

Business Rules Management Systems

PETR BERKA

University of Finance and Administration, Prague, Czech Republic

Abstract: Knowledge Management, an established research and application area aim at generation, representation, storage, transfer, transformation, application, embedding and protecting of (organizational) knowledge to “bring right knowledge to right people at right time”. KM efforts typically focus on organizational objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, and continuous improvement of the organization. Recently, the notion of business rules management systems (BRMS) emerges in the business people community as a new category of decision support systems. The paper reviews the basic principles of business rules and shows how they are influenced by expert systems, developed in the artificial intelligence community more than 30 years ago.

Keywords: knowledge representation, expert systems, business rules management systems.

1 Introduction

Knowledge representation and reasoning using knowledge are central to AI (artificial intelligence) research. Many of the problems of which machines are expected to solve will require extensive knowledge about the world. This fact has been realized in mid. 70th of the 20th Century and implemented in so called expert systems (ES), or knowledge-based systems (KBS), a “computer programs that emulate the decision-making ability of a human expert” (Jackson, 1990). The role of knowledge has been recognized also in the area of business and management. Knowledge Management (KM) comprises a range of practices used in an organization to identify, create, represent, distribute and enable adoption of insights and experiences. Such insights and experiences comprise knowledge, either embodied in individuals or embedded in organizational processes or practice. Knowledge management thus aims at generation, representation, storage, transfer, transformation, application, embedding and protecting of (organizational) knowledge to “bring right knowledge to right people at right time”. KM efforts typically focus on organizational objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, and continuous improvement of the organization. Recently, the notion of business rules management systems (BRMS) emerges in the business people community as a new category of decision support systems. The paper reviews the basic principles of BRMS and shows how they are influenced by expert systems, developed in the artificial intelligence community more than 30 years ago.

2 Business Rules

A business rule is a rule that defines or constrains some aspect of business and always resolves to either true or false. Business rules are intended to assert business structure or to control or influence the behavior of the business. According to [9], business rule is "a compact statement about an aspect of business". To quote further: "The rule can be expressed in terms that can be directly related to the business, using simple, unambiguous language that is accessible to all interested parties: a business owner, a business analyst, a technical architect, and so on". There is no single categorization of business rules. Different authors even consider not only IF-THEN structures but also other "pieces of knowledge" to be business rules. So Ross counts among business rules also definitions of business terms and facts [3], von Halle [12] counts among business rules also constraints ("MUST HAVE" statements), guidelines ("SHOULD HAVE" statements) or computations ("IS COMPUTED AS" statements). An example of a business rule in a IF-THAN form can be [11]:

*Check the product number in database SRU.
If the product number is equal to 422 [the part number of flip-flops]
and the product description is equal to plastic flip-flops,
then set the new product number in database ASC equal to 1547
and set the product description equal to Fun-in-the-Sun Flip-Flops
else if the product number in database is equal to 423 through 495
then set the new product number equal to 1647
and set the product category equal to Good for You, Too Sandals*

The next example of a IF-THEN business rule below shows, that even if uncertainty processing is not an issue for business rules, the rules can contain vague concepts ("rush" order, "hazardous materials", "remote" destination) [6].

*An order must be shipped by premium service if
the order is a rush order and
the order includes hazardous materials and
the customer is a platinum customer and
the order destination is remote.*

The basic principles of business rules have been expressed in the so called Business Rules Manifesto presented in [10]:

1. Primary requirements, not secondary: rules are essential for business and IT models.
2. Separate from processes, not contained in them: rules are explicitly formulated and apart from processes and procedures.
3. Deliberate knowledge, not a by-product: rules are explicitly formulated and formalized intentionally to capture the basic business knowledge.
4. Declarative, not procedural: rules should be expressed declaratively in natural language sentences for the business audience, the basic constructs of rules are facts and terms.
5. Well-formed expression, not ad hoc: business rules should be expressed in such a way that they can be validated for correctness by business people, to ensure this, business rules are formalized as logical expressions.

6. Rule-based architecture, not indirect implementation: A business rules application is intentionally built to accommodate continuous change in business rules; business rules should be executed in a rules engine; a business rule system must always be able to explain its reasoning.

7. Rule-guided processes, not exception-based programming: Rules define the boundary between an acceptable and unacceptable business activity, exceptions should be described using rules as well.

8. For the sake of the business, not technology: Rules are about business practice and guidance; rules are motivated by business goals and objectives.

9. Of, by, and for business people, not IT people: business rules should be formulated, created, validated and managed by business people.

10. Managing business logic, not hardware/software platforms: rules are more important to the business than are hardware/software platforms. Rules should be organized and stored in such a way that they can be easily ported to new hardware/software platforms. Rules should be easily modified.

Business rules can be interpreted and executed either by humans or by business rules management systems. In the former case, the rules are represented usually using natural language or semi-formal logic-based expressions and have a form of guidelines created by humans for humans. In the latter case, the business rules are represented using a logic-based formalism and are executed using a kind of inference. The same "piece of knowledge" can have all three forms. Following example is adapted from [6]. The first form of the rule is a natural language sentence:

*A loan may be approved if the status of the customer is high
and the loan is less than 2000 unless the customer has a low rating*

The second form is an IF-THEN rule expressed in a semi-formal way:

*IF the customer status is high
AND the loan is less than 2000
AND the customer does not have a low rating
THEN approve the loan*

*IF the customer status is high
AND the loan is less than 2000
AND the customer has a low rating
THEN dont approve the loan*

The third form uses the JBoss Drools syntax to express the rules [2]:

```
rule "Approve a loan"
when
    $Customer : Customer (Status == "high")
    $Customer : Customer (Loan < 2000)
    $Customer : Customer (Rating != "low")
then
```

```
        modify($Customer) {
            setDecision("approve")
        }
    end

    rule "Do not approve a loan"
    when
        $Customer : Customer (Status == "high")
        $Customer : Customer (Loan < 2000)
        $Customer : Customer (Rating == "low")
    then
        modify($Customer) {
            setDecision("do not approve")
        }
    end
```

3 Business Rules Management Systems Architecture

A full implementation of the business rules approach has three components [1]:

1. A methodology for rule management, that is, collecting, recording, validating, assessing, publishing, and evolving the business rules.
2. One or several more or less formal languages for expressing business rules at different stages of their life cycle and for different audiences (business, IT, and computer).
3. A tool set for managing and executing the rules, a Business Rule Management System (BRMS).

The three components are interrelated. The first component is necessary to acquire the business rules. business rules can be created by human expert (according to their knowledge and expertise) or by using data mining and machine learning techniques. Another source of business rules can be internal documents used in the company. People from BR community call this process rule harvesting. The second component is necessary to express the acquired rules in a human readable and/or machine readable form. As shown in the example above, rules can be expressed using natural language, using semi-formal IF THEN statements or using some implementation language. The third component allows to process the machine-readable business rules using so called rules engine. The rule engine typically goes through the business rules to find those rules that are applicable for given facts – this process is called pattern matching. All applicable rules at a given moment are placed to so called agenda. From here, only a single rule is chosen (using a conflict resolution strategy) to be applied. Such a rule then modifies (by its actions) the set of facts stored in the working memory and a new search for applicable rules can start. So the match – conflict resolution – act steps iteratively repeat. Fig. 1 shows a general form of a rule engine working in the described way, a so called production system.

Let's consider Drools as an example of a business rule management system. Drools is an open source project supported by JBoss and Red Hat, Inc. (JBoss.org, 2017). Drools is split into two main parts: Authoring and Runtime. Authoring part involves the creation of rules

files, so it supports the knowledge acquisition and encoding processes, runtime part involves the rule-based inference.

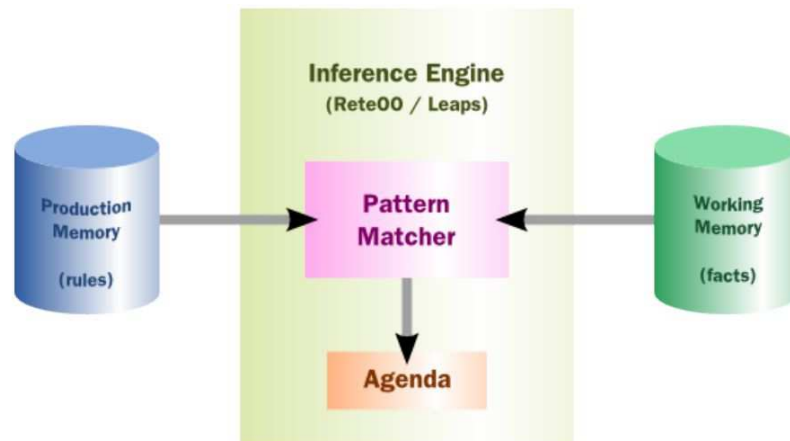


Fig. 1 High level view of a production rule system (docs.jboss.org)

Drools works with facts and rules. Fact represents true piece of information, they typically refer to attributes of an object. Rules have the general form

```
rule "<name>"
  attributes
  when
    LHS
  then
    RHS
  end
```

where LHS (left-hand side) consists of conditional elements (CE's) and RHS is a list of actions that can be performed if all conditional elements are true. An example rule in Drools syntax has already been shown in section 2.

4 Similarities with Expert Systems

Expert systems represent the prominent research area within AI in the 70th of the 20th Century. An Expert system is an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution [4].

An expert system consists of two main parts: knowledge base and inference mechanism. Knowledge base contains domain specific knowledge acquired from the experts, inference mechanism is a domain independent algorithm used for reasoning upon the knowledge base. Next part is the working memory that contains current data (questions of the system answered

so far, partial results). All these parts can be found also in the business rules management systems. If run in dialogue mode, the expert system contains also the communication and explanation modules.

We can distinguish two basic types of expert systems: diagnostic and generative. In diagnostic expert systems, the meaning of rules is declarative, i.e.

IF condition THEN conclusion

while in generative expert systems, the meaning of rules is procedural, i.e.

IF situation THEN action.

The inference mechanism of diagnostic systems is used to derive true conclusions (from true conditions), the inference mechanism of generative systems is used to perform actions. So from the expert systems point-of-view, business rule management systems are nothing else but generative expert systems.

5 Conclusions

Business rules management systems borrow a lot from expert systems: the idea of rule-based reasoning as used in generative expert systems, a fast and effective implementation of the pattern matching step, or the general architecture of production systems. Nevertheless, some differences remain: expert systems are used in a great variety of application domains while business rules management systems are oriented on applications in business and industry and rules in the area of expert systems are intended to be applied only by an inference mechanism, business rules can be used also by humans.

Literature

1. BOYER, J., MILI, H., 2011. *Agile Business Rule Development*. Springer.
2. BROWNE, P., 2009. *JBoss Drools Business Rules*. Packt Publishing.
3. Business Rules Group, 2017. *Defining Business Rules What Are They Really?* [online] Available at http://www.businessrulesgroup.org/rst_paper/br01c0.htm. [Accessed 10 September 2017].
4. FEIGENBAUM, E. A., 1979. Themes and Case Studies of Knowledge Engineering. In: *Expert Systems in the Micro-Electronic Age* (Michie, D., Ed.). Edinburgh University Press, Edinburgh, pp. 3-25.
5. GIARRATANO, J. C., RILEY, G. D, 2005. *Expert Systems Principles and Programming*. Thomson, Boston, Mass.
6. GRAHAM, I, 2006. *Business Rules Management and Service Oriented Architecture; A Pattern Language*. John Wiley.
7. JACKSON, P, 1990. *Introduction to Expert Systems*. Addison-Wesley.

8. KARDASIS, P., LOUCOPOULOS, P, 2004. Expressing and organising business rules. *Information and Software Technology* 46, pp. 701-718.
9. MORGAN, A, 2002. *Business Rules and Information Systems: Aligning IT with Business Goals*. Addison-Wesley.
10. ROSS, R. G, 2003. *Business Rules Manifesto*. [online] Available at <http://www.BusinessRulesGroup.org/BRManifesto.htm> [Accessed 10 September 2017].
11. ROSS, R.G, 2003. *Principles of the Business Rules Approach*. Addison-Wesley.
12. VON HALLE, B, 2001. *Business Rules Applied: Building Better Systems Using the Business Rules Approach*. John Wiley.

Contact data:

Prof. Ing. Petr Berka, CSc.

University of Finance and Administration

Estonská 500

10100 Praha 10, Czech Republic

berka@vse.cz