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KNOWLEDGE IN ACTION

Faculty of Business Economics
Master of Management

Master's thesis

Process views in auditing research. A structured literature review

Asmar Rzayeva
Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Business Process Management

SUPERVISOR :
Prof. dr. Mieke JANS

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This master thesis was written during the COVID-19 crisis in 2020. This global health crisis might have had an impact on the (writing) process, the research activities and the research results that are at the basis of this thesis.

FOREWORD

I would like to thank my supervisor professor Dr. Mieke Jans (UHasselt) and co-supervisor professor Dr. Jan Mendling (WU Vienna) for their extraordinary support, excellent guidance, expert advice and encouragement throughout this thesis process.

SUMMARY

INTRODUCTION

Business Process Management (BPM) is an established discipline which is not just about developing particular activities; rather it handles complete chain of tasks, events and decisions that bring value to the entities because of its contribution in increasing effectiveness in businesses. On the other hand, auditing, which is known as an established engine of regulation in predicting and preventing frauds in financial statements, has a capability to estimate and bring down entity's business risks, which serves as a significant process for quality and sustainability of company's earnings. After a careful and separate consideration of both fields, it became obvious that these concepts intersect and the combination of them can have stronger synergistic influences on the success factor of organizations rather their independent operation from each other. Bringing together BPM and auditing may lead to value-added consequences for entities and auditors while discovering potential opportunities for improvement. This paper is designed to be the first structured literature review that explores the link between BPM and auditing. Research on such a connection will help to explain the concepts and practices that appear in both fields by creating more synergies between the fields and eliminating inefficiencies. As there is no literature review performed to date to investigate interaction of these fields, very fundamental dimensions of each field are researched as a starting point. The list of fundamental dimensions is identified as: *audit phases, COSO framework, BPM lifecycle and business process modeling conventions.* The research questions based on each category have been asked as below:

1. *To what extent are the audit phases discussed with a process-based approach in academic literature?*
2. *Which components of the COSO framework are primarily addressed in the existing body of literature?*
3. *To what extent are the BPM lifecycle stages investigated in the body of accounting literature?*
4. *Which BPMN conventions are used in joint research on audit and business process?*

Moreover, we drill further down for gaining insights on the following additional dimensions: *audit tasks, research methods, and control perspectives.* Following research questions have been asked:

5. *Which audit tasks are featured in research on auditing and BPM?*
6. *What are the main research methods employed investigating combination of BPM and auditing fields?*
7. *Which control perspectives stand out the most when investigating the intersection of auditing and BPM?*

RESEARCH METHODOLOGY

The research methodology of this paper is carried out based on guidelines for literature review. The type of research approach that is used in this study is systematic literature review. This paper focuses on the classification of BPM and auditing studies based on selected categories that appear in coding scheme. Once the research questions are identified, an extensive literature search including the principles followed, databases used and query to search, is conducted. Next, selection procedure of literature based on inclusion and exclusion criteria is applied. Based on the resulting data set, the literature is synthesized in categories of classification criteria that are carried as coding scheme. As BPM has been in the center of attention in last two decades, it is predictable that the conjunction between BPM and auditing date back to more recent history leading the scope of literature for this research to be limited and defined from 2000 to date. Only 69 papers resulted in the final list of articles from relevancy screening while others were rejected as they did not perfectly fit with the targeted criteria for this study.

ANALYSES and RESULTS

The earliest publication bringing together BPM and audit dates back to 2002 even though the scope of this literature review was defined from 2000 onwards. This observation verifies the reality that linkage between BPM and auditing is quite a new topic for researchers.

The results illustrated categorization of publications by audit phases make clear that understanding client's business and audit planning is the most frequently covered category (72%). While the existing body of literature places major focus on understanding, documentation and evaluation of business processes and controls, test of operating effectiveness of these controls saw significantly less coverage (23%). Substantive phase has a minimal coverage (13%) in the specified list of articles. Reporting stage of audit saw no coverage at all and further input in respect of scoping this area into future research will be covered in recommendation section.

In addition to audit phases, audit tasks level is investigated to see what audit procedures are mainly employed to assess business processes. The results of audit tasks display that understanding client's business (23%) and internal control (19%) are sub-phases that encompass a wide range of audit tasks. Test of control along with analytical review appear to be very less frequently audit sub-phases specified in publications, with 10% and 3%, respectively.

Comparison between both results also points out that the audit phases has approximately 3 times less unspecified articles, as audit phases can be deduced from the context of paper, while it is not reasonable to assume audit task classification, unless specified by authors.

The results of COSO internal control framework illustrate that 48% of the articles do not cover COSO framework despite of its significance in risk management. Control activity is the most frequently used layer of COSO internal control framework by authors (35%). Risk assessments, monitoring activities and control environment of COSO framework are equally addressed in only 10% of publications. Communication and information (0%), which is a part of evaluation of internal control, never formed part of the publications reviewed.

Next, the results are related to the classification of the existing literature based on BPM lifecycle. While process discovery stage has highest coverage (58%), the other stages received fairly equal attention from researchers (13-19%). Also, it is visible that 2012 year appears to cover all aspects of BPM lifecycle can be regarded as a milestone because of two reasons. Firstly, the articles published in 2012 appear to cover all aspects of BPM lifecycle, which made 2012 a unique year amongst the rest. Secondly, starting from 2012 authors were increasingly making reasonably clear references to BPM lifecycle model in their publications (no non-specified articles since 2012).

Then, the results obtained from categorization of papers for the business process convention models demonstrate that 57% of all papers do not relate to any of the defined languages (categorized as "non-specified"), as the authors tend to conduct research on more generic level, talking about processes without making them concrete. The majority of the work appears to relate to the BPMN model (29 %) as it is accepted as a standard for business processes. The rest languages have demonstrated very minor coverage (4-12%). These results point out that, auditors prefer to use well known standard office software such as Excel, PowerPoint, MS Word instead of learning the BPMLs.

The results which underline trends in research methods of all publications point out that case study is the top research method utilized in the population of our study, with 28%. While experiments and analytical reviews have the same percentage of coverage (19%), all other research methods interchange between 4-6 %.

Finally, control perspectives dimension demonstrates that authors primarily focus on automated business processes in the context of audit as evidenced by the fact that almost three out of four articles has a mention of automated controls in comparison with manual controls. It becomes also clear that, authors of the articles cover almost twice more detective controls in their articles than preventative controls (64% versus 35%).

LIMITATIONS

Firstly, the scope of the literature review was limited to papers published from 2000 to 2019. Secondly, the time rage limits inclusion of up-to-date academic papers which were written already but have not obtained confirmation on online posting. However, it is worth to mention that both limitations are non-controllable and does not significantly impact the scope of our literature review

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ABSTRACT

Several years of academic research and conferences highlighted the significance of business process management (BPM) and role of process audit in leading to higher level of organizational advancements. Despite being separated as two different research topics, BPM and auditing are incorporated within the process-aspect of auditing field. Integration of business process management and auditing is emerging as an important area in the wake of competing world marketplace with continued trends of globalization. Bringing together BPM and auditing can have considerably huge effect on discovering value-added opportunities for organization's success. In this paper, we conducted the first structured literature review consisting of 69 academic articles on the intersection of two fields. The purpose of this literature review is to provide a detailed synthesis of the current literature that has integrated process-based auditing aspects with BPM discipline. This literature review might create a foundation for future research directions together with implications for practitioners.

1. INTRODUCTION

The field of business process management (BPM) is an established field, both in research and in practice. Techniques from BPM have been largely applied in various application domains such as construction or healthcare. For instance, Delgado and Marotta in their writings display two levels of BPM in supporting the process of building flexible Web Warehouses (WW) (Delgano & Marotta, 2016). On the other hand, Gomes et al. in their article adopt BPM in healthcare system, while trying to use the Business Process Model and Notation (BPMN) to model the processes as a solution for the Electronic Health Record (EHR) (Gomes et al., 2018). Also, Ferreira et al. conducted a study in order to analyse the results of studies which address the promotion of BPM and lean in health sector (Ferreira et al., 2018). The techniques that are related to the field of BPM comprise among others process modeling, process analysis, and process mining, which have been found useful to support the activities of the BPM lifecycle: process identification, process discovery, process analysis, process redesign, process implementation, and process monitoring.

In the field of auditing, challenges can be observed that share some common ground with BPM. First, a stronger process focus is stimulated by the International Standard on Auditing 315 (Revised 2019) on identifying and assessing the risks of material misstatement. This standard articulates the duty of the auditor to, amongst other things, obtain an understanding of the entity's system of internal control. To reach this goal, risk assessment procedures that comprise understanding different processes within the organisation are explicitly listed. A second challenge in

the auditing field is the availability of digital data, initiating new opportunities to generate audit evidence. These new opportunities also spark discussions on how the profile of the professional auditor might have to change to reflect to these developments.

At this stage, it is unclear to which extent research on auditing already recognizes and incorporates techniques from BPM. For this reason, a review of the literature on business processes and auditing is required. Such a review bears the potential to distill the state of the art in such a way that general insights become visible and blind spots are identified such that they can be addressed by future research. Specifically relevant is the question to which extent audit tasks and components have already been supported using BPM techniques, and which insights such adoption has revealed.

In this thesis, we conducted a systematic literature review. Top accounting journals and top information systems journals are screened for publications that report on studies addressing both an auditing and a BPM aspect. The period under investigation starts from 2000 to date. After identification of these publications, they were classified in terms of audit phase, audit task, COSO layer, BPM lifecycle phase, business process modeling convention, research methods and control activities. Closer examination of these classifications reveals that "understanding clients business and audit planning" is the most frequently addressed category of audit phases. OR43 and OR5 are audit tasks that appear more often compared to others. When considering the categories of COSO framework, "control activities" emerge to be the next most frequently investigated category among others in our research. Next, "discovery" stage of BPM lifecycle is primarily addressed in the defined list of publications, while BPMN stands out to be first among other business process modelling conventions. The majority of papers use "case studies" as their research methods while considering the conjunction of BPM and auditing. Finally, automated controls exceed manual controls in the joint research of BPM and auditing.

This thesis is structured as follows. Section 2 provides background on both BPM and Auditing and presents several research questions. Section 3 presents the methodology that is applied to conduct the study. In Section 4, the analysis and results of the structured literature review are presented. The paper concludes with a discussion in Section 5.

2. BACKGROUND

2.1 BPM

The general idea of the term business process is widely understood and many definitions of the term exist. A process is defined as a sequence of activities that is necessary to achieve a specific organizational goal. For every business goal, an entity has a set of activities that needs to be undertaken. The objective of business processes is to organize these activities along with understanding their interdependencies. Therefore, Business Process Management has become an

established discipline and received significant attention not only by companies but also from research communities in recent years. Since the late 1980s, it has become an intensively discussed topic in information systems (IS) research along with practice (Houy et al., 2010). The reason behind this fact was advancing of computer technology and processing speed that evolved in 1980/1990s and experienced a widespread adoption by organizations.

Various numbers of definitions of BPM are found in the academic literature. For instance, Zairi and Sinclair define BPM as "a structured approach that analyzes and continually improves primary activities such as manufacturing, marketing, communications and other major elements of an entity's operations" (Zairi & Sinclair, 1995). Elzinga et al. define BPM as "a systematic, structured approach to analyze, improve, control, and manage processes that aims to improve the quality of products and services" (Elzinga et al., 1995). Harmon claims that "BPM refers to aligning processes with the entity's strategic objectives, designing and implementing architectures, establishing process measurement systems, educating and organizing managers so that they will manage processes effectively" (Harmon, 2014). Dumas et al. define BPM as "the art and science of overseeing how work is performed in an organization to ensure consistent outcomes and to take advantage of improvement opportunities". The authors also emphasize that BPM is not just about developing particular activities; rather it handles complete chain of tasks, events and decisions that bring value to the entities (Dumas et al., 2013).

These definitions point out that the core task of Business Process Management is to create alignment among each component of process: input, output, resources, process structure, and process objectives. Once such alignment is achieved, the process quality and entity's performance is enhanced. Improved business processes are translated into a considerable rise in productivity, cost savings while it also ensures reducing waste, execution times, faster adjustment to environmental changes, and error rates (Dumas et al., 2013; van der Aalst, 2013). Thus, BPM is known as a management approach to an organization that contributes to improving strategy implementation to increase effectiveness in business. When effective, business processes are unique and critical corporate asset, which offer substantial opportunities to improve market share, decision-making and performance management for organizations (Seethamraju, 2012).

A study conducted by Hung of 236 Australian organizations indicates a positive correlation between process management and organizational success (Hung, 2006). Companies need to continuously implement best management practice principles, strategies and technologies in order to maintain competitive advantage and encounter growing global competition (Carpinetti et al., 2003). Therefore, BPM is the best tool for companies to preserve their competitive advantage. Organizations in highly rival market should prioritize the adoption of BPM as it enables them to establish dynamic and flexible collaborations in adapting to varying conditions of global market (Bandara et al., 2007; Liu et al., 2009). Performing investigations into BPM approaches and techniques by private and public organizations results in achievement of reduction in costs while advancing service level (van der Aalst, 2013). Moreover, BPM is defined as discipline that integrates knowledge from information technology

and management science and utilizes this by implementing operational business processes (van der Aalst, 2004; Weske, 2007).

However, corporate reality illustrates that there exist challenges posed by real-life BPM applications in handling complexities. One of the major challenges for organizations which promote BPM is clarification of strategic objectives and organizational business processes (Skrinjar and Trkman, 2013). Achieving maturity in management of business processes results in obtaining more definitive outlook of goals, increases efficiency in achieving those goals and improves the management of innovation abilities for businesses (McCormack et al., 2009). All these benefits are achieved only if the businesses concentrate on the customer's need meaning that development of BPM requires businesses to be oriented towards the customer's demand (Rosemann, 2014). Poor business process management, conversely, may result in poor financial performance, and lead to lack of innovativeness and increased organizational conflicts (Benner and Tushman, 2003).

In order to effectively understand the terminologies and features of BPM, BPM lifecycle is necessary to be analyzed. Association of Business Process Management Professionals (ABPMP) (2013) underlines that BPM is promoted through a lifecycle which consists of six phases beginning from planning strategy until refining. Organizations can improve their business performance, compliance, visibility and transparency by applying lifecycle phases which enables them to understand, document, model and analyze business processes (Seethamraju, 2012). In real-life, the organization's business processes are often poorly documented and relationships among various process types are not clearly demonstrated. Also, it should be noted that business processes are diverse across organizations. Some processes, such as production process in manufacturing organization, represent core business of an organization while human resources (HR) or finance processes support the core activities. On the other hand, processes can be machine-intensive and automated, while others are labeled as knowledge intensive or creative. As a result, there exists a problem called "one size fits all" approach in BPM. To overcome this problem of BPM it is crucial to classify processes into core, management and support processes by their degree of importance (Zelt et al., 2019). Therefore, recently many BPM techniques started to concentrate in handling complexity and dynamicity throughout the whole BPM lifecycle.

However, execution of lifecycle is subject to numerous risks that need to be addressed by management of BPM projects. The study conducted by Zur Muehlen and Ho (2005) shows that BPM projects face risks within the individual lifecycle phase as well as during transition between lifecycle phases. While these risks have received considerably less attention, COSO assessment framework has a specific role in identifying existing risks that BPM lifecycle are exposed to and planning the mitigation activities of those risks before they result in financial or organizational damages (Zur Muehlen & Ho, 2005).

Moreover, the notation of a process model has become foundational to BPM. The aim of process modeling is to capture various ways in which a case (e.g. any process) is handled. In order to

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model operational business processes some notations known as business process modeling languages (BPML) (e.g., Petri nets, BPMN, UML and EPCs) are developed to promote BPM lifecycle (van der Aalst, 2013). Those notations enable an integrated vision of current and future processes used in BPM projects (White and Miers, 2008). BPMLs have been developed for the purpose of visualizing financial impacts of business processes in order to be well understandable by both business users and developers. The common factor of those notations is that processes are described in terms of activities. The activities are modeled in order to describe causal dependencies. Moreover, the notations specify the creation and use of data such as modeling decisions, and determine the way how resources interact with the process (e.g. roles, allocation rules, and priorities) (van der Aalst, 2013).

Because of the reasons described above, BPM is considered to be an essential field in the business world. The existence of specialized conferences (e.g., the International BPM Conference) along with dedicated journals (e.g., the Business Process Management Journal) which combine a considerable amount of quality literature concerning BPM demonstrates the importance of this field. Although the research on BPM reached its maturity to some extent, the interest in subject is still rising as a result of the IT-based atmosphere and emerging digital breakthroughs (Giacosa et al., 2018). Compared to other disciplines such as accounting, BPM is considered to be a relatively new field that is growing via multidisciplinary research (Hung, 2006; Recker, 2014).

2.2 PROCESSES IN AUDIT

Financial Auditing is known as a process of examining financial records of a business in order to determine how accurate they are while also considering their completeness in accordance with accounting standards, regulations and laws. Annual statutory auditing is required by law in majority of countries in the world in order to prevent the cases of corporate fraud and bankruptcy. The objective of an audit of financial statements is to enable the auditor to express an opinion whether the financial statements are prepared, in all material respects, in accordance with an applicable financial reporting framework (International Federation of Accountants (IFAC), 2009, ISA 315). Therefore, auditors are expected to obtain reasonable assurance that the financial statements as a whole are free from material misstatement. This creates an audit risk which is defined as "the risk that the auditor expresses an inappropriate audit opinion when the financial statements are materially misstated. Audit risk is a function of the risks of material misstatement and detection risk". This can be illustrated as an equation below:

Audit risk = Risk of material misstatement + Detection Risk

Risk of material misstatement is defined as "the risk that the financial statements are materially misstated prior to audit". This consists of two components: inherent risk and control risk. Inherent risk is "the susceptibility of an assertion about a class of transaction, account balance or

disclosure to a misstatement that could be material, either individually or when aggregated with other misstatements, before consideration of any related controls". Control risk is "the risk that a misstatement that could occur in an assertion about a class of transaction, account balance or disclosure and that could be material, either individually or when aggregated with other misstatements, will not be prevented, or detected and corrected, on a timely basis by the entity's internal control" (International Federation of Accountants (IFAC), 2009, ISA 315). Detection risk is known as "the risk that the procedures performed by auditor to decline audit risk to an acceptably low level will not detect a misstatement that exists and that could be material, either individually or when aggregated with other misstatements" (International Federation of Accountants (IFAC), 2009, ISA 200).

Identifying audit risk is a very crucial stage in audit planning and because control risk is one of the factors making up the overall audit risk, audit standards mandate understanding of entity's internal controls. More specifically, International Auditing and Assurance Standards Board (IAASB) issues International Standard on Auditing (ISA) and *ISA 315 Obtaining an understanding of the entity and its environment and assessing the risks of material misstatement* provides direction on audit planning. This standard clearly highlights auditor's responsibility to understand the information system, including the related business processes, which are relevant to financial reporting; identify and evaluate risks of material misstatement through understanding the company and its environment, including the components of internal control.

The auditor needs to obtain the knowledge of internal control in order to examine how different aspects of internal control could have an effect on the audit. Internal control comprises of the control environment, the entity's risk assessment procedures, information systems, control activities, and the monitoring of controls (COSO, 2013). In other words, the evaluation of the strength or weakness of internal control is a key determination in the assessment of audit risk, and thereby will have a considerable influence on the audit strategy. The design and implementation of controls needs to be evaluated as part of gaining an understanding. The auditor needs to get the idea whether controls are manual or automated (International Federation of Accountants (IFAC), 2009, ISA 315).

An entity's business process audit also serves as a warning for administration to take action if necessary and a guarantee provided by auditors that the work is done in a proper way. Auditing of business processes is necessary, especially for large corporates, to remain competitive in global market, deliver expected value to customers and maintain business sustainability. Moreover, auditing of the business processes results in many benefits such as risk analysis, promoting more transparency, verifications of controls used and their suitability to business, adequacy of defined procedures and practices. Consequently, auditing of business processes aids companies to obtain the recent and reliable information on the way of how the processes are running and performing leading to making improved changes in processes and correct decision making.

In fact, the whole auditing process can be categorized into four audit phases beginning from planning, continuing with risk assessment and substantive testing, and ending with completion. These phases provide structure to audit production and the classification of procedures into phases is based on the nature of audit activity. Phases represent different types of audit activities. Regardless of the uniqueness of every audit project in every company involved, the auditors need to use same four phases in order to complete the auditing of an entity. These phases are provided by professional standards and they need to be followed in very auditing procedure. On top of this, professional standards provided by International Federation of Accountants (IFAC) are also supported in academic literature. For instance, Werner investigates the question of how necessary information aspects required for process audits can be provided using process models. As a starting point he adopts and presents all five phases of audit as a logical foundation for the development of the main artifacts for his research (Werner, 2016). On the other hand, Werner et al. follow the ISA 315 requirement in the examples of their study in order to show the shortcomings of contemporary audit procedures in an integrated and automated business process environment such as ERP systems (Werner et al., 2012). In their writings Schultz et al. claim that professional guidance of ISA parallels benefits of strategic systems approaches (SSA) that demand the attention to business risk which in turn assists auditors to get deeper understanding of clients operations. This assists to realize the impact of business risk on risk of material misstatement (RMM) and auditors are able not only to recognize business risks but also develop reliable benchmarks to determine inconsistent patterns of fluctuations in accounts during analytical procedures (Schultz et al., 2010). Moreover, Hui and Fatt by applying the audit phases prove that the integration of auditors' auditing routines and firms' organizational routines are beneficial in terms of better earnings managements for entities (Hui and Fatt, 2007).

To wrap up, auditing profession has traditionally been a discipline with determined goals and established methodologies. It is known as an established engine of regulation in predicting and preventing frauds in financial statements. Consequently, auditing has a capability to estimate and bring down entity's business risks, which serves as a significant process for quality and sustainability of company's earnings.

2.3 DISCONNECT BETWEEN BOTH FIELDS

In order to understand how these both fields intersect, following concepts need to be reviewed.

Firstly, management of the organizations is always looking for opportunities to improve business processes to achieve entities' goals. One of the by-products of auditing is communicating deficiencies of internal controls to management as a result of assessment of their design and implementation. Having the processes assessed by an independent pair of eyes enables the organizations to eliminate deficiencies in business controls and create a more robust environment to improve entity's value chain process. Therefore, it is in management's best interest to get views of

auditors on business processes and then re-design or establish controls following stages of BPM lifecycle.

Secondly, the ISA mandates auditors to properly gain and document an understanding of client's business processes and the environment in which it operates. Without a thorough knowledge of the business and its environment, an auditor would be unable to effectively assess the risk of material misstatement in the financial statements, and therefore could not plan the audit to minimize audit risk. Thus, the need to audit business processes does not only serve to fulfill management's expectation but also and more importantly is driven by mandated professional standards, creating a an indispensable link between both fields.

On top of this, it is obvious that currently the major drivers behind the changes in business processes are innovations in computing and communication. Automation of business processes has called for a shift from traditional audit procedures to technology-driven data and analytics tasks. While technology-integrated business processes provide an opportunity to gain a competitive edge in the market, they also entail new necessities for continuous monitoring and auditing regarding modifications in effectiveness of controls, process continuity and integrity. Thus, widening the use of technology in business entities brings new challenges and puts auditors into hard times since the monitoring of the business processes are becoming more complicated and complex. Auditors have to adapt to new technological innovations while they face mounting pressure from regulators in accounting industry to perform a very well-thought risk assessment, incorporating full understanding of business processes and controls. The pressing challenge from global accounting watchdogs to improve audit quality came in the wake of collapse of several large corporate businesses in the last two decades. Therefore, auditing standards have been updated to underline the significance of auditors obtaining an enhanced insight of an organization's operations and IT system in order to execute effective risk assessment and adopt the best audit approach.

It can therefore be concluded that the combination of the two fields can have stronger synergistic influences on the success factor of organizations than their independent operation from each other. Bringing together BPM and auditing may lead to value-added consequences for entities and auditors while discovering potential opportunities for improvement. Also, in order to determine, communicate and measure economic information to make valuable economic decisions for an entity, auditors need to refer to data reports driven by business processes, activities, tasks, transactions and events. These concepts are covered in BPM as well for the aim of planning, implementing, and controlling the way work is done in an organization. This similarity in both domains has become a good motivation for researching the literature that covers both fields at the same time.

Some academic studies have already discussed different viewpoints related to the intersection of BPM and auditing. For instance, Carnaghan argues that in order to appropriately plan and form risk assessments, auditors need to successfully analyze operations in the form of business processes. In her paper, she determines generally used business process modeling conventions, and characterizes

them relative to the needs of auditors while performing risk assessments at the business process level (Carnaghan, 2006). Müller-Wickop and Nüttgens claim that a deep insight of business processes is a very crucial factor for in-depth auditing in an organization's financial reporting since it leads to correct preparation, presentation and publication of financial statements. They presented a conceptual model that bridges the gap between processes and their financial impacts (Müller-Wickop and Nüttgens, 2014). Ritchi and Mendling argue about the benefits of adopting business process models for auditors for understanding entity's business processes and they conclude that the adoption of business process modeling in assurance is still on the stage of developing. Their analyses in audit-oriented business process modeling showed that the present utilization of business process models is used more on risk elicitation rather than risk assessments (Ritchi and Mendling, 2012). Kochetova-Kozloski et al. discuss a positive link between process analysis of primary business processes by auditors and the identification of process and entity-level business risks. They also found that while considering important process-level risks, auditors link their evaluation of misstatement risk at the process level to the identical assessments at the entity level (Kochetova-Kozloski et al., 2013). Bierstaker et al. explore the degree to which client-prepared internal control documentation and business process flowcharts has an influence on auditor's proficiency in revealing missing internal control. The experiment consisting of 395 experienced auditors resulted in the indication that auditors need to be provided with a flowchart of business process while evaluating the effectiveness of client's internal control system (Bierstaker et al., 2009). O'Donnell and Schultz in their study based on experiment concluded that audit support software formed around business processes can have an impact on decision output while conducting planning-phase analytical procedures (O'Donnell and Schultz, 2003). Ballou et al. studied strategic-systems auditing (SSA) approaches which require auditors to execute analyses of their clients based on two levels which are strategic and business-process levels while implementing auditing (Ballou et al., 2004). They claimed that by using SSA, auditors gain a complex understanding of the client and lead to recognition of the fact that one little action can have significant effect that raises overall business risks. Boritz et al. researched whether business processes represented in a format of diagrams or textual ways affect performance of new accounting professionals on accuracy and efficiency of their risk assessment. As a result, textual representation appears to be in higher efficiency for auditors while there was no impact on accuracy of risk assessments (Boritz et al., 2012). Ritchi et al. investigate on the question if visual representation of process models is superior to textual narratives to support analysis tasks in both auditing and business process modeling research. Their findings displayed that the representation format in fact has an influence on comprehension performance, and the size and direction of this influence depends on the type of audit tasks (Ritchi et al., 2020).

However, despite the earlier viewpoints, commentaries and analysis provided by different researchers on the intersection of BPM and auditing, there are still some research gaps in related work. Although there is a clear-cut and increasing interdependence between both fields, there has been limited consideration of what is the best way of representing and classifying the necessary information about business processes in the context of auditing (Carnaghan, 2006). Therefore, this

paper is designed to be the first structured literature review that explores the link between BPM and auditing. Research on such a connection would help to explain the concepts and practices that appear in both fields by creating more synergies between the fields and eliminating inefficiencies.

As there is no literature review performed to date to investigate interaction of these fields, it does make sense to research very fundamental dimensions of each field as a starting point. A quick discussion of basics of each aspect along with motivation for each of them will lead this study to ask research questions to be investigated on.

Audit phases are deemed to be foundation and necessity for conducting a well-planned audit engagement. The audit phases have been approved by International Standards on Auditing (ISA) which is a benchmark for auditors in auditing processes and all authorities from all over the world require them to follow ISA, or local alternatives of ISA. Considering significance of this dimension, we are interested in getting more precise idea of which audit phases are more frequently incorporated into research on intersection of audit and BPM. This curiosity compels the study to ask the following question:

To what extent are the audit phases discussed with a process-based approach in academic literature?

Secondly, in addition to audit phases, it would be interesting to drill further down to *audit tasks* level to see what audit procedures are mainly employed to assess business processes. Bringing this dimension into our scope will definitely provide an insight into intersection of both fields at a more granular level. The importance of this dimension has been explored and verified by Ritchi et al. (2020). In their study, they investigated in generic task types and representational effects on task performance in the context of auditing. Their findings have significant implications for research not only on auditing tasks, but also for software engineering and information systems research. Accordingly, considering all these facts the following research question is asked:

Which audit tasks are featured in research on auditing and BPM?

Thirdly, ISA 315 states that the concept of internal control is very essential for auditors in dealing with risks. The standard to organize an effective internal control system is *COSO framework*. This framework provides an excellent description of multidimensional concept of internal control referred by professional auditing and consists of five components. Further, the value of this framework has been confirmed in a study carried out by Fourie and Ackermann (2013) by conducting an experiment with real-life audit practitioners. They investigate COSO as recognized framework whose implementation results in an effective internal control system and serves as the basis for design of the research instrument. They also claim the fact that having a strong internal control system is the key in determining fraud for organizations. Hence, given the importance of COSO framework for auditors to assess control environment in any business the following research question is raised:

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Which components of the COSO framework are primarily addressed in the existing body of literature?

Next, *BPM lifecycle*, which is the universal aspect of BPM, is going to be investigated since it can be considered to be the backbone of the BPM field. ABPMP International publicly released a common body of knowledge on BPM (BPM CBOK), where BPM lifecycle is proposed as a reference model in analyzing the alignment between business strategy and processes (ABPMP, 2013). The value of this dimension has been also confirmed and investigated as the main part of coding categories in the literature review research conducted by Recker and Mendling (2016). They coded 347 conference papers according to BPM lifecycle as "these lifecycle models despite being presented for didactic reasons still provide balanced treatment of different concerns of BPM" (Recker and Mendling, 2016). Taking all of this into account, we are interested in the following research question:

To what extent are the BPM lifecycle stages investigated in the body of accounting literature?

Then, *Business process modeling conventions* are added to the research area of the study. In management information systems, researchers acknowledge that understanding the business processes that information systems need to support appears to be critical in detecting the needs of its users. However, it became to be very challenging for practitioners to model such business processes and relate them to software requirements to get the better understanding, analyses and improvements in processes because of the lack of required tools (Eriksson and Penker, 2000). The consequence of the introduction of the e-commerce and workflow management system directed to an integration of the interests and tools in IT community for modeling business processes by presenting business process modeling languages (Mili et al., 2010).

This dimension is especially important to investigate since it addresses the purposes of risk assessment in organizations. It is a tool that captures information and needs to be represented appropriately to auditors for usage by auditors. The form of information representation has a huge impact on auditors' or accountants' decision-making. Thus, it is crucial to find out which modeling conventions are most promising in terms of audit risk assessment (Carnaghan, 2006). As the business process modeling conventions are playing a crucial role in comprehension of the businesses and understanding of the insights related to business processes for auditors, this category is also included into this study and will help this research to wonder the answer for the following research question:

Which BPMN conventions are used in joint research on audit and business process?

Additionally, *research methods* are the next dimension that can be interesting to have a look at in order to evaluate maturity of methodological aspects of papers. The examination of papers typically associated with BPM or auditing may addresses different components of research design while being individually explored. However, because we are looking at the combination of two different research fields, this dimension become particularly interesting in order to obtain an overview of which research methods are being used on this intersection. Number of researchers such as Poston and

Grabski (2000), Ferguson and Seow (2011) and Recker and Mendling (2016) have included this category into their studies and summarizes the explicit discussion of research components from a methodological point of view in an attempt to identify the most and the least preferred research method utilized in articles within specific period of time. To that end, the importance of explicit discussion of research components over time leads us to formulate the following research question:

What are the main research methods employed investigating combination of BPM and auditing fields?

Finally, *Control perspectives* also play a crucial role and need to be taken into account while auditing internal controls. Automation of business processes has called for a shift from traditional audit procedures to technology-driven data and analytics tasks. Werner and Gehrke (2019) argue that because of growing integration of information systems for transaction processing and extremely increasing amount of data, auditors are facing new challenges while auditing internal controls. Moreover, Jans et al. (2013) introduce a case of why auditors need to reconsider process mining capabilities while auditing is carried out. Process mining is known as an innovative but comprehensive way of conducting auditing tests and understanding the state of control environment better than the procedures that auditors did before. In addition, Szenes (2012) claim that extending the scope of the information that is processed in a reliable, efficient and effective manner makes possible to find preventative, detective and corrective security controls by auditors which raise the level of operational quality and support the market success of institutions. All things considered, control perspectives dimension appear to be a center of interest for this study and following research question is identified:

Which control perspectives stand out the most when investigating the intersection of auditing and BPM?

The ambition of this work is to add more value on the ongoing discussions about the intersection of the BPM and auditing and to set a basis for future researches.

3. RESEARCH METHODOLOGY

The research methodology of this paper is carried out based on guidelines for literature review. The goal of the literature review is to represent a general view of the initial status of research that investigates BPM and auditing. Literature review papers enable researchers to obtain a deeper understanding of what is already completed as a study. It is known as a tool to save their time and resources for future research, and it contributes for productive growth of new knowledge (Wong, 2013; Webster & Watson, 2002).

Literature reviews can be grouped into two main categories- "systematic" and "traditional". In a traditional literature review, the author shows previously adopted approaches to a topic in order to

indicate that he is aware of current insights around subject. On the other hand, the aim of a systematic literature review is to analyze a predetermined question by using accessible scientific data. Here, the data contains a set of scientific literature that will be examined based on various variables of interest (Ridley, 2012). The type of research approach that will be used in this study is systematic literature review. The reason behind this approach is the fact that systematic literature reviews are highly structured and allow comprehensive, scientific analysis of existing literature.

Coding and citation are general approaches employed to carry out a systematic literature review. Coding method is applicable to the studies of published papers classified to effective groups with respect to pre-set dimensions while citation approach is used to categorize publications based on the level of references (Vessey et al., 2002). This paper focuses on the classification of BPM and auditing studies based on selected categories that appear in coding scheme.

In the application of the systematic literature review once the research questions are identified, an extensive literature search including the principles followed, databases used and query to search, is conducted. Next, selection procedure of literature based on inclusion and exclusion criteria is applied. Based on the resulting data set, the literature is synthesized in categories of classification criteria that are carried as coding scheme.

3.1 LITERATURE SEARCH

Since BPM has been in the center of attention in last two decades, it is predictable that the conjunction between these two areas should date back to more recent history. Therefore, the scope of literature for this research is limited and defined from 2000 to date. For the purposes of covering the whole spectrum of study the following steps were taken. Firstly, it was anticipated that the inclusion of BPM principles into an auditing context is primarily published in the research field of the application, i.e. auditing or in a more broad setting, accounting. Thus, in order to get the idea of how much BPM is integrated in auditing research top accounting journals have been investigated. Secondly, the research is elaborated further starting from IS journals where the magnitude of integration of auditing in the BPM research can be deducted. To further explore this phenomenon, Association for Information Systems (AIS) basket of top highly-rated and highly-cited 8 journals was incorporated into the scope. On the other hand, to mitigate the limitation in its scope, this study as well shifted its focus from top accounting journals to outstanding online databases in an attempt to extend the coverage of the literature review. The list of the multiple online databases used for this study is as follows:

- ProQuest Central
- Science Direct
- ResearchGate
- EBSCOhost
- Web of Science

- emerald insight
- Academia
- Semantic Scholar
- SpringerLink
- DOAJ

The shift to online databases is an attempt that has a huge significance in identifying possibilities for improving the scope of the study. A set of literature reviews performed by researchers used this tool for enhancement purposes of the current scope. For instance, Gray et al. (2014) in their literature review explored the life cycle of expert systems to deliver overall visions into the roles of accounting scholars in technology domains. The exploration of the expert systems related articles in the accounting and AIS domain were executed through a comprehensive search in multiple online databases such as EbscoHost, Science Direct, Wiley and Scopus. The authors achieved to find 315 accounting-related expert systems papers that were published from 1980 through 2011 years and concluded that the reason behind obtained number of articles was a broad number of research databases.

The preliminary search was based on three pairs of keywords: business process and auditing; business process and audit; and business process and assurance. The exact queries that were used while searching for papers are as follows: (audit OR auditing) AND (business process) in "title, abstract, publication title"; (assurance) AND (business process) in "title, abstract, publication title". At this stage of study 71 articles were found, 40 of which is a result of shift from academic journals to online databases.

However, the modification and change of the keywords were also taken into account as it has possibility of arriving to more optimal outcomes. Therefore, other similar terms that could substitute business processes were assumed and applied, as below:

- production process and audit (2)
- production service and audit (1)
- organizational routine and audit (1)
- organizational operations and audit (2)

The numbers in parenthesis indicate the related academic articles that were found according to these keywords. Accordingly, after the inclusion of new keywords the number of articles was increased to 77.

Moreover, the possibility of shifting terminology that can substitute "business processes" term was also taken into consideration. The reason behind this reconsideration of keywords in our study is to capture all other literature that would have been left out as a result of inadequate terms being searched. The careful consideration of research indicated that some articles highlighted similarities and substitutable usage of both fields, namely, "Business Process Management" and "Business

Intelligence". For instance, Marjanovic claimed that although BPM and BI fields come from different viewpoints they have shared interest in improved decision-making processes and both of them are aligned with the organizational strategy which creates a need of better integration (Marjanovic, 2009). Negash, in his turn, stated that in fact business processes that occur in the BPM literature are an unstructured input of a BI system together with graphics, spreadsheets, text and images (Negash, 2004). Kopf and Homocianu explained that the incorporation of both technologies and their data integrity allows businesses to achieve performance improvement and successful optimization (Kopf and Homocianu, 2016). Murali defines business intelligence as computer-based process that analyzes business and objective of which is to understand the firm's insight, relates the data to better decision making, leading to cost reduction and detecting opportunities for innovation (Murali, 2010). This common sense of interrelationship between BPM and BI lead to create a thought of shifting use of terminology from "business processes" to "business intelligence" over time. In order to factor this pattern into the scope of the literature review, a new search terminology – business intelligence – was employed to provide another refreshed examination into existing literature. As a result, the initial research for keywords business Intelligence and audit resulted in the increase of the number of articles by 12.

The importance of substitution of keywords is one of the main findings that can be found in academic literature reviews performed by outstanding researchers. For instance, Sutton et al. (2016) reconsidered Gray et al. (2014) work and concluded that in fact the artificial intelligence research in accounting has sustained to progressively grow over the past 30 years whereas Gray's findings suggested otherwise. The keywords selected by Gray et al. in their search criteria did not provide accurate representation of existing literature as he failed to take into account the fact that the 'knowledge-based systems' and 'expert systems' terms, widely-used in the late 90s, was subsequently substituted with 'intelligent systems' at the turn of the new century. As per Sutton, this shifting terminology may be the reason that Gray et al. (2014) did not apparently detect much behavioral work in the domain and viewed alternative classification of knowledge-based systems as a missed opportunity because of a simple search terminology phenomenon. By adding new keywords into the research Sutton et al. (2016) were able to add 872 unique articles into the scope of the research compared to Gray et al. (2014) where the number of articles was 315.

Careful consideration of keywords and an extensive search via selected online databases led to a significant increase and resulted in 89 articles. However, it is crucial to mention that this increased number of articles was more as a result of broad usage of online databases, rather than extension of keyword range. ResearchGate (36), ProQuest Central (14) and ScienceDirect (8) are considered to be the top databases with most number of articles in the final list of unique relevant articles from 2000 till 2019.

3.2 SELECTION PROCEDURE

Selection Criteria (Inclusion). Given the result set of all searches, next aim of the study was to select appropriate literature. A full review of the list was subjected to multi-staged relevance check to exclude any duplicate articles listed across databases and the false findings that were outside of the scope of this research were screened out. In the first step, the title, abstract, and the keywords of the papers were analyzed in order to check the appropriateness of the articles. In case the relationship of "BPM and auditing" was not clearly defined in the abstract, the second step was applied. In the second step, the content of the publications were investigated meaning each of the papers was read in full for confirming the accuracy of the selection process. The publications that concentrate only on one research area, either on BPM or audit, were excluded. Additionally to the primary search results, the backward snowballing and forward snowballing methods for references were applied for identifying the relevant literature that has not been found in the primary search process. If those publications complied with the selection criteria then they were identified as relevant literature. By investigating the references, some additional publications were found to the primary literature searches. Only 89 papers resulted from relevancy screening while others were rejected since they were not part of the relevancy criteria that was defined in the beginning of the study.

Exclusion. After analysis of 89 articles within each category, this number was further reduced to 69 as a final list of relevant publications because of the following reasons. Firstly, based on the revision of the 12 articles associated with business intelligence (BI), the final decision was to exclude them from analysis of this study. The reason behind this conclusion was the fact that although BI and BPM carry similar connotation, BI concept does not fit into the classification of BPM and therefore does not satisfy expectations of this research. In most academic papers concerning BI, auditors use the tools of BI (data mining technology, data warehouse technology, and multidimensional data analysis technology) as a key factor for making successful business decisions. With BI tools auditors are able to test large amount of data quickly and accurately that leads to increased confidence of the opinion provided by them (Ciprian-Costel, 2014; Murali, 2010; Che L. et al., 2017). However, this tool is not by definition process-oriented. Thus, the papers concerning BI do not fall under any category of BPM while it perfectly fits with auditing part of the study which leads to exclusion of them from the final list of articles. Secondly, after analysis of literature within each category was completed 4 more articles were eliminated from the final list as they were irrelevant to the context of study although containing the required keywords. These four papers are not a separate research study, but discussion papers to other articles which do not add any value to the current research. Thirdly, the other 4 papers were excluded from the listing since classification of these papers by either BPM or audit dimensions were impracticable. Therefore, the final number of relevant articles in the list was reduced to 69 which can be found in Appendix. In addition, the data suggests that the majority of the papers relates to the period post-2010, meaning the interest for these topics continues to build. Assuming this, it can be concluded that this study may not have captured all the articles that brought auditing and business

processes together and missed decent number of recent publications that have not yet been added to online databases. These missing papers could have enhanced the findings of this research and materially affect the final results.

3.3 CLASSIFICATION CRITERIA

Evaluation of BPM and auditing papers is developed based on multiple established approaches (Pare et al., 2015; Rowe, 2014). To conduct a review, we proceeded in the following steps: (a) all found papers (including keynote abstracts) will be collected; (b) coding scheme will be established in order to classify literature by specific dimensions; (c) gathered literature will be analyzed within each component.

The dataset of this study consists of a list of all papers listed in academic databases from 2000 to present related to the intersection of BPM and auditing. The information is gathered in a single Excel database file that will be classified alongside the targeted dimensions in order to achieve the aim of this study.

Classification criteria will be set out below in the same order as research questions postulated in section 2.3.

In order to answer the research question, *audit phases* are deemed to be essential dimension to include in the coding scheme. For being more precise and avoiding different classifications, these phases were adopted from the International Standards on Auditing (ISA) which is being issued by International Auditing and Assurance Board (IAASB) and globally recognized while ensuring common understanding in auditing (IAASB, 2013). Clarified and transparent auditing standards facilitate the understanding of what is being said and why it is being stated for users of audit, meaning people who initiate audit or look at the results. As per ISA below generally accepted audit phases are defined:

- Phase 1: Understanding clients business and audit planning (ISA 300&315) – consists of obtaining the insight of the relevant industry, the nature of the entity, the accounting policies applied in the entity, the related business risks that may result in material misstatement, the review of the organization's financial performance, and internal control relevant to audit.
- Phase 2: Test of internal controls (ISA 330) – are performed to assess the operating effectiveness of internal controls, including evaluation of client's recording of transactions and assessing likelihoods of misstatement in financial statement.
- Phase 3: Substantive testing and analytical procedures (ISA 330&520) - is applied where internal controls are strong and auditors need to apply Substantive Analytical Procedures to see if the numbers "makes sense" by comparing financial with non-financial information.
- Phase 4: Audit Report (ISA 700) - after all procedures are completed and audit objectives are reached, the combination of collected information and giving overall conclusion is required to be fairly presented.

In fact, *audit tasks* which are rarely investigated in academic context were added to coding scheme of the study in order to identify which tasks are addressed frequently in selected list of publications. Taxonomy presented in Abdolmohammadi's (1999) paper was consulted as a reference point for identification of specific audit task categories. The main objective of his paper is to give informative database on task structures, minimum professional rank and decision support which helps to perform each task. In order to achieve these goals all-inclusive list of audit tasks was formulated and submitted to audit managers and partners for their evaluation. This data consisted of 332 studied in detail audit tasks and was delivered with several audit phases. Since his paper presented a very narrow and exhaustive classification of audit tasks, only a handful of high-level classification is extracted for the purposes of this research. After analyzing the specifically identified papers based on audit task category, this study would reach the comprehension of the most investigated audit tasks by authors and make clear view of importance of audit tasks in the concept of BPM and auditing.

Given the rapid growth in technology and the need of businesses to adapt to new technologies examining internal control concepts is becoming one of the major components of interest to the accounting information systems community. The concluding opinion of the auditors that participated in Fourie and Ackermann's (2013) research was that the characteristics of COSO framework for "risk assessment", "information and communication", "control activities" and "monitoring activities" in fact, do provide an effective control system. Therefore, in order to identify which controls have been tested more, globally recognized five layers of COSO framework are taking a part in the coding scheme of this study. These layers are taken from renowned study book authored by Moeller (2013). The description of each layer of COSO framework is as follows:

- Control Environment – considers the entire attitude, awareness, and actions by the board of directors and management concerning the significance of internal controls in the business.
- Risk Assessment – considers the responsibility of management to evaluate the importance of a risk and to take appropriate actions to prevent it.
- Control Activities – considers ensuring the actions identified to prevent risks in the enterprise are executed by the responsible individuals.
- Information and Communication – considers the importance of required information to be communicated up and down the enterprise ensuring people fulfilling duties; effective ways of communication needs to be taken place with internal and external parties of the businesses.
- Monitoring Activities – considers broader monitoring of activities as control procedures may change over time by appearing to be not effective and efficient when it was first installed.

BPM lifecycle is the next coding scheme that appears in this study. Recker and Mendling's (2016) literature review of BPM conferences in the years from 2003 to 2014 raised concern over unequal coverage of each stage of BPM lifecycle at the conferences. As this study involves not only BPM but also auditing, the numbers in results can vary from those found in their paper. Nevertheless, this paper will follow the approach adopted by them in terms of identifying stages of BPM lifecycle to

ensure universal understanding and consensus. To this end, Dumas et al (2013)'s BPM textbook will be used to achieve consistent classification of BPM lifecycle, as below:

- Process Identification - is a phase where business problem is posed and it takes place before the actual cycle starts. It provides an overall picture of processes in an entity and their relationships and typically done in parallel with performance measure identification.
- Process Discovery (also called "process modeling") - is a phase where the current state of processes gets documented in the form of process modeling.
- Process Analysis- is a phase where problems with the current process are identified and documented and if possible quantified by using performance measures.
- Process Redesign (also called "process improvement") - is a phase where changes are identified and compared to the processes that would address the problems recognized in previous phase. The most promising change option is chosen to-be-process model.
- Process Implementation – is a phase where the changes from as-is process to the to-be process are arranged to be performed.
- Process Monitoring – is a phase where required data is first collected to determine how efficient the process is and bottleneck if any is identified and actions to remove it is taken.

Business process modeling conventions were identified as a next coding category in this research. In her paper, Carnaghan (2006) tried to identify different business process modeling conventions and represent them respectively to the auditors' needs while executing risk assessments at the business process level. Based on the literature review, the author described a number of regularly used business process modeling conventions. The list of conventions is defined as follows:

- Data flow diagram (DFD) – the key principle of DFD is functional decomposition which explains that every process can be subdivided into subprocesses, which can also be subdivided further.
- System flowcharts – the key principle of them is that they can capture flow of control via decision points and also capable of displaying manual versus automated operations and input.
- Research-event-agent (REA) modeling – is a basis to defining what should be modeled and the primary goal of REA is to assist the design of exhaustive database for business economic transactions.
- IDEF0/IDEF3 models – IDEF0 models processes and constituent activities which are transformed from inputs into outputs together with the controls that guide the transformation and mandatory resources for the process. IDEF3 delivers a process description diagram displaying causality and precedence of activities within a process.
- Extended event-driven process chain diagrams (EPC) – although being easily understandable, there exists an absence of a clear semantics to help with the interpretation of EPC and this creates problem in the usage of EPC.
- Unified Modeling Language (UML) activity diagrams – this type of diagrams covers both activities including a business process and the flow of control among the activities.

- Business process diagram (Business Process Modeling Notation-BPMN) – intends to deliver a notation which is quickly understandable to all business users including business analysts, technical developers and other business people. Since 2005, it's a standard that has been issued by Object management group (OMG) (Cozgarea G. & Cozgarea A., 2013).

The *Research Methods* is the next category that appears in the coding scheme of this study. Poston and Grabski (2000) introduced research methods as the part of coding scheme in their research on the nexus of accounting and information systems. On the other hand, Ferguson and Seow (2011) continued the same research as Poston and Grabski's (2000) did, by employing the same methodology and applied the same list of research methods for their research. As there is a similarity in terms of underlying research design and topic, the classification scheme of research methods used in Ferguson and Seow's (2011) paper was adopted. Therefore, the list was classified as follows: *analytical, empirical/survey, empirical/archival, experimental, field study, case study, literature review & synthesis and model building.*

Control perspective is the last component of coding scheme. Automation of business processes has called for a shift from traditional audit procedures to technology-driven data and analytics tasks. Traditional manual control testing turns to be inefficient since it demands highly specialized technical insight that is found very rarely. Therefore, it creates an interest for exploring whether control type is switching towards automated as years go by. In addition, Jans et al. (2009) investigates controls from a different perspective, reviewing nature of controls organizations design to mitigate internal fraud risk and build a strong control environment. While detective controls help companies to uncover the existence of errors, inaccuracies or fraud, preventative controls enable organizations to prevent their occurrence (Jans et al.,2009). Taking all these into account, control perspectives will be classified as follows: *automated & manual; detective & preventive & corrective.*

4. ANALYSIS and RESULTS

This section of the study analyzes and discusses the results obtained through the categorization of 69 articles and answers the questions that were posed in previous section. Before going further, it is important to mention one main finding. High-level review of the articles by publication date revealed that the earliest publication bringing together BPM and audit dates back to 2002 even though the scope of this literature review was defined from 2000 onwards. This observation verifies the reality that linkage between BPM and auditing is quite a new topic for researchers and becoming more popular in recent years. It is also essential to note that throughout the coding procedure a single paper may have been allocated to multiple subcategories within the same dimension of category.

year	Table 1:Audit Phases				
	Understanding clients business &audit planning	Test of internal controls	Substantive testing &analytical procedures	Audit Report	Non-specified
2000					
2001					
2002		1			
2003	1				
2004	3				
2005	3	2			1
2006	2	1	1		
2007	5	1	1		1
2008	1				
2009	4	2	1		
2010	2	1			1
2011	3	1	1		1
2012	6	2	1		1
2013	5	1	1		1
2014	7	1			
2015	2				
2016	1	1	1		1
2017	1	1	1		
2018	2	1	1		1
2019	2				
Sum	50	16	9	0	8
Share	72%	23%	13%	0%	12%

Table 1 illustrates categorization of publications by audit phases. It is clear from the Table 1 that understanding client's business and audit planning is the most frequently covered category (72%). This percentage is not surprising as audit standards explicitly refer to understanding of business processes in this phase. Auditors' traditional way of establishing the accuracy of the information and defining the client's levels of regulatory compliance no longer gives sufficient and deep information about the entities' structure. New audit processes demand auditors to get a complete understanding of their client's information processing system, to appraise the design effectiveness of the controls over that system, to have a detailed awareness of the client's operations, their business goals and strategies and the risks in realizing those goals. All these detailed information lead the auditors to design customized procedures which depend on every client's operations and business environment. However, the increased complexity and variety of the information systems (IS) lead auditors to face serious challenges as they have to know the data structure and process flow inside the system of each individual entity. Therefore, it is essential and mandated by accounting standards (ISA 315) to understand and assess design and implementation of business processes to formulate one of the following audit approaches: control based approach, substantive testing

approach, or a combination of both. Our findings are reflective of the fact that understanding of the business processes is a key to overall audit. However, while the existing body of literature places major focus on understanding, documentation and evaluation of business processes and controls, test of operating effectiveness of these controls saw significantly less coverage (23%). This means that authors are less inclined to extend the scope of their papers beyond understanding of internal processes and incorporate methods of test of controls and their results into research findings.

Substantive phase unsurprisingly has a minimal coverage (13%) in the specified list of articles. Some of them claim that it is more concerned about tracing existing transactions to supporting evidence to ensure they exist and are accurate and the recorded transactions are recorded, i.e. complete. Although overall business understanding is important to decide on an appropriate substantive test and test of control is crucial to assess risk of material misstatement, business processes are not directly linked to substantive phase of auditing. The 6% mainly relates to investigation of computer assisted audit techniques (CAATs) to substantively test IS and link between test of controls and substantive procedures in terms of reducing risk of material misstatement. (Huang et al., 2009; Li et al., 2007; Werner, 2016; Kogan et al., 2006).

On the other hand, the remaining ones cover data analytics, which is a new discipline that enables auditors to improve substantive testing. From a process point of view process mining is described as data analytics and has an influence on auditing (Jans et al., 2011). However, process mining is relatively young field and therefore there exist some challenges. Some articles which cover the application of process mining in an auditing setting have been reported in the academic literature (Jans et al., 2013; Jans et al, 2011; Jans & Hosseinpour, 2018).

Finally, reporting stage of audit saw no coverage at all and further input in respect of scoping this area into future research will be covered in recommendation section.

	Table 2:Audit Tasks						
year	Understanding the Client's Business	General Consideration	Internal Control	Risk Assessment	Test of Control	Analytical Review	Non-specified
2000							
2001							
2002							1
2003				1			
2004	2						1
2005					1	1	2
2006					1	1	3
2007	2	1	1	1			2
2008			1				
2009	2		2		1		
2010		1		1	1		1
2011	1	1	1	1	1		2
2012	3	2	1		1		3
2013	1	2	2	1			1
2014	3			1			3
2015	1						1
2016			1				1
2017		1	1				
2018		1	2				2
2019	1		1	1	1		
Sum	16	9	13	7	7	2	23
Share	23%	13%	19%	10%	10%	3%	33%

According to the Abdolmohammadi's (1999) paper, audit phases are divided into comprehensive listing of 332 audit tasks under fifty sub-phases. In this literature review, we noted down specific audit tasks, if specified, and allocated each of these publications to the general audit sub-phases using Abdolmohammadi's taxonomy of audit tasks, as specified in Table 2: Understanding client's business, general consideration, internal control, risk assessment, test of control and analytical review.

Understanding client's business (23%) and internal control (19%) are sub-phases that encompass a wide range of audit tasks. Further drill-down into specific audit tasks under this category enables us to summarize the most frequently investigated audit tasks, using Abdolmohammadi's coding, as follows:

- OR1 (setting up a permanent file to capture significant information) – 5;
- OR5 (evaluation of key financial management characteristics such as budgeting) -10;
- OR43(identification of critical audit, risk and judgmental areas) -8;
- CS1 (evaluation of internal controls) -4;

- CS8 (evaluation of policies to detect errors) -2;
- CS13 (determination of boundary controls) -3.

Test of control, risk assessment along with analytical review appear to be very less frequently audit sub-phases specified in publications, with 10%, 10% and 3%, respectively.

A quick comparison of audit phase and audit tasks classifications in Table 1 and Table 2 also points out that the latter has approximately 3 times as many articles under 'non-specified' category (8 versus 23). The primary reason behind this finding is that audit phases can be deduced from the context of paper, while it is not reasonable to assume audit task classification, unless specified by authors. The level of judgment in relation to classification will be discussed as part of limitation of the study.

	Table 3: COSO framework					
year	Control Environment	Risk Assessment	Control Activities	Information&Communication	Monitoring Activities	Non-specified
2000						
2001						
2002			1			
2003						1
2004		1			1	1
2005	1	1	2		1	
2006	1	2	3		1	1
2007	1	1	2		1	4
2008	1				1	
2009			1			4
2010						4
2011			1			4
2012	1		4		1	3
2013	2	1	4			1
2014			3		1	3
2015			1			1
2016		1				1
2017						1
2018			2			2
2019						2
Sum	7	7	24	0	7	33
Share	10%	10%	35%	0%	10%	48%

Table 3 illustrates COSO internal control framework which is very important for establishing effective assurance regarding achievement of entity's goals such as: company strategy; effectiveness and efficiency of operations; reliability of financial reporting; and compliance with applicable laws and

regulations (Rikhardsson et al., 2006). A quick glance at Table 3 indicates that 48% of the articles do not cover COSO framework despite of its significance in risk management. Sarbanes-Oxley Act (SOX) legislation in US, which was approved in 2002, requires business to secure the quality of financial reports by minimizing the risk of fraud while adapting internal control policies (Zur Muehlen & Ho, 2005). This legislation led to increased adoption of businesses since 2002 as it will be clear from Table 7.

Control activity is the most frequently used layer of COSO internal control framework by authors (35%). These are the procedures that ensure that business processes and controls are designed in a way that mitigates 'What Could Go Wrongs' (WCGW). As specified above, SOX Act was a main factor to legally force corporates to establish strong control activities to achieve an accurate and reliable financial reporting, compliance with laws and regulations, and effectiveness and efficiency of the organizations operations. Internal and external auditors, in their turn, are mandated to assess the compliance of corporates with SOX legislation. Among the many procedures, "segregation of duties" is considered to be the most basic as well as well most frequently specified internal control to reduce the risk of error and fraud. Different individuals should be responsible for authorizing transactions, recording transactions, having custody of assets, and performing comparisons/reconciliations. Segregation of duties can be designed as a manual control and through system applications. In terms of audit of this procedure, Braun and Davis mentioned that one of the difficulties that auditors face is a need to have a thorough understanding about information system applications and how they support the business processes. In order to do this, task auditors need to interview managers and determine who has the authority to run key control functions (Braun & Davis, 2003).

Risk assessments and monitoring activities were equally (10%) brought up by authors. Risk assessment of the COSO emphasizes the responsibility of management to assess the risk and take appropriate actions in case if there is a necessity. Risk analysis is considered to be critical to entity's overall success. On the other hand, the responsibility of management to monitor system activities is highlighted just as much in the regulations of SOX. To comply with this regulation, the BPGAP-Detecting Mechanism is used in both ways. It has a managerial implication for managers and auditors since firms can be aided in detecting the errors while auditors also increase their productivity. Moreover, BPGAP-Detecting Mechanism assists in detecting the process gaps between IS process flow and internal control flow. Auditors can take advantage of this mechanism and by monitoring audit more effectively and efficiently as it can directly uncover the reason for IS problems (Huang et al., 2009).

Control environment of COSO framework is addressed in only 10% of publications. These articles mostly focus on general attitude and actions by the board of directors and management concerning the significance of internal controls in the enterprise.

Information and communication (0%), which is a part of evaluation of internal control, never formed part of the publications reviewed despite of its significance.

	Table 4: BPM Lifecycle						
year	Identification	Discovery	Analysis	Redesign	Implementation	Monitoring	Non-specified
2000							
2001							
2002			1				
2003		1					
2004		1	1				1
2005	1	3	1	1	1	2	
2006	1	2	1		1	1	
2007		3		1		1	2
2008		1					
2009	1	4	1				1
2010		1		1	1	3	
2011		1	1	2	2		2
2012	3	4	2	2	2	3	
2013	1	4	1	4	2		
2014	3	5				1	
2015		1		1	1		
2016		2		1			
2017		1					
2018	1	4					
2019		2					
Sum	11	40	9	13	10	11	6
Share	16%	58%	13%	19%	15%	16%	9%

Table 4 illustrates classification of the existing literature based on BPM lifecycle. The results indicate that coverage of each stage of BPM is not proportional. As per Table 4, while process discovery stage has highest coverage (58%), the other stages received fairly equal attention from researchers (13-19%). The findings are very similar to the research conducted by Recker and Mendling (2016). They concluded that 56% of BPM conference proceedings included a discussion around discovery stage of BPM. Comparably, these figures are more or less the same in our findings (Table 4) even though audit element is incorporated into the scope of this literature review. This can be corroborated as follows. From audit point of view, discovery stage of BPM, to a large extent, overlaps with understanding of the business environment, which covers an understanding of relevant internal control and evaluation of the design of the controls. The number of publications falling under understanding of business category in Table 1 is therefore broadly similar to that of discovery category in the table above. However, it is also worth noting that audit procedures seek to ascertain whether the controls are designed, implemented and monitored properly. On top of this, re-design of the controls or compensating controls may also be suggested as a by-product of audit, which might

explain why there is a slight deviation from Recker and Mendlings' findings under the remaining categories.

Also, from Table 4 it is visible that 2012 can be regarded as a milestone because of two reasons. Firstly, the articles published in 2012 appear to cover all aspects of BPM lifecycle, which made 2012 a unique year amongst the rest. Secondly, we can see this trend to slowly start from 2012 where authors were increasingly making reasonably clear references to BPM lifecycle model in their publications (no non-specified articles since 2012).

	Table 5:BPM Convention							
year	DFD	System Flowcharts	REA	IDEF0/IDEF3	EPC	UML	BPMN	Non-specified
2000								
2001								
2002								1
2003								1
2004								3
2005								4
2006	1	1	1	1	1	1	1	4
2007	2	1	1		1	1	2	2
2008								1
2009	1	2		1	1	1	1	3
2010								4
2011			1		2		3	1
2012		1	1		1	1	3	4
2013							3	4
2014			1	1	2	1	3	3
2015								2
2016			1			1		
2017							1	
2018			1				2	1
2019							1	1
Sum	4	5	7	3	8	6	20	39
Share	6%	7%	10%	4%	12%	9%	29%	57%

Table 5 summarizes the results obtained from categorization of papers for the business process convention models. The table demonstrates that 57% of all papers do not relate to any of the defined languages (categorized as "non-specified"). This finding is in line with a previous study executed by Schultz & Mueller-Wickop (2014). They conducted a research among internal and external auditors in order to obtain an idea about the usage of BPMLs in audit domain. The auditors were questioned whether they apply any of BPMLs in a process audit at all. The result of this analysis

displayed that only 23% of respondents practice BPMLs (Schultz & Mueller-Wickop, 2014). This result clearly might support the finding in Table 5.

However, it might be also concluded that the majority of the studies on the intersection of auditing and BPM is not mentioning or investigating a specific modeling convention. In other words, this means that the type of research conducted is on more generic level, talking about processes without making them concrete. As only minority of authors specify which BPMLs in used in their research, it should not be surprising that these languages were not frequently subject to joint research of both fields.

Moreover, analysis reveals that among the articles which use BPMLs for describing business process under audit, the majority of the work appears to relate to the BPMN model (29 %). BPMN is widely accepted in industry along with academia. With the publication of BPMN 2.0 version in January 2011, it is known as de facto model for business processes and is accepted as a standard (Geiger, 2018). Although REA was originally designed as a base for accounting information systems which targets to define inclines and declines of value in an entity and differs from others by its economic abstraction (Weigand & Elsas, 2012), Table 5 demonstrates very minor coverage of REA among the articles. The least frequently used languages (6&4%) are data flow diagram (DFD) and IDEF0/IDEF3 which are other tools for auditors to set up key controls. For instance, according to Li et al., (2007), DFD can greatly save time for auditors and provide support not only in modeling system, but also being an effective tool for business planning and strategic planning.

In fact, examining the data in Table 5 from a longitudinal perspective, 2 key findings can be acclaimed. First, there were no articles which mentioned business process modeling languages until the year 2006. Second, despite the fact that BPMN is the most discussed language, it gained more popularity from 2011 onwards.

These results point out that in fact BPMLs are not widespread in process audit practice. Accordingly, it is also predictable that auditors prefer to use well known standard office software such as Excel, PowerPoint, MS Word instead of learning the BPMLs which may facilitate auditors demand for annotation and making auditing analysis more clear in a process modeling.

year	Table 6:Research Methods								
	Analytical	Survey	Archival	Experimental	Field Study	Case Study	Literature Review	Model Building	Non-specified
2000									
2001									
2002						1			
2003				1					
2004	1			2					
2005	1			2				1	1
2006	2						1	1	1
2007	3					1	1		1
2008		1							
2009				1	1	1			2
2010				1		1		1	1
2011	2					2			1
2012	1	1		1		5			
2013	1			1	1	3			1
2014		1		2	1	1	1	1	
2015						2	1		
2016	1						1		
2017				1					
2018	1					2	1		
2019				1					1
Sum	13	3	0	13	3	19	6	4	9
Share	19%	4%	0%	19%	4%	28%	9%	6%	13%

The results reported in Table 6 identify the detailed underlying trends in research methods of all publications. For the twenty year period, Table 6 clearly indicates that there was a lack of papers related to archival research method (0%). This can be explained by the innovative approach of the study where primary sources held in archives are hardly utilized. Given that BPM is a new research area, these findings are reasonable. Survey and field study (4%) together with model building (6%) are second lowest ranked research methods. Survey and field studies involve data collection, interviewing and observations. On the other hand, model building entails probabilistic approach and requires practical application. Therefore, these research methods are assumed to be very time consuming and costly, leading authors to select other research approaches.

Case study is a commonly used qualitative method by information systems evaluations (Huang et al., 2009), and is the top research method utilized in the population of our study, with 28%. This result indicates the fact that authors prefer an empirical inquiry that investigates real-life context (Yin, 2003). Case study methodology assists the researchers who need to analyze the case while proposing the reasons (why) and the sequence of processes (how) of the phenomenon. Articles that cover the

conjunction of BPM and auditing primarily investigate more on cause-effect relationship. Consequently, as a means of providing some insight into how responsive auditing procedures are to the business processes, case study is the most relevant research method to provide real-life illustrations.

Experiments (19%) enable researchers to have the means of evaluation risks and testing controls in business processes. Analytical reviews (19%) are an equally important and valuable research method. While experiments are for manipulating one variable to measure the change in the rest of variables, analytical research on the other hand uses facts or information already available for critical evaluation of the specified topic.

Finally, literature review that contains the current knowledge together with theoretical and methodological contributions to a certain topic was less frequently utilized (9%). This finding can be supported by the fact that there was not sufficient amount of literature covering BPM and auditing simultaneously to have allowed authors to perform a sophisticated review and come to a certain conclusion.

Overall, the figures displayed in Table 6 can provide a strong evidence to support the assertion that starting from 2011 the intersection of BPM and auditing domains became a topic of interest for researchers. Equally, this fact also helps to explain why there was a very few number of "non-specified" instances identified post-2011.

	Table 7: Control perspective					
year	Automated	Manual	Detective	Preventive	Corrective	Non-specified
2000						
2001						
2002						1
2003	1		1			
2004	2		2	2		1
2005	2	1	1	2		3
2006	5	2	4	3		
2007	5		3	2		2
2008	1		1			
2009	4		5			1
2010	3	1	4	1		1
2011	3	1	3	2	1	1
2012	6		4	3		1
2013	6	1	4	3	1	1
2014	3	2	5	2		3
2015	2		1	1		
2016	2	1	2			
2017	1		1	1		
2018	2	1	3	1	1	1
2019	2			1		1
Sum	50	10	44	24	3	17
Share	72%	15%	64%	35%	4%	25%

Table 7 demonstrates that authors primarily focus on automated business processes in the context of audit as evidenced by the fact that almost three out of four articles has a mention of automated controls. This is indicative of the trend towards increased adoption of technology and reliance of controls within ERP systems. With technological progress it was also recognized by auditing firms that there exist a need for introducing automated audit procedures. Introduction of system based and automated audit procedures are essential for significant gains in effectiveness and efficiency absence of error of financial audits (Werner et al., 2012). Highly automated systems give auditors the assurance of absence of errors for efficient control testing. The transition from manual auditing to automated auditing by different approach to audit system design and usage of technologies is accompanied with an essential increase in audit performance. Automating traditional auditing is done through computer-assisted auditing tools and techniques (CAATTs). However, not only internal and external auditors are the ones who benefit from availability of methods for automated auditing. Risk management, business management and process owners in general benefit from process mining, reconstruction and visualization that deliver the basis for analyses and

performance (Werner et al., 2012). The increased adoption of automated business processes and audit procedures explain the reason why authors rarely scoped manual controls into their publications. From Table 7 it becomes also clear that, author of the articles cover almost twice more detective controls in their articles than preventative controls (64% versus 35%).

5. DISCUSSION and RECOMMENDATIONS

This section of the study discusses the results and provides recommendation for further findings. The given recommendations specifically focus on least covered dimension in the findings in order to provide direction for future research.

Firstly, it is worth to mention that the coverage of business processes in the reporting stage of audit is non-existent in the current body of literature as reporting stage only involves communication of control deficiencies. However, this communication and reflection of the management on the control deficiencies are important to assess how willing the management/those charged with governance is to mitigate the risks arising from the control failures and create a more sound control environment for the purposes of the next year audit. As this is one of the by-products of audit, it is worth exploring to what extent audited businesses take advantage of the audit recommendations with regard to improvements in the business processes.

On top of this, with popularization of IS, computer auditing has become very significant. In order to support the auditing activity in acquiring knowledge of IS, various computer-assisted audit techniques and tools have been used (CAATTs) (Braun and Davis, 2003). However, most CAATTs provide substantive tests of IS. If CAATTs only provide the substantive test of IS, this may lead to failure of finding business process gap between IS process flow and internal control flow. Consequently, both the control test and substantive test are complement of each other and need to be included in the CAATTs since auditors need to audit not only the output data produced after IS process flow, but also focus on the activities operated during IS process flow itself (Huang et al., 2009).

Information and communication of COSO internal control framework is the next component that demands attention by the authors as the literature review showed zero input of this aspect of COSO in the publications. As part of any kind of evaluation in terms of internal control, information and communication flow or process in the organization is one of the most substantial elements that need to be understood. Although, information and communication come naturally, it is essential to remember its importance at all levels to achieve entity's operational, financial and compliance goals. For instance, in order to make a correct marketing decision, the information related to financial reports needs to be communicated to outside investors, as well as internal cost and external market preferences. Any information flow should be interpreted from top levels to lower levels and vice versa in a very clear and certain way. Therefore, the importance of keeping information and supporting

system consistency is one of the factors that authors do not have to forget while interpreting internal controls that auditors conduct.

Additionally, in case of research approach, it is obvious that there exist an opportunity for authors to strengthen their studies more by concentrating on quantitative studies of evidence. Table 6 shows that field studies and surveys (4%) along with model building (6%) are the least covered research methods among all the articles. By increasing the number of field studies will lead to get more precise and detailed data, and uncover social facts that may not be obvious at first glance. Surveys maintain high level of representativeness, while also possessing good statistical significance with precise results. By increasing the number of articles with model building as their research method will lead to the usage of computer science as theoretical base for research method. In fact, focusing on quantitative studies of evidence stimulates identification and qualification of effect size and its direction.

6. LIMITATIONS

This section of paper discusses acknowledged limitations of the literature review. When considering the results obtained, it is necessary to take into consideration the fact that they only provide starting points for future research given that there is no designed literature review covering the conjunction of BPM and auditing to approve or disapprove these postulated assumptions.

Firstly, the scope of the literature review was limited to papers published from 2000 to 2019. This scope was chosen deliberately since it is believed that the topic of this study is quite recent and most of the papers would be related to this time scope only. In fact, our analysis demonstrated that there was not any paper from 2000 and 2001 related to the conjunction of BPM and auditing topic, meaning that the time scope was chosen adequately right.

Secondly, the time range restricts inclusion of up-to-date academic papers which were written already but have not obtained confirmation for online posting. Obviously, inclusion of these papers in our data would slightly increase the probability of getting a few more recent articles.

However, it is worth to mention that both limitations are non-controllable and do not significantly impact the scope of our literature review.

Also, it should be noted that classification of the publications is subject to a degree of judgment however this was partly mitigated by having the classification reviewed by two other professors. Therefore, the level of judgment is deemed to be minimal and should not skew results of the literature review.

7. CONCLUSION

This structured literature review was conducted in order to facilitate the emerging need of research between the combination of two fields-BPM and auditing. This is the first structured literature review that collects and integrates all the related articles that brings BPM and auditing fields together. Overall, this study categorizes the collected list of articles with adopted classifications related two both fields. The first point to come out from this research is that "understanding clients business and audit planning" of audit phases was addressed mostly in the determined list of articles. Secondly, audit tasks such as OR43 and OR5 stands out more frequently when evaluating and testing business processes. "Control activities" perspective of COSO framework is primarily addressed in the defined publications of this research. Next, "discovery stage" of BPM lifecycle investigated more frequently compared to other stages of BPM. Then, among other business process modeling conventions BPMN appear to be in majority of papers in the existing body of literature. The main research methods classification that was addressed mostly in the determined list of articles is "case studies". Lastly, the data claim that joint research of BPM and auditing has shifted from investigation of manual towards automated controls. A sound overview and detailed synthesis of what have been covered up to date have been discussed while also focusing on potential opportunities that businesses may benefit. Combination of the two fields is associated with value-added opportunities for businesses. Given the identified deficiencies of existing research, this paper presents future research directions for further research about this important field of study.

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9. APPENDIX

List of the Articles for the Research:

	TITLE	AUTHOR	PUBTITLE	YEAR
1.	A Responsive Audit for Production and Order fulfillment Process	D. McFarlane, Y. Chang, J. Matson, A. Shaw	International Journal of Operations and Production Management	2002
2.	The Influence of Business-Process-Focused Audit Support Software on Analytical Procedures Judgments	O'Donnell, Ed;Schultz, Joseph J, Jr	Auditing: A Journal of Practice & Theory	2003
3.	Are Financial Auditors Overconfident in Their Ability to Assess Risks Associated with Enterprise Resource Planning Systems?	Hunton, James E;Wright, Arnold M;Wright, Sally	Journal of Information Systems	2004
4.	The Impact of Strategic-Positioning Information on Auditor Judgments about Business-Process Performance	Ballou, Brian;Earley, Christine E;Rich, Jay S	Auditing: A Journal of Practice & Theory	2004
5.	Principles of Analytic Monitoring for Continuous Assurance	Vasarhelyi, Miklos A. Alles, Michael G. Kogan, Alexander O'Leary, Dan	Journal of Emerging Technologies in Accounting.	2004
6.	Embedded Audit Modules in Enterprise Resource Planning Systems: Implementation and Functionality	Debreceny, Roger S;Gray, Glen L;Joeson Jun-Jin Ng;Lee, Kevin Siow-Ping;Woon-Foong Yau	Journal of Information Systems	2005
7.	Risk Management in the BPM Lifecycle	Michael zur Muehlen and Danny Ting-Yi Ho	Business Process Management Workshops	2005
8.	Continuity Equations in Continuous Auditing: Detecting Anomalies in Business Processes	Michael Alles; Alex Kogan; Miklos Vasarhelyi; Jia Wu	Working Paper, Chapman University	2005
9.	The influence of a business-process focus on category knowledge and internal control evaluation	Lori S. Kopp; Ed O'Donnell	Accounting, Organizations and Society	2005
10.	CONTINUOUS AUDITING: THE USA EXPERIENCE AND CONSIDERATIONS FOR ITS IMPLEMENTATION IN BRAZIL	Alles, Michael G;Tostes, Fernando;Vasarhelyi, Miklos A;Riccio, Edson Luiz	Journal of Information Systems and Technology Management : JISTEM	2006
11.	Business Process Risk Management, Compliance and Internal Control: A Research Agenda	Pall Rikhardsson; Peter Green; Peter J. Best; Michael Rosemann	Management Accounting Research Group	2006

12.	Business process modeling approaches in the context of process level audit risk assessment: An analysis and comparison	Carla Carnaghan	International Journal of Accounting Information Systems	2006
13.	Continuous monitoring of business process controls: A pilot implementation of a continuous auditing system at Siemens	Michael Alles;Gerard Brennan; Alexsander Kogan;Miklos A. Vasarhelyi	International Journal of Accounting Information Systems	2006
14.	Continuous Data Level Auditing: Business Process Based Analytic Procedures in an Unconstrained Data Environment	Michael G. Alles; Alexander Kogan; Miklos A. Vasarhelyi	Department of Accounting & Information Systems, Rutgers Business School	2006
15.	DEVELOPING A CONTINUOUS AUDITING ASSISTANCE SYSTEM BASED ON INFORMATION PROCESS MODELS	Li, Shing-Han;Huang, Shi-Ming;Lin, Yuah-Chiao G	The Journal of Computer Information Systems	2007
16.	Creating a Business Process Diagram and Database Queries to Detect Billing Errors and Analyze Calling Patterns for Cell Phone Service	Borthick, A Faye; Jones, Donald R.	Journal of Information Systems	2007
17.	Strategic organizational conditions for risks reduction and earnings management: A combined strategy and auditing paradigm	Loi Tech Hui; Quek Kia Fatt	Accounting Forum	2007
18.	An algorithm for the appraisal of assurance indicators for complex business processes	Fabio Massacci; Artsiom Yautsiukhin	Conference: Proceedings of the 3th ACM Workshop on Quality of Protection	2007
19.	Auditing Business Process Compliance	Aditya Ghose; George Koliadis	International Conference on Service-Oriented Computing	2007
20.	USING AUTOMATED CONTROLS TO Ensure Better, Faster, Cheaper Audits	Roland Holly	Financial Executive	2007
21.	System Diagramming Techniques: An Analysis of Methods Used in Accounting Education and Practice	Bradford, Marianne; Richtermeyer, Sandra B; Roberts, Douglas F.	Journal of Information Systems	2007
22.	Putting Continuous Auditing Theory into Practice: Lessons from Two Pilot Implementations	Alles, Michael G;Kogan, Alexander;Vasarhelyi, Miklos A	Journal of Information Systems	2008
23.	A business process gap detecting mechanism between information system process flow and internal control flow	Shi-Ming Huang , David C. Yen, Yu-Chung Hung , Yen-Ju Zhou, Jing-Shiuan Hua	Decision Support Systems	2009
24.	Do Client-Prepared Internal Control Documentation and Business Process Flowcharts Help or Hinder an Auditor's Ability to Identify Missing Controls?	Bierstaker, James Lloyd;Hunton, James E;Thibodeau, Jay C	Auditing: A Journal of Practice & Theory	2009
25.	An Investigation of Factors Influencing the Use of Computer-Related Audit Procedures	Janvrin, Diane;Bierstaker , James;Lowe, D Jordan	Journal of Information Systems	2009

26.	Knowledge-Intensive Business Process Audit: The Practical Aspect	Itzhak Aviv; Meira Levy; Irit Hadar		2009
27.	Enhancing Knowledge-Intensive Business Processes via Knowledge Management Audit	Meira Levy; Irit Hadar; Itzhak Aviv	Conference: Proceedings of the 15th Americas Conference on Information Systems	2009
28.	Auditing 2.0: Using Process Mining to Support Tomorrow's Auditor	Wil M. P. van der Aalst; Jan Martijn E.M. Van der Werf; Kees M. van Hee; Verdonk Marc	Computer	2010
29.	On-the-fly Auditing of Business Processes	Kees van Hee, Jan Hidders , Geert-Jan Houben, Jan Paredaens , and Philippe Thiran	Transactions on Petri nets and other models of concurrency IV	2010
30.	Business Process Analytics	Michael zur Muehlen; Robert Shapiro	Handbook on Business Process Management 2	2010
31.	Integrating business risk into auditor judgment about the risk of material misstatement: The influence of a strategic-systems-audit approach	Joseph J.SchultzJr.; James LloydBierstakerb ; EdO'Donnellc	Accounting, Organizations and Society	2010
32.	Automated Certification for Compliant Cloud-based Business Processes	Accorsi, Rafael; Lowis, Lutz; Sato, Yoshinori.	Business&Information System Engineering	2011
33.	Prolegomena of a modelling method in support of audit risk assessment- Outline of a domain-specific modelling language for internal controls and internal control systems	Strecker, Stefan & Heise, David	Enterprise Modelling and Information Systems Architectures	2011
34.	How to audit a business process excellence implementation?	Niels Gorm Malý Rytter; Torben Knudby; Kim Hua Tan; Rikke Vestergaard Matthiesen; Chris Voss	18th Annual Euroma Conference	2011
35.	A challenging success: a process audit perspective on change	Alison Parkes and Michael Davern	Business Process Management Journal	2011
36.	A business process mining application for internal transaction fraud mitigation	Mieke Jans; Jan Martijn van der Werf;Nadine Lybaert;Koen Vanhoof	Expert Systems with Applications	2011
37.	Linking accounting and process-aware information systems - Towards a generalized information model for process-oriented accounting	Jan vom Brocke; Christian Sonnenberg ;Ulrike Baumoel	Conference: 19th European Conference on Information Systems	2011
38.	The Effect of Business Process Representation Type on Assessment of Business and Control Risks: Diagrams versus Narratives	Boritz, J Efrim;Borthick, A Faye;Presslee, Adam	Issues in Accounting Education	2012

39.	Designing Continuous Auditing for a Highly Automated Procure-to-Pay Process	Borthick, A Faye	Journal of Information Systems	2012
40.	Intra/inter process continuous auditing (IIPCA), integrating CA within an enterprise system environment	Majdalawieh, Munir; Sahraoui, Sofiane; Barkhi, Reza.	Business Process Management Journal	2012
41.	Business process auditing on an SOA foundation	Shing-Han Li, Shih-Chih Chen, Chung-Chiang Hu,Wei-Shou Wuand Mark Hwang	International journal of innovative computing, information & control	2012
42.	Business Process Mining and Reconstruction for Financial Audits	Michael Werner; Nick Gehrke; Markus Nüttgens	Conference: 45th Hawaii International Conference on System Science	2012
43.	Business Process Models for Risk Analysis: Expert View	Hamzah Ritchi; Jan Mendling	International Conference on Information Resources Management	2012
44.	Supporting Applications Development and Operation Using IT Security and Audit Measures	Katalin Szenes	e-Informatica Software Engineering Journal	2012
45.	Key performance indicators for traffic intensive web-enabled business processes	Ka I. Pun, Yain Whar Si, Kin Chan Pau	Business Process Management Journal	2012
46.	The Predictive Audit Framework	Siripan Kuenkaikaew; Miklos A. Vasarhelyi	The International Journal of Digital Accounting Research	2013
47.	MODELING CONCEPTS FOR PROCESS AUDITS – AN EMPIRICALLY GROUNDED EXTENSION OF BPMN	Mueller-Wickop, Niels & Schultz, Martin & Nüttgens, Markus	Proceedings of the 21st European Conference on Information Systems	2013
48.	Towards Automated Analysis of Business Processes for Financial Audits	Michael Werner, Nick Gehrke, and Markus Nüttgens	Conference: 11th Internationale Tagung Wirtschaftsinformatik	2013
49.	Enriching Process Models for Business Process Compliance Checking in ERP Environments	Martin Schultz	Conference: Proceedings of the 8th international conference on Design Science at the Intersection of Physical and Virtual Design	2013
50.	Why Are Business Processes Not Secure?	Günter Müller and Rafael Accorsi	Springer, Berlin, Heidelberg	2013
51.	Auditor Business Process Analysis and Linkages among Auditor Risk Judgments	Natalia Kochetova-Kozloski, Thomas M. Kozloski, and William F. Messier, Jr.	Auditing: A Journal of Practice&Theory	2013
52.	The case for process mining in auditing: Sources of value added and areas of application	Mieke Jans; Michael Alles;Miklos Vasarhelyi	International Journal of Accounting Information Systems	2013
53.	The missing link between BPM and accounting	Christian Sonnenberg and Jan vom Brocke	Business Process Management Journal	2014

54.	Towards Auditors' Preferences on Documentation Formats in Business Process Audits	Martin Schultz; Niels Mueller-Wickop	Conference: Proceedings of the Modellierung 2014	2014
55.	Modeling Concepts for Internal Controls in Business Processes – An Empirically Grounded Extension of BPMN	Martin Schultz; Michael Radloff	Conference: International Conference on Business Process Management	2014
56.	SYNERGISTIC EFFECTS OF INTERNAL AUDIT AND LEAN-SIX SIGMA CONCEPT ON BUSINESS PROCESS IMPROVEMENT	Milica ĐorĐević, Bojana Novićević Čečević	Economics and Organization	2014
57.	Conceptual Model of Accounts - Closing the Gap between Financial Statements and Business Process Modeling	Niels Müller-Wickop; Markus Nüttgens	Modellierung	2014
58.	Business Modeling to Improve Auditor Risk Assessment: An Investigation of Alternative Representations	J. Efrim Boritz; Carla Carnaghan; Paulo S. Alencar	JOURNAL OF INFORMATION SYSTEMS	2014
59.	Continuous Auditing and Continuous Monitoring in ERP Environments: Case Studies of Application Implementations	Singh Kishore; Best Peter J.; Bojilov Mario; Blunt Catherine	Journal of Information Systems	2014
60.	Examining knowledge audit for structured and unstructured business processes: a comparative study in two Hong Kong companies	Jessica Y.T. Yip, Rongbin W.B. Lee and Eric Tsui	Journal of Knowledge Management	2015
61.	Accounting Information Systems: Evolving towards a Business Process Oriented Accounting	Antonio Trigo; Fernando Belfo; Raquel Pérez Estébanez	Procedia Computer Science	2016
62.	Process Model Representation Layers for Financial Audits	Michael Werner	Conference: 2016 49th Hawaii International Conference on System Sciences	2016
63.	Financial process mining - Accounting data structure dependent control flow inference	Michael Werner	International Journal of Accounting Information Systems	2017
64.	A Practical Extension of Frameworks for Auditing with Process Mining	Ella Roubtsova and Niels Wiersma	Conference: ENASE 2018 : 13th International Conference on Evaluation of Novel Approaches to Software Engineering	2018
65.	A systematic approach to diagnose the current status of quality management systems and business processes	Jose Arturo Garza-Reyes	Business Process Management Journal	2018
66.	Nexus between business process management (BPM) and accounting: A literature review and future research directions	Ahangama Withanage Janitha Chandimali Abeygunasekera, Wasana Bandara, Moe Wynn, Ogan Yigitbasioglu	Business Process Management Journal	2018
67.	How active learning and process mining can act as Continuous Auditing catalyst	Mieke Jans;Marzie Hosseinpour	International Journal of Accounting Information Systems	2018
68.	The influence of business process representation on performance of different task types	Ritchi, Hamzah; Jans, Mieke J.; Mendling, Jan & Reijers, Hajo	Journal of information systems	2019

69.	Application of the quick scan audit methodology in an industrial filter production process	Biao Yanga, Annabelle A. Obeng Frimpong, Ying Yang and Lana Liu	Production Planning & Control; The Management of Operations	2019