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Toward a Functional Reference Model for Business Rules Management

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Abstract

Business rules can be crucial to an organization's business operations. In view of a growing number of internal and external challenges (such as compliance with regulations, the need for organizational agility, or the need to retain organizational knowledge), organizations increasingly are forced to actively manage their business rules in order to stay successful. However, business rules management (BRM) is an organizational task that cannot be encountered simply by implementing a software system. The paper describes the design process toward a functional reference model for business rules management. The model provides three perspectives on tasks and functions to successfully manage business rules. Practitioners may use the model to establish BRM in their organizations, facilitate communication between business and IT, and evaluate software solutions for BRM. From a scientific perspective, the model is a design artifact, representing a theory for designing and developing information systems with the objective of managing business rules.

1. Introduction

1.1. Motivation and problem statement

Organizations usually operate in changing business environments. Changes are usually driven either by internal decisions of the management or by external forces [1] (regulations like REACH, for example, a directive by the European Union) [2]. In general, such changes lead to the replacement or alteration of existing business rules , which frequently results in business processes being adapted [1]. Therefore, business rules management (BRM) becomes a very important task. A business rule is a statement that defines or constrains a certain aspect of the business. It is intended to assert the business structure or to control or influence the behavior of the business [3, 4]. Business rules can be crucial to business operations. Leaving business rules unmanaged can have various consequences, like lost time-to-market, violation of regulations, or customer dissatisfaction [5].

The motivation for establishing BRM therefore is multifaceted. One driver of BRM – as already mentioned – is compliance. BRM is crucial to an organization when it comes to complying with regulatory, industry specific or company specific requirements. Another driver of BRM is the need for organizational agility, which is required for fast decision-making and to reduce coordination efforts. A third driver is the need to retain knowledge within organizations. Tacit knowledge needs to be formalized and transformed into explicit rules to avoid loss of knowledge (when employees leave the company, for example) [5, 6]. Thus, business rules are of high relevance within the practitioners' community [7]. However, despite their importance, business rules often remain unmanaged within organizations in the sense that they are not formalized and properly executed and monitored. Companies are unsure about what they need to consider when dealing with BRM.

Literature hardly provides answers to this question. There have been studies on the development of business rules management systems [1, 7, 8], the integration of business rules with business processes, or the establishment of business rules in business process management [4, 9]. Moreover, authors often limit their analysis to the process of modeling and specification of business rules [10, 11]. The Business Rules Approach (BRA) stresses the importance of managing business rules and provides aspects business rules management is concerned with [5, 12]. However, a comprehensive view of the functionality of business rules management in the form of a functional reference model is missing. The paper at hand proposes a comprehensive, application independent functional reference model for business rules management that companies can use as a framework for establishing BRM. Furthermore, the model has the objective to facilitate communication between business and IT in order to 'speak the same language' when talking about business rules management. The model also provides requirements for further design and development processes, like planning and development of business

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rules management systems. In addition, further refinement of the model allows evaluation of existing software solutions.

1.2. Research question and contribution

Following Bajec & Krisper (2005), we presume that the ultimate goal of business rules research is to find a way and facilities that support automatic propagation of changes to business policies, respectively the business environment, to information systems used within organizations [7]. BRM could support this goal. But this raises the question as to how a comprehensive functional reference model for BRM should be designed. As already mentioned before, there is a gap in research concerning identification and modeling of relevant aspects for successful BRM. There are many different vendor approaches as well as various so-called business rules approaches [13]. Among these approaches is the business rules approach proposed by von Halle [5], a methodology for the development of rule based systems provided by Morgan [14], and a methodology suggested by Bajec & Krisper presented in the form of a scenario [1, 13].It may be this plurality of different approaches that keeps organizations from establishing BRM, as they are unsure about what core tasks and functions are needed for managing business rules successfully. The approaches presented in literature do not provide a clear picture of this issue.

The paper at hand gives answers to the question as to what tasks should be comprised by BRM, and what functions are needed to execute these tasks. To answer this question, we follow the principles of Design Science Research (DSR) [15, 16]. The result of our research is a functional reference model consisting of three different perspectives on BRM: (1) the process perspective illustrates the tasks and the functions assigned to the tasks, as well as their interrelations; (2) the functional architecture perspective depicts the tasks and functions in a table-like view; and (3) the business goal perspective relates the business goals motivating companies to implement BRM to the tasks and functions.

2. Theoretical background and related work

Business policies provide broader governance or guidance for business processes that is not directly actionable. In contrast, business rules provide specific, actionable governance or guidance to implement business policies in tasks [17]. Business rules have their roots in the field of artificial intelligence. There, they are applied for representing knowledge in a form of complex networks of rules within knowledge based systems [7]. Since the end of the 1980s, there has also been a growing interest within the database research community to address the question as to how rules in database systems should be implemented and how business rules in data models should be represented (i.e. how existing modeling approaches like ERM can be extended to include business rules [7, 11]). Also in the object-oriented research community there is a great consent that business rules deserve attention. However, since today UML (Unified Modeling Language) does not provide much guidance for modeling rules [7].

Many authors have tried to define the term ‘business rules’ [7]. Most of these definitions are either pointed out from an IT perspective or from a business perspective. An often used statement when defining business rules is that business rules should be based upon facts, and that facts should be based upon concepts that are represented by terms [8, 18]. This statement is referred to as the business rules ’mantra’; it is an approximation that simplifies the explanation for business people and others new to the topic [17]. Two types of business rules are distinguished: structural rules describe structural characteristics (of data types, for example), operative rules control the behavior of tasks [17]. An example for a structural rule is: “A customer must be considered Gold Customer if the customer places more than 12 orders in a calendar year”. It defines uniquely what a gold customer is. A corresponding operative rule is: “a gold customer must be allowed access to the warehouse”. This kind of rule defines how to deal with a gold customer.

The Business Rules Group states that there ought to be an explicit motivation for setting up business rules [3]. This characteristic is implicitly included in the Business Motivation Model (BMM). The BMM, developed by the Business Rules Group, is a high-level model providing concepts, default terms, and a simple framework for business governance [19]. Business rules are also embedded in the BMM. They participate in three associations: first, business rules are derived from business policies; second, business rules may guide business processes; and third, business rules may have an enforcement level [20]. Following Schacher & Grässle (2006), business rules have to be reasonable; every business rule should be motivated by the organization`s business goals [21]. The BMM includes this requirement by deriving business rules from business policies that are formulated in response to opportunities, threats, strengths, or weaknesses of an organization [20].

One important concept regarding the management of business rules is the Business Rules Approach (BRA). It aims to ensure that a business behaves and

evolves as desired by its leaders. The BRA always begins with the identification of the goals of the business. The business itself is the starting point. Thus, the BRA includes tasks, roles, a rule repository, rules engines for automation, and formal ways of expressing rules, so that business policies can be quantified, accessed and changed as needed [5]. Moreover, the BRA stresses the importance of separating business rules from other parts of the software, as well as the need that business rules should be managed by business experts and not by IT [8, 14, 22]. Business rules are the means through which the link between business and IT is established. This constitutes the demand for managing business rules centrally [1].

Further important studies in the business rules domain have been provided by Bajec & Krisper (2005) [1, 7]. Like other authors (e.g. Graham (2006) [22] or Morgan (2002) [14]), they emphasize the relation between the business rules model and other parts of the business model [1, 8]. They have identified important requirements for tools supporting BRM. Additionally, they have pointed out aspects that have to be considered and included in BRM. Of utmost interest to business rules management research is a scenario they describe that integrates the activities for managing business rules in an organization [1].

Despite the relevance and importance of all these studies, the problem remains that there is still no comprehensive model that defines all the tasks and functions required for successful BRM.

3. Research approach

In general, our research follows the guidelines of Design Science Research (DSR), as proposed by Hevner et al. (2004) [15]. The design process is based on the principles of the Design Science Research Methodology (DSRM) [16]. Following Peffers et al. (2008), we use a sequential design process that incorporates several iterations of design and evaluation cycles [15, 16, 23].

In DSR, four types of artifacts are distinguished: constructs, models, methods, and instances [15]. In particular, we apply conceptual modeling as the design method for our artifact. Through abstraction, conceptual modeling emphasizes the core terms or concepts which characterize an application domain. It thereby neglects technical aspects related to the implementation of a specific software system [24]. Conceptual modeling can serve a variety of purposes [25]. One purpose is to better understand a domain and facilitate communication between various stakeholders (business users and software developers involved in a certain project, for example) [24, 26]. Moreover, the results of the modeling process can serve to set up a documentation of requirements for future design processes [26].

The model is designed in a iterative DSR process that offers various entry points [16, 27]. The entry point chosen for the DSRM process model described by this paper is characterized as a design and development centered initiation [16]. The design and development process follows a reverse engineering approach. In general, reverse engineering involves extracting design artifacts and building or synthesizing abstractions that are implementation independent [28].

By applying reverse engineering we drew upon previous studies and work both in the scientific and in the practitioners' community. The concepts identified for the management of business rules were aggregated and synthesized during the model design process.

Part of the model design process was a qualitative case study conducted with one of the world`s largest food suppliers. The findings of this case study were incorporated in the functional reference model.

Finally, we evaluated the model by means of a focus group assessment and by applying the multi-perspective evaluation approach proposed by Frank [24].

4. Design of the functional model

4.1. Design requirements

As a first step, we defined the objective of the solution to be developed in the form of design requirements to be met by a functional model for business rules management. Following the Guidelines for Orderly Modeling (GOM) [29], we identified correctness, relevance, economic viability, clarity, comparability, and systematical design as important criteria that our solution has to meet.

From an epistemological perspective, the functional model is an artifact. Thus, it is the result of design oriented research, which aims at designing artifacts in accordance to scientific principles allowing to solve practical problems. The objectives of our research resulted both from the practical challenges enterprises face and from our realization that the existing knowledge base did not deliver appropriate answers to these challenges. Obviously, there was a gap that demanded for a solution capable of abstracting and representing reality, facilitating communication about the topic, improving the understanding of the domain, allowing for evaluation of software solutions, and documenting the requirements for future design and development processes. In this sense, the functional

reference model contributes to the advancement of both the scientific and the practical state of the art.

4.2. Model overview

The functional reference model for business rules management comprises three perspectives:

- *BRM Process Perspective*. The Process Perspective emphasizes the relations between the different tasks and functions of BRM. It helps business people to get a quick understanding of BRM and its possibilities as well as its underlying process.
- *BRM Functional Architecture Perspective*. The Functional Architecture Perspective can be used to draw up a documentation of the requirements when implementing BRM in organizations or developing software solutions for BRM (e.g. business rules management systems).
- *BRM Business Goal Perspective*. The Business Goal Perspective is concerned with clarifying the impact of BRM on business goals (compliance, for example, see section 1.1). It gives answers to the question which BRM tasks directly support the achievement of certain business goals.

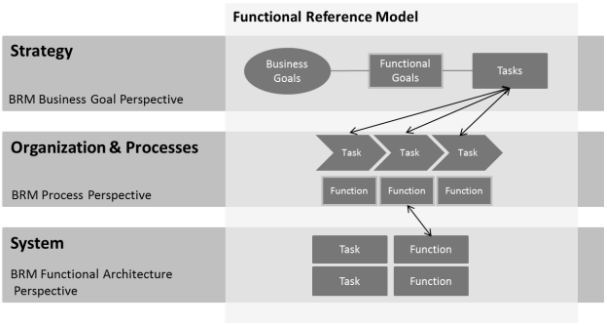

Figure 1. The functional reference model related to different levels of the enterprise architecture

The three perspectives are located on different levels of the enterprise architecture. With respect to the Business Engineering approach for modeling the enterprise architecture on different levels of abstraction, we distinguish a strategy level, an organization and process level, and a systems level. In general, Business Engineering serves as a framework comprising all key artifacts (and their relations) that are relevant to make strategic decisions in the overlapping area between business and IT [30]. One important principle of Business Engineering is that innovations in organizations become effective only if they are implemented on all levels [31]. The BRM Business Goal Perspective is located on the strategy level. It is directly related with the BRM Process Perspective on the organization & process level through the identified tasks. The BRM Functional Architecture Perspective is located on the systems level, as it provides functional requirements for developing software solutions for BRM. The relationship between the systems level and the organization & process level is incorporated through the tasks and the functions, respectively.

Figure 1 depicts the three perspectives of the functional reference model located on the different enterprise architecture levels. In the following sections, the different perspectives are described in more detail.

4.3. BRM process perspective

Figure 2 gives a graphical representation of the process perspective of business rules management. We identified six tasks that are deemed necessary for doing successful BRM. The tasks, which are represented in Figure 2 by means of the dotted rectangles, comprise several functions. The boxes inside the dotted rectangles depict these functions, which are required to execute the tasks. Table 1 describes the six tasks in detail:

Table 1. Description of BRM tasks

BRM task	Description
Requirements Analysis	Requirements Analysis comprises all functions for determining relevant internal and external factors influencing the business. Business policies are identified (function: *Business Policy Identification*).As many business rules are distributed across the whole organization (e.g. in spreadsheets, documents, application codes or databases), these rules need to be identified (function: *Legacy Rule Acquisition*).
Authoring	Authoring is concerned with the documentation and definition of the business policies previously identified (function: *Business Policy Documentation/Definition*) as well as with the derivation and formalization of business rules in a language that can be read by business people (function: *Business Rule Formalization*). Business rules need to be derived from the business policies to make them actionable. A formal language allows to check the business rules for consistency and integrity. The basis of the formalization language for the business rules are general concepts (e.g. definitions of business objects) and facts that need to be defined (function: *General Definition of Concepts and Facts*).
Change Management & Validation	Change Management & Validation deals with changes in the business policies and the business rules derived from them. If business policies are changed or renounced, the business rules derived from them have to be adapted. Changes in business rules can have a great

	impact on the consistency and integrity of a rule set. Therefore, a comprehensive impact analysis needs to be conducted when business policies and business rules are changed (function: *Impact Analysis*). Furthermore, consistency and integrity needs to be validated before new or changed business rules are deployed, as inconsistent rules may result in inconsistent behavior across the organization (function: *Consistency/Integrity Check*). Finally, change control comprises version and history management as well as the definition of roles that are allowed to create, change, or deploy business rules (function: *Change Control*).
Monitoring	Monitoring of business rules is needed since each business rule is a directive intended to govern, guide, or influence business behavior. To quantify the efficiency or KPIs of a business rule, for example, appropriate metrics have to be applied for measuring (function: *Metrics & KPI Definition*). The results of the measurements (function: *Measurement*) need to be documented in reports (function: *Report Generation*).
Deployment/ Implementation	Deployment/Implementation is concerned with the deployment of business rules to business processes (function: *Rule Deployment*) and with the implementation of business rules in program code that can be executed by a rules engine (function: *Rule Implementation*).
Execution	Execution refers to automatic execution of business rules during all kinds of transactions. Business rules that are modeled in business processes are automatically checked for violations, while a process engine executes the business processes (function: *Automatized Rule Execution*). Moreover, any other application or information system can use the rules engine to monitor compliance with business rules during transactions.

4.4. BRM functional architecture perspective

Figure 3 shows the Functional Architecture Perspective of business rules management. The column on the left consists of the tasks that we defined for the process perspective. To the right of this column, the functions identified for each task are listed. The Functional Architecture perspective allows, among other things, to evaluate software solutions for BRM, especially business rules management systems (BRMS) Also, this perspective may be used for documentation of requirements when it comes to developing BRMS or rule-based systems. Furthermore, companies can use this perspective when implementing BRM in their organization. However, not all the functions can be performed by a software system. In general, we can distinguish three types of functions: human functions, human-systems functions, and systems functions. Human functions (*Business Policy Identification*, for example) are only performed by people, without any help of a software system.

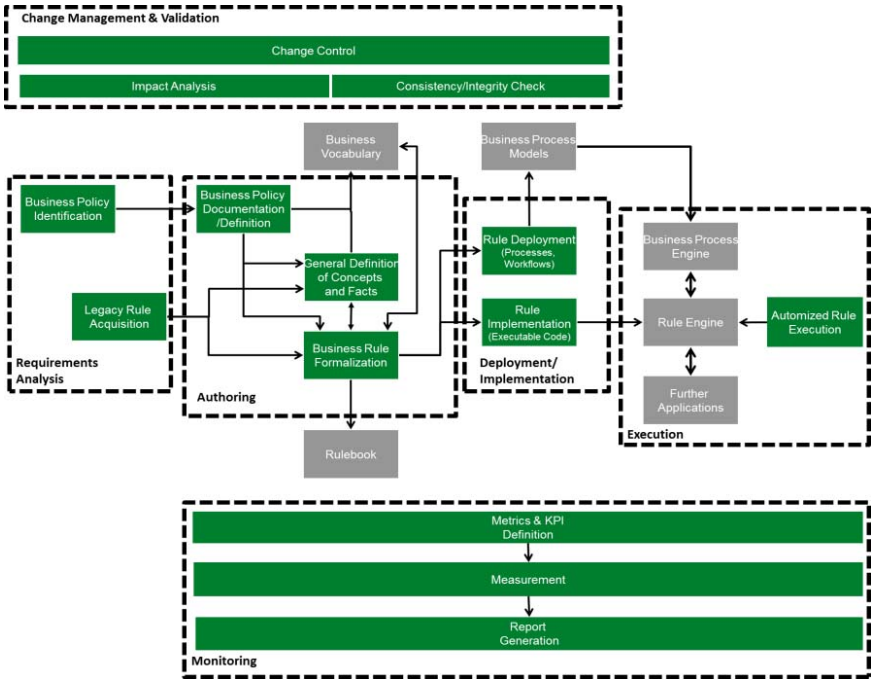

Figure 2. BRM process perspective

Human-systems functions always comprise some form of interaction between a human and a software system (a user entering a business rule into a system, or a system proposing phrases to help the user, for example). Systems functions, finally, are completely automated (a BRMS doing automatic consistency and integrity checks, or automatic execution of business rules by a rules engine, for example).

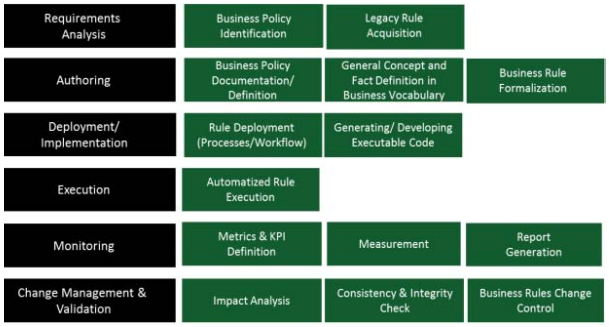

Figure 3. BRM functional architecture perspective

4.5. BRM business goal perspective

The Business Goal Perspective relates the business goals that motivate the establishment of BRM to the tasks of BRM. The impact and relationship of each task on each business goal is modeled through functional goals. Graphically, this relationship is represented by a goal graph. Figure 4 shows an extract of such an goal graph. It depicts that the business goal compliance conformance is directly related to three tasks: Change Management & Validation, Requirements Analysis, and Authoring. Relations with other tasks (Deployment/Implementation and Execution) are left out here, due to space limitations. The figure shows some functional goals that need to be achieved in order to become compliance conform. A company needs to determine all relevant external influencers. Secondly, all business policies (external influence factors) have to be documented. These functional goals relate to the Requirements Analysis task. Then, a third and fourth functional goal are that business rules are formalized and centrally stored. These goals are dependent on the former mentioned functional goals. Finally, these functional goals relate to the Authoring task.

Organizations can use this perspective to motivate for certain tasks and to rate their importance. Also, the perspective can be used to prioritize the implementation of tasks as their impact on the business goals becomes visible.

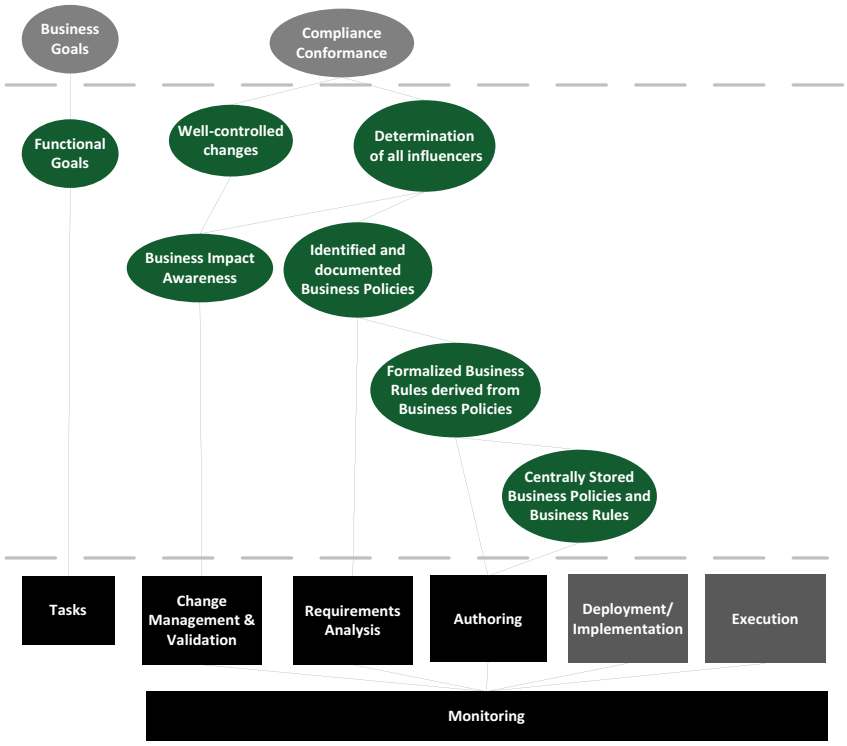

Figure 4. BRM business goal perspective

5. Case study

In the course of a case study conducted with an international food supplier (from now on called FoodSupply Corp.), we extended the initial design of the functional reference model, which was based mainly on BRM literature and documentation on BRM software tools. The need for BRM at FoodSupply Corp. arose when – in the context of an ERP consolidation project – a central ERP system was implemented. As one central requirement of the project it was decided that only data of high quality should be migrated to the central ERP system. Unfortunately, however, FoodSupply Corp had no centrally managed business rules that could be applied for conducting automatic data quality checks. As a response to this shortcoming, proactive business rules management was implemented. FoodSupply Corp. realized that business rules provide a granular level of detail about its business needs (e.g. rules for complaint management, legal contract management, vendor managed inventory, etc.). Other drivers for establishing BRM therefore were the need to retain organizational knowledge (in view of employees leaving the company) as well as the demand for a company-wide collection and harmonization of rules to prevent the loss of synergy effects between subsidiaries. During the case study we made an interview with a Business Excellence Manager for Data Management and Data Quality at FoodSupply Corp. Table 2 gives an overview of BRM at FoodSupply Corp. with respect to the six tasks of the functional reference model.

Table 2. Design of BRM tasks at FoodSupply Corp.

BRM task	Design at FoodSupply Corp.
Requirements Analysis	Business users (e.g. data or process owners) formulate their requirements.
Authoring	Business requirements are either formalized directly (using SBVR), or natural language is used and transformed. Initially, rules are modeled in collaboration with business users and then translated into SBVR by rule experts. All business users have access to the rules by providing role dependent user interfaces. RuleXPress is used to verify and visualize the rules as well as to check their integrity. All rules are stored in a central business rules repository.
Change Management & Validation	The business rule lifecycle is implemented in the overall change request process. Changes are formulated by business and translated into SBVR. The defined rules are validated and checked for integrity. Responsibilities are uniquely defined. Only rule experts are allowed to modify rules.
Monitoring	For every rule KPIs are defined and measured to monitor business rules efficiency.
Deployment/ Implementation	After the rules have been modeled and documented, they are (manually) translated into actionable program code. Rules are implemented in a rules engine, which executes the rules. Thus, processes and their respective logic are separated.
Execution	An in-house developed rules engine executes the rules.

The case study helped us identify the functions that need to be performed to successfully execute the six tasks. Due to the importance of motivating BRM on a strategic level, we came up with the three different perspectives of the functional reference architecture, as implementation of BRM affects the whole organization. The interrelation that exists between the perspectives shows the motivation for certain tasks and functions, which gives business users an idea why they should formulate business rules on their own (in response to identified weaknesses, for example). Moreover, each perspective has its own use cases, which were described in the previous sections.

Particularly one finding of the case study is noticeable: change control, impact analysis, and integrity/consistency checks seem to be extremely important functions of BRM at FoodSupply Corp.

6. Evaluation

Due to the active role the researchers took in the process of designing the functional reference model in the course of the case study, additional evaluation activities were required. We therefore conducted a survey among participants of a focus group. Moreover, we applied the evaluation criteria for reference modeling proposed by Frank to evaluate our model [24].

6.1. Focus group evaluation

In a survey among participants of a focus group we first asked to judge if they agree that the identified tasks were of importance and necessary for BRM. Secondly, we asked the participants to state their opinion regarding the importance of the functions needed to perform the tasks (see figure 5). We used a five-point Likert scale (‘strongly disagree’, ‘disagree’, ‘neither agree nor disagree’, ‘agree’, ‘strongly agree’). To improve readability of the bar diagrams (see below), we merged the answers stating ‘strongly disagree’ and ‘disagree’, as well as ‘agree’ and ‘strongly agree’, respectively. The results are presented

in percentages of the total number of answers (n=18). Almost all participants of the focus group agreed that the identified tasks were necessary for successful BRM. However, it is noticeable that regarding Authoring 30% of the participants were unsure whether they should agree or disagree (the reason for this result needs to be explored by future research). Also, there was one participant in the survey who did not consider Execution to be a necessary task. Here too, 18% were unsure whether to agree or disagree. Obviously, there is some uncertainty about these two tasks, which can also be detected in the results of the evaluation of the functions. In terms of the necessary functions needed to execute BRM tasks, the answers given were also largely supportive of the model. But, again, it is noticeable that the implementation of business rules and their automatic execution (which both are related to Execution) is seen critical. We believe that the reason for this judgment is that most of the focus group participants generally are more interested in centrally managing business rules in terms of capturing business requirements, authoring business rules, and assessing their impact. In contrast, execution of the rules on information systems level seems to be seen as a pure IT task. Another explanation may be that the model does not directly consider business rules that are not executable by a business rules engine (e.g. the CIO reports to the CEO). Thus, there could have been some uncertainty about the handling of such rules in the execution function.

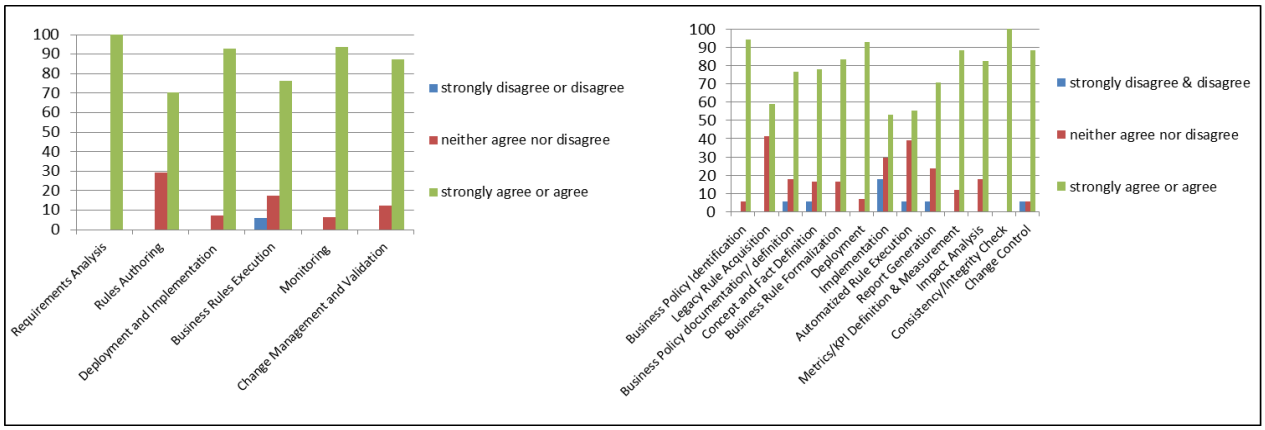

Figure 5. Evaluation of importance of BRM tasks

6.2. Multi-perspective artifact evaluation

For evaluation of the functional reference model a framework proposed by Frank was used [24]. The framework aims at fostering differentiated and balanced evaluation by observing and measuring how well the developed artifact supports a solution against the requirements outlined. Four dimensions were selected for evaluating the proposed model: Economic Perspective, Deployment Perspective, Engineering Perspective, and Epistemological Perspective. Figure 6 shows the results of the evaluation of the model against these dimensions and against the GOM by conducting the survey among focus group members.

- *Economic Perspective.* Criteria like costs and benefits cannot be evaluated yet in detail because of the lack of cases the functional model has been instantiated in. However, due to the generic structure of the model, costs for adaptation can be considered relatively low (see Engineering Perspective). Moreover, one benefit is that the model is capable of simplifying the exchange of knowledge concerning BRM implementation in organizations.

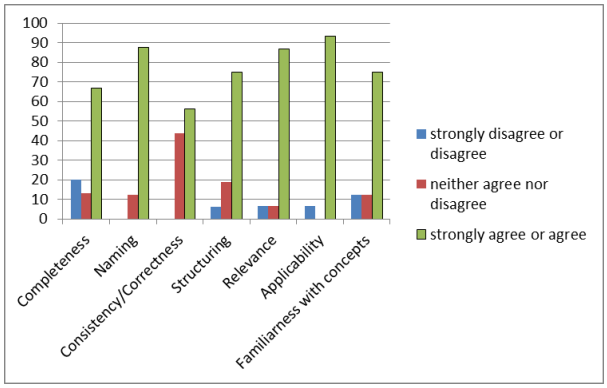

Figure 6. Multi-perspective evaluation of the functional reference model

- *Deployment Perspective.* The case study demonstrated that the model is well applicable. Also, more than 90% of the focus group participants

stated that the model can be applied to evaluate software solutions for BRM.

- *Engineering Perspective*. We evaluated the validity of the design of the artifact by assessing whether the requirements (formulated on the basis of the GOM in the first step of the design process) are met (Table 3)
- *Epistemological Perspective.* The evaluation of the model through the participants of the focus group showed that it is capable of abstracting and representing an organization`s reality.

Table 3. Compliance with GOM

GOM	Description	Assessment
Correctness	Model consistency and completeness	Most of the focus group participants had the opinion that the model was complete. However, 20% of the participants disagreed here, mainly because they were missing more functions that we consider to be sub-functions of the functions already included in the model (the demand to cope with the impact of business rules on data, for example; in our understanding, this would be a specialization of the Impact Analysis function). As far as consistency and semantic correctness of the model is concerned, no survey participant argued with these aspects of the model.
Relevance	Appropriateness of model boundaries Appropriate level of abstraction	The focus on business rules management is of relevance, as described in section 1.1 of the paper. The level of abstraction was proven as appropriate.
Economic viability	Reasonable modeling effort	No significant expenditures were needed for developing the model. The model fulfils the criteria of the economic perspective according to Frank (2007) [24] (see above).
Clarity	Comprehensibility, readability	Due to the model`s simple structure, it can be understood easily.All focus group participants agreed on the naming of tasks and functions.More than 70% said they were familiar with the concepts used in the functional reference model.
Comparability	Compatibility to other models, Support of "as is" and "to be" models	We did not evaluate the compatibility to other models. The model can demonstrate "as is" situations in a company, as shown in the case study. In general, there should be no obstacles to demonstrate also "to be" situations.
Systematic design	Decomposition into views, layers, etc.	Our functional model is structured hierarchically and consists of different levels. More than 70% of the focus group participants agreed or strongly agreed on the structural design of the functional reference model.

7. Conclusion

The paper describes the design of a functional reference model for business rules management (BRM). The design of the model followed a Design Science Research process. We evaluated the model by conducting a survey among participants of a focus group. As a result we can state that the functional reference model for BRM is beneficial with regard to the advancement of the state of the art both in practice and in science. From a scientific view, the functional model provides new knowledge in terms of abstracting and representing reality [24]. In particular, the functional reference model can be seen as a representation of an information system, due to the fact that it defines requirements for the functionality of a business rules management system. Explication of the research process allows for verification, correction, and differentiation of the designed artifact. Practitioners may use the model to establish BRM in their organizations, facilitate communication between business and IT, and evaluate software solutions for BRM. The correctness of the functional model was verified by following an iterative Design Science Research process, in which we identified tasks and functions by applying a reverse engineering approach and conducting a case study. Future research should extend the identified functions by identifying useful sub-functions. Based on more case studies, organizational roles for BRM should be further examined. Automatic translation of formalized business rules into executable code is one major gap in current research that should be explored further. Moreover, the focus group members had problems with the understanding of the business rules execution function. Obviously, as discussed in the evaluation section this may be caused due to the fact that the function does not consider the existence of rules that

can only be executed manually. This is an important issue that needs to be addressed in a follow-on study.

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