Developing a Process-Oriented Notation for Modeling Operational Risks –
A Conceptual Metamodel Approach to Operational Risk Management in
Knowledge Intensive Business Processes within the Financial Industry

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Abstract
According to the Basel II committee operational risks are the least understood and manageable risks in banks. Operational risks in banks are closely linked to the underlying business process landscape. Recently, researchers have suggested to model this process landscape in banks with new semantic business process modeling approaches. These enable banks not only to model their business processes more efficiently, but also analyze them in a (semi-)automatic way for multiple purposes (e.g. process weakness identification, IT investment decisions etc.). In this paper we extend such a semantic business process modeling language (SBPML) for banks by a risk view for modeling and analyzing operational risks in business process models from a conceptual modeling perspective. As a result of a case study at a bank, seeking to combine business process management and risk management in an integrated approach, we present an enhanced metamodel of the SBPML, which enables banks to model and analyze their processes and operational risks in a holistic way.

1. Introduction

The single core asset of bank’s everyday business is dealing with information. Centering on handling information in almost every aspect or organizational unit of a bank, also the business processes reflect this core characteristic of banks. They are driven by information (e.g. credit ratings, market pricings, risk strategies, etc.) and knowledge about how to handle this information (which is thus an implicit part of many daily business processes in a bank) and can thus be referred to as knowledge intensive business processes (KIBPs) [1-3]. Although these KIBPS are routinely executed, they “tend to be complex and time consuming, requiring collaboration and the sharing of knowledge within specific work contexts” [4]. From a relevance point of view, KIBPs are often also those processes within an organization “that result in high value outcomes [and belong to organizations’] core competencies, giving them strategic and tactical advantages and making them more competitive” [4]. This is in particular true for financial institutions, such as banks, as they only gain profit from offering their knowledge intensive “products” in the form of services, which are implemented within KIBPs. Since these processes are mainly knowledge intensive and handled by human specialists, there are many operational risks involved in offering the typical banking products (e.g. credits to consumers).

So far, these operational risks are mostly identified, documented, analyzed and managed apart from the business process management perspective by separate organizational units – namely risk management and risk controlling – in banks. Due to the arrival of many legal directives in the previous years, banks are not only forced to carefully manage their operational risks, but are also requested to systematically identify, document and analyze their operational risks and establish control instances [5]. Since modeling and analysis of KIBP have been a recent focus of research [6], experts currently also discuss the suitability of process models with regards to knowledge documentation in terms of modeling operational risks, as risks are easier to understand and to systematically identify in a process context [5, 7-11]. For example, within Basel II, processes are explicitly mentioned in the risk definition [5]. As the importance of understanding process-related risks increases in the context of business process management (BPM) due to legislative requirements, this topic shifts into the focus of researchers [7, 9-16] and is also of special importance to the financial sector [7, 9-11, 17-19].
particular, the Advanced Measurement Approach (AMA), a risk technique proposed under the Basel II capital adequacy rules for banks, forces banks to systematically analyze and identify their operational risks in order to benefit from lower capital margins underlying the capital at risk. As banks aim at allocating as little equity capital for insuring against their risks as possible, they currently search for solutions for realistically identifying operational risks in a process context within a reasonable effort-utility-ratio [20]. Domain-specific process modeling languages like the bank-specific semantic business process modeling language (SBPML) [21-23] have been proposed to provide a fair effort-utility-ratio for process modeling, while at the same time providing extensive possibilities for automatic analysis of process models, which is especially desirable in the context of not only identifying and documenting, but also analyzing operational risks in banks.

Within this article, we aim at extending an existing bank-specific semantic business process modeling language (SBPML), which is especially suited to model KIBPs in banks [21-23], with a risk view, in order to enable banks to systematically identify, document and automatically analyze operational risks in the context KIBPs by means of their process models. Hence, we investigate the metamodel of the SBPML [24] within a case study at a universal bank and extend this to the needs of banks regarding operational risk management based on the requirements of Basel II and AMA.

2. Theoretical framing

2.1. Risks and risk modeling languages

Risk can be understood as the effect of uncertainty on objectives and can either occur in a positive or negative way [25]. Risks in the finance sector can be enterprise risks, credit risks, investment risks, environmental risks, technical risks, etc. In process management, risk is usually allocated to individual activities and the order of these activities – often without sufficient links to formalized risk models [16, 26]. In order to identify, analyze, prioritize, and react to negative risks, risk management should ensure the coordinated usage of resources for avoiding, reducing, and controlling the probability and/or impact of such events [27].

In recent publications [9-11, 16, 28-32], there have been initial discussions on suitable risk modeling languages in the context of process modeling and analysis, although the topic itself is still in its infancy [7, 9-11, 19]. However, these risk management approaches are mainly based on general business process modeling languages and do not cover bank specific requirements. Although they offer valuable help in risk management, they are not capable of automatically detecting and calculating risks. Nevertheless, this would be desirable when it comes to large process models. Furthermore, they do not address the specific needs of risk managers in banks when it comes to the identification and evaluation of bank specific risks in general and risks mentioned in Basel II in specific. Finally, the use of general purpose process modeling languages does not allow for a prestructuring of risks and individual attributes as a semantic modeling help or even from a semantic analysis point of view. As a consequence, we introduce a novel risk view on top of an existing bank-specific semantic process modeling language that allows for an automated analysis of processes and hence serves as a basis for modeling and automatically analyzing operational risks. We aim at extending the bank specific process modeling language to the area of risk management by introducing a metamodel of a risk view that is closely linked to the core constructs of the original semantic process modeling language.

2.2. Research methodology

The research methodology in this article follows a design science paradigm [33] and deals with the construction of scientific artifacts in terms of methods, languages, models, and implementations with regard to specific research goals. The artifacts to be constructed have to represent an innovative contribution to the existing knowledge base within the actual research discipline. Subsequent to the construction of the artifacts, these have to be evaluated in order to prove their fulfillment of the research goals.

In this contribution the scientific artifact is the risk modeling approach outlined in Section 1. This artifact aims at solving the relevant problem of modeling and automatically analyzing risks on the basis of business process models of banks. So far, related work does not provide satisfactory solutions for the financial sector in specific and for the automatic analysis in general (cf. Section 2). Hence, in terms of finding a suitable solution according to the design science paradigm, we build upon an approach to semantic business process modeling (cf. Section 3) and perform a case study in a bank to derive requirements for a risk view that can be integrated into business process modeling (cf. Section 4). Based on these findings we develop a new conceptual model for integrating operational risk management with business process management on the basis of the given language artifact (cf. Section 4), within the design and development phase of the design
science approach. To validate the feasibility of our approach, we apply it to a given business process (demonstration phase) within our case study at the bank (cf. Section 5). Our article closes with a reflection of our research (evaluation phase) with respect to a conclusion, limitations, the contribution and a future outlook (cf. Section 6).

3. Semantic business process modeling language

Our research is based on our experience with process modeling in banks. As a result of the inefficiency of generic process modeling languages in terms of modeling and analysis [20], researchers have developed a semantic pattern-based process modeling language for easy modeling of processes, as well as the automatic identification of process weaknesses in banks [21, 22, 34]. It focuses on an economic domain-specific and thus semantic modeling approach, based on reusable process building blocks that are designed specifically for banks, as well as automatic analysis (due to semantic modeling).

The modeling notation consists of four views, comprising a process view (“how is a service delivered?”), a business object view (“what is processed or produced?”), an organizational view (“who is involved in the modeling process?”) and a resource view (“what resources are used?”). The core constructs of this language are domain-specific process building blocks (PBB), which have an integrating role by connecting all views. A PBB represents a certain set of activities within an administrative process and applies a domain-specific vocabulary. PBBs are atomic, have a well-defined level of abstraction and are semantically specified by a domain concept. With PBBs problems like naming conflicts during model comparison are avoided, because the name of a PBB is specified by the language designer rather than the modeler. Examples of four of the 24 PBBs currently used in banks are “Document / Information Comes In”, “Perform a Formal Verification”, “Enter Data into IT”, or “Archive Document”. The subprocesses, representing the activities of just one organizational unit, are in turn part of a larger process, which usually involves multiple organizational units and thus subprocesses.

Additional facts about the processes can be collected with the help of attributes assigned to each PBB. Attributes specify the properties of the corresponding PBBs in detail. For example, a possible attribute for the PBB “Enter Data into IT” is “Duration”. Attributes provide the core information for a subsequent process analysis. They establish a connection to the business object, organizational, and resource view. PBBs belong to the process view and represent the lowest abstraction level of a process model. They are contained within different variants of subprocesses.

In the modeling notation, processes are represented as a sequential flow of PBBs. This sequential order restricts the degrees of freedom of the modeler and simultaneously promotes the construction of structurally comparable process models, since they are linear on a subprocess or variant level.

However, on the downside, this strict sequence approach does not allow for intersections. As a solution, the notation for banks allows either the modeling of process variants that define an alternative sequence within a subprocess (e.g. checking a credit application signed by only one credit applicant as a [Variant A] or checking the credit application documents that have been provided by a married couple and thus two credit applicants [Variant B]) or the annotation of special attributes. The later can be used to hide simple cases of process complexity by avoiding additional variants (e.g. for alternate communication channels) or by specifying optional PBBs in a sequence with percentage values, regarding their actual occurrence in subprocesses. Furthermore, an anchor (control flow on the process level connecting subprocesses and variants) allows for connections between PBBs in different subprocesses and also variants to enable parallel or concurrent process structures. In Figure 1, the core constructs of the business process modeling language are represented on the basis of a conceptual metamodel [24].

4. Integration of operational risk modeling within business process modeling

To derive requirements for the development of a risk view, we chose to do an extensive case study in cooperation with a bank. We chose a universal bank, which was globally operating in all major and typical product fields of banks. We cooperated with this bank’s German subsidiary, which focused on consumer credits, investment counseling, credit cards, and giro accounts for its customers. It was serving over 3.4 million customers with 6,600 employees in over 335 branch offices, with a balance sheet total of 12.87 billion euros in 2008. Our partners at the bank represented the risk management department, which was responsible for identifying, analyzing and tracking all risks and risk related issues in the bank – esp. concerning operational risks in the business process landscape.
Operational risks were managed through a regular risk control and self assessment (RCSA) of the main business processes, which was tediously carried out in an intensive laborious work on a quarterly basis. Before our cooperation started, operational risks had been identified on a high level without the help of process models, even though these were abundantly available in the bank. This resulted in a fragmented view of the operational risks, as the roughly 200 business processes of the bank that were defined by the risk management department did not match to the nearly 1,200 processes that were defined by the process management department. To get a full view, we also cooperated with the process management department, which had modeled the entire process landscape mainly for legal and documentation reasons and as a prerequisite for manual business process optimization purposes. Both departments were highly motivated to join the research endeavor of integrating risk and business process management. The process department was interested in uncovering yet another source of business value from the cost-intensive process modeling and process model maintenance initiatives in the bank and the risk management department was seeking a way to implement the Advanced Measurement Approach from Basel II to reduce risk capital costs by systematically identifying and continuously tracking the entire operational risks of the daily business (and thus business processes).

A series of interviews, round-table discussions and workshops were conducted from October 2009 until March 2010. From the side of the bank three officials from the risk management department, including the head of the risk management department, as well as three officials from the process management department, including a BPM manager, were involved in the work sessions. From these we derived requirements for integrating a new risk view into process modeling approaches according to the bank’s current state of the art, as well as future needs and desires of the bank in the context of the Advanced Measurement Approach and in particular regarding operational risk management. Our findings for
introducing the general element of an operational risk, referred to as a risk model afflicted element.

The core concept of a risk view is the construct of risk itself. As we relate risk to business processes, we refer to risk in our narrow context only in the sense of an operational risk that occurs during the execution of a business process. Referring to the widely used definition of operational risks, according to Basel II, an “operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events” [5]. An operational risk can occur either within a single activity (process building block) or a chain of activities (process building block chain) and can be related either to the business process view (e.g. in terms of an activity that is afflicted with a risk), the business object view (e.g. in terms of a material object that is afflicted with a risk), the organizational view (e.g. in terms of a person that is afflicted with a risk i.e. of stealing money) or the resource view (e.g. in terms of an IT system that is afflicted with the risk of not functioning properly or even completely breaking down) – here referred to as a risk model afflicted element.

According to Basel II it is not sufficient to merely introduce the general element of an operational risk, but each risk identified in a process landscape needs to be classified. Thus, a risk type is necessary. In particular the bank suggested to use the Basel II risk typology that hierarchically defines risk on three different abstraction levels.

Apart from the type of a risk element (the bank suggested to use the level 2 risk types according to Basel II as they provide enough details and can be aggregated to level 1 risk types according to Basel II), there is further information that has to be captured for each risk element to be meaningful within our enhanced SBPML approach from a semantic point of view. As a basic information, the bank identified the need to capture an identifier, a short description for each risk element that is manually entered by the process modeler for readability and comprehensibility purposes of the risks in a process model. Furthermore, each risk element has a responsible person, denoting who is in charge for the management of the risk. In addition, it is important to capture if there is an insurance against a certain risk, since insurances reduce risks and are therefore relevant to the AMA approach in the sense of reducing the bank’s risk costs, which are necessary to proactively cover all operational risks found in the bank’s processes. Information about the insurance should include excess and limit of the liability if applicable. Apart from this basic information, the bank also identified a number of further risk attributes describing for example the value at risk, the risk frequency, risk severity and possibility of discovering a risk.

According to the bank, each risk needs to be controlled by a risk control action, which monitors the actual occurrence of risks in the daily business processes and is used to minimize certain risks in the process landscape by proactively managing them [35]. These risk control actions can be distinguished by two types of control mechanisms. In-process controls are performed within the same business process as the activities they control. On the contrary, (internal) audit processes are separate business processes, which are carried out ex-post and maybe even only on a smaller sample of process instances to check the correctness of actions in a certain business process. On a meta-level this risk control action in return also has to be monitored by another risk control testing action to assure that the risk control action is effective and discovers occurring risks correctly.

A further concept that was identified in the context of risk and especially natural catastrophes and disasters, is the concept of business continuity management [36, 37]. The task of business process continuity management is to provide plans for the case that a certain risk occurs. Its core idea is to guarantee the continuous smooth operation of the business, even if risks occur that hinder the normal routine business processes from being executed. Hence, a further requirement for the modeling approach was the possibility to link these business continuity actions to normal activities or process chains, which they would replace in case of emergencies. Similar to risk control testing actions business continuity actions also have to be tested periodically regarding their effectiveness. Thus, business continuity testing actions also needed to be captured within the new risk view.

Finally, the last concepts that were identified throughout the workshops with the bank were the concepts of separation of duties [38, 39] as well as the four-eyes-principle. Whereas the four-eyes-principle can be seen as a simple attribute complementing an action (process building block), the separation of duties concept required a more sophisticated implementation concept. For this purpose the bank suggested the use of simple business process rules that could be used to formally express separation of duty rules such as “the employee that is executing activity A may not be the same as the employee, who is executing activity B” or “the employee that is executing activity C must be the same as the employee, who is executing activity A”.

All of these requirements were then implemented into a new risk view that was linked to the original views of the SBPML specification. The result of this conceptual modeling effort is depicted in Figure 1. The risk view is modeled completely, whereas the
conceptual elements of the other views of the SBPML are only modeled if they are closely or even directly linked to the risk view.

5. Validation of the risk view in business process modeling

To validate this new integrated approach for combining risk modeling and business process modeling, we asked the bank for a business process that was complex enough to be interesting on the one hand and also frequent for banks, so as to evaluate the generalizability of our approach for banks in general. As a result the bank provided us with the details of its most complex business process (in terms of the number of activities performed throughout the process) – namely the credit application process. In fact, this is also the most widely studied banking process in the literature and is common to many commercial banks.

For this credit process (one process model on an end-to-end view and six process models on a subprocess model granularity). In addition, we were given the chance to experience the process in action in side-by-side sessions with the bank’s specialists that executed certain subprocesses of the overall credit application process. We also had the chance to do follow-up interviews and ask any questions regarding the business process to the specialist department owning and executing the business process, the business process management department and the risk management department during the course of our process and risk modeling effort.

From a risk point of view we received further risk related material that the bank’s risk department had collected apart from the process management department (e.g. a risk control and self assessment matrix with a high-level process-oriented view on risks – the granularity level corresponded to that of one or more similar end-to-end processes, which were not defined equally but similar to the process documentations done by the process management department – as well as the operational risk categories used by the bank – these were similar to Basel II as the bank had only joined a few risk types on levels 1 and 2 of the Basel II approach). Regarding implemented separation of duties and in-process controls the specialist department complemented our picture of the complete business process from a BPM and risk management viewpoint.

With this initial material, we first modeled the entire credit application process for the internet business of the bank in our SBPML notation. A simplified overview of this effort is schematically depicted in Figure 2. The internet credit process included six main subprocesses. At first a customer would send his credit application documents to the bank and the bank would then check if all documents were complete and signatures given where they were necessary. If all documents were complete, the same person as in the previous subprocess would make an initial credit scoring and yield an initial credit decision regarding approval or disapproval of a credit. In case a credit

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Figure 2. Demonstration of the risk view in a business process from a bank

The bank therefore gave us its process documentations as well as process related handbooks

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application was given an approval in the first run, a second person (due to separation of duties) would yield a final credit decision.

This second credit approval check within the third subprocess was thus also an in-process control of the second subprocess. If the result was again positive, the credit approval clerk would forward the final decision to another person (which could also be the first person involved in the process) for booking of the credit. After the booking, the payment of the credit was transferred to the customer’s bank account by a third person. Finally, another person – apart from the person of the previous subprocess doing the pay out, would be asked to do a check if the correct amount of money was transferred to the correct bank account and booked accordingly.

To also validate if our process model was correct and included all relevant business process modeling and risk modeling aspects, we asked the managers from the process management department, as well as from the credit processing department (specialist department) to check our process model with regards to content. After the successful validation, we also invited the risk department together with the process management and credit processing departments for a risk assessment workshop using our newly developed risk view. As a result, we were able to systematically identify all process-related operational risks (e.g. risk of internal fraud regarding money transferral and credit approval, risk of external fraud regarding legal documents for the credit application, risk of data entry errors, risk of system breakdown etc.) in a very structured way and annotated them to the process activities.

In addition, the separation of duties was annotated on a process level in the form of matrix with all the relevant business process rules regarding the bank employees that could execute a subprocess with respect to the employees who had executed previous parts of the process (cf. Figure 2). The attributes of each identified risk type were annotated in part on the level of PBBs (e.g. which in-process controls, separate audit controls, or business continuity processes existed and if there were insurances against certain risks, as well as who would be responsible for monitoring each risk). Since the bank was not able to estimate the risk attributes regarding the value at risk on a PBB level (i.e. risk severity – monetary loss potential – and risk frequency – probability of the occurrence of a certain risk in a given activity), but was only able to do this on a process level, this information was annotated on a process level, where all risk types from the underlying subprocesses were aggregated. These risk attributes were mostly tracked in terms of a qualitative scoring (from 1 = low to 10 = high risk severity or probability of occurence) as a quantitative scoring did not seem feasible, since the risk management department officials from the bank did not have sufficient historic values or benchmarking data from other banks.

Finally, we also used our extended modeling approach to analyze the identified operational risks. We provided the bank with several risk reports for investigated process, to demonstrate the potential of automatic analyzability potentials of our semantic modeling approach. The bank was most interested in setting up a matrix with processes, subprocesses, process variants and activities on one axis of the matrix and the level 1 and level 2 Basel II risk types on the other axis of the matrix. It then wanted a risk profile of its process landscape, which would sort those processes, subprocess, process variants and activities with the highest monetary risks (calculated with the help of the value at risk approach if the level of detail was sufficient for subprocess, process variant or PBB analyses) on the first axis and by sorting those risk types on the second axis, which led to the highest value at risk regarding the given process landscape. In addition, the bank was most interested in generating a risk map, with one axis being the frequency that certain risks occurred and the other axis being the severity with which the risks occurred and the markers in the risk map representing the different processes, subprocesses, process variants or activities (depending upon the level the value at risk attributes were maintained) regarding the whole process landscape. Due to the inherent semantics of our presented risk modeling approach (esp. the risk typology and analyzable semantics of the relations, that the risk types are part of, together with other elements from other views of the SBPML method), it was possible to automatically generate these reports for the bank without further manual analysis effort.

Finally, many further specifications of automatically generated operational risk reports are imaginable from every view of the SBPML approach. For example from the organizational view, the positions or organizational units with the highest responsibility for risks can be computed. This information can be used for human resource procedures, or for adjusting the responsibility distribution throughout the organization. Furthermore, the realization of a prescribed separation of duties can be controlled to a certain degree. Since our approach does not extend to workflow management measures, it will not be possible to detect a neglect of the separation of duties during the execution of a process. However, it can be ensured that the separation is included on a conceptual level, when necessary. From the resource view, resources with the highest risk frequency, highest risk severity or highest risk assessment indicator
throughout the process landscape can be identified. The business object view can provide insights into the most risk-related business objects, such as certain legal documents, etc. It is also possible to detect business objects with high possibilities of risk (e.g. fraud) that are also involved in business continuity processes, or are also used in in-process controls or audit controls. Thus, from an analysis point of view, the evaluation of our artifact has also indicated that our approach to operational risk modeling and analysis bears significant potential for many risk analysis purposes, regardless of the types of process-related analyses to be conducted.

Concluding our modeling demonstration, all responsible from the bank – including the top management of the entire bank, who were given a presentation on the outcome of the integrated approach – were surprised how easy and structured the identification of the operational risks with the help of the process models extended by our risk view could be done. With this first pilot they decided to make a follow-up testing with a set of 10 further processes from very different areas to validate the newly developed approach from the perspective of being able to sufficiently model and analyze operational risks on a wider range.

6. Conclusion, contribution, limitations and outlook

The identification, modeling and analysis of operational risks within large and complex companies and especially knowledge intensive and multifarious business process environments, such as those that characterize banks, is very difficult, but required by both internal and external stakeholders. For banks in specific, a better documentation of risks within their complex business process environment can pay off in terms of a lower necessity for tied equity capital to compensate possible risks. As risks are easier to understand and to systematically identify in a process context, the documentation of risks along business processes seems to be a valuable approach. With our domain-specific risk and process modeling approach, we contribute to this issue by providing an easy to use process modeling language for banks that also offers a risk view.

In addition, from a knowledge management perspective, we also contribute to the area of managing (esp. explicating and modeling) knowledge-intensive business processes in banks with a special focus on operational risks. We do this by presenting an integrated method to explicate the implicit knowledge about handling processes, as well as risks in banks, in terms of modeling this in a semi-formal way. Furthermore, we also contribute to the area of managing operational risks within knowledge intensive business processes in a holistic way, by reflecting on the perspectives of people, strategy, processes and technology:

People: At the core of a bank’s business are the employees, which use their specialist knowledge (e.g. from various credit fraud cases) to operate the daily business processes (e.g. the credit process). These employees, on the one hand, produce several risks for a bank (e.g. the risk of insufficiently screening credit applicant documents) and at the same time, on the other hand, also try to manage risks (e.g. by rejecting credit applicants that do not seem creditworthy) that occur in a bank. Our approach addresses this issue by making it possible to model operational risks (esp. including those coming from the employees that are involved e.g. in a credit decision and due to insufficient separation of duties) that occur in a typically knowledge intensive business process (e.g. the credit application process) of a bank, along with the actions that are taken to prevent these risks (e.g. risk control actions), or to deal with the occurring risks (e.g. business continuity actions).

Strategy: Concerning risks, banks try to balance these, as part of their daily business, along with the possible profit gains of living with certain risks, actively managing (eliminating, avoiding or mitigating) risks, or insuring against certain risks. Our approach is part of a risk management approach, as it makes it possible to model operational risks (and thus formerly mostly implicit knowledge) - especially in knowledge intensive business processes of banks. Thus, it is a basis to optimize and balance risk against other interests of a bank (e.g. process-based cost management and risk controlling, as well as customer-friendliness of business processes).

Processes: Processes in banks have many types of operational risks as stated by Basel II, and the process of managing these operational risks in itself is knowledge intensive, as many types of different operational risks have to be balanced continuously and in parallel and a large variety of knowledge intensive business processes (operated by highly trained specialists and supported by complex IT systems) in banks have to be overviewed and coordinated to produce a risk balancing result. The presented approach takes this into account and provides a first approach to combine both business process management and operational risk management to get a holistic view of the mostly complex and knowledge-intensive processes of a bank (e.g. for a holistic business process optimization and risk balancing approach in banks).
Technology: Providing a conceptual metamodel for the integration of a business process modeling tool and a risk modeling tool is the basis for developing a BPM suite that can handle both approaches in an integrated way. In our project at a bank, we not only conceptualized on the integration, but also implemented such a tool to demonstrate the feasibility of the presented approach. Thus, the contribution of this paper is also the basis to developing a tool for any bank, or advancing existing BPM suites to incorporate a risk perspective already on the database level.

Recapitulating our research aim, we had the goal of integrating operational risk modeling with semantic business process modeling in the domain of banks. With the help of an in-depth case study at a major German bank it was possible to achieve this objective and provide several contributions. We were able to derive requirements for integrating both the risk management view and the business process management view with each other. By using a conceptual metamodel of a SBPML, designed specifically for banks, we were able to translate the documented integration requirements into a novel semantic risk view. This new risk view complemented the original SBPML views so that all major constructs could be linked with each other in a semantically meaningful and analyzable way. With the help of a follow-up case study at the bank, we were able to validate the feasibility of our integrated approach for modeling and analyzing business processes and operational risks on an enterprise-wide level.

Nevertheless, despite of the first positive findings that our research has produced, we also critically note that the research performed has only been verified in one bank and within one common banking process. Future research will be necessary to validate our first findings on a wider basis and thus prove the general applicability of our approach to help banks in their search for methodologies, with which they can start to implement the Advanced Measurement Approach – as recommended by Basel II. In addition, our investigated research approach so far has focused on the needs of Basel II, which rather limits our findings to European banks. However, many other countries such as the USA are also considering implementing the requirements.

From the perspective of KIBPs, research challenges remain regarding the modeling and analysis of the linkage of operational risk management to business process compliance management and compliance-related business process rules management. This is especially important, since organizations, which fail to be compliant with legal regulations also expose themselves to operational risks – by operating non-compliant business processes.

Further commenting on an outlook, we can also imagine that our approach can be of partial help in also documenting other types of risks in banks, apart from only operational risks (e.g. the common credit, liquidity, market price risks etc. frequently found in bank’s day-to-day business). If further research will be able to prove this outlook to be true, a very tight and complete integration of risk management and business process management will be the result, offering new vistas for applications yet to build upon this new close linkage (esp. in the area of risk and business process analysis). Finally, we assume that the presented approach may also be suitable to other industry sectors, apart from that of the financial industry [34], as operational risks can also be found in production companies and since administrative processes (for which the SBPML approach was designed) can be found in almost every business.

7. References


