BUSINESS RENOVATION: FROM BUSINESS PROCESS MODELLING TO INFORMATION SYSTEM MODELLING

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Abstract: The main objective of this paper is to present the characteristics of business renovation efforts and the research on some aspects of the business process and information modelling. Process renovation is a re-engineering strategy that critically examines current business policies, practices and procedures, re-thinks them through and then redesigns the mission-critical products, processes, and services. Renovation is presented as the key element of e-business orientation and the highest level of strategy for managing change that usually cannot be handled by continuous improvement and reengineering methods or organisational restructuring. The paper also introduces different business rule categories and discusses the relationships that exist between business rules and other business-related concepts, addressed in business modelling.

Keywords: Business renovation, BPR, Business modeling, Business rules

1. INTRODUCTION

Business Renovation (BR) or business process renovation efforts integrate the radical strategic method of Business Process Reengineering (BPR) and more progressive methods of Continuous Process Improvement (CPI) with adequate Information Technology (IT) infrastructure strategies. Process renovation is a re-engineering strategy that critically examines current business policies, practices and procedures, re-thinks them through and then redesigns the mission-critical products, processes, and services [Prasad, 1999].

In this paper, business renovation is presented as the highest level strategy for managing change that cannot usually be handled by continuous improvement and re-engineering methods or organisational restructuring. BR argues for a balanced approach in which we attempt to manage realistic changes rather than always seeking radical change. According to Jacobson, we view business renovation as an umbrella concept for strategic IS planning, and both BPR and business improvement [Jacobson, 1995]. For thorough and effective renovation, organisations should combine a radical shift (BPR) with those that permanently increase business efficiency and effectiveness (CPI). We also observe that business renovation is now taking significant roles in business processes - creating new business rules, causing new product development and commanding new procedures. Following full implementation of IS in an organisation, these internal changes may also lead to broader shifts in products, markets, and society as a whole [Bosilj-Vuksic *et al.*, 2001]. The relationship and influence between BPR and IS (IT) strategies is a key part of the classic texts in the area [Davenport, 1993], [Hammer and Champy, 1993].

Rapid and constant changes that are very common to today's business environments affect not only the business itself, but also its supporting applications. As a result, information systems (IS) require constant change, renovation and adaptation to meet actual business needs. In this regard, business rules have become very popular in the last few years. They have become recognised as distinct concepts that play a key role in developing applications which are flexible and amenable to change [Bajec *et al.*, 2000; Barnes and Kelly 1997; Date, 2000; Youdeowei, 1997]. Whilst a lot of work has already been done in various fields of business rule research, most notably in rule analysis, classification, articulation, and formalisation (Hay and Healy, 1997; Herbst, 1996; Herbst, 1997; Moriarty, 2000; Ross, 1997; Tanaka, 1992), a broader view, namely an organisational view on business rules, is required. The fact is that business rules constantly change at the business level, but we are not able to keep up with the changes that are required in supporting IS. Thus, an ongoing business rule management environment is required in which each business rule instance can be traced from its origin through to its implementation.

In IS maintenance such a link is essential as it provides information on the software modifications required in response to changes in business policies, organisational tactics, external laws, regulations etc (Figure1).

The need to establish an explicit link between business and IS modelling has been recognised before [Bubenko and Wangler, 1993; Dobson, 1992;

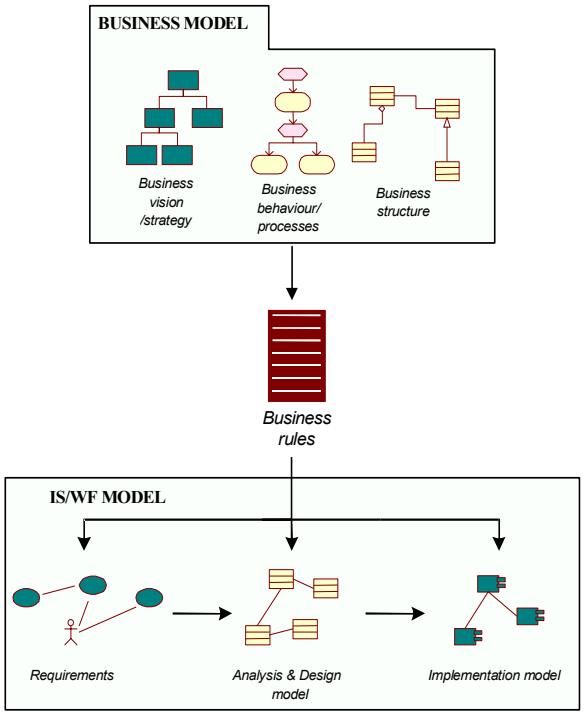

Figure 1: Business rules as integration link between business and IS modelling

Do Prado Leite *et al.*, 1998; Krallmann and Derszteler, 1996; Perkins, 2000; Rosca *et al.*, 1995; Rosca *et al.*, 1997]. In this paper, we show how business rules can be used to realise this link. Our experience has shown that the existing "linking" methods or interfaces fall within the BR umbrella. These interfaces might provide some syntactical translation but cannot bridge the semantic gap between business and IS/WF models.

In the process of modelling we distinguish different levels of abstraction: the value chain, the business processes, the activities, the business rules, the (application) services and the data [Joosten, 2000]. Business modelling covers the first three levels, whereas information modelling or Information Architecture (IA) thinking covers the latter three levels. An overlap exists at the activity level. Concerning this, usually an **n:m relationship** between business models and information (workflow) models also exists. As a result, we propose business models for use only as a starting point for the development of IS/WF models.

We introduce a framework that employs an enterprise-modelling method for business rule elicitation and specification (for comparable work, refer to Rosca *et al.* [1995, 1997]). In their paper, the authors described a robust meta-model for the business rules environment consisting of an enterprise meta-model, business rule meta-model, and decision space meta-model. The authors were particularly focused on the decision space meta-model, which is a basis for managing non-deterministic business rules. They propose a rule-based methodology to provide a uniform modelling approach at different abstraction levels. This approach suggests transforming a rule-based description of a business process in one or more refinement steps into a rule-based WF specification (Knolmayer *et al.*, 2000).

The paper is organised as follows. In Section 2 we provide the background needed for further discussion. Sections 3 and 4 are the core of the paper. In these sections we focus on business process and IS modelling, the related problems, concepts, methods and tools for business rules analysis and refinement. Section 5 provides conclusions of this study.

2. BUSINESS RULES AND BUSINESS MODELS

For a thorough and effective renovation project, organisations should first meet certain conditions before starting. First, organisations should abandon all obsolete rules and procedures used up to that time. Breaking rules is how we recommend people learn to think inductively about technology during the reengineering process [Kovacic *et al.*, 2001]. Application of Information Technology (IT) can break old business rules that limit the way in which work is performed (some typical examples are given in Turban *et al.*, [Turban *et al.*, 1998]. In addition, they should abandon other inadequate organisational and production principles [Kelly, 1998]. Global competition, economic downturn, and the potential offered by emerging technologies are driving organisations on to fundamentally review their business processes [Kalkota and Robinson, 1999]. At this point, the design of a renovated and redesigned organisation should start.

It should be pointed out that a higher level of automated procedures brings about more or less negative results. Even if some of the results of such actions are positive, they prevent managers from seeing all the opportunities offered by the

informatisation of a redesigned business process and the infrastructure role of informatics. Radical process innovation has been encouraged by some quality experts [Davenport, 1993]. There is a natural process improvement sequence that occurs as organisations apply TQM to their work. Watson [1994] suggests an elimination sequence procedure. He stated that most problems can be attacked by applying the basic quality tools of problem-solving and quality improvement processes before there is a need to automate work processes or seek IT intensive solutions.

2.1. Business Rules

Business rules are explicit statements that regulate how a business operates and how it is structured. Besides being important as an organisational asset, they are also significant for the information systems that support the business. While it has been emphasised many times in the last few years that business rules - if appropriately implemented - can help keep information systems aligned with the business environment, there is still no framework to explain how to do this. In this respect, our paper presents one of the first steps. Its motivation is to establish an environment in which business rules can be traced from their origin in the business environment through to their implementation in information systems. This provides the information necessary for rapid information system maintenance and adaptations to changes in the business environment.

Business rules can be categorised in many different ways. The categorisation described here is only an example of business rule taxonomy that we have found useful for our research. The taxonomy is based on Odell's work [Martin and Odell, 1998] with additional classes coming from the GUIDE scheme [Hay and Healy, 1997]. A list of different business rule taxonomies can be found in Gottesdiener (1997).

In general, business rules can be divided into *definitions*, *derivations* and *constraints* (Figure 2). Definitions present defined concepts or statements of facts that express some aspect of the structure of an enterprise. They can be further classified into *terms* and *facts*. While terms are words or phrases that have a specific meaning for a business, facts represent associations between two or more terms. Constraints represent another business rule category. Their role is to specify policies or conditions that restrict a business structure and its behaviour. They are divided into *structural constraints*, *stimulus/response rules* and *operational constraints*. Structural constraints specify policies and conditions of elements of the business domain and their associations. Stimulus/response rules, on the other

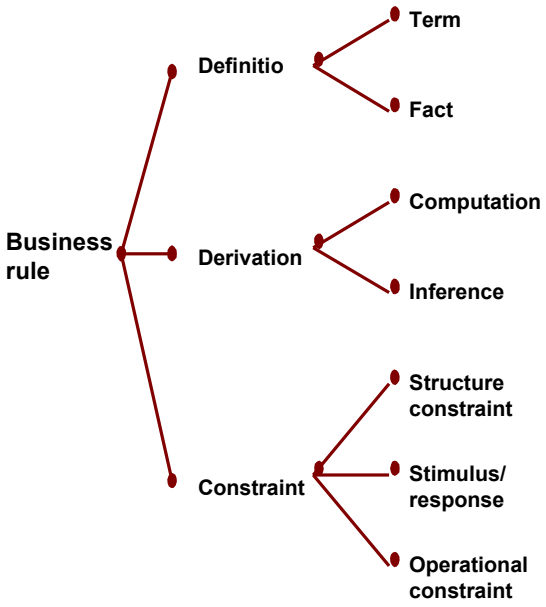

Figure 2: Business rule categories

hand, constrain behaviour by specifying when and in what circumstances an operation has to be triggered. Finally, operational constraints specify those conditions that must exist before and after an operation to ensure the operation runs correctly. The last business rule category is a derivation. Derivation is an algorithm used to compute or infer a derived fact. While a base fact is something we know about the business domain, a derived fact is created from other facts, either by an inference or through a mathematical calculation. Accordingly, a derivation can be an *inference* or a *computation*.

3. BUSINESS MODELING

Business process reengineering was a favourite managerial buzzword in the 90s, but it seems that another popular term for the 21st century is 'business model reengineering'. The traditional 'old economy' companies urgently need to build on and re-evaluate their current business models and create new ones. Accordingly, e-business initiatives have truly strategic imperatives: creating a totally different business model. An e-business model generally means the adapting of a company's current business model to the Internet economy. The main purpose of developing and analysing business models is to find revenue and value generators inside a reversible value chain, or a business model's value network. Traditional business models were (and still are) quite simple. Thanks to technological revolution and convergence, the Internet economy is dramatically increasing the number and combinations of possible business models and is creating new hybrid models.

There have been several attempts to formally describe and classify a business model. Venkatraman and Henderson [1998] define a business model as a co-ordinated plan to design strategy along three vectors: customer interaction, asset configuration and knowledge leverage [Venkatraman, 2000]. Some authors relate the high capitalisation of Internet companies to new business models. Other definitions rely on business models' revenue and value potential.

A business model is an abstraction of a business that shows how business components are related to each other and how they operate. Its ultimate purpose is to provide a clear picture of the enterprise's current state and to determine its vision for the future. There are several reasons for producing business models [Eriksson and Penker, 2000]:

- *A business model helps to understand the business*: one of the primary goals of business modelling is to increase understanding of the business and to facilitate communication about the business.
- *A business model is a basis for creating suitable information systems*: descriptions of the business are very useful in identifying the information systems necessary to support the business. Business models also act as a basis for engineering requirements when a particular information system is being designed.
- *A business model is a basis for improving the current business structure and operation*: as it shows a clear picture of the business current state, a business model can be used to identify the changes necessary to improve the business.
- *A business model provides a polygon for experiments*: a business model can be used to experiment with new business concepts and to study the implications of changes for the business structure or operation.
- *A business model acts as a basis for identifying outsourcing opportunities*: using a business model, the core parts of a business system can be identified. Other parts considered less important can be delegated to external suppliers.

Modelling a complex business requires the application of multiple views. Each view is a simplified description (an abstraction) of a business from a particular perspective or vantage point, covering particular concerns and omitting entities that are not relevant to this perspective. To describe a specific business view, several diagrams are usually used and complemented with textual descriptions.

One possible way of adequately representing business architecture is suggested in Eriksson and Penker (2000). The approach recognises four basic views: *Business Vision view*, *Business Process view*, *Business Structure view*, and *Business Behaviour view*. In the next section we discuss the Business Process view, concentrating on the role business rules play with respect to IS/WF-related concepts.

3.1. Business Process View

The Business Process view presents an important aspect of the business. Its job is to describe the activities that must be undertaken to achieve an explicit goal. As such, it is based on the Business

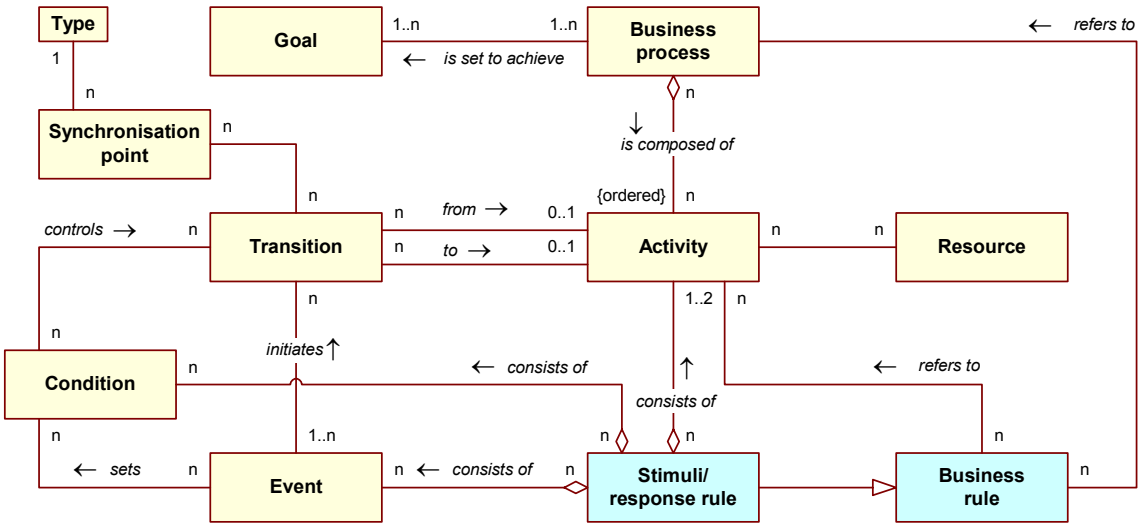

Figure 3: Business process meta-model

Vision view which sets up the objectives of the business.

As depicted in Figure 3 (see previous page), a business process may be represented as a set of one or more linked activities which collectively realise a business objective or policy goal [WfMC-TC-1011, 1999]. Activities are linked with transitions that represent points during the execution of a process where the thread of control passes from the activity that ends through to the activity that starts. A transition may be unconditional, so that the completion of one activity always leads to the start of another or conditional, meaning the sequence of an operation depends on one or more conditions. Each transition may also start or end in a synchronisation point, which allows the thread of control to be split or merged. A condition is associated with an event in the sense that when the event occurs the condition becomes true or false. Activities comprising a business process may require several resources when being executed. Such resources include participants in the process (human resources), associated IT applications (mechanical resources) and data (information resources).

When examining business rules with regard to business processes, the following three relationships stick out:

- Business rule relating to the overall business process;
- Business rule relating to business process activity; and
- Business rule relating to a business process definition.

Business rules that relate to an overall business process act as an interface between a particular business process and the goal that the process has to achieve. Such rules may be broken down into detailed rules governing specific business process activities or even further into rules that control the operations within these activities. When developing applications in support of business processes, both business rules that apply to an overall process and the rules that apply to a specific process activity have to be considered and broken down into detailed rules. Those detailed rules then act as specifications of requirements for the applications.

Another important relationship, depicted in Figure 3, illustrates a business rule as an aggregation of business process components. It was shown in the work of Herbst (1996) that a combination of events, conditions and activities (known as an *ECA structure*) can be used to specify single business rules (*stimuli/response rule*) and even to define an entire business process. Thus, a business process can be viewed as a sequence of business rules that define how the thread of control is passed from one activity to another and in what circumstances the transition can happen.

4. FROM BUSINESS (STRATEGIC) TO INFORMATION SYSTEM (OPERATIONAL) MODELING

A number of authors have identified the need for a business model prior to information modelling for the design of an information system in Information Architecture (IA) [Avison and Fitzgerald, 1988]. [Curtis, 1989], [Valiris and Glykas, 1999]. Information architecture is defined here as the planning, designing and constructing of an information blueprint which can satisfy the informational needs of business processes and decision-making. It is derived from a business model and the global IS orientations described in the corporate strategic IS plan. IA calls for full recognition of the importance of data in the design and development of information systems, for a perspective which exhibits a balance between processes and data.

The main results of the IA development process are a company's information system (workflow) model, global data model, and organisational/technological foundations or platform referring to the computer hardware, software, communications network and programming tools by which computing and information resources are run, developed and delivered to users in a company. This platform also addresses the company's organisational question and the question: "How to organise IS resources to tailor them best to the company's business needs?"

The notion of a workflow is in this framework clearly and closely related to the notion of a process and its execution. At a general level, workflow can be defined as a co-ordinated set of interdependent activities which are performed by actors in an organisation in order to achieve a set of common goals [Yu, 1996, p. 239]. In other words, workflow can be understood as a concept that embraces the initiation, realisation and management of business processes.

Different types of workflow are defined in the literature, such as *action workflow, ad-hoc workflow* or *administrative workflow*. This mainly has to do with the structure of the processes for which the concept of workflow is applied. The first two concepts - the *action workflow* and the *ad-hoc workflow* - are related to those processes whose structure cannot be predicted in advance. It can only be defined during the running time of a process. *Administrative workflow*s are related to those processes with predefined structures and where the

predefined chain of events and activities, which are triggered by the events, governs execution of the process.

4.1. The IS/WF Modeling Environment

The IS/WF modelling environment provides a structured way of identifying and capturing all information, relationships and business rules that make up a business process. Several methods and tools have been developed to describe business and information (workflow) processes. These methods and tools differ in their constructs, notation, ease of use, and other aspects. Often, different methods are employed at different stages of the development process. Modelling should be divided into strategic (business) and tactical/operational (information, workflow) levels [Knolmayer *et al.*, 2000]. Business modelling includes the analysis of corporate strengths, weaknesses, and culture, the assessment of information systems in the organisation, and organisation and management competencies. It is the basis of all further actions and is carried out by corporate management. Corporate goals, strategies, and critical success factors form the basis of selecting and modelling core business processes at the global level of description. Such a model, together with information on the organisation's current state, is fundamental for evaluating and benchmarking vis-à-vis other corporations.

Detailed information system modelling of the processes or workflow structures takes place at the tactical/operational level. Workflow systems are able to support business processes if the business process is clearly structured and defined. Workflows are refined and modelled at the level of particular interdependent business activities that are performed by actors (resources) in an organisation in order to achieve common goals. At this level, the more exact and certain information about a workflow is, the better the modelling results will be.

The problem lies in the conflict of aims between the need for accurate information and the difficulties of obtaining it due to the often obsolete documents describing flow structure, varying or even contradictory statements from employees, and time constraints [Grover *et al.*, 1995]. Here, we can add that the purely activity-based modelling approach dominant in the WF practice is unsuitable. At this level of detail, the reengineering tools for business rules analysing and refinement are needed. Such tools allow users to build and tune a workflow before developing application solutions (applications).

4.2. Methods and Tools for Business Rules Analysis and Refinement

In order to discuss the methods and tools for business rules analysis and refinement, some limitations of existing BPR modelling methods need to be addressed:

- Business modelling is performed using either inadequate descriptive notations from management accounting or through poor use of graphical notations that were created for software development and do not take into account organisational issues [Valiris and Glykas, 1999].
- There is no formal underpinning to ensure consistency across models. When graphical notations are used in business modelling and business redesign, there is no means of verifying the logical consistency of the resulting models. Semantic mistakes or disregarding of relevant aspects can lead to some possibly expensive misjudgements.
- On the other hand, some organisations have a tendency to over-analyse an existing system and therefore get stuck in the business analysis phase of the project (e.g., analysis paralysis) from which they are never able to move on [Chen, 1999].

The objectives of using business modelling are: (1) to help the BR team obtain a holistic view of the process under study; (2) to identify areas for improvement; (3) to visualise the impacts and implications of new processes [Chen, 1999]; and (4) describe the rules that underlie the business process.

Business rules should be described in a natural language and the business process should be modelled only at the level of detail that is sufficient to achieve these objectives.

As discussed in the previous section, the introduction of a workflow system should be driven on by a business perspective usually and a n:m relationship between business models and information (workflow) models also exist. Mostly, all interfaces (methods and tools) between business and IS/WF modelling simply implement a 1:1 coupling.

In order to resolve this problem, the Workflow Management Coalition's (WfMC's) work group is developing an integration model (Interface 1) based on a modelling language for dynamic extensions. Interface 1 Definition deals with passing Process Definitions from external tools to the workflow engine where there are enacted. The coalition published a new language - the Process Definition Language - as a precursor to the Interface definition. This interface includes a common meta-model for describing the process definition and also textual grammar for the interchange of process definitions (Workflow Process Definition Language – WPDL)

[WfMC-TC-1016-P, 1999]. This model meets standardisation requirements but has very limited practical applicability.

There are some other possible 'tool-supported' approaches to the deployment of business models (i.e. ARIS) for select application. Applications can be implemented either by: (1) adapting and assembling process-oriented business objects or by developing applications from scratch, (2) implementing standard business applications (i.e. SAP), (3) implementing workflow systems, or (4) object-oriented system development using the Unified Modelling Language (UML) [Sheer, 1999]. Here, a BR framework consists of the following four levels: Process design, Process management, Workflow and Application. The connections between particular levels are explained [Sheer and Allweyer, 1999], yet the refinement method which supports the transition is not defined. In using these approaches, experience has shown the tendency to over-analyse existing business processes and IS implementation problems.

To support the transition between the business model and the IS/WF model we propose a hierarchical derivation of business rules from the higher to the lower level of abstraction. Here the manual revision of workflow models is often a more economic efficient than the use of interfaces (i.e. WfMC Interface 1) or the use of connection principles (I-e-ARIS). These interfaces might provide some syntactical translation but cannot bridge the semantic gap between business process models and workflow models [Becker *et al.*, 2000].

In order to assist the developer in obtaining consistent representation over all abstraction levels and at different degrees of accuracy, the modelling process should be supported by appropriate methods and tools. Some authors propose a rule dictionary [Krallmann and Derszteler, 1996] or rule repository where business rules have to be represented [Herbst, 1997, Knolmayer *et al.*, 2000]. This repository is the core of a development environment providing appropriate tools for process, workflow, data and organisation modelling, process refinement, as well as import and export capabilities. A rule repository system also provides the opportunity to implement capabilities for analysis and simulation [Knolmayer *et al.*, 2000]

In the light of our experience we agree with the rule transformation approach. This approach suggests transforming a rule-based description of a business process in one or more refinement steps into a rule-based WF specification [Knolmayer *et al.*, 2000]. We regard the business process meta-model presented in the previous section as an appropriate starting point for the business rule refinement process. The business rules that underline the business process are first described in a natural language. In subsequent steps, these rules are refined in a structured way as a set of structured rules representing the business process at different abstraction levels. In the case of small and less complex models, a manual revision is more economic and less time-consuming. In most cases, the modelling process should be supported by an appropriate rule repository. Our experience leads us to agree with the authors that this rule-based methodology has advantages over established tool-supported approaches such as Petri nets (i.e. Income) and Event-driven Process Chains (i.e. ARIS).

5. CONCLUSIONS

The challenges of today's ever changing business environment can best be faced by a radical redesign of business processes and the implementation of application programme solutions. In this paper, business renovation is presented as the highest level of strategy for managing change that cannot usually be handled by continuous improvement and reengineering methods or organisational restructuring. Business renovation argues for a balanced approach in which it is attempted to manage realistic changes rather than always seeking radical change.

The rapid and constant changes that are very common in today's business environments affect not only the business itself, but also its supporting applications. As a result, information systems (IS) require constant change, renovation and adaptation to meet actual business needs. Thus, a continuous business rule management environment is required in which each business rule instance can be traced from its origin through to its implementation. In IS maintenance, such a link is essential as it provides information on the software modifications required in response to changes in business policies, organisational tactics, external laws, regulations etc.

In the paper we show how business rules can be used to create the missing link between business and IS modelling. Our experience shows that the existing 'linking' methods or interfaces fall within the business renovation umbrella. These interfaces might provide some syntactical translation but cannot bridge the semantic gap between the business and IS/WF models.

In the process of modelling we distinguish different levels of abstraction: the value chain, the business processes, the activities, the business rules, the (application) services and the data. Business modelling covers the first three levels, whereas the

information modelling or Information Architecture (IA) thinking covers the latter three levels. An overlap exists at the activity level. In this context, an 'n:m relationship' between business models and information (workflow) models usually also exists. Because of this, we propose business models for use only as a starting point for the development of IS/WF models and we introduce a framework that employs an enterprise-modelling method for business rule elicitation and specification.

In practice, some organisations have a tendency to over-analyse their business process which leads to questions such as: What are the benefits of our business modelling? Why did we spend years charting and analysing business processes, and why did the IS implementation project still fail? We believe that most of the answers to these questions lie in the appropriate rule transformation approach.

REFERENCES

Avison D.E. and Fitzgerald G. (1988), "Information Systems Development: Methodologies, Techniques and Tools, Blackwell Scientific Publications, Oxford.

Bajec M., Krisper M. and Rupnik R. (2000), "Using Business Rules Technologies To Bridge The Gap Between Business And Business Applications". *Proceedings of the IFIP 16th World Computer Congress 2000, Information Technology for Business Management* (RECHNU, G. Ed), pp. 77-85, Peking, China.

Barnes, M. and Kelly, D. (1997), Play by the Rules. *Byte* (Special Report), 22(6), pp. 98-102.

Becker J. M. Rosemann and C. von Uthmann (2000), *"Guidelines of Business Process Modeling"*. W. van der Aalst et al. (Eds.), *"Business Process Management"* LNCS 1806, pp. 30-49.

Bosilj Vuksic V., M. Spremic and A., Kovacic (2001), "*Managing Change Toward E-Business Era: Slovenian and Croatian Perspectives"*, Proceedings of the 8th Slovenian Informatics Conference, Slovenian Society Informatika, Portoroz, Slovenia, pp. 12-27.

Bubenko J.A. jr. and Wangler B. (1993), Objectives driven capture of business rules and of information systems requirements. *Proceedings of International Conference on Systems, Man and Cybernetics. 'Systems Engineering in the Service of Humans'*, pp.: 670 -677 vol.1.

Chen M. (1999), "BPR Methodologies: Methods and Tools". In: Elzinga D.J. et al. (Ed.), Business Process engineering", Kluwer Academic Publishers, Massachusetts, pp. 187 – 212.

Curtis G. (1989), Business Information Systems: Analysis, Design and Practice. Addison Wesley Longman, Inc.

Date C. J. (2000), What Not How: The Business Rules Approach to Application Development. Addison Wesley Longman, Inc.

Davenport T. H. and J. Short (1990), "The New Industrial Engineering: Information Technology and Business Process Redesign", Sloan Management Review, Summer 1990, pp. 121-127.

Davenport T. H. (1993), "Process Innovation: Reengineering Work Through Information Technology", Harvard Business School press, Boston, Mass.

Davenport T. H. and M. C. Beers (1995), "Managing Information about Processes", *Journal of Management Information Systems*, Vol. 12, No. 1.

Do Prado Leite, J.C.S., De Sao Vicente, R.M. and Leonardi, M.C. (1998), Business rules as organizational policies. *Proceedings of Ninth International Workshop on Software Specification and Design*, pp. 68-76.

Dobson, J. (1992), *A Methodology for Managing Organizational Requirements*, University of Newcastle upon Tyne, Newcastle, UK.

Eriksson H.E. and Penker M. (2000), "*Business Modeling with UML", Business Patterns at Work*. John Wiley & Sons, Inc.

Gottesdiener E. (1997), "Business Rules show Power, Promise". "*Application Development Trends"*, 4 (3), pp. 36-42.

Grover V., S. R. Jeong W. J. Kettinger and J. T. C. Teng (1995), The implementation of business process reengineering, *Journal of Management Information Systems*, 12:1, 109-144,.

Hammer M. and J. Champy (1993), Reengineering the corporation, Harper Collins Books, New York

Hay D. and Healy K.A. (1997), *GUIDE Business Rules Project*, Final Report – revision 1.2. GUIDE International Corporation, Chicago.

Herbst H. (1996), Business Rules in Systems Analysis: A Meta-Model and Repository System. *Information Systems*, 21 (2), pp.147-166.

Herbst H. (1997), *Business Rule-Oriented Conceptual Modeling*, Heiderberg, Physica.

Jacobson I. (1995), *"The Object Advantage",* Addison - Wesley, ACM Press Books.

Joosten S. M. M. (2000), "Why Modellers Wreck Workflow Innovations". In: W. van der Aalst et al. (Eds.), *"Business Process Management"* , LNCS 1806, Springer, pp. 289-300.

Kalkota R. and M. Robinson (1999), *"E-Business: Roadmap for Success",* Addison-Wesley, Reading.

Kelly K. (1998), *"New Rules for the New Economy",* Penguin Putnam Inc., New York.

Kettinger W. J. and V. Grover (1995), "Toward a Theory of Business Process Change Management", *Journal of Management Information Systems,* Vol. 12, No. 1.

Knolmayer G, R. Endl, and M Phahrer (2000), "Modeling Processes and Workflows by Business Rules". In: W. van der Aalst et al. (Eds.), *"Business Process Management"* , LNCS 1806, Springer, pp. 16-29.

Kovacic A., Krisper M., Groznik A. (2001), "Business Process Renovation: Rethinking toward e-business". *Proceedings of the 7TH International Conference on Re-Technologies for Information Systems*, Lyon, France, pp. 175-188, 2001.

Krallmann H. and Derszteler G. (1996), Workflow Management Cycle, In: Scholz-Reiter, B., and Stickel, E*., Business Process Modeling*, Springer, Berlin.

Martin J. and Odell, J. (1998), "*Object-Oriented Methods", A Foundation*, Prentice Hall.

Moriarty T. (2000), "Business Rule Management Facility: System Architect 2001", *Intelligent Enterprise*, 3 (12), August 2000.

Perkins A. (2000), Business Rules = Meta-Data. *Proceedings of 34th International Conference on Technology of Object-Oriented Languages and Systems*, 2000. TOOLS 34, pp. 285-294.

Prasad B. (1999), "Hybrid re-engineering strategies for process improvement", *Business Process Management Journal*, Volume 5, No. 2, pp. 178 – 197,.

Regan E. A. (1998), "The Critical Success Factors for Effective Reengineering", *Special Study*,

Rosca D, Greenspan S., Wild C.A., Reubeinstein H., Maly K. and Feblowitz M. (1995), Application of a Decision Support Mechanism to the Business Rules Life Cycle. Proceedings of the 10th Knowledge-Based Software Engineering Conference, pp. 114-121.

Rosca D, Greenspan S., Feblowitz M. and Wild C.A. (1997), Decision making methodology in support of the business rules lifecycle. *Proceedings of the 3rd IEEE International Symposium on Requirements Engineering*, pp. 236 –246.

Ross R. (1997), *The Business Rule Book: Classifying, Defining and Modeling Rules*, Second Edition, (Ross Method, version 4.0). Business Rule Solutions, Inc., Houston, Texas.

Sheer A.-W. (1999), "ARIS-Business Process modeling", Springer, Berlin-Heidelberg.

Sheer A.-W. and Th. Allweyer (1999), "From Reengineering to Continuos Process Adaptation" In: Elzinga D.J. et al. (Ed.), Business Process engineering", Kluwer Academic Publishers, Massachusetts, pp. 1– 24.

Tanaka K. (1992), "*On Conceptual Design of Active Databases"*. PhD Thesis, Georgia Institute of Technology, Georgia.

Turban E., E. Mclean, J. Wetherbe (1998), *"Information Technology for Management",* John Wiley & Sons, ISBN: 0-471-17898-5.

Valiris G. and M. Glykas (1999), "Critical review of existing BPR methodologies", *Business Process Management Journal*, Vol. 5 No. 1, pp 65-86.

Venkatraman N. (2000), "Five Steps to a Dot-Com Strategy: How To Find Your Footing on the Web", *Sloan Management Review*, Spring 2000, pp. 15-28.

Venkatraman N. and Henderson J. C. (1998), "Real Strategies for Virtual Organizing", *Sloan Management Review*, 40 (Fall 1998), pp. 33-48.

Watson G. H. (1994), *"Business System Engineering",* John Wiley&Sons, New York.

WfMC-TC-1011 (1999), *" Terminology & Glossary"*, Workflow Management Coalition Document Number WFMC-TC-1011, February 1999.

WfMC-TC-1016-P (1999), *"Process Definition Meta-Model&WPDL*", Workflow Management Coalition Document Number WFMC-TC-1016-P, February 1999.

Youdeowei, A. (1997), *The B-Rule Methodology: A Business Rule Approach to Information Systems Development*, PhD Thesis, Department of Computation UMIST, Manchester, United Kingdom.

Yu L. (1996), "A Coordination-based Approach for Modeling Office Workflow". In: Scholz-Reiter B., and Stickel E., Business Process Modeling, Springer, Berlin.

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