

From Traditional to Technologically Influenced Audit : A Compliance Perspective

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Abstract—Business monitoring is characterized as multi-disciplinary, which has its roots in service sciences and accounting. A major challenge in this area of research is to bridge the gap from two distant worlds of service science and accounting. Smart auditing framework proposed an initial solution to bridge the gap. In this paper, background knowledge for basic and related concepts to understand the relationship of compliance and Service Oriented Architecture (SOA) has been established. Basic concepts behind these two worlds are highlighted along with related techniques such as process mining and Resource Event Agent ontology (REA). Different types of audit along with effecting factors have been discussed as well.

Index Terms—Compliance Checking, Information Audit, Monitoring

I. INTRODUCTION

Globalization require not only improved compliance regulations but continuing enhancement as well. Risk factors are also considered in parallel with development of rules and regulations for compliance facilitation [1]. Risk factors are based on business process analysis, business process models and compliance regulations. European Union (EU) is also putting effort with more control applications and by re-designing legislation through the use of IT. HIPAA, Basel II, Sarbanes-Oxley (SOX) are among few compliance regulation standards which help organizations to align their business processes with compliance standards set forth in the legislation.

When compliance is a strong demand then it's optimization and implication becomes a strategic concern. These business compliance requirements are possible to achieve by using smart audit techniques [2] [3]. Based

on background knowledge the research objective of this paper is "increasing the effectiveness and efficiency of audit process by using smart techniques" In traditional setting audit is performed by analyzing each and every transaction and calculating profit and loss. Traditional approach was very much satisfactory until the emergence of E-commerce businesses. Both for traditional audit or e.business audit, the basic of audit process is consist of comparing to-be state (IST model) with the as-is state (SOLL model) of the business. Moreover business environment is rapidly changing in last few decades, the tools and techniques of audit are evolving as well such as periodic audit is replaced by continuous and/or online audit.

In order to find the impact of technology on traditional techniques of audit, section 2 discusses abstract Smart Auditing Framework [2]. Section 3 is for foundation building. Where we are discussing conceptual needs of a smart audit process. Finally, section 4 wraps up with discussion around the concepts and audit types. We closes our paper with conclusion and future research direction.

II. SMART AUDITING FRAMEWORK

Smart auditing framework is one of the framework designed to for evaluation of information reliability from organizational prespective. Figure 2 shows smart audit framework where sensors detect a real-world condition, for example student enrolment. After data authorization, data cleaning is performed for data analysis purpose. In our proposed smart auditing framework data analysis is

CEP technology process the meaningful events within an event cloud [13]. This technology is a step by step process. In the first step complex event processing extracts the knowledge from different business layers of an organization. In the second step CEP process the events and finally in the third step CEP describe about the subsequent actions.

CEP is applicable in many domains such as schedule and control processes, performance prediction and intrusion detection and many more. Kamodo advocated use of complex event processing in almost all the industry areas such as Transportation, Telecommunication, Logistics and Manufacturing [14]. We can see development of process mining concepts in these industry areas as well [15].

3) *System Adaptation*: The term ‘adaptive system’ refers to a system that automatically detects changes in its environment. According to some business rules and other compliance requirements, the system decides how to react on the changes. Finally, the system executes the decision.

Hiel created the taxonomy of adaptation based on several other existing taxonomies [16]. In his work, adaptation is described as an ongoing process and is therefore depicted as a cycle and the cycle is composed of three phases: Detect, Decide, and Execute.

In the first phase, the system detects changes using different means such as through exceptions (faults), through observation, or through notification. In the second phase, the system has to make decision on where and when to respond to the changes. The final phase, the system takes an action to execute the decision. The granularity of adaptation can be categorized into two general approaches [17]:

- Parameter adaptation: modifying variables to influence the dynamic behaviour of the system;
- Composition adaptation: altering structure or architecture to influence the dynamic behaviour of the system.

The concept of autonomic computing lies very close to the concept of adaptation discussed by [4]. The initiative was taken by IBM in 2001 [18]. The term autonomic computing derived from autonomic nervous system in human biology. An architecture of an autonomic manager shown as a loop of four parts that share knowledge plus sensor and effector which later on provide the foundation of internet of things. [19]:

B. Theories

This section revolve around tools and techniques that can help to understand and apply service based auditing

solution. Auditing of business processes, controls and event logs has been widely discussed by [20] in terms of business-process-focused audit, software and internal control auditing, flowcharts and business models auditing [20]. In parallel, Jans et al. and Aalst introduced the concept of process mining in the research on auditing and supported the ideas of (i) extracting knowledge from event logs, (ii) their analysis and (iii) audit evaluation report generation [21].

Business data is analyzed based on choice of activities and the process instance. For event logs analysis and compliance checking PROM and DISCO are process mining tools. Services triggers events, and events are analysed by using event logs. For auditing in SOA environment, process mining and PROM tool are identified as fundamental building blocks [22].

Audit process is performed by the guidelines proposed by different accounting bodies for example AICPA and CICA [23]. There exist a number of business ontologies, each ontologies have its own focus as discussed by Gilly [24]. Business Modelling Ontology (BMO), Value ontology and REA ontology are some of the well known ontology [25], [26], [27] From literature it is found that economic aspects of business and REA ontology emphasizes on economics of events and replaces double-entry bookkeeping with semantic models of economic exchanges.

1) *Process Mining*: Process mining is known as discipline which is based on event log analysis. Where business process models are extracted from event logs [28]. Process mining is closely related to *business activity monitoring (BAM)*, *business operation management (BOM)*, *business process intelligence (BPI)*, and *data/work-flow mining* [28]. Van der Aalst et al. has proposed the use of process mining technology to support auditing under the name of “Auditing 2.0” [28]. Process mining is a collection of methods used to distil structured process descriptions from an event log. These event logs are based on raw data, which is mostly from enterprise resource planning (ERP) systems. Jans and her colleagues conducted a case study on using process mining of event logs in internal auditing of a procurement process [29]. The case study validated usefulness of event log for audit purpose.

2) *Computational Auditing*: Computational auditing is based on mathematical and computational notions. It is developed on the Dutch audit doctrine. Computational auditing is based on Petri-net theory and deontic logic. Fundamental concepts are value cycle behaviour structure, value jump, segregation of duties (in relation to the value cycle), spanning reconciliation checks, axiomatic

proviso and auditee's behaviour in the modalities 'Soll' (i.e., normative) and 'Ist' (i.e., actual). Computational auditing knowledge provides the foundation for the development of a system known as *Smart Audit Support*, this system was primarily used for the international audit practices of Deloitte Touch Tohmatsu International [30] [31].

3) *Resource Event Agent*: is consist of economic ontological concepts, where shared data environment is highlighted for professionals (accountants and non-accountants). The REA ontology was first formulated in 1982 [27]. Basic philosophy of REA is:

"If an enterprise wants to increase the total value of resources under its control, it usually has to decrease the value of some of its resources". Basic concepts behind REA are (a)resource that is an object controlled by an agent and is of value for another agent. (b)An agent is considered an individual or business have some economic value in the form of economic resources. The interaction between economic resources via agents is called as economic events. Semantic data model of REA is proposed by McCarthy [27]. Basis of REA are accountability and control principles and it is based on principle of economic reciprocity (i.e., give and take), just like accounting ledgers [32].

IV. DISCUSSION

Service-oriented design approaches are becoming popular not only among IT practitioners but for the business community as well. However, there are many places where you can see fraudulent activities in the business. Audit in/of service oriented environment give rises to a number of questions. such as Security and monitoring of external services, question of services maturity when they are being reused, Existing business process analysis tools can be used for audit processes or one need to rely on special tools (such as PROM, SENTINAL) used for information auditing? Another in line is Online Auditing Tool (OLAT), whcih is based on Auditing 2.0 and evaluate the interactions between information system whereas this research is build upon accounting information system (AIS) concepts such as business rules auditing, information auditing, service based auditing therefore OLAT and its underling concepts have potential to be used in service world.

In the literature, there is a great deal of variation for classifying auditing see e.g. [33]. In Table I, we have provided classification of audit from different perspectives.

Moreover, internal auditing is characterized as: "Monitor and evaluate the effectiveness of an organizational

Classification Basis	Audit Types
Based on organizational structure	Statutory audit, Private audit, Government audit
Based on timing and scope of audit procedure	Continuous auditing, Internal audit, Interim audit, Final/Periodical audit, Balance sheet audit
Based on specific objective	Cost audit, Special audit, Tax audit, Management audit, Operational audit, Marketing audit, Environmental audit, Social audit, HR audit, Energy audit

TABLE I
AUDIT CLASSIFICATION

risk management and control system" [34]. External auditing provides the assurance on the accuracy of the statements (mostly financial). Compliance issues pave the way for organizations to monitor and evaluate business processes compliance [35]. The work performed by external vs. internal auditing is differ on (a)objective and (b)risk evaluation. The external audit's objectives is typically about rights and obligations and valuation of financial statements. Institute of Internal Auditors (IIA) in *International Professional Practices Framework* (or known as the Red Book) states that "the internal audit activity must assist the organization in maintaining effective controls by evaluating their effectiveness and efficiency and by promoting continuous improvement."

Audit is a comprehensive discipline and how it is performed depends on: (a) data to be audited (b) type of audit to be performed (c) type of outcomes required from audit process such as COSO ERM framework describes four categorization of an organization's objectives (a) strategic (b) operations (c) reporting (d) compliance [36], [37] Propose a framework for augmenting business process with reusable process fragments to stimulate compliance by design. We have found that the most populat classification of audit is execution based and that is: (i) internal audit (ii) external audit. According to the international standard on auditing (ISA) standard 2013 internal auditing typically include "*assurance and consulting activities designed to evaluate and improve the effectiveness of the entity's governance processes, risk management and internal control*"

Auditing is performed at different organizational levels, depending on the subject (who performs the audit?) and the object of audit (e.g. transactional data, or control procedures) [2]. Thus according to IIA auditing is as an examination of data, records and operations. The main task of auditing is to give an opinion about the effectiveness of risk management, control, and governance in service domain.

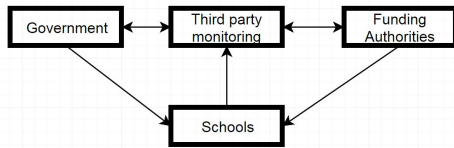


Fig. 2. Third Party Monitoring Educational Scenario.

Third party auditing and monitoring is also dependent on the Subject and object concept of audit. In this case subject of audit is an independent person who is responsible for the compliance of a product or a service from multiple party perspective. Consider example educational monitoring scenario with flow of audit data, as shown in the Figure 2.

In third party monitoring most of the times government organizations are involved. We can see three parties concerned about the progress (a) funding authorities such as World bank wants to monitor the project progress, (b) where Government as a principle benefactor is also want to know about the progress and (c) project it self needs monitoring. When audit is for different objects then objective of audit is also different.

Third party audit can be continuous audit. Continuous auditing is based on automation technology and audit activities continuously and frequently [38]. Therefore, continuous auditing can be considered as real-time or near real-time opposite to periodic traditional auditing. Due to automation of continuous auditing, internal auditor's involvement reduced [39].

Aalst et al. advocates auditing as "continuous monitoring of transaction data" [22]. Moreover the concept of continuous monitoring is highlighted in literature quite often (see e.g., [22]) but it is not yet widely implemented. Although a number of continuous auditing models have been developed but only a few of them have been implemented in real time systems. Flowerday et al. not only discuss the continuous auditing models but also describe a comparison of well known continuous auditing models [40].

V. CONCLUSION & FUTURE WORK

Traditional audit ensures operating effectiveness of control. If these controls are not in place or do not function properly, the auditors can only analyze samples which are only a portion of the overall data. Fortunately, changing in information tools and technologies can improve auditing techniques significantly. We have found there exist some challenges in the field of audit such

as (i) accuracy and completeness of transaction data, (ii) reliability checks of internal control system, (iii) for continuous auditing, the system need to be real time which is expensive to achieve, (iv) data compatibility formats. Moreover we have found that auditing of SOA are warranted by business rules and these business rules are enhanced over time, therefore need to be adapted continuously. Policy management is another complicated orientation where there is a big gap between execution level addressed by IT and requirements by business. Moreover If audit is identified as a service then what potential benefits and limitations this could have and to what extent can on-line auditing be non-intrusive, i.e., no interruption to the normal operations and obey transparent security requirements. Different tools fulfil different requirements for domain specific demands, there is a need for "audit process/event/control/service analyses" which can be developed by integrating existing tools or could be developed from scratch. Moreover, effectiveness and efficiency of these identified tools and techniques are also questions for future research direction.

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