (Shin et al., 2013). Therefore, appropriate rules and project monitoring tools should be established.

The (8) *Analysis of the Organization's Environment and the Nature of Testing and Controls* and (9) *Definition of the Audit Objectives* are strongly related to each other. The former is mentioned by various authors (Byrnes, Ames, et al., 2012; ISACA Standards Board, 2002) and explicated in audit standards, such as International Auditing Standard 315. The importance of controls for auditing is also mentioned by experts, as for instance by SCHULTZ et al., (2012) who conducted expert interviews in this field: "*A process audit is mainly a controls audit, the process is just a link between controls*". Again, matters such as the segregation of duties have to be considered as well. In conjunction with Article 26 of the EU Directive, which suggests that statutory auditors and audit firms conduct statutory audits in compliance with international auditing standards, this CSF is necessary for traditional audit as well as CA. Considering the audit objective (9, *Definition of the Audit Objectives*), VASARHELYI et al. defined four *Levels of Assurance and Audit Objectives* related to CA (*transactional verification, compliance verification, estimate verification*, and *judgment verification*) in order to support the auditor in fulfilling this CSF.

The documentation of IT projects in general and thus, the (10) *Documentation of CA projects* in particular are frequently discussed in literature. For instance, SHIN et al. (2013) stated that "*continuous monitoring scenarios must be systematized and standardized*", which requires appropriate documentation. In contrast, SUN (2012) stated that "*It is insufficient to build the computer auditing routines only by documentation, because it is not easy to change the auditing methodology of auditors. It still depends on the cooperative learning environment of project members*". Moreover, auditing standards cover the documentation of results (e.g. paragraph 32 of the International Standard on Auditing, 315 IFAC, 2013b). However, there is no legal reference for the documentation of IT projects in the audit sector, which clarifies the responsibilities for the change management, maintenance, and documentation of (continuous) audit projects.

The (11) *Cooperation of the Client's IT Staff and Data Owners* is a recognized success factor of CA projects (e.g. Alles et al., 2008; Debreceny et al., 2005; Kuhn and Sutton, 2010; Shin et al., 2013). For

example, the minimization of data protectionism as well as the willingness and expertise of the IT staff to support the implementation of the CA techniques are included within this CSF. It can be derived as a special characteristic of CSFs (1), (2), and (7) at the level of systems and data.

KUHN and SUTTON (2010) mentioned the (12) *Clarification of Legal Liability*. Legal liability can understood in terms of damage to the client's system, or when auditors fail to identify material misstatements or frauds using CA. Subsequently, liability and the possibility of litigations can affect the independence of auditors (5) as well as the quality of the results. Therefore, the legal liability has to be clarified for each system or data extraction.

Numerous references related to (13) *Technical Implementation* can be found in literature. Issues discussed include "*alarm floods*" (Alles et al., 2008), performance issues (Debreceny et al., 2005; Kuhn and Sutton, 2010), and the implementation of the CA techniques (EAM or MCL) within the ERP itself. Whatever the intended CA project may look like, its implementation should be tested in an encapsulated Test Facility with appropriate Test Data. This CSF is aligned to the level of the specific (ERP) system or the accounting data of interest, that is, the level of Systems and Data. (14) *Data Security and Information Security* are closely connected with the Technical Implementation, as mentioned multiple times by researchers (e.g. Debreceny et al., 2005; Woodroof, Searcy, 2001). The EU Directive does not include any reference related to the (technical) implementation of (continuous) audit systems and the security issues of auditing. These issues are the subject matter of the proposed EU Directive 2013/0027 (COD) concerning measures to ensure a high common level of network and information security across the Union (European Parliament, 2013).

Finally, CSFs (15) *Changing IT Environment and (Audit) Systems* and (16) *Legal Framework* are recognized as external effects pertinent to all levels of CA projects: CSF (15) is inter alia related to the consideration of parallel projects (e.g. migration to new AIS), the modification of ERP and business processes (Alles et al., 2008; Shin et al., 2013), or IT trends (e.g. Big Data, Cloud Computing). Regarding CSF (16), the EU Directive proposes the consideration of national law as well as national and international audit standards, such as the International Standards on Auditing (ISAs), the International Standards on Quality Control (ISQC 1), or the Standards of the International Federation of Accountants (IFAC) (European Parliament, 2014, Article 26). Overall, the Directive itself would mean an enormous change to the legal framework if it is adopted in the national law of the EU Member States.

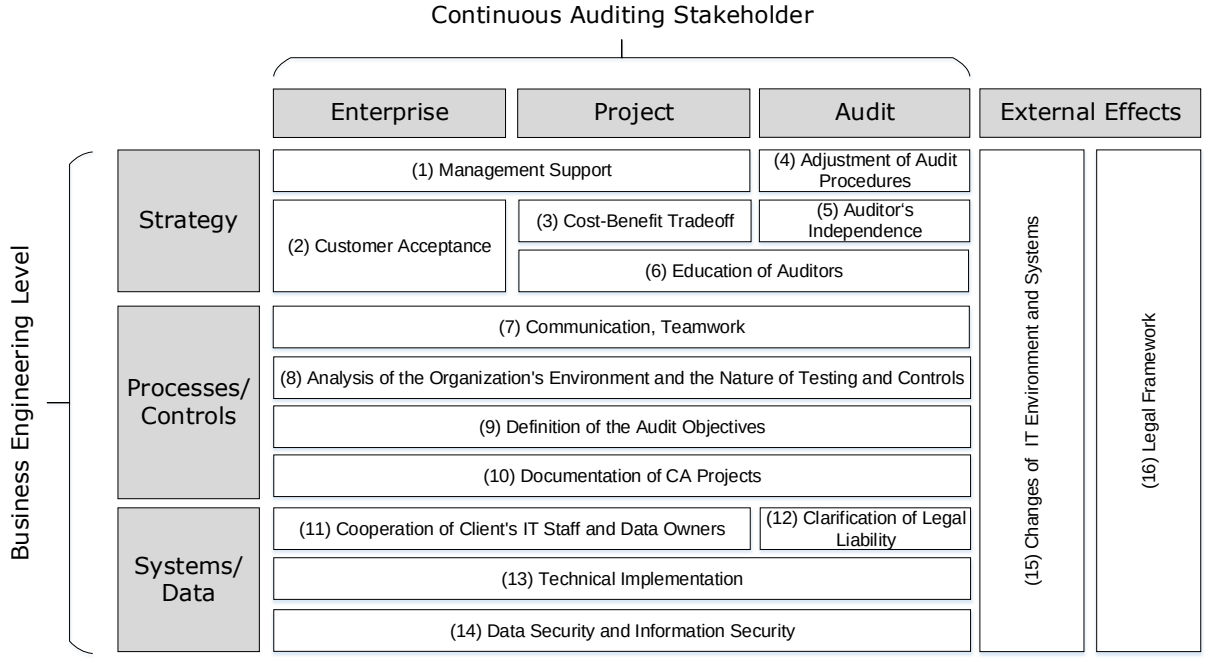

Figure 2. Implementation Framework for CA projects

5 Example Scenario and Evaluation

5.1 Continuous Auditing Implementation Scenario

As mentioned before, the evaluation of the artifact, which is namely the proposed implementation framework in the previous Section 4, is conducted by means of an informed argument based on a fictitious scenario. According to WEIDENHAUPT et al. (1998, p.35), a scenario-based approach has to consider four views on scenarios, which are purpose, form, content, and lifecycle. The *purpose* of the scenario is the reduction of complexity in terms of a usage-oriented decomposition from the very beginning (Weidenhaupt et al., 1998, p. 39). Overall, the goal of the scenario is the evaluation of the proposed implementation framework, which represents a reflection of a static conceptual model. The *content* of the scenario comprises two parts:

(1) An *architecture* focusing on the needs of business environments, which produce a high volume of machine-generated data, and that uses the aforementioned CA techniques (i.e. EAM and MCL) (Kiesow et al., 2014).

(2) An *implementation methodology* encompassing two phases, which are briefly described in the upcoming Sections 5.1.1 and 5.1.2 (Kiesow et al., 2015).

The *form* of the scenario is a combination of narrative text with one descriptive image, which is shown in Figure 3. Therefore, the structure is semi-formal and considered rather more static than interactive. From the *lifecycle* view, the scenario is at its second iteration. To satisfy scientific rigor, it was necessary to assess the relevance and the applicability of both parts of the scenario. Therefore, the parts were examined as separate artifacts which were introduced and evaluated in previous publications. The authors of this paper assume that the scenario will evolve in terms of top-down decomposition as well as incremental scenario development.

5.1.1 Phase 1: Implementing EAM in accounting-relevant processes

The diffusion of the CA approach is incorporated within the business strategy, then adopted into the IT strategy, and, finally, tactically spread over all the affected business areas and supporting activities. Subsequently, all necessary actions, such as training programs, data ownership, or inter-divisional collaboration, are declared and monitored by management (**P1:1**).

The idea of the scenario is that the CA approach is first implemented along the business processes of the enterprise business process model, which are generating *material* financial statements (**P1:2.1**). Hence, the materiality of a financial statement determines the order of the processes where CA will be implemented. As is known, financial statements are generated by (accounting-relevant) business processes. Therefore, the financial statements have to be mapped to their individual business processes, which have to be documented in the enterprise business process model (**P1:2.2**). After the accounting-relevant sub-processes are selected, the existence and nature of the (application) controls in place will be identified (**P1:2.3**).

Because the CA architecture requires the results of controls in an electronic and analyzable form, the manual application controls have to be transformed into automated application controls (**P1:3**). Finally, all controls have to be suitable for integration into the EAM.

The EAM allows for the direct and permanent monitoring of the controls. They generate automated alerts in the case of a control violation, which enables the auditor to react instantaneously. The last step of Phase 1 is the integration of the EAM into the accounting-relevant systems (**P1:4**).

5.1.2 Phase 2: Implementing an Audit Cockpit

The first step of Phase 2 is a comprehensive data assessment **(P2:1)**. Attributes related to data are frequency of occurrence, data format (structured, unstructured), accounting-relevance, and contribution to the financial statements. Additionally, information about data owner, origin of data (internal or external), and sensitivity will be identified. This information has to be collected in a centralized *Data Inventory*. The importance of the control environment was mentioned in the prior sub-section. Similar to the Data Inventory, a centralized *Control Inventory* has to be constructed **(P2:2)**. This inventory contains the subject matter of control, the frequency of control, the nature of control (preventive, detective, or corrective), and the control initiator.

The EAM has to execute three essential functions: First, the result of every application control activity has to be transferred into a separate *Results* table **(P2:3)**. This is accomplished via reports, which are generated by the EAM, and automated real-time connections between the EAM and the Results table. Second, the EAM enables direct access to the processed data via a restricted audit interface. Further investigations about the quality and accuracy of the data can be achieved through the development of instantiations of *General Audit Software* (GAS), which can be applied on real data **(P2:4.1)**. Thus, the auditor has to develop instantiations of GAS, for instance fraud detection tools. The last function is to enable the input of Test Data. This empowers the auditor to process the control with his or her own generated Test Data and to assure the completeness and correctness of the application **(P2:4.2)**.

All collected information is visible within a centralized *Audit Cockpit*, which enables one to understand which data are controlled and which result was produced **(P2:5)**. Ultimately, through the continuous monitoring of processes and controls as well as the data assurance provided by the usage of GAS and Test Data, the CA approach is implemented (see Figure 3).

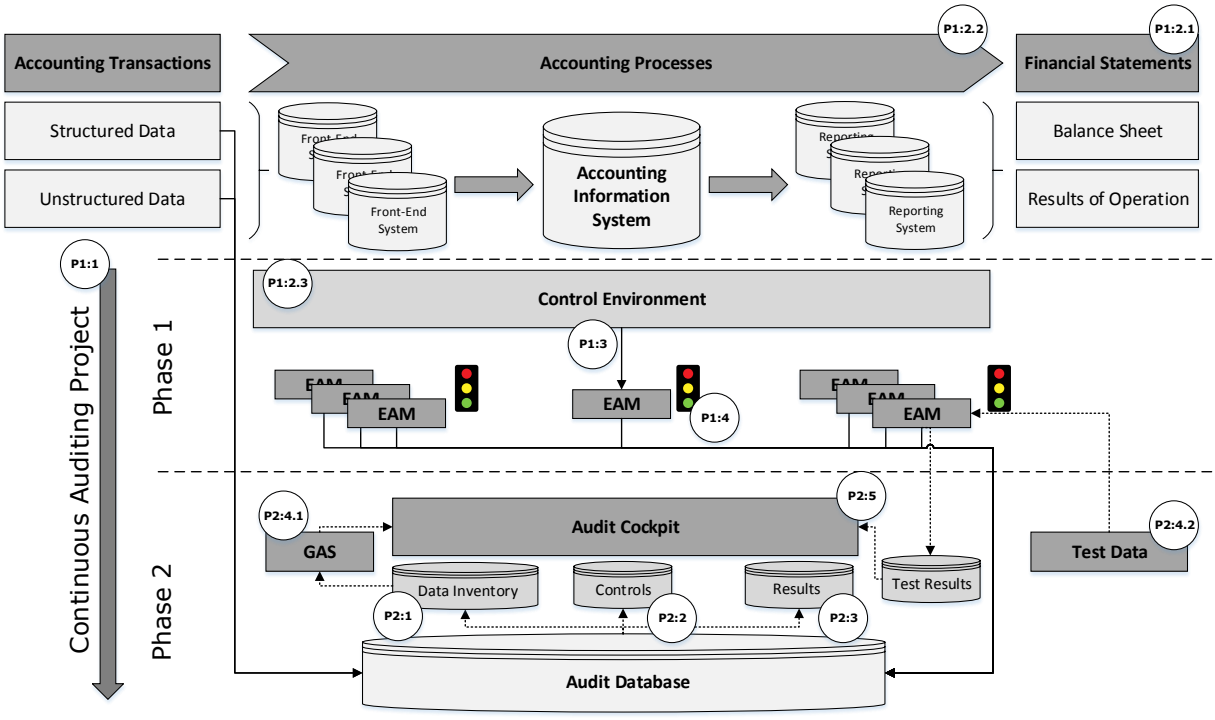

Figure 3. Exemplary CA project (cf. Kiesow et al., 2014)

5.2 Descriptive Evaluation

The aim of this section is to build a convincing argument for the utility of the artifact (Hevner et al., 2004, p. 86). The implementation scenario described was analyzed with respect to the implementation framework in Section 4, which is representative of the information of the knowledge base. At the strategic level, the CA project at hand is decided upon by management and made part of the business strategy. Therefore, it can be assumed that the management supports the project (1), which sets the baseline for further actions, for instance how the acceptance of end-users (2), communication and teamwork (7), or the cooperation of the client's IT staff and data owners (11) are facilitated. From a project management perspective, the scenario does not describe how the resources and costs of the implementation are monitored. Hence, the project runs the risk of failing to achieve a positive cost-benefit tradeoff (3). Moreover, there is no information about whether or how the audit department adjusts its processes to enable continuous auditing (4), or ensures its independence (5). However, it can be assumed that the adjustment of audit procedures is arbitrary considering the usage of the Audit Cockpit. Additionally, the scenario does not describe any education- or training-related actions for auditors or further participants (6). At the process level, the scenario requires an extensive analysis of the organization's environment and the nature of testing and controls (8) because it is based entirely upon the results of controls. Therefore, it can be assumed that this task is fulfilled. Furthermore, because the scenario stipulates the implementation depending on the materiality of financial statements, the definition of the audit objectives (9) is given: on a high level, the audit objectives are the material financial statements, on a process level, they are the accounting-relevant processes, and, finally, on the lowest level, every single control. The last CSF at the level of processes, the documentation of the CA project (10), is not directly part of the actions introduced in the scenario description. However, through the gradual approach along the accounting-relevant processes, it can be assumed that traceability of conducted actions is given. As mentioned above, at the level of systems and data, the scenario seems to be insufficiently planned. There are no actions to enhance the (11) cooperation of the client's IT staff and data owners, though the project is part of the strategy. Moreover, the description does not contain any actions to clarify the legal liability (12) in the case of errors or control violations caused by (continuous) auditing or implementation actions. Issues related to the technical implementation (13) as well as data and information securities (14) are not highlighted in the scenario. As mentioned before, the CA project is part of the IT strategy. Therefore, it can be assumed that the project is coordinated with other IT projects and that the project is recognized as a long-term change (15). However, the scenario does not give any information regarding external IT trends. Nevertheless, the CA project seems to fail in the consideration of the (16) legal framework, since there is no involvement of the legal department of the enterprise, nor further information about compliance with audit standards.

CSF	Evaluation Result	Related Steps
(1)	fulfilled	P1:2.1-2.3
(2)	partial	P1:2.1-2.3, P2:1-3
(3)	low	None
(4)	low	None
(5)	low	None
(6)	low	None
(7)	partial	P1:1
(8)	low	None

CSF	Evaluation Result	Related Steps
(9)	fulfilled	P1:1
(10)	partial	P1:1
(11)	low	None
(12)	partial	P1:1, P2:5
(13)	low	None
(14)	low	None
(15)	partial	P1:1
(16)	fulfilled	P1:2.1-2.3

Table 1. Results of the Evaluation of the Implementation Framework

In summary, the evaluation presented in this section shows that the introduced scenario seems to fail considering major critical success factors of CA implementation (see Table 1). Consequently, a project

management board would have to recapitulate the proposed methodology and extend it with respect to the implications pointed out using the proposed implementation framework.

6 Summary and Discussion

Beyond the technical considerations, an auditor's main task is to ensure the completeness and correctness of financial statements according to national and international law. This goal is increasingly influenced by the evolution of technology (e.g. Big Data paradigm, Cloud Computing) and regulatory pressure (e.g. SOX, Directive 2014/56/EU). As mentioned in Section 1, the intended reform of the audit sector in the EU has a massive impact on the organization and work of external auditors. It can be assumed that the demand for computer-assisted audit approaches is being increasingly studied. In this context, the concept of CA is frequently discussed in literature. CA enables the permanent monitoring of accounting-relevant processes as well as the assurance in terms of accuracy and completeness of accounting data. However, the development and implementation of appropriate CA approaches are considered to be an academic topic rather than a subject matter for practitioners (Byrnes, Al-Awadhi, et al., 2012). The reasons for this situation are, inter alia, technical concerns, lack of acceptance by end-users, and insufficient evidence of cost-benefit tradeoffs. Currently, CA issues are analyzed and discussed as results separately from CA projects.

For the very first time, the authors of this paper have tried to condense critical issues from various CA implementation projects presented in literature to achieve an IS artifact which empowers both researchers and practitioners to develop appropriate CA implementation approaches. The result proposed in this paper is an implementation framework comprising sixteen CSFs aligned to the enterprise, project, and audit perspectives. Moreover, the framework is intended to shed light on the three different levels of CA implementation (strategy, processes/controls, systems/data), all of which are influenced by BE.

The subject matter of the evaluation (Section 5.2) was an informed argument in terms of a fictitious scenario. The scenario was based on a conceptual CA architecture (Kiesow et al., 2014) as well as an implementation methodology (Kiesow et al., 2015). Through the assessment and according to the introduced implementation framework, various limitations of the approach were laid out. First, the evaluation emphasized the salient position of management support, because other success factors (e.g. Communication, Teamwork, or Cooperation of IT staff) depend on the strategic diffusion of CA. In detail, top management has to see to appropriate recruitment, training, and the establishment of an organizational culture which supports collaboration and sharing of data. Second, the approach does not include the clarification of legal liability or the consideration of the legal framework. It can be assumed that without a clarification of liability at the level of systems/data, IT staff and data owners would not cooperate and install EAM in running systems. Additionally, the approach does not cover any actions in the case of technical implementation difficulties, such as change management, or fallback scenarios.

In short, the proposed implementation framework was able to identify major limitations of the scenario. Furthermore, it emphasizes the versatility of CA projects and highlights the necessity to consider different organization levels (strategy, processes/controls, and systems/data). Nevertheless, various shortcomings can be found. First, the authors are aware that the proposed implementation framework is relatively broad and unspecific. For example, the a priori calculation of costs (3) is a recognized challenge and demands deeper investigations in future work. Additionally, the variety of technical difficulties (13) can hardly be estimated prior to a prototypic implementation. Furthermore, the success of CA projects depends, inter alia, on an updated and correct enterprise business model, and an operational change management which enables the accurate transformation of controls as well as the integration of EAM into accounting-relevant systems. Moreover, the authors are aware that a descriptive evaluation is the weakest of the evaluation methods proposed by HEVNER et al. (2004), the other types mentioned being observational, analytical, experimental, and testing. Nevertheless, with respect to the

nature of the research stage and output of this paper, the authors are of the opinion that an argumentative, descriptive evaluation fits best. Additionally, considering that research in the field of CA is mostly driven by researchers in North America and Asia, awareness of the need for CA solutions is comparably low in Europe. Therefore, cooperating organizations and experts in this field are both difficult to find, which impedes the prototypical implementation of CA. Moreover, an agreed-upon definition of CA has not yet been arrived at in Europe. For example, the technical concepts of EAM and MCL, which have been discussed and analyzed for more than two decades by US researchers, have hardly spread among practitioners in Germany at all (Eulerich and Kalinichenko, 2014).

The implications for the intended reform of the audit sector in Europe are as follows: On the one hand, the European Parliament would impose extensive requirements for the quality assurance system and the auditor's organization in order to monitor the market quality and force competition. However, although it is the consensus among researchers that CA contributes to the quality of audit, neither Regulation No. 537/2014 nor Directive 2014/56/EU addresses the increasing demand for CA. Consequently, a major research challenge is to analyze to what extent CA can be used to measure and compare the quality of external auditors. On the other hand, through the investigations proposed in this paper, evidence can be found that the fulfillment of success factors of CA, which are discussed in literature, contribute strongly to the fulfillment of requirements stated by the EU Parliament. However, the EU directive remains on a strategic level. Characteristics related to relevant processes/controls or system/data are missing. Consequently, it would be up to the professional audit associations of the Member States how to adjust national audit standards according to the requirements of the EU Parliament.

The paper also highlights the need for future work. Interdependencies between the CSFs have to be thoroughly investigated. The goal of further analysis could be a reference model for CA implementation which could be adjusted to every organization independent of the individual ERP system or internal control environment. According to the discussion of the implications of the European regulation and directive, the impact on IT-Governance frameworks (e.g. COSO, COBIT 5) and audit standards (e.g. ISA) in matters of CA have to be soundly explored. Overall, a major goal of the authors of this paper is to increase the awareness of CA in Europe. To this end, the involvement of decision-makers (e.g. politicians, field leaders, and researchers) is required.

7 Conclusion

Regulatory pressure and technical evolution have a tremendous impact on both accounting and auditing. In this context, appropriate IS solutions are of increasing importance. Because CA is a sophisticated audit approach, the concept is frequently discussed in literature. However, the implementation of CA is a recognized challenge among researchers and practitioners. In this context, the RQ arises as to *how* the implementation of CA can be planned. In this paper, sixteen major CSFs of CA projects were extracted from literature and analyzed. The general principles of BE inspired the authors of this paper to condense these CSFs into an implementation framework. Using this framework supports the planning, implementation, and evaluation of CA projects at the three levels of strategy, processes, and systems. Although limitations and requirements were uncovered, the authors of this paper believe that both researchers and practitioners will benefit from the insights proposed in this paper. Future work will require stronger evaluation in terms of testing, experiments, and observations. Hence, the subject matter of further research is at least the prototypic implementation of a CA in a test system, deeper investigations into the requirements of the European law, and its implications for international and national audit standards.

References

Abbasi, A., Albrecht, C., Vance, A. and Hansen, J. (2012), "Metafraud: a meta-learning framework for detecting financial fraud", *MIS Quarterly*, Vol. 36 No. 4, pp. 1293–1327.

AICPA. (1972), *Responsibilities and Functions of the Independent Auditor*, SAS No. 1, section 110; SAS No. 78; SAS No. 82, United States of America, pp. 1–2.

Alles, M.G., Kogan, A. and Vasarhelyi, M.A. (2005), "Implications of Section 201 of the Sarbanes–Oxley Act: the role of the audit committee in managing the informational costs of the restriction on auditors engaging in consulting", *International Journal of Disclosure and Governance*, Palgrave Macmillan, Vol. 2 No. 1, pp. 9–26.

Alles, M.G., Kogan, A. and Vasarhelyi, M.A. (2008), "Putting continuous auditing theory into practice: Lessons from two pilot implementations", *Journal of Information Systems*, Vol. 22 No. 2, pp. 195–214.

Arnold, V., Benford, T.S., Canada, J., Kuhn Jr, J.R. and Sutton, S.G. (2007), "The Unintended Consequences of Sarbanes-Oxley on Technology Innovation and Supply Chain Integration", *Journal of Emerging Technologies in Accounting*, Vol. 4 No. 1, pp. 103–121.

Atkinson, R. (1999), "Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria", *International Journal of Project Management*, Vol. 17 No. 6, pp. 337–342.

Bhagat, B., Chagpar, Z., Chapela, V., Gee, W., Marks, N. and Pasfield, J. (2014), *ISACA: Generating Value from Big Data Analytics (Whitepaper)*, Rolling Meadows, IL, USA.

Bojilov, M., Chew, R., Kaitano, F. and Zororo, T. (2013), *ISACA: Privacy & Big Data (Whitepaper)*, Rolling Meadows, IL, USA.

Braun, R.L. and Davis, H.E. (2003), "Computer-assisted audit tools and techniques: Analysis and perspectives", *Managerial Auditing Journal*, MCB UP Ltd, Vol. 18 No. 9, pp. 725–731.

Brown, C.E., Wong, J.A. and Baldwin, A.A. (2007), "Research streams in continuous audit: A review and analysis of the existing literature", *Journal of Emerging Technologies in Accounting*, Vol. 4 No. 1, p. 1.

Byrnes, P.E., Al-Awadhi, A., Gullvist, B., Brown-Liburd, H., Teeter, R., J. Donald Warren, J. and Vasarhelyi, M. (2012), *AICPA: Evolution of Auditing: From the Traditional Approach to the Future Audit*, New York, USA.

Byrnes, P.E., Ames, B., Vasarhelyi, M. and Warren Jr., J.D. (2012), *AICPA: The Current State of Continuous Auditing and Continuous Monitoring (Whitepaper)*, New York, USA.

Chew, R., Genicola, K., Li, B., Philip, J. and Tichanona, Z. (2013), *ISACA: Big Data Impacts & Benefits (Whitepaper)*, Rolling Meadows, IL, USA.

Debreceny, R.S., Gray, G.L., Ng, J.J.-J., Lee, K.S.-P. and Yau, W.-F. (2005), "Embedded audit modules in enterprise resource planning systems: implementation and functionality", *Journal of Information Systems*, Vol. 19 No. 2, pp. 7–27.

El-Masry, E.-H.E. and Reck, J.L. (2008), "Continuous online auditing as a response to the Sarbanes-Oxley Act", *Managerial Auditing Journal*, Emerald Group Publishing Limited, Vol. 23 No. 8, pp. 779–802.

Eulerich, M. and Kalinichenko, A. (2014), "Die Continuous Auditing - Diskussion aus wissenschaftlicher Sicht", *Zeitschrift Interne Revision*, Vol. 49 No. 1, pp. 34–45.

European Commission. (2013,December17), "Commissioner Michel Barnier welcomes provisional agreement in trilogue on the reform of the audit sector", *MEMO/13/1171*, Brussels, available at: http://europa.eu/rapid/press-release_MEMO-13-1171_en.htm (visited on 11/18/2013).

European Commission. (2014), "European Parliament backs Commission proposals on new rules to improve the quality of statutory audit", *STATEMENT/14/104*, available at: http://europa.eu/rapid/press-release_STATEMENT-14-104_en.htm (visited on 11/18/2013).

European Parliament. (2013), *Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning measures to ensure a high common level of network and information security across the Union*, European Union, available at: http://ec.europa.eu/digital-agenda/en/news/commission-proposal-directive-concerning-measures-ensure-high-common-level-network-and.

European Parliament. (2014a), *REGULATION (EU) No 537/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on specific requirements regarding statutory audit of public-interest entities and repealing Commission Decision 2005/909/EC*, Official Journal of the European Union, European Union, available at: http://eur-lex.europa.eu/legal-content/DE/TXT/?uri=CELEX:32014R0537 (visited on 11/18/2013).

European Parliament. (2014b), *DIRECTIVE 2014/56/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 amending Directive 2006/43/EC on statutory audits of annual accounts and consolidated accounts*, Official Journal of the European Union, European Union, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0056 (visited on 11/18/2013).

Gregor, S. (2006), "The nature of theory in information systems", *MIS Quarterly*, JSTOR, Vol. 30 No. 3, pp. 611–642.

Groomer, S.M. and Murthy, U.S. (1989), "Continuous auditing of database applications: An embedded audit module approach", *Journal of Information Systems*, University of Toronto, Vol. 3 No. 2, pp. 53–69.

Hevner, A.R., March, S.T., Park, J. and Ram, S. (2004), "Design science in information systems research", *MIS Quarterly*, Vol. 28 No. 1, pp. 75–105.

IFAC. (2013a), "International Standard on Auditing 200", *Handbook of International Quality Control, Auditing, Review, Other Assurance, and Related Services Pronouncements*, International Federation of Accountants, New York, 1sted., p. 74.

IFAC. (2013b), "International Standard on Auditing 315", *Handbook of International Quality Control, Auditing, Review, Other Assurance, and Related Services Pronouncements*, International Federation of Accountants, New York, 1sted., pp. 267–320.

ISACA Standards Board. (2002), "Continuous Auditing: Is It Fantasy or Reality?", *Information Systems Control Journal2002*, Vol. 5.

Kiesow, A., Zarvic, N. and Thomas, O. (2014), "Continuous Auditing in Big Data Computing Environments: Towards an Integrated Audit Approach by Using CAATTs", *Management of complex IT-Systems and Applications (MITA) - INFORMATIK 2014*, 44. Jahrestagung der Gesellschaft für Informatik e.V. (GI); Lecture Notes in Informatics (LNI), Stuttgart, Germany, September 22-26, 2014.

Kiesow, A., Zarvic, N. and Thomas, O. (2015), "Design Science for Future AIS: Transferring Continuous Auditing Issues to a Gradual Methodology", *10th Proceedings of the International Conference on Design Science Research in Information Systems and Technology (DESRIST 2015)*, Dublin, Ireland, May 21-22, 2015.

Kuhn, J.R. and Sutton, S.G. (2010), "Continuous auditing in ERP system environments: The current state and future directions", *Journal of Information Systems*, Vol. 24 No. 1, pp. 91–112.

March, S.T. and Smith, G.F. (1995), "Design and natural science research on information technology", *Decision Support Systems*, Vol. 15 No. 4, pp. 251–266.

Moffitt, K.C. and Vasarhelyi, M.A. (2013), "AIS in an Age of Big Data", *Journal of Information Systems*, American Accounting Assocation, Vol. 27 No. 2, pp. 1–19.

Österle, H., Becker, J., Frank, U., Hess, T., Karagiannis, D., Krcmar, H., Loos, P., et al. (2011), "Memorandum on design-oriented information systems research", *European Journal of Information Systems*, Nature Publishing Group, Vol. 20 No. 1, pp. 7–10.

Österle, H. and Blessing, D. (2003), "Business Engineering Modell", in Österle, H. and Winter, R. (Eds.),*Business Engineering-Auf dem Weg zum Unternehmen des Informationszeitalters*, Springer, Berlin Heidelberg, 2. Edition., p. 80.

Österle, H., Brenner, C. and Gassner, C. (1995), *Business Engineering: Prozess-und Systementwicklung. Band 1: Entwurfstechniken*, Springer, Berlin, 2. Edition., Vol. 13.

Papas, N., O'Keefe, R.M. and Seltsikas, P. (2012), "The action research vs design science debate: reflections from an intervention in eGovernment", *European Journal of Information Systems*, Nature Publishing Group, Vol. 21 No. 2, pp. 147–159.

Rajan, S., van Ginkel, W. and Sundaresan, N. (2012), *Cloud Security Alliance (CSA): Top Ten Big Data Security and Privacy Challenges*.

Rezaee, Z., Elam, R. and Sharbatoghlie, A. (2001), "Continuous auditing: the audit of the future", *Managerial Auditing Journal*, Vol. 16 No. 3, pp. 150–158.

Schultz, M., Müller-Wickop, N. and Nüttgens, M. (2012), "Key Information Requirements for Process Audits – an Expert Perspective", *Proceedings of the 5th International Workshop on Enterprise Modelling and Information Systems Architectures*, EMISA, Vienna, pp. 137–150.

Shin, I., Lee, M. and Park, W. (2013), "Implementation of the continuous auditing system in the ERP-based environment", *Managerial Auditing Journal*, Emerald Group Publishing Limited, Vol. 28 No. 7, pp. 592–627.

Singh, K., Best, P.J., Bojilov, M. and Blunt, C. (2014), "Continuous Auditing and Continuous Monitoring in ERP Environments: Case Studies of Application Implementations", *Journal of Information Systems*, Vol. 28 No. 1, pp. 287–310.

Sun, C.-M. (2012), "From CAATTs Adoption to Continuous Auditing Systems Implementation: An Analysis Based on Organizational Routines Theories", *MIS REVIEW: An International Journal*, 國立政治大學 &Airiti Press, Vol. 17 No. 2, pp. 59–85.

Thomas, O. and Scheer, A.-W. (2006), "Tool support for the collaborative design of reference models – A business engineering perspective", *Proceedings of the 39th Annual Hawaii International Conference on System Science (HICSS'06)*, IEEE, Vol. 1, pp. 1–10.

Vasarhelyi, M.A., Alles, M., Kuenkaikaewa, S. and Littley, J. (2012), "The acceptance and adoption of continuous auditing by internal auditors: A micro analysis", *International Journal of Accounting Information Systems*, Vol. 13 No. 3, pp. 267–281.

Vasarhelyi, M.A., Alles, M.G. and Kogan, A. (2004), "Principles of analytic monitoring for continuous assurance", *Journal of emerging technologies in accounting*, Vol. 1 No. 1, pp. 1–21.

Vasarhelyi, M.A. and Halper, F.B. (1991), "The continuous audit of online systems", *Auditing: A Journal of Practice and Theory*, Vol. 10 No. 1, pp. 110–125.

Weidenhaupt, K., Pohl, K., Jarke, M. and Haumer, P. (1998), "Scenarios in system development: current practice", *Software, IEEE*, IEEE, Vol. 15 No. 2, pp. 34–45.

Woodroof, J. and Searcy, D. (2001), "Continuous audit: model development and implementation within a debt covenant compliance domain", *International Journal of Accounting Information Systems*, Elsevier, Vol. 2 No. 3, pp. 169–191.