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From the Stone Age to the Cloud: A Case Study of Risk-Focused Process Improvement

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Abstract

Organizations strive to continually improve organizational performance while maintaining compliance to increasingly complex rules and regulations. Several methods and techniques for the identification and management of operational risks in business processes have been proposed in the academic literature, yet there are few examples of practical applications. This paper addresses this gap through a case study of a process improvement project that employed some of the proposed risk and compliance management techniques. We describe a business process reengineering project within the purchasing and accounts payable operations of a university United States. The project focused on improving service quality by improving the transparency and predictability of operations through the introduction of a workflow management system. We outline the stepwise transformation of manual process operations through technology, and discuss the risk and compliance objectives identified throughout the project and their impact on process design. This case study illustrates how process re-engineering techniques can improve process designs while balancing performance and compliance objectives. It provides guidance for the selection of an appropriate level of abstraction during process analysis and demonstrates how process objectives and technology capabilities shape the design of to-be processes.

Keywords

Process Improvement, Value-focused Modeling , Risk Management, Regulatory Compliance

1. INTRODUCTION

Business Process Management (BPM) is typically regarded as a "systematic, structured approach to analyze, improve, and manage processes with the aim of improving the quality of products and services" (Elzinga, et al. 1995). The continual improvement of process performance and operational quality has a long tradition in business and is embodied in approaches such as Total Quality Management, Lean Six Sigma, or Business Process Reengineering. A recent Gartner Group survey found that for five years in a row corporate CIOs named the improvement of business processes as the number one expectation they receive from the line of business (Gartner 2009). But while many of the existing process improvement approaches focus solely on performance objectives, recent corporate scandals and financial crises have elevated the consideration of risk and regulatory compliance to similar, if not greater importance.

The BPM approach has been suggested as a solution for risk identification and control at different levels of granularity (Jallow, et al, 2007; Eicher, Ruder, 2007). BPM researchers also seek to conceptualize business rules compliance at the process level in the modelling techniques (zur Muehlen and Indulska 2009). BPM has gone beyond its traditional role as a performance improvement driver as more people look to BPM-based solutions for risk and compliance management. However, there is a lack of validated advice as to how both performance and compliance objectives can be addressed during process improvement initiatives. Rikhardsson, et al. (2006) point out that there have been few academic studies focusing explicitly on the integration of risk management, compliance and internal controls while the topic has generated intensive discussion in the practitioner publications (e.g., OpRisk & Compliance Journal). Even though risk and compliance management generate relatively more attention in the practitioner community, few detailed reports can be found how risk and compliance management frameworks, including the wide-known COSO (2004) and CobiT (2005), can be implemented (Samad-Khan, 2005).

This paper presents a case study of a process improvement project that leverages reengineering techniques to align operational performance goals with risk management and regulatory compliance considerations. We apply a value-focused process engineering approach to harmonize performance objectives, risk control objectives, and regulatory compliance objectives. The remainder of this paper is structured as follows: In section two we introduce the background for the case study and the organization where the case study took place. In section three we describe the information gathering process and the modelling of the as-is processes. In section four we introduce the value-focused process engineering approach for business analysis and how it facilitates the design

of to-be processes. Finally, the paper concludes with a summary of key findings and an outlook on the future of the project.

2. CASE STUDY BACKGROUND

The methodology for this case study is action research (Checkland and Howell, 1998). Both authors actively participated in the project in business analyst, systems analyst and project manager roles. Both had background in process improvement and workflow automation in both industry and academia. Project documents were gathered in a central repository, and nine interviews with stakeholders that lasted between 30 minutes and 2 hours in length were audio-recorded and independently transcribed. Overall we collected more than 8 hours of interviews, 10 models of different processes in BPMN and numerous policy and procedure document.

2.1. Case Study Organization

The organization where this case study took place is a private research university in the north-eastern United States with a student body of about 2500 undergraduate students, a postgraduate enrolment of more than 2400 students and about 150 full-time faculty members, organized in four schools. The majority of externally funded research projects receive funds from government sources such as the National Science Foundation, the Defense Advanced Research Program Agency, the Office of Naval Research, NASA, and others. A central information technology department provides support for student, staff and faculty computing, and maintains a number of central information systems, such as a Campus Portal, the e-Learning Environment, Active Directory as well as several administrative applications.

Most administrative processes in the case study organization are manual, paper-based, and rely on the same forms and routing slips that were in place 30 years ago. Information required to perform the process as well as analytics information was captured and disseminated through paper-based instruments: forms and reports designed for various purposes. The process reengineering project was initiated by the CFO of the university and targeted the core procurement and financial processes of the organization. The stated goal was the automation of existing paper-based processes through the introduction of a workflow management solution.

2.1. Project Scope

Figure 1 shows the high-level map of the purchasing processes that were considered as part of the project (the activities without shading were considered out-of-scope). The purchasing process was chosen as the pilot due to its high visibility throughout the organization and the immediate financial benefits that could be realized through improved transparency and control. The process starts with the creation of a purchase requisition by an individual requester, which upon approval is routed to the purchasing department for the issuing of a purchase order. Once goods are received and validated, a payment process to the vendor is initiated. This pathway constitutes roughly 50% of the purchases handled within the university. The remaining 50% are split evenly between purchases that have been funded by the individual staff or faculty member and lead to a reimbursement request (e.g. travel expenses) and purchases that have been paid for with a university-issued Purchasing Card, where the monthly statement is paid through a central payment process.

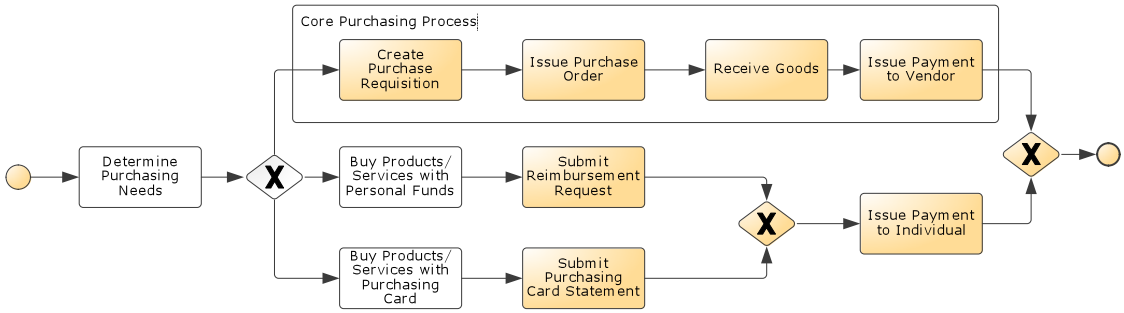

Figure 2: High-Level Process Map

Each of the end-to-end processes crosses multiple departments, and individual sub-processes were governed by different process owners. While the creation of a purchase requisition took place in individual departments, the purchase order was issued by the purchasing department, and payments were issued by the accounts payable department. Table 1 outlines the relationship between the individual processes, their respective owners and the participating business groups.

Table 1: Participating processes and the corresponding owners and departments

Process	Process owner	Corresponding Business Group

Create Purchase Requisition	Department Head	Individual Departments
Submit Reimbursement Request	Department Head	Individual Departments
Submit Purchasing Card Statement	Individual Faculty/Staff	Individual Departments
Issue Purchase Order	Procurement Director	Procurement
Receive Goods	Procurement Director	Central Receiving
Issue Payment to Individual	Associate Controller	Accounts Payable
Issue Payment to Vendor	Associate Controller	Accounts Payable

The main objective of the improvement project was to automate the participating processes by introducing workflow management systems. The workflow management solution was expected to eliminate processing time and human errors resulted from the overloaded paper work. It was as well expected to streamline the current human-driven process design and create a system-driven workflow environment. Workflow management systems should support real-time business rule execution and monitoring to avoid the occurrence of unexpected events that might pose potential threats to the institution's finance. This was also where risk management and regulatory compliance came into play in this process improvement project.

2.2. The As-Is Management of Business Processes

There was no formal documentation of the participating processes but the text-based "process memoranda" that were prepared by the office of finance specifically for external auditors. The process memoranda provided a basic overview of the participating processes, but they were not maintained on a regular basis, nor were they used to regularly evalute the performance of process participants.

Almost all financial transactions or finance-related activities occurred on paper before they were recorded in the accounting information systems. In the participating processes, paper-based forms or routing slips were used to retrieve, disseminate, and update information requested from the accounting information systems. Ultimately, all transactions were entered into the Financial Reporting System (FRS), the core accounting information system of the researched institution, upon their completeness. FRS had been the accounting information system and repository of the university for 25 years. It consolidated the collected accounting information and produced financial reports for both internal and external use. FRS provided a terminal-based work environment and ran on a VAX mainframe that only allowed for authorized access during a specified time frame. Access to the system was granted to staff members in accordance with their job responsibility. Due to the close association between FRS and the accounting practices institution-wide, the individuals who were able to master FRS skills became critical yet scare human resource to the administration. As a result, many processes were highly dependent on individual performers that knew how to use the specific screens of FRS.

In addition to the role of collecting required information for FRS, the paper-based work instruments also served as a key vehicle for enforcing control policies at the operational level and tracing approval procedures of each transaction instance. In a way, the underlying design of the paper-based instruments suggested on how the participating processes evolved to the features of FRS in the core accounting operation. This was a typical example of technology adoption through organizational change.

The key deliverable of the process improvement project was the successful implementation of a workflow management system that was expected to replace the existing paper-based operations using a web-based self-service interface. Since the implementation of workflow systems was expected to automate some of the manual finance-related activities the integration between the workflow system and FRS was of critical importance to the project's success.

2.3. Process Improvement Initiative

The member of process improvement initiative included the CFO, the associate controller, the procurement director, the CIO, an external consultant, and the authors of this case study. In several preliminary meetings the project scope was established, key project objectives were defined, prospective solutions were previewed, a general timeline was agreed upon, and major implementation and financial risks were documented. After a brief market survey a workflow vendor was invited to demo their solution and to provide guidance regarding a proposed implementation timeline as well as project staffing considerations. In addition to the core team members, senior financial managers attended some of the planning meetings in order to prepare for possible process or organizational changes. A liaison team was formed to facilitate the communication between the university improvement initiative and the consulting services group of the workflow vendor. The final project team included two engineers and a project manager from the vendor side to support the design of user screens and the back-end integration of the workflow solution with FRS.

The project duration was defined as six months, split into two stages of three months each. First, a pilot project would be initiated to ensure that all implementation issues, both technical and social, were explicitly addressed and carefully managed. The back-end integration between the workflow systems and FRS would not go live until the existing manual processes had successfully been migrated into the web-based workflow-driven environment.

3. MODELING THE AS-IS PROCESSES

3.1. Selecting a Modelling Technique

The mapping of the as-is processes served two purposes in this project. On the one hand, the resulting process maps provided a common ground for understanding how the processes were actually carried out. On the other hand, the as-is maps were used as a baseline for evaluating the design of the to-be maps. The processes were documented in the Business Process Modelling Notation (BPMN) using a Visio-based BPMN plugin (itp Commerce). BPMN was selected over other process modelling techniques due to various practical concerns. First, BPMN is a rich notation that allows the expression of rich semantics in process maps (Recker, et al, 2008). Secondly, BPMN can be extended with constructs that are critical for risk assessment at the process level (Carnaghan, 2006). Third, the designated workflow tool uses BPMN for the internal representation of business processes, making the transfer of process designs from the design environment into the execution environment straightforward. In addition, both the Visio plugin and the workflow system adopted in this project supported the interchange of process models using the XML Process Definition Language (XPDL), which would save a great deal of effort on migrating the new process design to the execution environment.

3.2. Collecting Information

The information required for creating the as-is process maps was collected from three sources: The process memoranda, in-person interviews, and other supporting documents, such as faculty handbooks, forms, and notes by process participants. Process memoranda were textual process walkthroughs that focused in particular on the responsibilities of the participating departments. Although we found out that information provided by process memoranda was not entirely up-to-date, it was sufficient for the initial drafting of the as-is maps.

The project team continued the mapping effort by interviewing process owners and key process participants. All interview conversations were audio-recorded with the interviewees' consent and were later transcribed. The early drafts of process maps significantly facilitated the interview process as they provided a visual aid for communicating the process logic. Several key process participants were also interviewed to reaffirm the correctness of the information previously obtained. The interviews were conducted in a semi-structured fashion using a set of seed questions. The interview questions were designed mainly to extract the process structure as well as the interaction between participants during process execution.

Finally, the project team collected supporting documents from participating departments: forms, slips, e-mail templates, reports, and snapshots of FRS use in real-time. The design of these documents not only helped validate the process maps but also provided measures for process quality. It is worth noting that although the interviewees had limited knowledge of BPMN, they had few problems understanding the maps with the help of an explanatory narrative.

3.3. Process Map Refinement

One of the authors was involved in the entire mapping exercise. Process maps were sketched out based on process memoranda, in-person interview, and other supporting documents, and subsequently refined. The purpose of map refinement was to ensure that all obtained information was documented in the process map so that the map truthfully reflected reality. The interviewees were asked to validate process maps with the project team whenever a major modification was applied. Some finance function groups preferred to validate process maps internally before sharing consolidated feedback with the project team. The feedback from the map validation activity became input for the next revision. A total of seven major revisions were made for the processes under consideration.

One reason for the number of revisions was the fact that at the initial level of abstraction certain idiosyncrasies in the processes could be identified, but several operational deficiencies that the interviewees had mentioned were not reflected in the diagrams. For example, the as-is models showed clearly the use of batch processing by using wait events with labels such as "wait until Thursday", but they did not reflect the different styles in which activities were performed. For example, when a finance staff member required additional information for the processing of a request, some staff members called the requestor, while others sent an email, and yet others used the in-house mail service to return the request documents to the requester with a note attached. During this revision cycle, some staff members kept copies of the original documents, while others did not. These

differences at the execution level were not captured in the initial as-is models, but were crucial details that would change with the introduction of the workflow solution.

4. PROCESS ANALYSIS AND DEVELOPMENT OF THE TO-BE PROCESS

Three quality factors were taken into account in the process analysis: process performance, risk control, and regulatory compliance. The purpose of process analysis, particularly in this project, was to investigate how well the three quality factors were addressed in the as-is process design. The project team was interested in how well the three qualify factors were managed to the best interest of the institution. In order to do so, the project team first identified business objectives and their interdependencies based on performance measures. A value-focused assessment approach was used to evaluate the degree of alignment between the business objectives.

4.1. Value-focused Approach

The value-focused approach to process engineering is not new. Boehm (2003) proposed a value-based software engineering agenda and called for an updated version of software engineering life cycle constructed around the realization of business benefits. A value-oriented approach was suggested for e-business process design to ensure the satisfaction of customer needs (Gordijn and Wieringa, 2003). A similar approach can also be found in the evaluation and management of new produce design process (Fang and Rogerson, 1999). The main purpose of adopting a value-focused approach in process improvement is to eliminate redundancy and uncertainty in business processes. In addition to its traditional role in process improvement, the value-based approach has gained increasing attention in the risk management community. Segal (2006) reported how value-based management could complement enterprise risk management (ERM) and resulted in a value-focused ERM process cycle. At the operational level, Neiger, et al. (2009) demonstrated the practice of value-focused thinking in risk identification. In other words, an organization may benefit from a systematic and holistic risk management solution by adopting value-based approaches.

Business processes are designed to achieve one or more business objectives. Business objectives, however, are not necessarily determined in a holistic fashion, in particular in non process-oriented organizations. Ideally, business objectives are defined to maintain the well-being of organizations in the given business environment. Nevertheless, the misalignment or conflict between business objectives is likely to cause resource waste and introduces vulnerabilities into business operations (Goldratt, 1990; Rummler and Brache, 1995). The performance of a process can be at risk if its business objectives are in conflict. Therefore, it is critical to clarify the dependency between business objectives and identify potential conflicts before process redesign is attempted.

4.1. Identifying Business Objectives, Objective Interdependencies, and Potential Conflicts

In this project, business objectives were identified based on the interviews of key process participants. The interviewees were asked about the intended goals or objectives of their processes. While the identification of business objective was straightforward, there was no clear consensus on the interdependency between the objectives. A strategy-map-based framework was thus adopted to show the dependencies between objectives within the context of value creation. Strategy maps were introduced by Kaplan and Norton (2004) based on their earlier work of the Balanced Scorecard (Kaplan and Norton, 1996). The application of the Balanced Scorecard in risk management (Calandro and Lane, 2006) and regulatory compliance (Souissi, 2006) is known in industry. While a balanced scorecard focuses on measuring how well an organization translates business strategy into daily operations, a strategy map illustrates how business value is created by an organization and suggests how an organization's actions should be aligned. A strategy-map-based framework provides the business context required for reasoning about the cause-and-effect relationship between business objectives. Such a business context was recommended as a critical input to understand the nature of enterprise-wide risk management and regulatory compliance (Abrams, et al. 2007).

A generic strategy map is composed of four value-driven perspectives: learning and growth, internal processes, customer value, and financial objectives. In this project, the strategy map model was enhanced with a risk perspective to address performance, risk control, and regulatory compliance considerations in the value creation process. Value management concerns such as regulatory compliance, risk control, and internal policy were added to the generic strategy map model while in the learning and growth perspective both tangible and intangible assets were considered as fundamental value drivers and are utilized to achieve process-level objectives. Based on the extended strategy map model, the process-level objectives may aim to increase customer satisfaction or to comply with internal policies. While customer satisfaction is regarded as positively related to the financial performance of a business, failure to address regulatory compliance at the internal policy level may pose a significant risk to business viability. In addition, the modified map contains an explicit risk-control layer. A high-level strategy map focused on the case study processes is shown in figure 3.

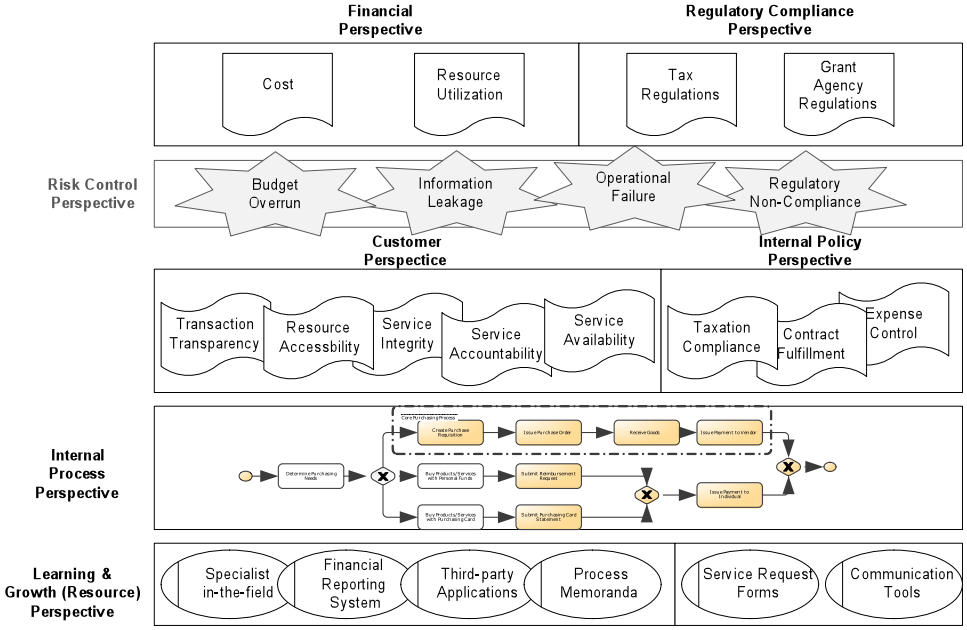

Figure 3: Extended Strategy Map

One of the objective conflicts identified in the resulting strategy map had to do with the necessity of paper work. For example, the administrative departments were requested to make copies for purchase request documents. While the copies were needed for monthly review, it turned out that each participating department made their own copies routinely for each purchase case. In other words, making copies of the purchase request documents, which was designed to better control operational risk, actually contradicted the process efficiency objective since the same activity was performed multiple times in the purchasing process. In the to-be process design the very conflict was resolved by the workflow system, which provided a central document repository and allowed for the simultaneous updating of documents. The project started with the resolution of business objective conflicts.

4.2. Removing Process Redundancy

In order to reduce redundancy and ensure the performance of critical activities, each process activity was classified into one of three categories: performance-related activities, risk control activities, and compliance-related activities. *Performance-related activities* form the skeleton of value-creation process. They are activities that are directly involved in the creation of products or services as defined in the process goals. *Risk control activities* are activities that are designed to mitigate, avoid, or transfer operational and compliance risk (zur Muehlen and Rosemann, 2005). Finally, *compliance activities* are designed to ensure the compliance of a process instance with internal policy and government regulations. Process activities may serve more than one purpose depending on the granularity of the process map. Activities that were not associated with any business objective were treated as potentially redundant and removed from the process in the to-be design. Table 2 illustrates the activity classification for the process "Create Purchase Order".

Table 2: AS-IS Process Activity Classification for the "Create Purchase Order" Sub-process

Process	Create Purchase Order	
Process Objective Statement	"To provide institution-wide purchase services"	
Process Objective Breakdown	Performance-related Objective: - Transparent transactions - Timely purchasing services - Timely communication with external parties Compliance-related Objective: - The availability of information requested by FRS - The availability of information required for tax filings - The purchase is allowed only if the referred account has sufficient fund	
Performance-related Activities	(6) Drop purchase request (upon customer's request) (7) Create purchase order in FRS (8) Create purchase order printouts (10) Send purchase order (copy) to vendor	Purchase Dept Staff Purchase Dept Staff Purchase Dept Staff Purchase Dept Staff

	(12) Send purchase order (copy) to client	Purchase Dept Staff
Risk Control Activities	(9) Purchasing manager signs off on purchase order (11) Send purchase order (copies & the original) to Accts Payable	Purchase Dept Mngr Purchase Dept Staff
Compliance-related Activities	(1) Validate purchase request (2) Request more information (3) (4) Check funds availability (5) Communicate budget issues w/ appropriate parties (13) File purchase order with supporting documents	Purchase Dept Staff Purchase Dept Staff Purchase Dept Staff Purchase Dept Staff Purchase Dept Staff

4.3. Assuring Risk Control and Control Efficiency in the As-Is Process Design

In the proposed value-based process improvement approach, control activities are designed against both operational risk and compliance risk. Not only should they ensure proper execution of process activities but also eliminate the negative impact resulting from unexpected events. In this project, risk controls were first designed to handle risk at the activity level and then the overall design was adjusted process-wide efficiency. Streamlining control activities, while commonly neglected in the performance-focused improvement project, is critical to the overall performance of business process since they usually consume specialized and thus scarce resources. For instance, as illustrated in figure 3, if the reimbursement request is above a certain amount, both the Provost and the CFO of the institution need to consent to the reimbursement. Considering the limited time that the Provost and the CFO can spend on reimbursement requests, the requests are either likely to remain on their desks for a while, or the level of diligence in reviewing the requests is lowered. In this example, Provost and CFO are on the critical path of the process, although the main purpose of their involvement is purely informational. The issue of control efficiency is even more substantial when it comes to the linear design of the participating processes, where activities are heavily paper-based.

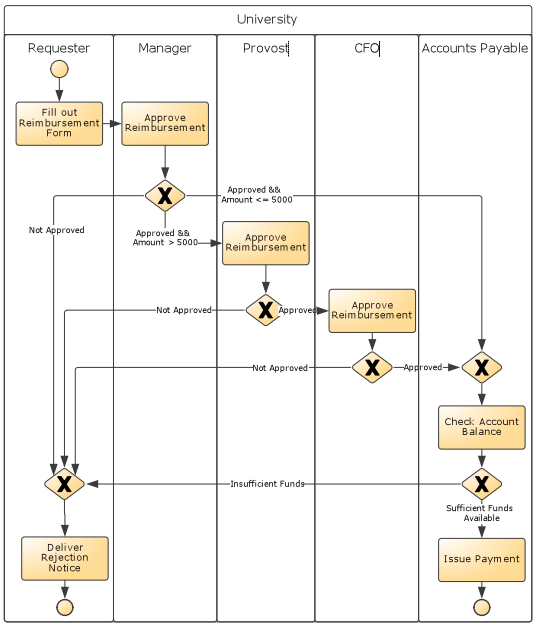

Figure 4: As-Is Expense Reimbursement Process (Simplified)

4.4. Introducing Workflow Management Systems in the Process Design

The introduction of workflow technology enabled a significant redesign of this process. From the performance point of view, the workflow system eliminated the use of paper and therefore minimized possible error occurrences during information exchange. The workflow systems also coordinated information flow across participating departments. From the regulatory compliance perspective the workflow system enforced business rules wherever necessary. As to the regard of risk control, the workflow system enabled real-time process monitoring. With the built-in dashboard functionality, the workflow system was able to provide the process-wide performance overview and allowed for timely decision-making in critical situations.

In the example of reimbursement process, because a workflow management system provides live tracking and auditing of process instances, Provost and CFO can review outstanding purchase orders and related financial performance data on demand, enabling them to exercise their oversight mandate without blocking potentially urgent requests. In addition, because the existing paper-based transport times for requests would be reduced to instantaneous information flows, requests could be sent back and forth between requesting departments and the office of finance. This enabled the deployment of triage patterns in which the most critical aspect of a request could be answered before any further steps are initiated.

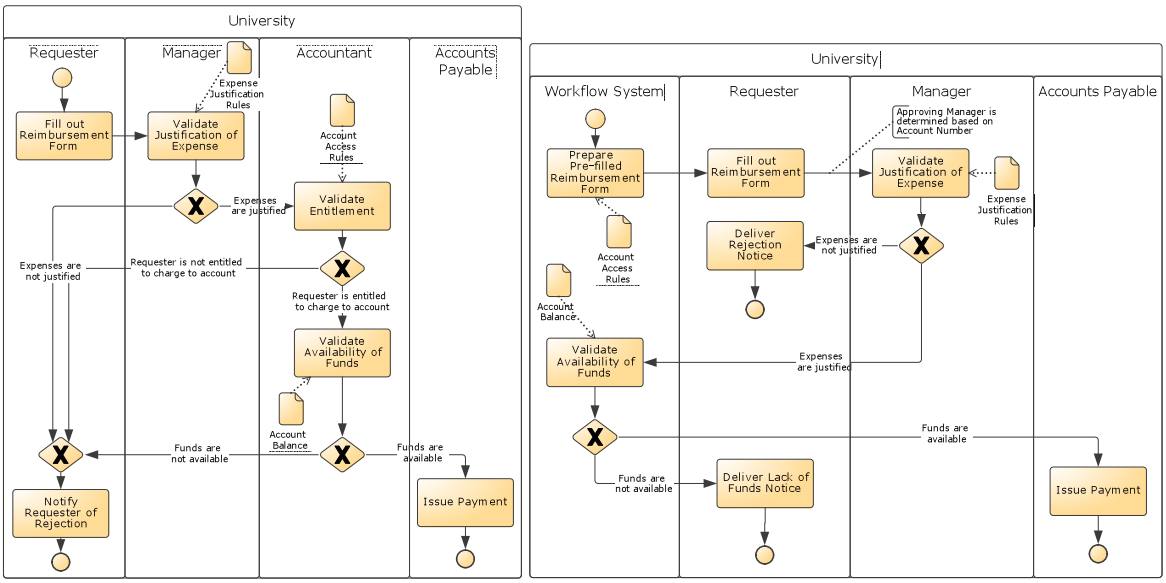

Figure 5: To-Be Expense Reimbursement Process Stage 1 (left) and Stage 2 (right) (Simplified)

In the pilot project, all information flows would be coordinated by the workflow management system, but the execution of individual activities would remain manual. For instance, if a request needed to be recorded in FRS, an accounting staff member would be prompted to enter the information shown on the screen into FRS. In the second stage the workflow system would interface directly with FRS, automating some of the manual data entry and retrieval tasks. Figure 4 illustrates the difference in process design. In the stage 1 deployment the requester would fill out the reimbursement form, the manager would attest to the justification of the expenses, and the request would be routed to an accountant to validate the entitlement of the requester and the availability of funds. In the stage 2 deployment the workflow system would be able to pre-fill some areas of the reimbursement form based on the identity of the requester. For instance, it would be able to limit the selection of account numbers to those accounts that the requester was entitled to. Furthermore, the system could determine which manager to route the request to, based on the account number entered. The workflow system could also check the availability of funds automatically, freeing the accounting staff to do more value-added work.

4.4. Working Workflow Management System in the To-Be Process

Table 3 shows the activity classification for the process “Create Purchase Order” in the to-be design. The risk portfolio of the participating processes did not remain the same due to the change of business infrastructure. The introduction of the workflow management system mitigated some of the existing operational risks. However, it introduced new vulnerabilities to the processes. For instance, while the visibility into the old process was very limited, the new infrastructure allowed administrators to view any purchase or reimbursement request. This poses a potential privacy risk that did not exist previously. Therefore, the project team designed new control activities for the newly introduced process risks while unnecessary controls were removed from the to-be design. It should be noted that table 2 and table 3 are to demonstrate the implementation of value-based process improvement approach in this project and therefore are intended to provide a highly level overview for this purpose. More detailed process analysis and design are included in the implementation plan for both pilot project and the full-scale implementation.

Table 3: The TO-BE for the "Create Purchase Order" Sub-process (Pilot)

Process	Create Purchase Order	
Process Objective Statement	"To deliver transparent transactions and timely purchasing services"	
Performance-related Activities	(6) Drop purchase request (upon customer's request) (7) Create purchase order in FRS (10) Send purchase order to vendor in the requested doc formats (12) Send purchase order (copy) to client (14) Keep client posted on the status of purchase req	Customer/WfMS Purchase Dept Staff Purc Dept Staff/WfMS Purchase Dept Staff WfMS
Risk Control Activities	(New) Inform client about request cancellation (9) Purchasing manager digi-signs off on purchase order	Purc DeptMngr/WfMS Purc DeptMngr/WfMS
Compliance-related Activities	(1) Validate purchase request (2) Request more information (3) (4) Check funds availability (5) Communicate budget issues w/ appropriate parties (13) File purchase order with supporting documents	Purc Dept Staff/WfMS Purc Dept Staff/WfMS Purc Dept Staff/WfMS Purchase Dept Staff WfMS

5. LESSONS LEARNED AND FUTURE WORK

This paper describes the case of a process improvement project that targets the purchasing and accounting processes of an academic institution. We have leveraged BPMN and Strategy Maps to identify the objectives, strengths and weaknesses of the existing processes and classified the process activities according to value-creation, risk mitigation, and regulatory compliance. This classification enabled us to question existing process controls and design more efficient controls for the to-be processes. In the analysis of the as-is processes we found that many of the weaknesses were only indirectly reflected in the process maps. Inconsistency in process execution and the intransparency of currently running process instances were two aspects that process stakeholders criticized frequently, yet a process map at the requirements engineering level typically does not reflect such details. The extension of the strategy map framework with risk and compliance aspects was helpful to both complete the as-is analysis and to focus the to-be design. Since this paper reports on a research in progress case, we plan on applying Neiger et al.'s (2009) Value-focused Process Engineering methodology to complement the Balanced Scorecard approach with a methodology that takes the dependencies between activities into account.

An open question for further research is the relationship between risks that can be mitigated through the use of technology, and the risks that are being introduced by this technology. As mentioned in the previous section, while the workflow system removed or lowered several operational risk factors, there are concerns regarding data aggregation and visibility that did not exist in a manual environment. How these concerns can be addressed in the design phase of a process improvement project is an open question.

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