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# Business Process Models for Risk Analysis: Expert View

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## ***Abstract***

The recent financial turbulences raise questions on how risk analysis is conducted. Regulatory requirements and professional standards have been introduced in the last decade in order to obtain a more reliable internal control on financial reporting process with a new emphasis on business processes. However, there are no standards yet available on how business processes should be captured for facilitating risk analysis in audit assignments.

Representations of business processes have been investigated in the field of business process modeling. There exists a broad spectrum of notations and formalisms with relative strengths and weaknesses. Many of the popular notations build on a graph-based representation where activities of a process are connected with directed arcs defining the control flow. Such notations have been widely adopted for redesigning business processes. But also text-based formats have been defined. Corresponding process specifications define the activities of a process as lists with additional free text information. This raises the question whether the tools and methods for analyzing business process risks in auditing practice is appropriate for its objective.

This paper reveals the benefits of adopting business process models for auditors toward understanding a companies business processes and the issues need to be considered for further development. The analysis also shows that practitioners use process models rather for risk elicitation and less in risk assessment.

## ***Keywords***

Business process model, risk and control, risk assessment, risk elicitation, cognitive science

## **1. Introduction**

Business processes have been under ongoing investigation in both research and practical studies. Among those disciplines that are in active inquiry are organizational strategy, accounting and auditing, computer science and information system. Attention has been increasingly drawn to business process understanding to serve assurance practitioners identify, analyze, and measure risks of accounting material misstatement tied to identifiable business risks and the associated controls mitigating such risks.

The recent financial turmoil due to business misconduct raises questions on how risk analysis is conducted. Compliance management approaches comprising both regulatory requirements and

governance standards have been introduced in the last decade in order to fortify accuracy of description of the financial situation of a company as well as the business process performed within the company. Standards such as the International Standard on Auditing (ISA) echo the cause by the introduction of a new emphasis on business processes (IFAC 2010).

Furthermore, companies are increasingly relying on information system for the execution of their business processes, making business process risk and control assessment a more comprehensive undertaking to auditors. A proper documentation of the company's business processes on a detailed level provides suitable foundation step to analyze the company's risk situation (Karagiannis 2008). However, there are no standards yet available on how business processes should be captured for facilitating risk analysis in audit assignments or assurance practices in general.

Business process models typically capture specific properties with regards to an organization's processes. It basically involves an abstraction from the real-world business process for certain purposes (Mendling 2007 p.29). A recent study showed that modeling business process for documentation, improvement and collaboration are among the top six purposes of conceptual modeling (Davies et al. 2006). While process modeling appears to be established in business process redesign, questions persist on the capability of process model to better document, understand, and accurately identify areas of risk (Boritz et al. 2010).

Representations of business processes have been investigated in the field of business process modeling. There exists a broad spectrum of notations and formalisms with relative strengths and weaknesses. Many of the popular notations build on a graph-based representation where activities of a process are connected with directed arcs defining the control flow. Such notations have been widely adopted for redesigning business processes. But also text-based formats have been defined. Corresponding process specifications define the activities of a process as lists with additional free text information. This raises the question whether the tools and methods for analyzing business process risks in assurance practice is appropriate for its objective.

Cognitive science literatures have demonstrated that different kinds of representations may or may not fit well with certain tasks. One theory with strong empirical validation to date is cognitive fit theory as proposed by Vessey (1991). It provides a good foundation for discussing the question of representational appropriateness. In line with this observation, the main contribution of the paper is to identify a set of requirements that a prospective standard for process modeling in audit assignments would address. We investigate process-related risk analysis using an expert interview method. The interviews also reveal the need for a more formalized approach, which should facilitate automatic analysis in order to quickly draw relevant conclusions under time pressure.

The paper is structured as follows. Section 2 introduces the backgrounds of process-level risk analysis, the conceptual foundations of business process modeling, and a cognitive research perspective on different types of process representation. Section 3 describes our research approach, namely the expert interview guideline and the participants we interviewed. Section 4 presents the findings. We identify two levels of process analysis, which are risk elicitation and risk assessment. The analysis shows that practitioners use process models rather for risk elicitation and less in risk assessment. Finally, Section 5 concludes the paper.

## **2. Theoretical Background**

### **2.1 Process Risk Analysis**

Current accounting and auditing practices are progressively adopting a risk-based audit approach. In this approach, risk analysis places more emphasis on the broader business risks rather than financial risk of the underlying business processes (Vîlsănoiu & Şerban 2010). Risk analysis entails eliciting relevant business risk beneath the underlying business processes (risk elicitation) and assessing the magnitude of such risk for any subsequent tests (risk assessment). Risk assessment conveys the judgment of auditors as the result of the educating risk information. It is important to find out how business process model would facilitate auditors in making any attestation judgment optimally.

The risk-based audit approach initially determines business risk exposures facing an accounting information system, such as any errors and irregularities. It then identifies a set of standard controls that would reduce the risks likelihood. Then, the existing controls and the set of standard controls are compared and any deficiencies and solutions are identified. Finally, auditors and managers test these controls to verify if they are performing as documented (Xiong & Martin 2006). Risk-based analysis thus requires identifying and documenting business processes and controls associated with financial reporting as prerequisites for risk assessment.

Moreover, greater reliance on information systems for timely, comprehensive and accurate execution of business processes results in accompanying business risk relevant to the process of provisioning accounting information (IFAC 2010). Corporately integrated systems arguably become more and more influencing to and an integral part of financial reporting process in which they are integrated in initiating, authorizing, recording, processing and reporting accounting information corresponded to typical business cycles encompassing like purchasing, manufacturing to selling.

The international Standard on Auditing (ISA) 315 states the importance to understand information system and business processes (IFAC 2010, paragraph A84).

“Obtaining an understanding of the entity’s business processes, which include how transactions are originated, assists the auditor to obtain an understanding of the entity’s information system relevant to financial reporting in a manner that is appropriate to the entity’s circumstances.”

Application and systems have controls programmed into them. Some of these programmed controls may be critical to the evaluation of internal control over financial reporting. It is therefore imperative that auditor acquire sufficient knowledge of all automation technologies in business process execution to evaluate its role on risk exposure and internal control efficacy.

### **2.2 Business Process Modeling**

From a resource-based perspective, business processes as instrumental factors toward a company’s distinctive resources – valuable, rare, non-substitutable – are costly and difficult to imitate (Bharadwaj 2000). A free interpretation of a business process defines it as a set of logical and interrelated sequence of activities in a certain loop, which are performed to accomplish a particular business object (event or goals) delivered to business related parties (division, customer, supplier, etc). It is regarded as the key instrument to organizing activities and to improving the understanding of their interrelationships (Weske 2007).

Criticality of business processes is demonstrated through business process management (BPM) and its life cycle (Mendling 2007). According to Aalst et al. (2003) BPM is defined as “supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents and other sources of information”. Once business processes are defined, they can be subject to analysis, improvement, and enactment from organizational and technical perspective.

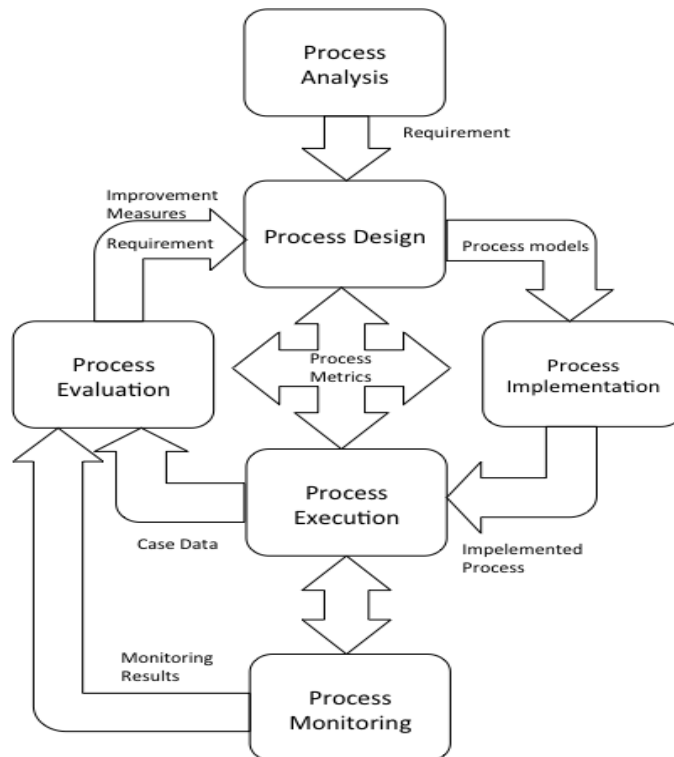
BPM is organized according to a lifecycle comprising process discovery, analysis, design, implementation, execution, monitoring and controlling (zur Muehlen & Ting-Yi Ho 2006). Figure 1 displays these phases. All phases comprehensively incorporates IT elements, reflecting the instrumental role of IT in the business and IT collaboration. A business process model – a graphically oriented way of how organizations conduct their business processes – plays an important role in the design, implementation and enactment phases of the BPM lifecycle, e.g process improvement, compliance, quality assurance and software development (Mendling 2008).

Several works have reported the use of business process modeling. The work of Davies et al. (2006) report that process modeling is among the top six purposes of conceptual modeling. They are used for improvement of internal business processes, workflow management, and improvement of collaborative business processes. Other purposes, namely identification of value added activities and internal control assessment also gain fewer score. Nevertheless, they may be attributed to the purpose of business process modeling. Process modeling takes place in different BPM phases: to document organizational processes and to specify information system requirement (Figl et al. 2009); to conduct process improvement, understanding and communication between participants (Indulska et al. 2009); and to provide specification of an executable automation or semi automation workflow (Mendling et al. 2008).

As of today, the range of business process modeling languages spans simple flowcharting diagramming (American Standard National Institute 1970), software requirement engineering oriented languages like UML activity and use case diagram (Booch et al. 1999), data flow diagramming (Gene & Sarson 1979; Demarco 1979), REA model (McCarthy 1982), dedicated process oriented notation like EPC (Scheer 1992), Petri nets (Petri 1962) and BPMN (Object Management Group 2008). Proliferation of such modeling techniques thus necessitates a rigorous evaluation and comparison on the syntactic, semantic or pragmatic aspects of such techniques.

### **2.3 Business Process Representation for Risk Assessment**

Business process models are essentially visual representations of a business domain (Moody 2009). Studies of business process modeling for the assurance domain are at the nexus of business process modeling, cognitive science and accounting information system. The business process modeling literature is used for explaining what needs to be modeled to understand a business process, and demonstrating the feasibility of business process modeling. With relation to cognitive science, the studies center on how an alternative business process representations externally impacts a user’s problem solving performance (Alencar et al. 2008). Accounting information system resources focus on risk and control consideration over financial reporting process and various corresponding business processes in a company



**Figure 1: Business Process Management Lifecycle**  
Source: (zur Muehlen & Ting-Yi Ho 2006)

Studies on the relationship between business process representation and process level risks analysis includes two categories. First are those examining the relationships between general information representation with judgment and decision making in accounting. Early work of Larkin and Simon (1987) suggest that the form of visual information representation can have a significant impact over textual representation on the efficiency recognition of information, and inference upon the information extracted, provided that the representation creates not only informational equivalence but also surpasses alternative forms with its computational equivalence.

Cognitive fit theory (Vessey 1991) posits that a correspondence between task and information representation leads to superior task performance for individual user. Different kinds of representations therefore may or may not fit well with certain tasks (Shaft & Vessey 2006; Tuttle and Kershaw 1998; Vessey & Galletta, 1991). Empirical research has been conducted examining the cognitive fit between four modeling techniques but do not extend to the comparison with narrative representation of business process (Griggs et al. 2006; Jones et al. 2002). At the same domain, Kelton et al. (2010) develop an integrated model of information presentation research based upon the theory of cognitive fit and use the model to summarize prior literature.

The second relevant field is concerned with analysis of business processes for the assurance practice. Carnaghan (2006) suggests business process related internal controls as a way to address business risk and the risk of material misstatement. The effect of business process representation to risk assessment in this area however is reportedly undecided. Dunn and Gerrard (2001) examined the effects of alternative forms of information system documentation on auditor

decision making and found that when there was a high degree of localization, user experience importance was decreased.

In line with that, Kopp and O'Donnell (2005) suggest that a business process focus is found to be more effective for organizing internal control evaluation task and category knowledge than an objective focus. Furthermore, O'Donnell and Schultz (2003) found that audit seniors were better able to identify risks when using audit evidence according business process as opposed to transaction cycle. Xiong and Martin (2006) describe a pair of data centric and process centric diagramming techniques (REA and DFD) that can be used to map internal controls, but do not empirically test them.

Other works appear to show opposite results. While business assurance had long been utilizing process documentation tool, namely flowcharting, Recker et al.'s (2009) ontological analysis reported lack of constructs which may explain the limited capability of using relaxed form of business process model for auditing. Also, Boritz et al. (2010) report that no difference exists from business process presentation methods for risk assessment between business process diagrams with narrative. Given that no strong claim over the above mentioned studies, the question whether business process models have an influence on risk assessment remains open.

Although auditors have to comply with standards, the approach to fit with the standards may differ from firms to firms. These firm specific audit methodology may or may not adopt business process model to help their job done. Since business process representation format and user characteristics are considered important for creating cognitive fit and better domain understanding and decision making (Recker & Dreiling 2011; Khatri et al. 2006; Dunn and Grabski 2001), investigation of how a business process model is adopted and presented for risk and control assessment for business process is warranted.

### **3. Research Approach**

This research aims at clarifying current issues involved to achieve at a preliminary practice-driven research agenda in business process modeling use for risk and control assessment. For this purpose two steps are conducted:

1. Expert interviews with selected auditors in business assurance and information assurance. These interviews aim at obtaining the current state of the practical use of business process models in the assurance and advisory domain. We need to understand what role and to what extent the types of the adopted business process representations play in helping auditors to assess risks and application controls at a business process level.
2. Literature analysis with selected business process modeling related papers to achieve sufficient level of agreement with the interview transcription. In this way, we strive to achieve a structured way of validating the findings identified during the interviews with issues and requirement that are seen relevant within the extant literature of business process modeling issues and benefits. The resulting outcome is a literature-validated set of requirements of business process model for risk and control assessment.

#### **3.1 Expert Interview**

The interviews were conducted with six assurance professionals working in financial audit and information system audit at Germany's big four consulting firms. Participants were interviewed over a three month period (September 2011 to November 2011), including the transcription and analysis process. Five of the meetings were personal meeting while one of the meetings was

telephone conference. Due to confidentiality and ethical reasons, the details of the companies are not revealed in this paper.

Rikhardsson et al. (2006) advise for establishing key criteria for engaging an interview. The selection of the participants as well as the firms is based on the following considerations:

1. Familiarity. Consulting firms and accounting firms are the perfect locus to represent the adoption of business process model and risk assessment since it is expected that most of engagement requires specific steps of assessing risks and controls.
2. Size. The companies have a size sufficient for risk management and internal control to take place in comprehensive manner.
3. Working Experience. We strive to get participants with senior or manager expertise. Having sufficient experience would indicate the strength of intimacy within risk assessment and business process analysis domain. One participant had less than two years working experience though. We included the participant however, with hope to maintain a balanced view of what more senior participants commented.
4. Breadth of Task. Equivalent with working time, we target participants with a comprehensive set of engagements. This would make the participants able to identify specific issues and predict particular challenges ahead.
5. Accessibility. The participants selected are based on their support and acceptance for research projects. As part of the research program is to disseminate results to the corresponding interview participants.

An explorative semi-structured interview was the chosen approach of research. It enabled the interviewees to think about topics, themes and core content in a more expressive way and to reflect upon and link their experiences and perceptions as well as to express additional ideas and perspectives. Each interview lasted approximately 30 minutes to 1 hour. The question guide was used mentioning several broad issues within risk and control assessment and business process modeling use for risk identification. Figure 2 exhibits the collapsed version of main questions to the interviewees.

The question list however was set to be in a relaxed setting to motivate senior consultants and managers to speak of what they had impulsively in mind in relation to business process model use for risk assessment. The profile of the participants interviewed is shown in table 1. All conversation are recorded and transcribed, except one interviewee objected for being digitally recorded. Doing this work may empirically exhibit limitation. But it is important to note that this preliminary work of the sample is to point out areas that are currently relevant for further robust empirical investigation.

Respondents have been providing services to a variety of industries and clients ranging from energy, power utilities, technology, real estate, construction, industrial, logistics, automotive, to retailers. Banking and financial client are normally handled by other divisions. Their clients' size varied, ranging from small medium companies up to global enterprises, though these firms' clients are normally multinational in nature.



- + Demographic questions
- + General approach to risk and control assessment
  - + Importance of risk assessment
  - + Importance of business process understanding for risk evaluation
- + Detailed analysis with process models adopted
  - + Important features to capture
- + Detailed analysis without process models adopted
  - + Important feature to capture
  - + How to achieve business process understanding
- + Strength and weakness perception of using process model for assurance

**Figure 2.** Questions list during interview

Participants	Working Experience	Position	Domain of Expertise	Firms	Interview Mode
P 1	More than 5 years	Senior Manager	Information System Assurance and Advisory	Big 4 Accounting Firm	In person
P 2	5 years	Senior Consultant	Business Assurance	Big 4 Accounting Firm	In person
P 3	More than 5 years	Senior Consultant	Business Assurance and Information System Assurance	Big 4 Accounting Firm	In person
P 4	5 years	Assistant Manager	Business Assurance	Big 4 Accounting Firm	In person
P 5	More than 5 years	Manager	Information System Assurance and Advisory	Big 4 Accounting Firm	Telephone
P 6	1.5 years	Consultant	Information System Assurance and Advisory	Big 4 Accounting Firm	In person

**Table 1.** Demographic profile of interviewees

**3.2 Literature Review for Key Areas Classification**

At the outset, we examined prior research papers whose topics were on issues, challenges or benefits specifically within the BPM and business process modeling field. To ensure relevancy of the domain knowledge, papers selected shall be authored by scholars who are actively engaged in business process modeling development. This work analytically examines issues in BPM and business process modeling which are regarded relevant for risk assessment from prior research papers. For instance, we use papers reported by Indulska et al. (2009a) that work on the identification of process modeling benefits through a Delphi study design. The other example references include but are not limited to Indulska et al. (2009b), Indulska et al. (2007), Bandara et al.(2007) and Indulska et al.(2006).

Key areas discussed in the selected literature may encompass benefits of business process modeling, business process language standardization, key risks and control important to BPM or modeling projects and communication issue within project management. Findings from the prior works are then analyzed and mapped to the classification of a set of issues and requirements applicable to business process risk assessment as close and relevant as possible.

To the best of our knowledge, no guidelines exist for mapping general BPM issues to domain specific matters. However, care was taken to ensure the mapping procedure demonstrates rigorous scrutiny. Requirements for business process risk assessment must have a logical

relationship with those in the more general list. Interview results are then matched and classified with issues specific to assurance to enhance external validity of the findings.

## **4. Findings and Discussion**

We organize and discuss our findings into two related parts. The first part discusses findings from the interview and literature analysis. Table 2 shows issues that are most frequently mentioned and emphasized based on the questions posed in the interview. As explained in Section 3, the literature serves as the complementary analysis and explanation for the overall findings. Therefore, Section 4.1 will address overall issues from the perspective of both interview and literature review. Please note that the order does not indicate importance. The second part converses the extent of business process model use as perceived by the experts in light of process-level risk analysis.

### **4.1 Issues in Business Process Model Use**

#### *4.1.1 Importance of Risk Assessment*

Assurance practitioners work on specified rules, procedures, judgments, and risk assessment processes which are based on generally accepted professional standards. Thus, it is not surprising that common agreement exists across participants on the importance of risk assessment, as risk assessment and other procedure are mandatory elements in a risk-based audit approach. Even, most of participants confirm that building the understanding of risk is very important during the interview. Auditors start from evaluating risks and then they build the special audit program that answers the identified risks. One participant reconfirmed that assessing risk and control is quite important as *“we are going to determine on the risk and control assessment on how much a substantial testing we are going to do. So if you have good controls and good IT systems we are basically doing less substantive tests“*.

The notion of risk assessment importance however seems to have been hardly mentioned in the literature investigating recent issues in BPM as explained in section 3.2. The arguments for this may be that these BPM studies focus relatively more on phases of BPM like process design and process execution, leaving the importance of risk assessment as an indirect element of business process model study. Nevertheless, as risk assessment is clearly linked with how business processes are conducted, it is worth to inspect the best possible ways of locating risks in business process model.

#### *4.1.2 Standardization*

Standardization of process models is an equally stressed topic across participants during the interview. The interviews generally show two findings based on two questions. One question asks what process model is currently used by financial and information system auditor. As much as the potential benefits promised by the use of common business process language, the majority of financial and information system auditors being interviewed however are continuously using flexible forms of flowcharting while others are using unspecified diagrams which only understood by a small group. One possible explanation for the relaxed use of business process modeling languages is that these grammars are seen as if auditors were using a transaction cycle audit approach, which views business process diagrams as part of normal requirements rather than a critical document for thoroughly understanding the business process. The recently proposed standard BPMN (Business Process Modeling Notation) by OMG (OMG, 2008) does

not seem, in the short term, replace the flowcharts as a tool for risk and control identification according to the responses by interviewees.

The other question asks whether auditors using business process model should adopt a standardized language for every audit assignment, especially for risk and control assessment. The participants respond that the adoption of a standardized business process grammar for risk analysis is desirable, provided that all stakeholders in the assurance engagement are speaking the same language. If it is a widely adopted standards, “it would be really really helpful, because then you basically speak the same language ... *If it's just one of many standards, it's not really a big use for me, because I have to make sure that I understand different standards.*” Another concern in relation to standardization of business process models involve what notations would facilitate business process risk and control understanding to user and what features auditors need to capture given the complexity of client’s business processes.

Standardization is also a topic receiving significant attention from the literature. It is considered as one of relevant issues and future challenges within the business process modeling community (Indulska et al. 2009; Bandara et al. 2007). The interview result confirms that the same issue also applies within assurance community when it comes to the understanding of business process for risk assessment.

#### *4.1.3 Communication*

Communication relates to how best information about risk and its associated controls are effectively shared within teams, inter teams, and with clients. This applies both to financial and information system auditing. IS auditors perform audits over a client’s IT control in conformance with the assertions prepared by financial auditors. The resulting work is an opinion regarding the effectiveness of IT controls that relate to the financial reporting.

Most of participants share the same opinion that visualization is one property of business process model that is important. It allows auditors, clients and regulators to communicate about processes more efficiently. The bottom line is that everybody knows what is going on. Other advantages in communication are handing over engagement from prior year staff to the new staff. “*And they need to understand what has been done in year before. I think this kind of tools they had to get an understanding in shorter time about the business, to understand what's going on. If you only need to understand the diagram, it's much easier, faster compared than if you have to read 10 pages.*”

Communication is not always a bright side of using business process model. It is a fact that between business assurance and IT assurance there are somehow different procedures guiding each of them, including the use of business process models to help each of them identifying the risks. Since a business process model is not required obligatorily in audit program, the adoption of business process models for mediating both sides makes it a future challenge.

#### *4.1.4 Understanding*

Generally, all participants see understanding as an immediate benefit of using business process model for helping doing risk assessment. The understanding can be viewed as a quicker overall view process and at the same time providing a certain level of detail. A business process model is also useful for organizing complex procedures that otherwise would be hard to understand in all the different aspect of operation.

One participant said that the importance of a business process model is to help auditors understand the key processes, which may have risk factors residing in the business process. The ability of an auditor to understand business process risk through a process model indicates its importance. Ensuring that a process model provides ease-of-use understanding to users might be a critical challenge for the acceptance of process model. Practically, all participants emphasize understanding as fact and future challenges need to be considered.

The understanding issue also poses future challenges. This problem does not stand alone, rather it depends on various factors. One of the factors is the extent of knowledge of the users reading the process model and eventually articulating them into risk assessment. Individual cognitive characteristics play a role and it works side by side with the tool used by the user.

#### *4.1.5 Methodology*

The absence of business process model integration in audit methodology is not viewed to be a serious issue. What happens currently is that the audit working program has not yet enclosed business process modeling specifically for risk assessment, even though all participants confirm the merit of analyzing business process risk through diagrammatic representation. Hence, the vision to integrate business process modeling remains a future challenge for the assurance community.

#### *4.1.6 Modeling level of detail*

The detail of modeling is the second most mentioned issue by participants. It seems that even though a business process model reserves potential benefits for making complex process more manageable, a business process model has not been used for detailed complex process. When an entity does not have really good measures of control overall, auditors may look at a more detailed transaction or business process level to verify that the risks are mitigated at that level. *“However, to depict this, it may not be visible to use flowchart or process model, for that they may have to describe something in form of narrative”.*

Both literature analysis and interview place sufficiency of leveling the model as an issue. The finding from the interviews shows a slightly different perspective on the applicability of modeling detail from the one in the literature. From the interview side, the modeling detail is relatively limited when auditors need to gain understanding of a specific situation. One possible answer for this limitation is the time consumed for modeling, analyzing, and communicating risk and control extracts in a tight audit schedule. This makes text-based checklist and narrative more appealing than using business process models. From the literature side of BPM however, this issues which is related to the definition, identification or modeling of an adequate level of detail is considered important. A business process model should be able to represent an adequate level of detail without losing consistency.

#### *4.1.7 Expertise and Training*

During the interview, only few participants mentioning education and expertise requirements for business process models. Training and promotion are seen as factors important for the dissemination of any chosen business process model language. Moreover, the success of educating auditors and clients for adopting business process models may lead to the wide acceptance of business process models. Having business process models widely accepted enables the usage of a standardized notation as a means of communication and collaboration.

The body of literature confirms training as among the top ten issues in business process modeling. This reflects the different position between the BPM community and the assurance community. It appears that accelerating the recognition of business process models to assurance people through training would increase the value and the expected adoption of business process models.

Expert Interview	Related issues mentioned in Interview	Participant Mentioning Importance
Risk and control assessment	<ul style="list-style-type: none"> <li>• Using business process model to help auditor identify risk and control aspects for</li> <li>• Identification of business risks that lead to material misstatements</li> <li>• Use of relaxed version of process model rather than accepted standard.</li> </ul>	P1, P2, P3, P4, P5, P6
Standardization	<ul style="list-style-type: none"> <li>• Language standards</li> <li>• Notation</li> <li>• Features to be captured</li> <li>• Methodology</li> </ul>	P1, P2, P3, P4, P5, P6
Communication	<ul style="list-style-type: none"> <li>• Between business auditor and IS auditor to determine risk factor based on assertion</li> <li>• Difficulty in assessing what to do with findings from the IT audit.</li> <li>• Communication within team</li> </ul>	P1, P2, P3, P5, P6
Understanding	<ul style="list-style-type: none"> <li>• Risk identification of business process from process model</li> <li>• Help understanding key processes</li> <li>• Maintain logical reference to financial assertion</li> <li>• Integrated business process view</li> </ul>	P1, P2, P3, P4, P5, P6
Methodology	<ul style="list-style-type: none"> <li>• [process model] not mandatory in audit program</li> <li>• Inclusion of certain business process model for risk analysis purpose</li> <li>• Level of adoption in the audit team</li> <li>• Reference model for assessing business process and IT risk.</li> </ul>	P1, P2, P3, P4, P5, P6
Modeling level of detail	<ul style="list-style-type: none"> <li>• Trace risk on detailed business process level</li> <li>• Preferred for overview process but for specific task, narrative is still used</li> </ul>	P1, P2, P3, P6
Expertise and Training	<ul style="list-style-type: none"> <li>• A challenge to get big audit firms or universities to actually promote this process model</li> <li>• Education of business process modeling for assurance domain</li> </ul>	P2, P3, P6

**Table 2.** Business Process Models issues on Risk and Control Assessment

Readers however should be alerted. Those participants that are not listed on the summary table do not necessarily mean they are not stressing an issue. Instead, they may not be included since their comments, if any, do not lead to the perception that they emphasize particular facts. For example, business value (ability to measure process) is not included though mentioned by one participant, because the motive was more related to the risk calculation based on the structural metrics of process models. While this would be a good idea, including it as part of business value fact appears to be less proper.

## 4.2 Extent of Business Process Model Use

Having investigated a set of requirements of business process models, we are interested in finding out whether business process modeling practice is beneficial for two levels of risk analysis, namely risk elicitation and risk assessment. The interview with participating auditors show that the level of adoption of business process models is more on eliciting risks in the

business process rather than using the identified risks as part of formal audit judgment, albeit the progress of current adoption of business process modeling. Based on the interview excerpt, the following explanation provides two interrelated concepts that may lead to the elicitation of risk.

#### *4.2.1 Computational Equivalence*

The benefit of using business process models can be seen from the work of Larkin and Simon (1987). A business process model is considered to exhibit the advantage for risk extraction over presenting a business process model by sequential format due to its efficient data structure, program, and localization properties. The data structure regarding sequence flow is indexed within a particular space which promotes an easy discovery of risk nodes and patterns. The attention management system and the grammar representing the “program” efficiency in the form of ease of searching, matching and deducing could help auditors to enjoy computational equivalence in identifying risks of business process.

An excerpt from an interview reveals that auditors view business process models as to help “*to have a quick understanding of what the process* “. “*It's really easy to break complex structures down with it, and display certain aspect of it in comprehensible manner.*” It is the computational efficiency of the visualization of business processes that helps detecting risk.

#### *4.2.2 Understanding Processes Orchestration*

Orchestration denotes the internal processes in an organization. It comprises of several processes managing and coordinating to create a higher process. The fact that orchestrations are happening within an organization indicates that they consist of process elements that exist together within a well-defined context, or locus of control. The elements include control flow with pointing arcs defining the flow, decision gateways representing situational nodes, functional responsibilities, particular events and data flow, and other notations deemed necessary. Interview partners also mentioned the need to depict a company’s process orchestration.

The well-defined context where the process orchestration takes place allows auditors to obtain specific patterns related to the risk of the underlying business process. Therefore, organizing business process models displaying orchestration help auditors in revealing unspotted risk and control factors, which are otherwise hard to elicit without the help of a business process model.

The two concepts describe how business process models are used to help auditors elicit relevant risks. As a business process model is not imposed in an audit methodology, the business use of process modeling for risk assessment is not yet fully proven. Please note that the role of business process models in identifying risks and controls is contingent to the match between representation format, characteristic of users, tasks, and the mental representation of auditors. It is expected that formal inclusion of standardized business process modeling languages for risk and control in auditing environment can turn into wide acceptance of business process model.

## **5. Conclusions**

Business process modeling is an important aspect within BPM, yet its adoption in assurance is still in developing. This paper presents the results of a preliminary work examining the issues surrounding the benefits of business process modeling as perceived by auditors when performing risk assessment. The identification of the issues facilitates deeper insights for both research and practice. The research contributes to the literature by revealing those issues relevant in audit-

oriented business process modeling and by concluding that the current use of business process models is more on the risk elicitation rather than formal risk assessment.

A limitation of the paper is its focus on relaxed semi-structured interview and inductive reasoning for obtaining relevant figures of possible facts and challenges of business process risk assessment. However, it opens several avenues of future research. First, it is of potential value to study the inclusion of business process models in audit methodology. A question for future research to address in this field is how to formally use business process models to help auditors managing their audit program through risk assessment. Furthermore, the propositions of this research require further testing in terms of real world case studies or surveys. Finally, the merits of business process models should be examined with respect to the cognitive capabilities of individuals who deal with the model. Our future research plan is to conduct such empirical research in an experimental setting with a focus on model pragmatics.

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