ALIGNMENT OF BUSINESS PROCESS MANAGEMENT AND BUSINESS RULES

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Abstract

Business process management and business rules management both focus on controlling business activities in organizations. Although both management principles have the same focus, they approach manageability and controllability from different perspectives. As more organizations deploy business process management and business rules management, this paper argues that these often separated efforts should be integrated. The goal of this work is to present a step towards this integration. We propose a business rule categorization that is aligned to the business process management lifecycle. In a case study and through a survey the proposed rule categories are validated in terms of mutual exclusivity and completeness. The results indicate the completeness of our main categorization and the categories' mutual exclusivity. Future research should indicate further refinement by identifying rule subcategories..

Keywords: Business Process Management, Business Rules Management, Business Rule Categories, Business Rules.

1 Introduction

Organizations execute their coordinated value-adding activities to realize business goals and thereby create value for the organization. Continuing trends as fast-changing customer demands and increased regulation urge organizations to properly manage and adapt their business models and processes. Adaption is measured in terms of agility which is the ability (Qumer and Henderson, 2006, p3) "to accommodate expected or unexpected changes rapidly, following the shortest time span, using economical, simple and quality instruments in a dynamic environment and applying updated prior knowledge and experience to learn from the internal and external environment". Agility is related to the management and execution of 1) activities and 2) decisions. The first perspective focuses on the quality, speed and yield of activities. The second focuses on the quality, speed and yield of decisions related to activities to be executed.

The management and execution of business activities and decisions is studied in the fields of business process management (BPM) and business rules management (van der Aalst, ter Hofstede & Weske 2003). Although both fields have existed for over 50 years, the last decade has witnessed an increased interest from both scientists and professionals regarding the linkage of the two (Gottesdiener, 1997). Both fields have their own history, and they approach business operations and constraints from different viewpoints. Business rules management (BRM) formulates constraints based on descriptions and facts while BPM addresses business operations from a(n) activity/resource approach. As more organizations are deploying BPM as well as BRM solutions, this paper argues that efforts should be made to synchronize both. In this, we are in agreement with Kovacic (2004) that a broader view of integrating business processes and business rules must be taken. As well, a full research agenda continues regarding business process and business rule formalisation, classification and articulation (Zur Muehlen and Indulska, 2010). In this paper we focus on the classification of business rules. The specific research question addressed in this paper is: *how to categorize business rules such that an integrative relationship is established with the business process development and management lifecycle?* We believe that answering this question will help practitioners better integrate BPM and BRM concepts, while adding to the body of knowledge regarding business rules management by, thoroughly validating defined business rules categories.

The remainder of this paper proceeds as follows. The next section provides a context by describing business processes, BPM, business rules, BRM and related research. The third section describes the determination of rule categories and their integration in the business process lifecycle. Section four validates the identification of rule categories, presents the results of a data analysis and discusses research implications. The final section summarizes the study's core findings and contribution.

2 Theoretical Grounding

Business processes are used to manage and execute an organizations' coordinated, value-adding activities and are thereby among their most important assets (Rikhardson et al., 2006) or capabilities. The definition used for *business process* is adopted from the Workflow Management Coalition (WfMC, www.wfmc.org) and described as the "set of one or more linked procedures or activities which collectively realize a business objective or policy goal, normally within the context of an organizational structure defining functional roles and relationships". Many different practices and principles have been developed over the last century for the maintenance and improvement of business processes. Examples include: total quality management, business process reengineering, economies of scale, just-in-time principles and performance focii (Ravesteyn, 2007). Although there are differences among these practices/principles, the main focus has been on a set of common fundamental goals namely: cost reduction, time reduction and output quality (Porter, 1985; Hammer and Champy, 1993; Prim and Trabasso, 2005; Jeston and Nellis, 2006). Recently BPM has gained much attention by management and IT departments to manage business processes. BPM originates from multiple above-

mentioned existing phenomena and focuses on the whole business process lifecycle (Ravesteyn, 2007). In our study, BPM is defined as (van der Aalst, ter Hofstede & Weske 2003, p. 4) "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" As with many theories and models, multiple development and management lifecycles exist within the scientific and professional literature (Kettinger, 1997; Jeston and Nellis, 2006; Weske, 2007). Although there are differences between the lifecycles three main stages can be distinguished namely; discovery, (re-)design, runtime and construction (e.g. Kettinger, 1997; Weske, 2007). Within the (re-) design phase in a business process lifecycle, the business process is designed by assigning process elements and roles to it. The construction phase that occurs during the implementation of the infrastructure to controls support of the process (Jeston and Nellis, 2006). This generally means the implementation of some type of information system or BPM platform or "suite." The runtime phase of a business process lifecycle is when the process has gone live and is executed within the company. In this phase, the activities and decisions made within the processes need to be monitored and controlled for proper execution. To control and monitor the processes, activities and decisions need to be monitored at runtime so that the execution of a related activity is guided.

The purpose of this research, as defined by the research question, is to specify a rule classification scheme that is aligned with business process life-cycle. This implicitly sets the criterium that the defined business rule types should be defined based on the concepts underlying the definition of a business process. Decomposing the definition of a business process three elements can be distinguished: (1) a structure of process elements (activities and decisions), (2) people executing the process or an individual process element and (3) output/input of the process or activity. Further, following Morgan (2002), a business rule is defined as: "a statement that defines or constrains some aspect of the business intending to assert business structure or to control the behaviour of the business". In the remainder of this section, we elaborate on current rule classifications and indicate their (mis) alignment towards business process concepts.

Domain based classification schemes use application or focus areas as dimensions to classify business rules (Ross, 1997; Karadis & Loucopoulos, 2004). Within literature two types of domain-based classification schemes can be distinguished 1) business *function* categorization and 2) high level business *domain* categorization. The first type classifies business rules based on the business function they affect, for example marketing, sales, procurement and logistics (Ross, 1997; Karadis & Loucopoulos, 2004). Whereas classification on high level business domains generally identifies categories like core business rules, productivity business rules, decision making rules and regulatory business rules (Ross, 1997). Thinking beyond departments and business functions is one of the foundations underlying BPM. Therefore domain-based classification will not assure a proper alignment between business processes and business rules.

A second dimension to classify business rules is by *implementation technique*. This form of classification is seen frequently in the literature addressing a specific implementation technique (Vassiliadis et al., 2000; Coltrera, 2002; Park and Choi, 2004). Examples of such techniques are software code, database (engines), business rules engines and expert systems (Ram and Khatri, 2005). Based on a single technique multiple classifications regarding various implementation forms are formulated. An example of such a classification is the Oracle CDM Ruleframe which classifies over ten different categories of database rules (Jellema, 2000). Both BPM and BRM include the selection and support of tooling. In both management principles tools are seen as a supportive factor. As such, we believe *implementation technique* will not support a proper classification to align business processes and business rules.

Multiple authors also define classification based on the *level of specification* of a business rule (Ross, 1997; Kardasis & Loucopoulos, 2004; Park and Choi, 2004). The level of specification is based on the ambiguity and possible interpretation of a statement. An example of a classification based on specification can be: policies, business rule statements, operational business rules and formal rule statements (Hay and Healy, 2000). Note that policies and laws are open for interpretation and formal

rule statements can be interpreted in one way and one way only. Policies, laws as well as formal rule statements can affect every element of a business process. As such no real distinction can be made regarding how they can or should affect a business process. We judge *level of specification* not to be a good classification scheme with which to align business processes and business rules.

The fourth, and probably most used, categorization is based on the *intended behaviour* of the specified business rule (Gottesdiener, 1997; Ross, 1997; Shao and Pound, 1999; Von Halle, 2001). Scholars and professionals alike have proposed multiple underlying taxonomies. A summary of these can be found in Gottesdiener (1997). We will not extensively elaborate on differences among Gotterdiener's specified classifications here. Rather we give a definition of the overall taxonomy underlying most categorizations: constraints, derivations and definitions. Definitions give meaning to terms, concepts and facts used within the organisation such as customer and order. Derivation represents statements that use knowledge such as terms, concepts and facts for computation and inferences. Constraints are statements limiting the actions of the actors within the enterprise as a whole.

In addition to the preceding four dimensions limited research has already been conducted on integrating business rules and business processes. To the best of our knowledge current research on the integration and alignment of business rules and business processes exists for theoretical classifications that have not been thoroughly validated (Kovacic, 2004; Kardasis and Loucopoulos, 2004; Park and Choi, 2004). For example, Kovacic (2004) proposes the use of three high level categories: global rules, activity rules and structural rules. In contrast Karadasis & Loucopoulos (2004) and Park & Choi (2004) present multiple, very detailed, taxonomies including over 15 different rule categories for the operational level. The proposed theories have limitations. Both Karadis & Loucopolous (2004) and Kovacic (2004) use the ECA structure for defining rules. Using the ECA structure (Karadasis and Loucopoulos, 2004 and Park and Choi, 2004) limit the possibilities when defining rules, as for example: no rules can be stated regarding the content of an order. We elaborate on current studies by classifying a rule categorization and validate its completeness and mutual exclusivity in practice.

3   Rule Categories

As described in the previous section a business process can be decomposed into three components (1) the structure of the process elements (activities and decisions/gateways), (2) actors executing individual elements or the entire process and (3) output/input of the process or activity. The unit of analysis in our literature review is a business rule or other concept defining or constraining one or more of the decomposed components of a business process. During the first step of analysis no other sampling criteria were used. Databases containing journal articles, working papers, theses, dissertations and conference proceedings were searched using relevant keywords. A particular emphasis was placed on literature in business process management, business rules management, accounting, risk management, compliance management and corporate governance.
In step two, all restrictions (rules) have been grouped based on the three decomposed process components. During the third step the rules grouped under 'structure of process elements (activities and decisions)' and 'output/input of the process or activity' have been further decomposed resulting into the current five rule categories: structural sequencing rule, actor inclusion rules, transactional sequencing rules, data condition rules and outcome control rules. Due to space limitation the complete matrix could not be added to the paper. A snapshot of the concept matrix has been added instead, see table 1. Note that we define generic rule categories and not yet detailed subcategories. Detailed subcategories would describe rules that further decompose a main category (such as a structural sequencing rule) into multiple low-level business rules. Example of low-level business rules are: and/or split rules, and/or join rules, starting time rules and duration rules (Choi & Park, 2004). Our assertion is that a set of high level categories needs to be defined and validated before classifying subcategories. This section describes the consequent rule categories defined. To help ground these rule categories they are illustrated by an example drawn from the "Customer Due-diligence" guidelines stated by the BASEL committee (2003).

Structural Sequencing Rule (SSR). A Structural Sequencing Rule (SSR) is defined as a rule that influences the structural execution position of process elements. Each business process has an underlying blueprint indicating the sequence by which activities, events and decision elements (process elements) are executed (Kettinger et al, 1997; Jeston and Nellis, 2006; Weske, 2007).

Rule Category	Author	Defined Categories
Structural Sequencing Rule	Choi and Park (2004)	1) Iteration Rules, 2) Dependency Rules, 3) And/or split Rules, 4) And/or join Rules, 5) Starting time Rules, 6) Duration Rules, 7) Deadline Rules, 8) Sequence Restriction, 9) Frequency Rules, 10) Concurrency Rules, 11) Regulation Restrictions, 12) Standard Rules
	Ghose and Koliadis (2007)	1) Activity/Event/Decision Inclusion, 2) Activity/ Event/Decision Coordination, 3) Activity/ Event/Decision Assignment, 4) Effect Coordination, 5) Effect Modification
Actor Inclusion Rules	Awad et al. (2007)	Direct Allocation, Role-based Allocation, Authorization Separation of Duty, Case Handling, Retain Familiar Capability-based Allocation.
	Ghose and Koliadis (2007)	1) Actor/Resource Inclusion, 2) Actor/Resource Interaction
	Choi and Park (2004)	1) Resource management, 2) Regulation Restrictions, 3) Standard Rules
Transactional Sequencing Rules	Choi and Park (2004)	1) Regulation Restrictions, 1) Standard Rules
	Ross (1997)	1) Decision-Making Rule
Data Condition Rules	Knorr (2000)	1) Object structure, 2) Domain Restriction, 3) Persistency Rules, 4) Occurrence Rules, 5) Ownership Rules
	Ross (1997)	1) Integrity, 2) Calculation, 3)Access & Security, 4)Core Business Rule, 5) Productivity-Enhancing Rule, 6) Regulatory Rule
	Choi and Park (2004)	1) Regulation Restrictions, 2) Standard Rules
Outcome Control Rules	Choi and Park (2004)	1) Regulation Restrictions, 2) Standard Rules

Table 1.   Snapshot concept matrix

Business rules can affect the extent to which organizations and employees are able to freely decide the blueprint they want to execute. In the literature, two high level types of SSRs can be distinguished. First there are rules that state whether a specific process element cannot or must be performed in a

specific process. Secondly there are rules indicating that a process element cannot or must be performed in a certain sequence with respect to other process elements (Ghose and Koliadis, 2007). Within the business process lifecycle the process sequence is decided upon during the (re-) design phase when the process model is developed (Kettinger et al, 1997; Jeston and Nellis, 2006; Weske, 2007). Morgan (2002) assessed the possibility of enforcing business rules affecting sequencing of the process at runtime, concluding that the design phase has a preference above the runtime phase. Following Morgan (2002) and best practice, we assign the (re-) design phase as the proper phase to enforce SSRs. An example of a SSR is that banks within the European Union need to positively identify individuals that are none-customer of the bank before transferring funds on their behalf (BASEL, 2003).

Actor Inclusion Rules (AIR). An Actor Inclusion Rule (AIR) defines a rule that stating which process element an actor can or cannot execute. Process elements are performed by actors that are either humans or computer systems. Assigning non-compliant combinations of specific process elements or entire processes to actors can lead to of risk-like fraud and speculation (Marchetti, 2005; Tarantino, 2008). Therefore business rules should constrain actors/roles/persons/users (actors) executing specified process elements (Awad et al, 2007; Ghose and Koliadis, 2007; Wolter and Schaad, 2007; Mendling, Ploesser and Strembeck, 2008). Two categories of actor inclusion rules can be distinguished (Knorr, 2000; Knorr, 2001; Marchetti, 2005; Awad et al, 2007; Ghose and Koliadis, 2007; Protiviti, 2007; Wolter and Schaad, 2007; Tarantino, 2008), namely: 1) certain actors cannot or must execute certain process elements or processes and 2) an actor can or cannot execute a specific combination of process elements. Ghose and Koliadis (2007) argue the inclusion of two additional categories: 3) adding an actor/resource to the process and 4) actor/resource interaction. Although the additional categories highlight different perspectives we argue that both of the additional categories are an implicit part of appointing an actor to a process element. When a process element is assigned to an actor that actor also needs to be included in the process. Furthermore when an actor is removed from the process then the assignment of a task to that actor no longer exist. Therefore the interaction between actors and resources is being determined by the fact that actors are included in the process itself. Within the business process lifecycle, actors are appointed to process elements within the process model (Kettinger et al, 1997; Jeston and Nellis, 2006; Weske, 2007). The preferable business process lifecycle phase to enforce changes to the process model is the (re)- design phase (Kettinger et al, 1997; Jeston and Nellis, 2006; Weske, 2007). An example of an AIR is: simple identification activities as for example -- resident consumer customers can be handled by a clerk while more complex identification activities must be overseen by a senior staff member. Complex identification activities can entail trusts and third party managed accounts (Basel, 2003).

Transactional Sequencing Rules (TSR). A Transactional Sequence Rule (TSR) defines a rule that influences the decision of an individual process instance based on the case at hand. An individual business process has an underlying blueprint indicating the sequence in which process elements are executed. The blueprint indicates all possible routes a single process instance can follow. However, not every process instance will execute every possible route. The actual route followed is based on data, actors or events particular for that process instance. TSRs require information only acquired during runtime phase (Morgan, 2002; Debevoise, 2005). Certain type of customers such as politically exposed personas or non-face-to-face customers are likely to pose a higher risk to the banks operations and image. During the identification process the risk a certain customer posses is calculated based on the data at hand. The rules used to calculate the risk level of a customer is a TSR.

Data Condition Rule (DCR)s. A Data Condition Rule (DCR) \ defines: 1) what data needs to be stored, 2) how the data is stored, 3) how long the data is stored, 4) and which authorizations are required concerning the access and modification of the data. The importance of completeness and accuracy of data registration is recognized within many studies (Marchetti, 2005; Tarantino, 2008). Rules influence completeness by stating which data (elements) need to be registered regarding the objects within the process (Marchetti, 2005; Rikhardson et al., 2006; Tarantino, 2008). Accuracy indicates the degree to which the stored data reflects the reality concerning an object (Protiviti, 2007;

Tarantino, 2008). DCR rules influence the accuracy of data by defining the meaning of concepts and enforcing predefined structures in which the data needs to be stored (Protiviti, 2007; Tarantino, 2008). In addition to completeness and accuracy. DCRs' also influence authorization regarding the adjustment of data. Authorization, in general, consists of three parts (Rabbiti et al, 1991): (1) a *subject* that has an (2) *authorization type* for a (3) *data object*. The subject indicates the role or employee the authorization applies to. Authorization type indicates which actions the subject can perform. The data on which these actions can be performed are called data objects. A DCR concerning data authorization also needs to contain these three parts. Within the business process lifecycle, there's not a specific phase that can be pinpointed to address these issues (Kettinger et al, 1997; Jeston and Nellis, 2006; Weske, 2007). The reason for this is the way in which data is collected during the process. For example, if data is collected by means of manual input in computer systems, the control needs to be enforced during runtime. But when the system itself collects the data the controls already need to be available during the (re-) design phase. However (from the rule and control mechanism field) a preferable phase can be identified i.e. the implementation phase (Debevoise, 2005; Tarantino, 2005; Protiviti, 2007; Tarantino, 2008). Therefore the most preferable phase is the implementation phase.

Placing DCRs in the context of a customer opening a new bank account leads to the following rules. The data a bank needs to store about the consumer are: last name, first name, date of birth and postal code. This data needs to be accurate as well as complete. As not every employee of the bank must be able to change the data of customers rules are in place defining which employees can and cannot change the data. Lastly rules are in place how the data must be stored.

Outcome Control Rules ()CR). An Outcome Control Rule (OCR) is a rule that defines how results from process elements (undesirable or desirable) occurring in business processes are identified. Previous rule categories affect the execution of a business process. However, it may be impossible or undeseriable to formulate rules in such a strict manner that they hinder actors to perform their work. Additionally rules may focus on the outcome of processes or process activities because of regulation. OCRs influence the way in which processes must be monitored. The enforcement of monitoring compoments within the business process lifecycle cannot be appointed to one specific phase (Kettinger et al, 1997; Morgan, 2002; Jeston and Nellis, 2006; Weske, 2007). The main reason for this is that the manner in which monitoring takes places differs from activity to activity. The outcome of an individual activity may be monitored with information systems or by hand but reconciliation as monitoring tool can be an entire process. For example, a rule within account is that reconciliation must occur between accounts payable and vendor statements (Cobit, 2007; Protiviti, 2007). We summarize the above discussion by presenting figure 1 giving an overview of the preferred pairing of business process lifecycle phases and rule categories.

Business Process Lifecycle Phase	Rule Category
(Re-) Design	Structural Sequecing Rule
	Actor Inclusion Rule
	Outcome Controle Rule
Implementation	Data Condition Rule
	Outcome Controle Rule
Execution	Transactional sequencing rule
	Outcome Controle Rule

Figure 1.   Rule categories matched to business process lifecycle phases

4   Data Collection and Analysis

According to the structures of Design Science, designed artefacts must be measured by predefined variables. With regards to the defined rule categorization, multiple variables can be measured such as

usefulness, use, mutual exclusivity, completeness, quality and impact. As design research is a continuous cycle of building and evaluation (Hevner et al., 2004), we decided to focus on mutual exclusivity and completeness, and implicitly usefulness, before measuring other variables. The reason mutual exclusivity and completeness are measured first is because of their value regarding classifications in general. If a (rule) classification is incomplete or lacks mutual exclusivity its value decreases. The data has been collected via quantitative and qualitative analyses. Both analyses were performed in the context of risk (compliance) management as this field has an effect on business processes in its full richness. Stated differently, risk (compliance) management affects all of the individual components of a business process such as people, information and activities (Tarantino, 2008).

4.1 Qualitative Analysis

The initial data gathering consisted of analyzing a checklist used by multiple consultancy organizations to assess risk and compliance issues: the COSO framework checklist. Recently the security and exchange commission as well as the Public Company Accounting Oversight Board accepted the COSO framework as proof of compliance with the Sarbanes–Oxley Act of 2002. The list consists of 298 elements of risks, accompanied by business rules, which can affect the proper execution of business processes. Therefore, the list provides a good foundation to assess the mutual exclusivity and completeness of our defined rules categories.

Process	Business Rule	Category
Human Resource	Access to HR records is restricted to personnel working within the human resource department	Restriction of accessing data, Data Control Rule
Logistics	Match dates on Receiving information and Inventory information	A tasks that needs to be executed when information is received, Structural Transaction Rule
Logistics	Compare materials received, including verification of quantities received, to properly approved purchase orders	A tasks that needs to be executed when an order of materials is received, Structural Transaction Rule
Logistics	Purchase orders must contain shipment mode and delivery date	Stating which data elements need to be on plans, Data Control Rule
Funds	Reconcile accounts payable records with vendor statements	Accounts payable must be reconciled / compared to vendor statements, Outcome Control Rule.
Funds	Restrict access to accounts payable files and files used in processing cash disbursements	Restricting the access of data, Data Control Rule

Table 2. Extraction Qualitative Analysis

The coding scheme used was designed a priori, based on the previously defined business rule categories. The initial coding scheme was subjected to one round of refinement using eleven judges. We coded all 298 elements while the remaining ten judgers (reliability coders) coded 33 randomly selected risk policy statements. An extract of the coding scheme is shown in table 2 above. 33 items represents 11% of the total sample size. According to Wimmer & Dominick (1997) this can be seen as appropriate number of elements for reliability coders. After the first round of coding two inter-rater reliability indexes were calculated: percent agreement and the Krippendorfs alpha, an inter-rater reliability index that measures the agreement between judges (Krippendorf, 2003). The reason for using a combination of indexes lies in the interpretation of both measurements. Percentage agreement is widely used but multiple authors indicate it is a misleading, and therefore inappropriate measure (Krippendorf, 2003) because it does not take chance into account.. Krippendorfs Alpha, on the other hand, takes randomness into account and is considered to be a more conservative measure of inter-rater reliability. Therefore the combination of both indexes should provide a more reliable view. The inter-rater reliability index after the first round of coding resulted in a 93.33% average agreement and

a Krippendorff's alpha of .868. Both values therefore have acceptable scores as the average agreement is above 70% and Krippendorff's alpha is above .8 (Boyatzis 1998; Krippendorfss, 2003). For this reason the refinement process required only one round. The combination of inter-rater reliability indexes and the fact that all 298 elements could be appointed to a specific category leads us to the conclusion that our categories can be considered complete, useful and represent mutual exclusivity.

4.2   Quantitative Analysis

The quantitative data for this study was collected by an online survey. The professionals and academic researchers that participated in the preceding qualitative analysis were excluded from this survey. Following a single round of data collection, 32 usable responses were obtained. The low response rate may be attributed to the time it took a respondent, on average, to complete the survey: 45 minutes. Forty-two percent (42%) of the respondents had over ten years of experience in the BPM and/or business rules management field. The remaining 58% of the respondents had a diverse level of expertise ranging from less than two up till nine year(s) of experience.

During the survey two constructs were measured: *completeness and mutual exclusivity* of the business rule categories. The first construct was measured by means of an open-ended question. After presenting the five rule categories, respondents were asked to state rules that cannot be assigned to one of these categories. The construct of mutual exclusivity was measured by presenting a list of twelve proxy values representing the five rule categories, and then asking the respondent to assign them to a rule category. To already obtain a further indication on how to enforce specific rule categories, an open-ended question was added at the end of the survey asking the opinion of the respondents regarding this topic.

Regarding the construct of completeness we found that 81% (26 out of 32 respondents) could not refute or extend the defined categories. Hence, agreeing that the five rule categories give a proper illustration of rules encountered in practice. The remaining 19% did not propose an additional category but argued the separation of event based rules from the structural sequencing categories as according to the respondents this would give an improved overview.

	Internal Consistency
Structural Sequencing Rules	0,249
Actor Inclusion Rules	0,814
Transactional Sequencing Rules	0,642
Data Control Rules	0,762
Outcome Control Rules	0,644

Table 3. Internal Consistency Respondents Answers to Rule Categories

Mutual exclusivity can be calculated by two different indexes: percent agreement, and Cronbach's Alpha. Percent agreement measures mutual exclusivity as the percentage of respondents that appoint a single proxy value to the same category, while Cronbach's Alpha measures the consensus (mutual exclusivity) among the answers of a single respondent (Van Wijk, 2000). Although scholars debate which value to use when scaling internal consistency, a score of 0.7 or higher is considered as sufficient when using a normal to average scale of four proxy values. Our survey uses two proxy values to determine the Cronbach alpha's score, thereby negatively affecting its calculation (Van Wijk, 2000). In these situations a limited number of proxy values is used, and a Cronbach's Alpha of 0.6 or higher is considered sufficient (Van Wijk, 2000). Mutual exclusivity calculated by percent agreement resulted in no single score higher than 40%. All, except one, Cronbach Alpha values exceeds 0.6, see table 3. Indicating that consensus among answers of individual respondents exist regarding four of the five rule categories. Thus, although not agreeing amongst each other respondents appoint for four of five categories the proxy value to the same category indicating mutual exclusivity.

5 Conclusions and Further Research

Comparing the results from the qualitative and quantitative analysis leads to interesting conclusions. First, based on the qualitative analysis we can state that the defined rule categories are mutually exclusive and appear to be complete (collectively exhaustive) as well as indicating usefulness. Although the last two characteristics are strengthened by the results of the quantitative research, this can only partly be stated for mutual exclusivity. The answers from individual respondents are mutually exclusive for four out of five categories but the respondents do not always appoint rule statements to the 'proper' rule category. A possible explanation with regards to mutual exclusivity may be found in the time it took to complete the survey in combination with a lengthy explanation of the rule categories during the introduction. Further, after the refuting question, not having the availability of going to the rule categories.

When organizations (re-) design business processes it is fertile to already indentify and define SRRs, AIRs and OCRs during the redesign phase and incorporate them in the process design. During the implementation phase process managers need to make sure that DCRs and OCRs that could not be dealt with during the (re-) design phase are included and accounted for. TSRs and remaining OCRs must be addressed during the actual execution of the designed business process. When incorporating business rules and business process (re-) design in such a manner, a higher degree of alignment can be reached.

We believe that this work represents a further step in research on synthesizing business rules (management) and business process (management). While this work has focused on validating mutual exclusivity and completeness of the main rule categories, future research should explore sub-categories, related rule templates, representation of business rules in process models and the preferred business process lifecycle phase to enforce a specific rule category. As previous research already focused on some of these questions the main emphasis must be on quantitative and qualitative research in industry. Of particular interest is the optimal balance regarding the storage of business knowledge in terms of business process and business rules based on characteristics like existing architecture and agility.

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