

BUSINESS RULES AS PART OF INFORMATION SYSTEMS LIFE CYCLE: POSSIBLE SCENARIOS

Kestutis Kapocius^{1,2,3}, Gintautas Garsva^{1,2,4}

¹*Vilnius University, Kaunas Faculty of Humanities, Department of Informatics
Muitines str. 8, Kaunas Lithuania,*

²*Kaunas University of Technology, Information Systems Department,
Studentu str. 50, Kaunas, Lithuania*

³*kestutis.kapocius@ktu.lt,* ⁴*gintautas.garsva@yukhf.lt*

Abstract: As the need for flexible business rules approach based solutions increases, the shortcomings of existing models and methodologies become more apparent. Whereas traditional information system (IS) development approaches are relatively well documented and clarified, the business rules approach still lacks a clear view on how exactly can rules enrich the standard IS development process. This problem is addressed in this paper by introducing the methodical look at the possible roles of business rules in the IS life cycle. Six key scenarios are defined and overviewed. Based on the analysis, desirable features of the new business rules driven solutions are formulated including the guidelines for the improvement of the rules-based IS development method that is being developed by the authors.

Keywords: business rules, information systems life cycle, requirements engineering, system design.

1. Introduction

Current trends in information system (IS) development put increasing emphasis on the business rules (BR) approach. The central feature of the BR approach is that business oriented constraints or business rules are treated like a separate layer of IS requirements, design and architecture, thus resulting in a certain “three dimensional” (data, business rules and processes) view of the system. The application of business rules approach has been problematic due to ambitious aim to separate constraints from the program code, yet we can now see new tools and scientific solutions appearing on a regular basis. Despite the growth of the field, majority of available methodologies and models lack consistency or are limited in scope. We think that relatively poor understanding of the ways business rules could enrich the stages of traditional IS life cycle is one of the reasons behind a relatively slow development of the BR approach.

The aim of the research summarised in this paper was to find and define the previously lacking key scenarios of the BR approach application during the development of IS. Discovering the key features of the BR-enriched IS life cycle would allow to formulate the basic requirements for BR driven IS development solutions. We also aimed at putting a solid basis for the improvement of the IS development method that we are currently developing.

The second chapter of this paper includes an overview of the principles behind the business rules life cycle and it's relation to the traditional view on IS development. Key scenarios of the BR integration into the IS life cycle that were formulated during the research are overviewed in Chapter 3. The main implications of the research are outlined in Chapter 4, which is followed by the conclusions.

2. The Principles of the Business Rules Life Cycle

A widely recognized Zachman enterprise architecture framework includes business rules as an integral part of the IS architecture. The basic principles of the BR life cycle could already be extracted from this framework, where rules correspond to the motivation (why) column (Sowa, Zachman, 1992; Zachman, 2004). However, research has been carried out in the field of business rules life cycle and the results suggest that the following four basic stages are enough to portray the rule change during the IS development: rule start, rule capture, rule quality and rule deployment (Innovations, 2007). From a practical point of view one could differentiate between the business and IT levels of the BR life cycle. At the business level rules can be analysed and modified by the stakeholders, while the IT level addresses the technical aspects of rule storage in the repository as well as their implementation using a specialized software sys-

tem called BR engine. It is important to note that feedback should be available from the IT level to the business level even during the exploitation of the system thus enabling the users to change rules freely (Wolfgang, 2006).

In any case the specification of business rules during the IS development using the BR approach should be a two (or more) level process (Morgan, 2002; Von Halle, 2001):

Rules are specified using templates (usually natural language templates) so that they could be understood and modified by stakeholders. This level of formalisation is useful during the requirements specification stage. Here structural rules (terms and facts) can be either expressed as elements of conceptual data model (e.g. fact model) or as natural language statements. It would be practical to allow both representations via flexible conceptual model related rule templates.

Rules are expressed formally focussing on the needs of system designers and implementers. At this stage non-structural rules maintain links with the structural rules that by this stage are already transformed into a data model (e.g. UML class diagram).

Note that when it comes to application of formalised business rules during the IS implementation, they can either be transferred straight to programmers resulting in a traditional implementation (without flexible rule changing capabilities) or go to the implementation level repository, which would be handled by a business rules engine (Fig. 1, cases A and B respectively). A mixed approach is also possible. These scenarios are overviewed in Chapter 3 of this paper.

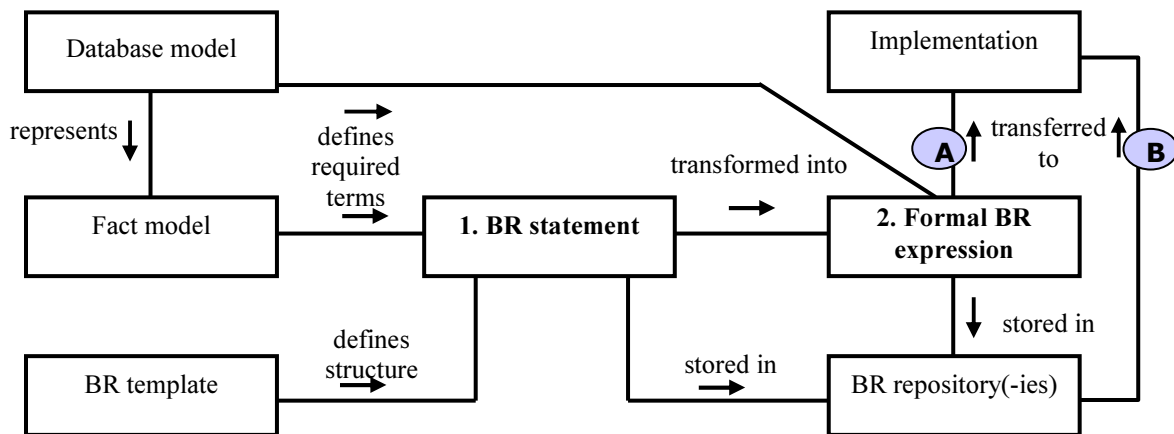
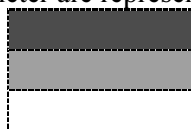


Fig. 1. BR states in a simplified life cycle (extended from (Morgan, 2002))

3. Integration of Business Rules into the Information System Life Cycle

To illustrate the different approaches or scenarios of integrating business rules into the IS development process, the simplified waterfall IS life cycle model (Royce, 1970) consisting of four stages has been used (see Fig. 2–4). All presented scenarios are formulated and can be compared based on the combination of the values of one qualitative parameter – the relative emphasis given to the certain layer of IS during the certain stage of IS development. To make the presentation clearer, conceptual values of this parameter are represented as follows:



- the layer of IS is strongly emphasized,
- the layer of IS is only partially emphasized,
- the layer of IS is emphasized weakly or not at all.

Under the **traditional approach** (Fig. 2) business rules can be partially analysed only during the initial stages of IS development. After that the image of the IS would become „two-dimensional“, with rules distributed in data and process layers of the system.

The application of the BR approach, on the other hand, means that the work is being carried out in a „three-dimensional“space, where data, business rules and processes are independent dimensions. However, the emphasis we put on them can differ. We have formulated six basic scenarios that are overviewed below.

(a) Theoretical goal (Fig. 3). Theoretical principles of the BR approach summarized by the Business Rules Group (BRG) and other researchers convey the idea that rules should be the main core of requirements, project and implementation of the system (Business, 2003). In such scenario, starting with scoping

and planning, the focus is placed on universe of discourse aspects that will be required to structure the rules. During the later stages both structural requirements (i.e. objects of the conceptual data model) and, partially, features of computerized processes should be expressed as business rules. Finally, during the IS implementation both structural and non-structural rules should be prepared for the processing by a specialized BR engine. At this stage users should be given the tools to change the majority of important system characteristics without rewriting the program code or directly changing the structure of the database.

The theoretical vision has been researched by R. Ross, T. Morgan, B. von Halle and others. Von Halle method deserves a special mention as it supports the entire IS life-cycle (Von Halle, 2001). However, such solutions have not yet gained any considerable recognition, and only their fragments are sometimes applied in practice. Below we will overview other approaches that we think could be more efficient.

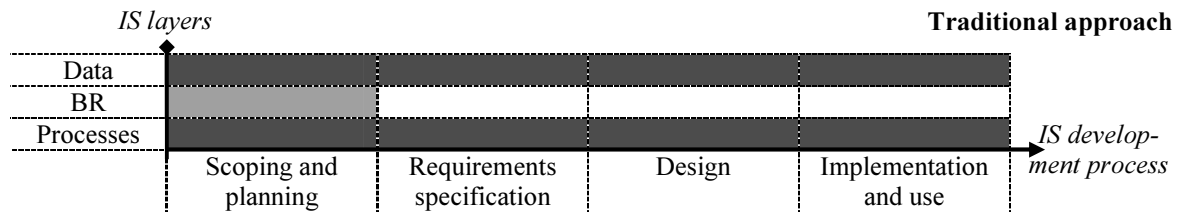


Fig. 2. Possible ways of integrating the BR layer into the IS development process (I)

(b) Realistic goal (Fig. 3). It is safe to say that maintaining an optimal, yet achievable balance between all three dimensions of IS can yield good results. In this case a full-fledged database model should be created. Process models and program code of the system should be balanced in such a way that the latter includes the rules that do not have to be prepared for the changes. Further in this paper a somewhat similar selective approach is described. However, the key difference lies in the fact that here all rules that can be implemented in the final system maintain their independence from other layers of the system throughout the IS design and implementation.

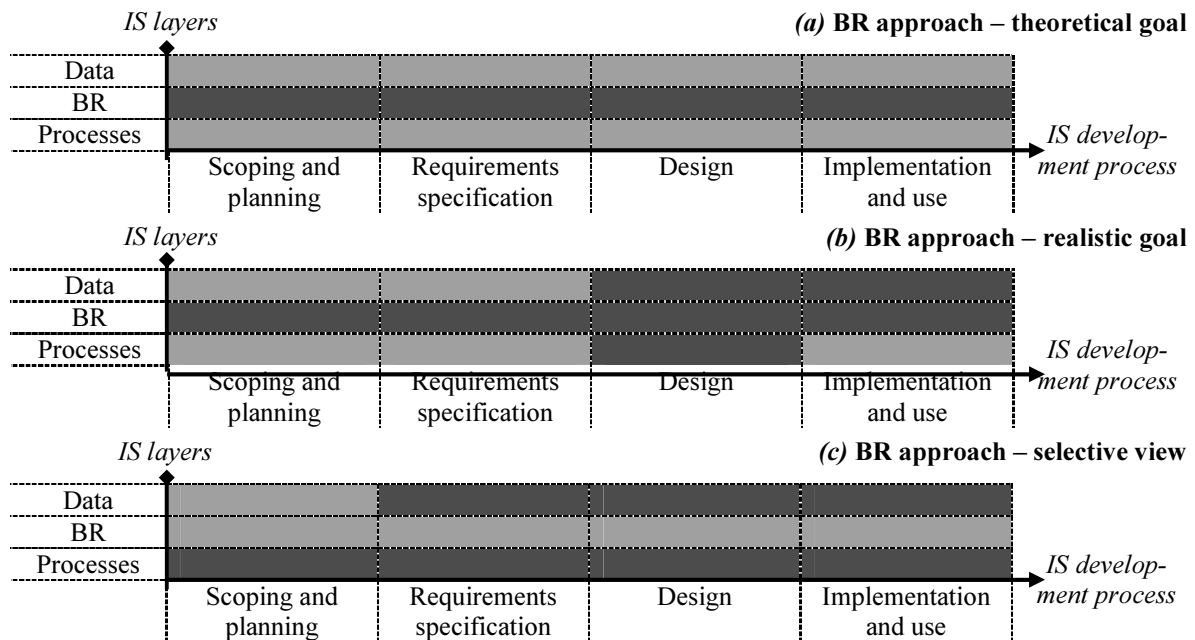


Fig. 3. Possible ways of integrating the BR layer into the IS development process (II)

Because in this case a BR-based IS would be developed, during the creation of data model only structural business rules are used, while non-structural ones are prepared for the management by the BR engine or other technical solution. Likewise, during the process analysis only a small part of discovered business rules are used, while the remaining ones must “stay” in the business rules layer as an independent part of the future IS.

(c) **Selective approach** (Fig. 3). In case of the selective approach only a semantically or otherwise constructed subset of business rules is separated from other elements of requirements. We think that such selection of important rules is advisable under the following circumstances:

- It is known in advance or is determined during the scoping/planning that only some of constraints will have a tendency of changing during the IS development or its use.
- The available BR implementation platform supports only certain types of rules.

Constraints that do not have to be prepared for changes can be recorded in traditional data and process models and implemented in the application program code or as database constraints.

Selective approach allows achieving a reasonably balanced cost of BR-based IS development, as only a portion of rules have to be formalized to the level required by the business rules engine. Furthermore, according to the nature of rules, a simpler BR management solution can be used. Among the shortcomings of the selective approach one could distinguish the need to combine several IS requirements specification, design and system implementation methodologies.

It is important to emphasize that any of the scenarios discussed in this paper could gain a selective character when BR layer is populated only by rules from a certain subset, while all of the remaining constraints are recorded traditionally.

(d) **Transformation from traditional IS into a BR-based IS** (Fig. 4). In this case business rules are separated from data and process models only during the implementation of IS. Such scenario is indeed possible. However, it would most likely be ineffective in typical applications. One of the reasons why it is not advisable to rely on this approach is because the extraction of business rules from various requirements models and their expression in the unified and formal manner is relatively costly. The possibilities of automating this process would be very limited.

Observations suggest that separation of business rules from other layers of IS during the design or especially implementation stages would be expensive because requirements analysis would likely have to be repeated. However, the discussed alternatives can be considered when a BR-based IS has to be developed using a previously developed IS requirements specification or project. This scenario is possible when the client has the detailed business analysis, which is not BR-based, or wants to modify the existing IS by introducing the business rules processing tools.

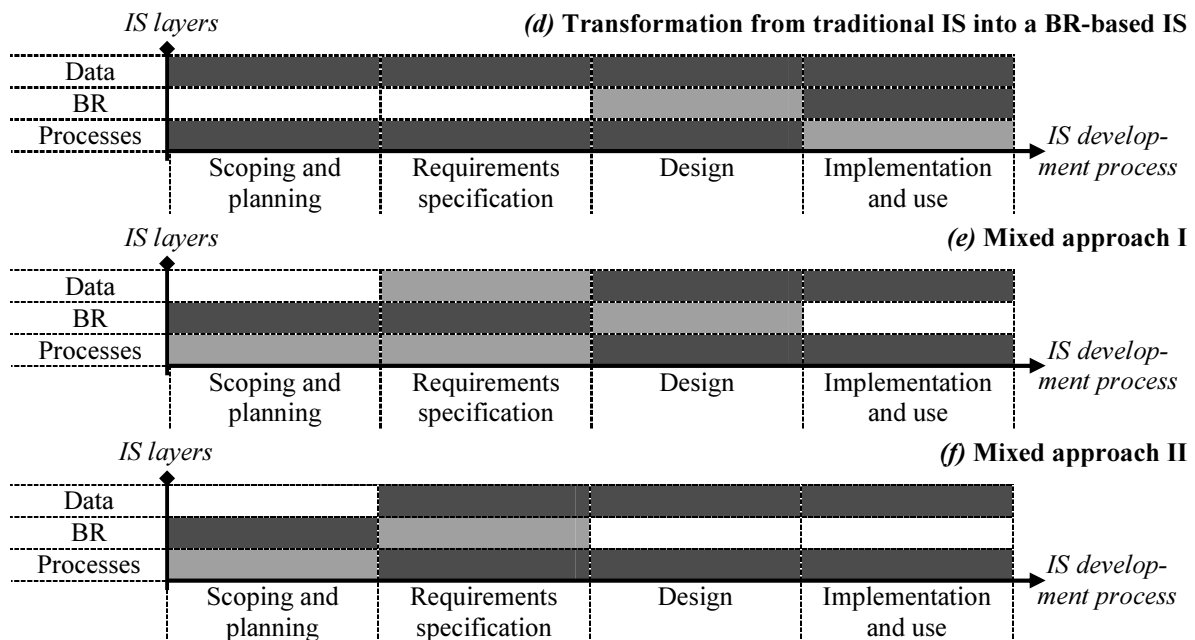


Fig. 4. Possible ways of integrating the BR layer into the IS development (III)

(e, f) **Mixed approach** (Fig. 4). The main principle of the so called mixed approach is merging the elements from both traditional and BR-based approaches into a single process. Unlike in the consistent BR approach driven methods, in this case BR-based requirements serve only as an information source during the detailed specification and design while the resulting system does not differ from the one developed using traditional, non-BR-based methods (Butleris, Kapocius, 2003).

The first of the formulated scenarios (Fig. 4, (e)) represents the case where the BR approach is used only till the start of the design process. This allows for a prompt and efficient approval of the requirements specification by the stakeholder or user. User's participation becomes limited during the later stages of development and business rules are distributed among other components of IS architecture. User can still take part in the process although his participation is limited to corrections of only those rules that can be transformed into lower level models (semi)automatically (as changes to such rules do not require any manual redesign of the low level models).

During the data model development all discovered structural business rules as well as some constraint type business rules (e.g. domain constraints) are applied. Despite of that, just like all non-structural rules and even some structural ones (e.g. certain generalizations), these constraints are also used by the process analyst and eventually can be implemented in the application code.

The second scenario (Fig. 4, (f)) is similar to the first one, yet in this case stakeholder's / business expert's participation in the IS development process ends earlier, during the requirements specification and analysis. Therefore BR elements (strategies, aims, rules) are analysed only at the conceptual level, aiming to better understand the context of the universe of discourse and prepare for the formalization of requirements. In both cases, after the IS has been implemented, the user can manage rules only to the extent specified in the computerized functions requirements.

The following advantages of mixed approaches over the (a)-(d) scenarios have been formulated (Butleris, Kapocius, 2003):

- The project can be implemented using stable and time tested tools, without additional financial and workforce investments into the assimilation of new software.
- Implementation does not require complicated solutions (BR repository and BR engine).
- Design stage is potentially more efficient because majority of requirements have to be formalized only two dimensionally (as data and processes).

4. Implications for the Undergoing Research

Based on the results presented above the following key implications can be formulated:

- It is safe to presume that BR-based IS development methods should ideally be of the universal nature. In other words, they should be oriented towards the realistic goal scenario yet compatible with selective and mixed approaches.
- BR approach driven IS development methods should be constructed in a way that their components intended for requirements specification and design could also be used separately as well as in connection with other models. This is especially important for the business rules models that are used as the benefits of new and limited models introduction are questionable.
- Finding the right approach for the system implementation stage involves balancing the costs and features of the system. Business rules models can be applied in two basic ways here: by using them for application code generation or by storing them in a managed repository accompanied by the appropriate BR engine. It is important to note that in case of the first scenario it is advisable to record the relationships between rules and the application code thus simplifying the modification process. However, the second scenario provides the user with much better rule management capabilities, but is more costly to implement.

It is important to note that the presented research also provides theoretical basis for the strategic decisions made in the business rules based IS development method that we are currently working on (Butleris, Kapocius, 2002; Kapocius, Butleris, 2006). The following features have to be addressed in order to make the method compatible with the key BR approach life cycle scenarios:

1. Bridging the gap between the available requirements specification and design solutions by introducing the methodology for the transformation of the natural language based business rules into formal Ross method based expressions.
2. Emphasizing the universal nature of the developed requirements specification method by developing a set of rules and guidelines for the application of requirements specification in various IS design processes. The method has to be applicable not only in BR-driven development scenarios, but also in mixed and traditional approaches. Research into the extension of the Object Driven Requirements Specification Method (ODRES) method has already shown that the developed BR model can be applied to extend another methods (Kapocius, Danikauskas, 2006), but further elaboration on these opportunities is required

3. Emphasizing the universal nature of the developed BR model for IS design by creating the set of rules and guidelines for the implementation of the model in various scenarios.

5. Conclusions

The presented set of scenarios of BR integration into the IS life cycle is not finite. Different views are possible, if a different process of IS development would be taken as a basis for analysis. However, at this point the described set it is considered as complete. It is safe to say that the most important decisions are made while moving from requirements specification to the design phase.

Apart from a theoretical goal approach four other ways of integrating business rules into the IS life cycle were defined: realistic goal, selective view, mixed view (two cases) and the transformation of traditional IS into a BR-based IS. The key differences between the scenarios lie in the intensity of emphasis put by the developers on business rules. It can decrease as the system development progresses (as in mixed approaches that result in a traditional IS) or stay stable/increase (as in the case of realistic goal or selective approaches that result in a (more or less) business rules based IS). Ideally it is advisable to chose or develop solutions that have clearly separable parts that can be applied in all three key scenarios (realistic goal, mixed and selective).

Future work includes further elicitation of the defined scenarios and creation of the guidelines for the development of versatile and widely applicable BR-based solutions. Feasibility of the formulated guidelines would be evaluated during the ongoing work on the BR-based information systems development method.

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