Business process, a rule-based view

Khaled I. Attia and Mohamed. Wahba
Arab Academy for Science and Technolgy and Maritime Transport
K_attia1@yahoo.com ; m_wahba2003@hotmail.com

Abstract:
"Firms across all industries are looking to BPM to help gain new efficiencies, create a more consistent customer experience, and provide better data insights" – Forrester, August 2008 "... Business Process Management (BPM) has helped organizations survive by identifying ways to improve business processes and cut costs at the same time" – Gartner, March 2009. These headlines are examples of the benefits that practitioners and literatures of business processes are promising. This article emphasises the importance of process and reviews key issues of process enhancements. The author presents business process management and process modelling as concepts to understand, manage and improve processes and how process modeller could benefit from process rules and entities. Definitions of process rules and entities are presented and the interrelationship between them is declared. Finally, a new modelling technique for a business process using the relationship between process entities and rules are presented.

Keywords: process, process modelling, process rules, process entities.

Introduction

There is no general agreement on process definition; business process can simply be defined as the step that produces a specified value to meet customer needs. Here after a presentation of several process definitions to clarify the meaning. Business process is the activity that creates or augments the value of a product or service for a customer (Succi et al, 2000) and the group of processes are "A structured, measured set of activities and flows which are independent of departmental structures and that use necessary resources of the organisation to provide specified output for a particular customer" (Gingele et al, 2002). Al-Mudimigh (2007) defined business process as "set of interrelated activities which have definable inputs and when executed, result in an output that adds value form a customer perspective". Shaw et. al.(2007) defined business process as "a socio-technical system, executed by humans and machines" .Sila and Ebrahimpour (2003), presented an extended definition of process that encompasses different stakeholders (customers, future generation and nature) "A process is a network of activities that by the use of resources repeatedly converts an input to an output for stakeholders".

Process definitions include different components that could be summarised in people or partners, materials or machines and environment. The literature review conducted by Palmberg (2009) identified six components that can be seen in a majority of the definitions: input and output, interrelated activities, Horizontal: intra-functional or cross-functional, purpose or value for customer, the use of resources and repeatability. And the definitions could be condensed to: *A horizontal sequence of activities that transform and input (need) to an output (result) to meet the needs of customers or stakeholders*.

The importance of business processes

Business benefits which include: financial surplus, bigger market share, visionary leadership, rapid prototyping of new methods to meet customer expectations, and the

smooth moving of scarce expertise between different production units or service outlets, need continuous awareness of the corporate internal capabilities. Organisations are using available capabilities to produce values within products or services to meet certain customers' needs and to achieve their strategic levels. The continuous recognition of corporate capabilities and business opportunities reflect the dynamic interactions with surrounding changes. The corporation has to be continuously aware of its resources, capabilities and processes to modify them, acquire new resources or even dispose of them. The ever changing environment and the increasing of multiple interchangeable variables made it imperative to adopt new managerial techniques to manage work. Examples of these techniques are lean management (focus on flow and reducing non-value added activities) and content management that helps to leverage internal efforts and its tools (for example; records management, document management, web content management, email management, identity management/user authentication, content authentication, content addressed storage, digital signatures and hierarchical storage management) which presented means to manage processes smoothly and efficiently. According to Forrester, the industry of Enterprise Content Management (ECM) is projected to have reached $3.9 billion in worldwide license revenue in 2008.

Organisations need to focus resources around delivering strategy and meeting their customer's needs or simply orientate the entire organisation both culturally and operationally around the business processes that lie at its heart (Terry, 2007). The organisational processes are related to a changing environment with many influences that may cause resources to be diverted from proper goals (see for examples Sauer and Willcocks, 2003; Lei and Slocum, 2002; Terry, 2007). "Business process capabilities had a larger impact on service quality than did people capabilities" (Kumar et.al., 2008, Quoted from Frei et al., 1997). If the processes' designers are not meeting surrounding difficulties, over time, the processes of an organisation will tend to become convoluted and messy. Moreover, a bad experience would add more twists to the processes that make attempts to plug the increasing loopholes difficult. Eventually the corporation would seek an appropriate tool to mediate the change effect. Process driven organisation are gaining better benefits than functional driven ones (see table-1).

Business process improvement
"Business processes, process analysis and improvement issues are within the most important and common titles in both literature and applications" (Coskun et. al, 2008). Sila and Ebrahimpour(2003) conducted a study that proved process management is the critical factor to capture benefits when applying TQM project. Having flexible business processes becomes not just an important requirement but also a permanent need for corporate survival. To stay competitive it is paramount to improve processes because all activities within an organisation can be described in terms of processes" (Armistead, 1999). Each stage within each process, whether it is an action, interaction or a refinement, is supposed to add value. These additions could be direct in a product or service or indirect by adding more impetus to other activities, which are in front of the final product or service. Since the early 1990s, the popularity of business process orientation has yielded a rapidly growing number of business process techniques and methodologies. Unlike many management trends, the interest in process management has raised (Palmberg, 2009). The importance of process improvement has shifted from the operational level to the organisational level (Armistead, 1999) and process improvements ranged from minor process changes (redesign) to radical processes reengineering (Mansar and Reijers, 2007).

The importance of business processes made it critical to discover enterprises processes. Discovering processes face challenges such as; the complexity of the enterprise, the inaccuracy of information and the changing environment (Xu et. al, 2007; Julien, 2007). Analysis tools such as; analytic hierarchy process or goal programming are used to reduce deviation between enterprise goals and actual processes. Process thinking and process management are approaches emerged to direct processes toward improvement because "excellent" are a time dependent concept (Coskun et. al, 2008). Business Process Management (BPM) is a discipline that deals with process analysis and improvement and it is a structured approach to understand, analyse, support, and continuously improve fundamental processes (Al-Mudimigh, 2007). The merits of using BPM applications could be, improve efficiency, effectiveness, standardization, flexibility, performance metrics, information access, integration, remove paper from a process, reduce errors and eventually improve customer satisfaction. In addition, Functional departments use BPM tools to automate and optimize their organisational processes, deploy process applications to solve process problems and improve profitability (Julien, 2007; Hedge, 2007). Palmberg (2009) conducted a structured literature review over the period 1993-2007 to identify contemporary models and definitions for process management using Emerald, EBSCO and Compendex. Figure (1) shows a summary of the search findings.

Process driven organisations compared with functionally driven ones

Silo / Functional view	Process view
Directors direct functional units and focus on functional targets	Directors direct the way the organisation works. Focus on how the business works and the business targets.
Focus on boss (understand what the boss needs)	Focus on customer (understand what the customer needs)
Internal focus – Improvement focused on functions	External focus – Improvement focused on customer
More inter-functional conflict – functional objectives can conflict	Co-operate across functions with cross-functional teams. All working on the same process to serve the same customer so objectives tend to align.
'us and them' – other functions compete for resources	'us' – other functions are customers or suppliers
Political	Collegiate
Building empires	Building the business
Directive management – Individuals unclear of customer needs and therefore need more day-to-day management direction which, if not forthcoming, will lead people to pull in different directions.	Empowering management – people understand what the customer needs and need little direction to deliver it. People tend to pull in the same direction.
Decisions deferred to management	Decisions made by the individual
People unclear how what they do contributes to delivering the strategy and meeting the business objectives	People know how what they do contributes to delivering the strategy and meeting the business objectives

Table 1: The process-driven approach to management compared with the functionally-driven approach showing the different consequences of these two approaches to managing the overall organisation.
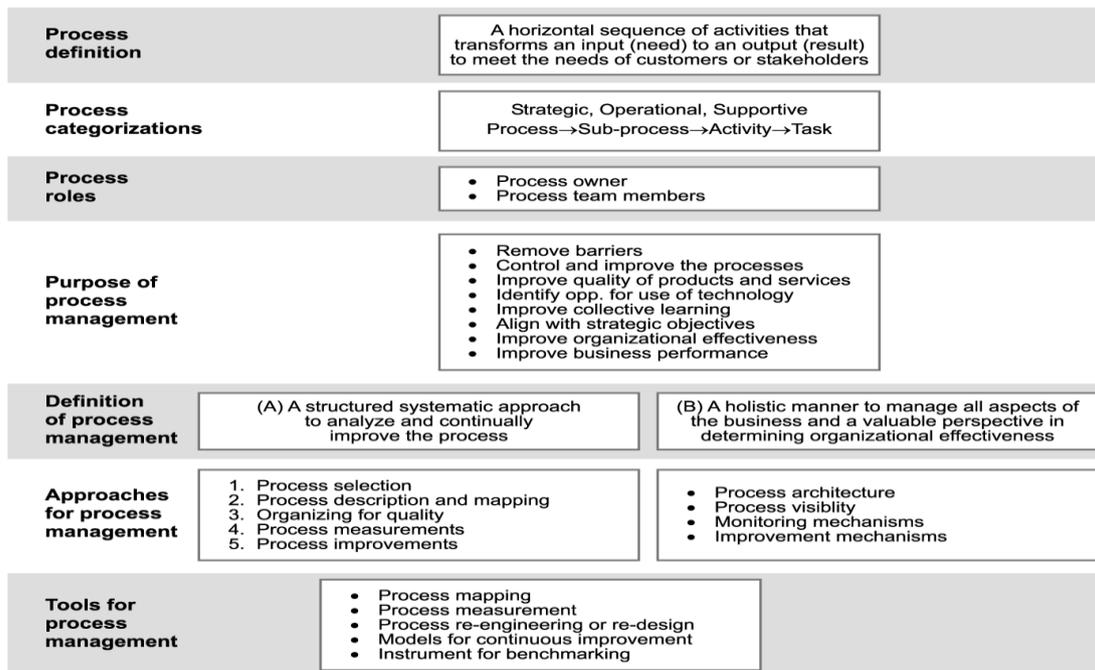
(Source: Terry, 2007)

Process definition	A horizontal sequence of activities that transforms an input (need) to an output (result) to meet the needs of customers or stakeholders	
Process categorizations	Strategic, Operational, Supportive Process→Sub-process→Activity→Task	
Process roles	• Process owner • Process team members	
Purpose of process management	• Remove barriers • Control and improve the processes • Improve quality of products and services • Identify opp. for use of technology • Improve collective learning • Align with strategic objectives • Improve organizational effectiveness • Improve business performance	
Definition of process management	(A) A structured systematic approach to analyze and continually improve the process	(B) A holistic manner to manage all aspects of the business and a valuable perspective in determining organizational effectiveness
Approaches for process management	1. Process selection 2. Process description and mapping 3. Organizing for quality 4. Process measurements 5. Process improvements	• Process architecture • Process visiblity • Monitoring mechanisms • Improvement mechanisms
Tools for process management	• Process mapping • Process measurement • Process re-engineering or re-design • Models for continuous improvement • Instrument for benchmarking	

Figure (1) Contemporary models and definitions of process management.

(Source: Palmberg , 2009)

The approaches used to understand and improve business processes are several but a holistic solution not yet appeared. Efforts still try to reach a high degree of efficiency and benefits. The lack of a theoretical basis for BPM constructs derived Shaw et al (2007) to conduct an extensive review of literature and business practices to indicate the elements of Business Process Management System (BPMS). The review recommended that BPMS needs the ability to make process changes and to automatically react to process changes. A medium to be automatic, it has to be enacted by a machine and software application through formal model construct. Shaw analysis dealt with *hard issues* of process improvements but other dimensions should be considered. Even though, hard issues are different. For example, Hedge*III* (2007) demonstrated different tasks for different BPM solutions. Nevertheless Enterprise Systems (ES) packages are experiencing rapid growth and they aim to integrate businesses processes and functions to present a holistic view of the business from IT viewpoint. ES implementation did not achieve complete success. The success factors included "soft issues" that should be considered such as; commitment from top management, changing of the existing processes and deploying change management (Al-Mudimigh, 2007).

The process representation methods were also criticized. For example; Tyler (2008) criticised the process mapping methods and described their life as limited and do not warrant the efforts spent. Tyler presented external consultants, six sigma or lean methodologies as approaches to improve business processes. Though six sigma and lean management concepts present more accurate and statistical analysis of process problems to reach zero defects, as they are developed based on decades of quality enhancements and improvements, they lack scientific method for process representation.

The comprehensive behaviour of an approach is a necessity to have consistent solutions to benefit end users. Bryan Baker , enterprise consultant for Xerox Global

Services said " *if the end user does not benefit from BMP/ workflow tools and applications, then I question the success of these efforts*" (Julien, 2008). Al-Mudimigh, (2007) analysis of several case studies showed that comprehensive solutions relate heavily to people, appropriate process management structure and performance measures and enterprises tend to reengineer their business processes when installing technology solutions.

Despite the popularity and acceptance of business process attitude, practitioners tend to benefit from best practices as fast and successful way to treat certain problems (Mansar and Reijers, 2007). Literatures and practitioners are still presenting more business process methodologies and applications to reach comprehensive and holistic solutions.

Process modelling
The important thing when improving the process is to understand the current situation. Modelling and weak point analysis is an approach to understand situation (Coskun et. al, 2008). Process modelling or mapping are tools for activities such as process improvement, process reengineering or restructuring, technology transfer or process standardisation. The value of business process modelling is in making the knowledge explicit where the modelling of business process is the description of a business process (Succi et al, 2000). Modelling is a creative, implicit and iterative set of tasks (Cameron and Ingram, 2008; Kumar et al, 2008)
Anjard (1996) described process mapping as a "road map" that highlights major steps taken to produce an output. Process mapping can be used at various levels of detail. It starts from top-abstract levels (macro) and ends at bottom-detailed levels (micro).
Process mapping is an organisational tool to diagnose and to explore how far integrity exists. It brings out the communication, redundancy, rework, and weakness areas. Because integration is characterised as co-operation and communication between internal teams and functions (Braganza, 2002), process mapping exposes the enterprise's integration, which is a positive linkage between its parts.

Xu et. al,(2007) presented a methodology and a case study application of business process discovery (PBD). PBD stands on dividing and harmonizing process components. PBD method is divided into three layers to understand the businesses design and their interdependency: the component layer enables high understanding of the business process; the operation layer provides sets of basic local process fragments and the operation integration layer provides the information interaction between the other layers. The methodology presented emphasized the operational aspects of business processes but it needs experts' efforts to understand and analyse.

There are many process modelling techniques, methodologies and tools. For example, Aguilar-Saven (2004) reviewed more than 7000 scientific journals and conference proceedings since 1985 to indicate and classify the frequently used business process modelling techniques, tools and methodologies (also see Lindsay et al, 2003). The review showed that flow-charting is the most inflexible technique with lesser scope of purposes than other presented techniques. The GRAI technique was presented as the most flexible technique that has a wide range of usage.
In addition to the commercially available tools to help managers in modelling, other tools can be found in the literature. For example Chen-Burger (2004) introduced IBM's-BSDM, which is business-modelling software that helps in identifying the business entities and their relationships, and Mentzas et al (2001) presented Workflow

Management Systems (WFMs) as a tool by which consistent information flow between the participants in the process can be achieved. Tyler (2008) presented xBML as a modelling methodology with a graphical interface to be more easily and friendly. xBML based on the process of answering W5 (who, what, which, where and when) questions and then a set of pictures is produced which depict who is doing what with which information, where and when.

Key issues of process enhancements
Business characteristics of BPM have been identified by Smart et al, (2007) into five common components: Process strategy, Process architecture, Process measurement, Process ownership and Process improvement. Smart et. al., declared that the management efforts to develop the *process mindset* are a function of three interrelated activities: the extent to which process management is undertaken and activated, *macro process management* which reflects the hierarchy, abstraction and decomposition of processes and centrality of processes and their links to customers.

Cameron and Ingram (2008) presented the results of an international survey of process modelling practices which experienced in 2005. The results showed the most common lifecycle phases that the modelling work addresses. These are conceptual design, research and development, operations and detailed design. Techniques used for model conceptualization include brainstorming with process experts; selecting important phenomena based on literature searches and approximate calculations; a mixture of top-down and bottom –up approaches; checklists and reference to similar problems. Though, modelling increases insight into system behaviour, the survey respondents strongly belief that current methods do not adequately capture knowledge and a significant loss of expertise occurs when people in charge leave the organisation. The results included the modelling key elements which are: expertise of modellers; organizational procedures and modelling tools

Based on exploring several business process frameworks, models and after surveying Dutch and UK consultants in the field of business process redesign, Mansar and Reijers(2007) presented a set of ideas to help practitioners when dealing with business process in the context of redesign. These ideas resulted in seven weighted components which are ranked as follows; process customers, process information, process products, the operational and behavioural view of a process, the organisational structure and population of a process, process technology and a process external environment. The researchers articulated top ten business process redesign practices against their impact on time, flexibility, quality and cost. The best practice that is reported to have the highest impact on the quality dimension is the "integral business technology" while "unnecessary task elimination" was found the best practice that had the highest impact on the process cost. Integration with customers or suppliers was found the best practice that had the highest impact on the process time. Workers' empowerment had the highest impact on the process flexibility.

Process mining is an incoming trend of process modelling. Process mining derives from the field of data mining and aims to reconstruct actual business processes by using statistical tools on previous information and logs (Tiwari and Turner, 2008). In addition, Isaksson (2006) presented a management system that combines values, methodologies and tools from Total Quality Management (TQM) and Sustainable Development (SD). The management system considered process management as key player of the new system and highlighted the values of stakeholders, sustainability, accountability, processes methodologies, maps, indicators and GRI guidelines and system perspective. On the other hand, Julien(2007) and HedgeIII(2007) reported

important factors that should be considered when commencing BPM project. To start, it is important to gain top management support with proper budget and resources. The starting point of the project is to execute SWOT analysis to indicate the objectives. After indicating the project objectives, assign *process owner* who should be a cooperation bridge between IT management and business management to drive the project. To gradually improve operational efficiency as a result of applying BPM solutions, the project starts on a specific area of business and then expands.

Process modelling
The changing environment and the continuous need to the dynamic building of a process make it important to focus efforts to process modelling. Formal models are built using two tools: formal modelling notations and ontology-based modelling grammer (Shaw et. al., 2007). Notations have to provide constant interpretation of process symbols and modelling grammer should have systematic definitions to describe processes or subjects and their interrelated connections. The level of details and how to describe the process (reality) depend on the abstraction degree chosen by the modeller. Though modeling is a highly creative activity and iterative and implicit tasks, the integration between organisational contents can be modelled according to several criteria, such as: (Sutcliffe, 2000)
- Control lines or authority shape;
- Teams and subunits that perform certain activities or core and supportive processes (Aguilar-Saven, 2004);
- The anticipated goals and objectives;
- *Agents* or individuals doing the activities;
- *Roles* which group some activities and people;
- Formal communications between actors.

There are different tools to model a process but a key problem in business process design is how to structure and manage relationships between different internal and external partners or the key mechanism to improve or change the business process (Lindsay et al, 2003).

Inadequate process structure may result in undesirable effects. For example, role ambiguity emerges when the role has many expectations and role conflict shows when incompatible demands face the employee (Tubre and Collins, 2000; Rau and Hyhand, 2002). In addition, role ambiguity and conflict tend to be associated with tension in the work environment, Low job satisfaction and blurred roles (No clear distinction of responsibilities). Organisations seek to reduce ambiguity and uncertainty by routinising work. Routine requires process explicitness and clear business rules to govern that work (Vat, 2003).

Dynamic metaphor of business processes show different weights of tangible factors (tools, assets, manpower…) and intangible factors (behaviour, knowledge, believes….) that interact according to changing variables (internally and externally). Modelling a process should take in account both intangibles which expose in workers' actions and tangibles that could be reflected in corporate capabilities.

Behavioural aspect of modelling
The employees express actions through their behaviours. The employee behaviour relates the implicit and the explicit knowledge and experiences. The organisation is a system of roles and the employee role is defined as a pattern of behaviours (Tubre and Collins, 2000). According to the Cambridge Centre for Behavioural Studies (2003), behaviour is what people do and say and the environment provides consequences for

behaviour. Because the behaviour mapping perspective involves both the actors and activities, the richer the notations to reflect these engagements, the more details of the interactions between actors/activities, hence the more knowledge is gained.

Examples of the tools that map the process from the behavioural prospective are Unified Modelling Language-Activity Diagram (UML-AD) and Role Activity Diagram (RAD). Activity diagrams are a type of state transition diagram.

Despite the fact that activity-based modelling enables observation of the tasks, interdependencies, is more convenient for automating tasks and able to handle complex processes, it lacks a strong mathematical construct and needs process modelling expertise (Mentzas et al, 2001).

Dumas and Hofstede (2001) investigated the adequacy of UML-AD notations for workflow specifications by confronting it with a set of workflow patterns. The investigation results included the following drawbacks (also see Odeh et al, 2002 and Andersson et al, 2002):

- Some UML-AD constructs lack a precise syntax and semantics.

- UML-AD does not fully capture important kinds of synchronisation.

The behavioural modelling presented could not capture full view of a process. The following presentation of process rules may compensate the need of modeller expertise, absence of mathematical construct and lack of modelling notations.

The process rules and entities

According to the Business Rules Group, business rules could be a term, fact, derivation or/and constraint. The process rules and regulations represent the boundaries within which the process should be accomplished. The process contains a number of activities, which in turn contain the actors and the activity elements (e.g. tools, documents or computer systems). The visible and invisible knowledge of the activity actors are reflected within their behaviours. The process's rules constrain the relationship between the process elements and the actors' behaviours.

For example, the Generally Accepted Accounting Principles (GAAP) that were issued by the Financial Accounting Standard Board (FASB) in the U.S.A. are considered the general rules that must be followed by accountants (actors) while preparing the financial statements (activities) to be accepted by financial markets.

The process rule must contain at least the following components:
- An entity state or instance that applies the rule.
- A statement that directs the state into a certain category or dimension.
- A new entity state.
- The conditions of the new state.

The rule only deals with one dimension without interacting with other rule boundaries. Process rules are embedded in almost all process aspects such as: the forms used computer applications and financial statements. A set of rules that cover all or most stages of a process, would specify the process itself. The process rule is triggered by an event. The event could be another rule within an action or interaction.

The more rules that describe an activity within a process, the more knowledge are reflected from that activity. The processes that have a more static nature are easily

expressed by rules and the constrained boundaries, while in the more dynamic processes it is hard to collect and determine the rules that govern them.

The process rules can be categorised according to different measures. These measures could be scope and interest, construction language (Morgan, 2003), rule components: (Van Halle, 2000) or Odell (1998) classification of business rules. Steinke and Nickolette (2003) presented a survey of different classifications of business rules.

Liu and Ong (1999) presented an approach to understand the process rules. The approach stands on the interrelation between one of the process components (conditions) and the agent's behaviour. Anderson et al (2002) introduced the concept of State Flow (SF) to understand and control process modelling. SF describes a process as a group of states during the process's life cycle. The process state shows the achievement level of the process objectives. A process current state is called "planning rules". Both examples attempted to understand a process through interrelating one or more of its components (or its object) to the people who are doing the work (behavioural norms) or more surrounding elements (planning rules). Throughout such interrelation, the process agents are supposed to clearly understand and express their actions and conditions.

None of these attempts presented a holistic direct relationship between process components and their controlling or working rules. These attempts are using some of the process components (people behaviour, process states, conditions, events and triggers) to initiate a construct that explains the process rules that benefit certain objectives.

Based on the discussion presented concerning process and process modelling techniques, process rules are related to the process components and connections. Therefore, rules classifications and categories are a reflection of process structure, objectives, relations and connections. Accordingly, the following introduction is the author explanation of process entities and rules and how they can be extracted from a process.

Process entities
The process entities can be divided as follows:
- *The construct entity*
  It is the boundary within which a group of related relational entities are working. The construct entity is considered the vessel where a certain group of the relational entities add value to one or many of the final product components.
  For example, a product X has three components x1, x2 and x3. Each of these components is processed in different units and then all of the three processed components are grouped in a separate unit. In such a case, there are four construct entities. Each adds value in a different way. By tracing the inputs or the raw material of the process, the construct entities can be assessed and recognised.
- *The relational entity*
  It is the corporate tool and method to achieve the process objective or it is the corporate recipe or mixture to add value. A relational rule expresses the relationship between these relational entities inside a certain construct.
- *The connection entity*
  This group of entities can be classified into the following:
    - Out/In connection

These entities connect the construct entities with the previous constructs in other processes.
- In/Out connection

These entities connect the construct entities with the next construct within the same process.
- *The result entity*

It is the anticipated result from the process.

The interrelationship between process entities and process rules

The construct entities

Based on the previous definition of the construct entities, a subset of the definition rules will identify the construct entities to the degree that handle all input objects. In addition, this group of entities have to be equipped with a collection of definition rules that reflect the different types and states of the process's main object.

The relational entities

This group of entities has two interrelated groups of rules. The first group is the definition rules of the relational entities, that describe the special tools or actions that will deal with the process's main object. The second group is the relational rules, which describe the sequence and the relationship between these relational entities. The more the definition rules the more description of the process special mixture and the more reflection of the knowledge used. It is important to notice that the definition rules of the relational entities could include the definition of an external event that triggers one or more of the out/in connections.

The connection entities

This group of entities will be related to the connection rules. The out/in connection rules will deal with the external events that change the states of the process's main object, and the in/out connection rules will deal with the internal transition of the process object between different process constructs.

The result entities

This group is defined with the anticipation rules and the development rules. The anticipation rules describe the states of the process object that are accepted as a result of the process actions. The object states resulting could include new objects and a new state of the initial object state. The development rules are pulling the efficiency of the process elements (especially the actors) into new desired levels.

The definition of the process rule

A rule can be in one of two main groups:
- Structure rules.
- Objective rules.

The structure rule consists of three types:
- A construct or definitions rule that defines the process participants or entities.
- A relational rule that states the interrelation between two relational entities of the same construct within a process.
- An external connection rule that states the relationships between two or more relational entities of different constructs within the same process.

The objective rule consists of two types:
- An anticipation rule that states the accepted level of the process outputs.

- A development rule that stimulates the process operation level into a new direction (such as a higher level of efficiency).

The elasticity of the structure rules is higher than the objective rules, because the first one is supposed to change faster to cope with the internal and external opportunities and threats. When restructuring the process, most likely some of the structure rules could be modified or discarded and new rules can be inserted.

In the business community, these different categories of rules can be classified into the following types:
- The operation rules, which contain the structure rules.
- The result rules, which contain the objective rules.

And the operation rules can be identified according to the knowledge types and intensity into the following levels:
- Declarative knowledge rules, which define the actors or entities (construct rules).
- Procedural knowledge rules, which state the relationships between actors, entities and roles (connection and relational rules).

Both of these rules can be classified into two levels as well:
- The formal level, which has an explicit knowledge and accumulated fractions of implicit knowledge. The more explanation and diffusion of these rules, the more knowledge embedded within the corporate outputs.
- The informal level, which has an implicit knowledge. By assessing the field rules (the actual implemented rules), the informal rules can be extracted and embedded.

The rules are applied on the process components to produce the process objective. The process components are the shared entities. The process components can include the process actors, production tools, methods, computer systems and documents.

In addition to the rules that are available in the corporation documents or manuals, the following sources may confirm the formal rules and provide some of the field rules. Field rules are the rules that emerge as a result of the relationship between the process's aspects. These rules contain the formal and the informal. It is essential to assess the field situations to determine real relationships.
- Because the rules have a great influence to shape the process, the **definition rules** can be assessed and elicited throughout the process boundaries or structure.
- The relationships between different process elements and entities are built to confirm the special corporate recipe of doing work. Therefore the relationships of the process elements reflect this group of **connection and relational rules**.
- Each activity within a process is supposed to add value. This added value is the final output of that activity. The expected outcomes from the process activities can reflect the third group of rules, which are the normal objectives or **anticipation rules.**
- Because the process is always developed and enhanced to achieve new levels of performance to cope with the surrounding continuous changes, the third group of rules, which are **development rules**, can be assessed from the incentives that stimulate the process level into a higher level of efficiency.

Modelling the process by the use of process rules-entities concept

Based on the previous discussion, the following section illustrates the modelling procedures.

1-Extract, classify and interrelate the process rules and entities

The process rules could be extracted and the entities of certain business process could be identified from the rules. For example the process entities of debt confirmation process within higher education institution can be classified as follows:

The construct entities	The relational entities	The result entities
The Debt Account	The account printing	The debt letter
The Auditor Debt Record	The record printing	The debt summaries
The Employee Affairs Debt Record	The preparation	Matched Debt Account
The Debt Summary File	The account check-up	Matched Auditor Debt Record
The connection entities	The auditor check-up	Matched Employee Affairs Debt Record
The matching 1	The update	
The matching 2	The correction	
Send to summarise	The modification	
Send prepared letter	The summarisation	
The mailing		
Payroll declaration		
Posted entries of payroll account		

Table- 2: The entities of the confirmation process

According to the interrelation between rules and entities, these relationships can be summarised as follows:
- The definition rules identified the construct entities and the relational entities.
- Both relational rules and external connection rules use the construct entities, the external connection entities and the relational entities to produce the result entities.
- The result rules indicate the desired states of the result entities (object types).

The following table demonstrates the relationship between the process rules and its entities.

Process rules	Number of rules	Process entities	Number of entities
The definition rules of the process's main subject (initial object)	11		
The definition rules of the construct entities	4	The construct entities	4
The in/out connection rules The out/in connection rules	7 2	The connection entities	9
The definition rules of the relational entities The internal relational rules	17 9	The relational entities	9
The anticipated result rules	4	The result entities	5
The development result rules	1		

Table-3: The relationship between process rules and the entities in the case study presented

2-Developing the process rules
The need to restructure the process could be assessed from many sources such as; complains, system failure, regular checking or installing new technology. For example the auditors of the process presented claimed that it takes more than 15 days to prepare the debt letters (too much time). After checking, the auditor's reasons were dealing with the connections with other constructs, therefore the connection rules and entities were investigated. Then, some connection rules were removed and others were modified.
Table (4) presents the process entities and rules after restructuring.

Process rules	Number of rules	Process entities	Number of entities
The definition rules of the process's main subject (initial object)	11		
The definition rules of the construct entities	4	The construct entities	4
The in/out connection rules The out/in connection rules	5 2	The connection entities	7
The definition rules of the relational entities The internal relational rules	14 9	The relational entities	9
The anticipated result rules	4	The result entities	5
The development result rules	1		

Table-4: The relationship between process rules and the entities in the case presented

Classifying the process components made it easier to concentrate the restructuring efforts in the direction that affects the process objectives (result entities). With the use of the new concept, the analyst will deal directly with the process rules without the need to: first, map the process; second, restructure the process; and finally, change or remove some of its rules.
The process components are the construct entities, the connection entities, the relational entities and the result entities. The process entities are representing the operation templates. The process rules (whether they are formal or informal) reflect the knowledge that determines when, how, who, where and why, the interactions of the process entities. The definition rules must define the main components of a process. The number of the defined entities (by the definition rules) must equal the number of the process entities.

The transient object within a process (the main process subject) is the element that has changed states. The process object state is changing by the effects of the relational entities. By enriching the process rules with the definitions of both the object changes (or states) and the description of the relational entities, the process rules will reflect a greater proportion of the process implicit knowledge. The definition rules that reflect both the object changes and the description of the relational entities could be simple or compound, where the latter contains two or more constraints.

In the case presented, the different states of the process object are defined by the use of 11 rules. These 11 rules identified the different states of the process object (Debt) within the four main constructs. The descriptions of the relational entities are defined by the use of 14 definition rules. If both of these numbers are grouped and compared with the numbers of the relational entities (or internal relational rules), the resulting ratio will give one of the following cases:

- The ratio is less than one. It means that the number of the relational entities (or the internal relational rules) is bigger than the total number of both the definition rules of the object states and the definition rules of the relational entities. This case reflects a very slim description of the process rules.
- The ratio is one or more than one. It means that the number of the relational entities (or the internal relational rules) is equal or smaller than the total number of both the definition rules of the object states and the definition rules of the relational entities. This case reflects a good description of the process rules. The positive ratio between the two groups indicates the degree of implicit knowledge of the process that is reflected in the process rules. The minimum acceptable ratio is '1' because at least every one of the relational entities is described with one simple definition rule. If the knowledge skeleton has an iceberg shape, the minimum ratio describes the visible proportion of the knowledge berg.

The ratio calculated is called Rule-Knowledge Ratio (RKR). The RKR is calculated and presented to provide a ratio that reflects the knowledge level of the rules extracted (and developed). If the calculated ratio is not acceptable, more rules could be extracted from the process under development.

Conclusions and recommendations

This article emphasised the importance of processes and efforts spent to improve their adequacy. Recent attempts to enhance processes were introduced and discussed. An improved methodology based on process rules and entities was presented. The author believes that the wide use and development of the new concepts (by the use of different techniques) would address the complexities and paradoxical elements of practices and in-depth criticism could be available. Accordingly, the author points to the importance of conducting additional testing within different cases to investigate the applicability and validity of the new concept of modelling in a wider scope. A manager might use the new modelling concept as part of SWOT analysis to improve processes layout, flow and relationships. Linking process rules and entities with decision systems, authority and responsibility lines would enrich the results from enhancing processes.

References:

Aguilar-Saven, Ruth Sara, 2004. Business process modelling: Review and framework. *International Journal of Production Economics*, 90, pp. 129-149.

Al-Mudimigh Abdullah S., 2007 " The role and impact of business process management in enterprise systems implementation", Business Process Management Journal, Vol.13, No.6, pp.866-874.

Andersoon, Tomas, Ceder, Annika, Andersson, and Bider, Ilia, 2002. State-flow technique for business process analysis: case studies. *Logistics Information Management*, 15(1), pp. 34-45.

Anjard, Ronald P., 1996. Process Mapping: One Of Three, New, Special Quality Tools For Management, Quality And All Other Professionals. *Microelectron. Reliab.*, 36(2), pp. 223-225.

Armistead, Colin, 1999. Knowledge management and process performance. *Journal of Knowledge Management*, 3(2), pp.143-154.

Braganza, Ashely, 2002. Enterprise integration: creating competitive capabilities. *Integrated Manufacturing Systems* [Online], 13(8), pp. 562-572. Available from:http://www.emeraldinsght.com/0957-6061.htm [Accessed 7/2003].

Cambridge Centre for Behavioural Studies, 2003. [Online]. Available from: http://www.behavior.org [accessed 5/2003].

Cameron, I.T. and Ingram, G.D., 2008 "A survey of industrial process modeling across the product and process lifecycle", *Computers & Chemical Engineering*, Vol.32, No.3, pp.420–438.

Chen-Burger, Yun-Heh, Robertson, David, and Stader, Jussi, 2004. A Case- Based Reasoning Framework for Enterprise Knowledge Sharing and Reusing. [Online]. Available from: http://www.ifcomputer.co.jp/sol2000/papers/jessica.pdf [Accessed 10/2004].

Coskun Semih, Basligil Huseyn and Baracli Hayri, 2008 " A weakness determination and analysis model for business process improvement", Business Process Management Journal, Vol.14, No.2, pp.243-263.

Dumas, Marlon, and Hofstede, Arthur H.M., Ter, 2001. UML Activity Diagrams as a workflow specification language. [Online] In proceedings of the Fourth International Conference on the Unified Modelling Language, 1st-5th October 2001, Toronto, Ontario, Canada. Available from: http://tmitwww.tm.tue.nl/research/patterns/documentation.htm [Accessed 4/04]

Frei, F.X.,Kalakota, R. and Marx, L.M., 1997, "Process variation as a determinant of service quality and bank performance: evidence form the retail banking study" Working paper 97-36, The Wharton Financial Institution Center, Philadelphia, PA.

Gingele, J., Childe, S.J., and Miles, M.E., 2002. A modelling technique for re-engineering business processes controlled by ISO 9001. *Computers In Industry*, 49, pp. 235-251.

Hedge III Arthur J., 2007 " The right fit: make sure you get the right business process management tool for the job", AIIM E – Doc Magazine, Vol. 21, No.6, pp. 19-21.

Isaksson Raine, 2006" total quality management for sustainable development- process based system models", Business Process Management Journal, Vol. 12, No.5, pp.632-645.

Julien Janelle, 2007 "Managing the flow: How can your organization leverage BPM technology to improve business efficiency?", DOC Magazine, Nov/Dec, Vol.21, No.6, p.12.

Kumar V., Smart P.A., Maddern H., and Maull R.S., 2008, "Alternative perspectives on service quality and customer satisfaction: the role of BPM", International Journal Of Service Industry Management, Vol.19, No.2, pp.176-187.

Lei, David, and Slocum Jr., John W., 2002. Organization Designs to Renew Competitive Advantage. *Organizational Dynamics*, 31(1), pp. 1-18.

Lindsay, Ann, Downs, Denise and Lunn, Ken (2003) *Business processes—attempts to find a definition.* Information and Software Technology, 45 (15). pp. 1015-1019.

Liu, Kecheng, and Ong, Tina, 1999. A Modelling Approach for Handling Business Rules and Exceptions. *The Computer Journal*, 42(3), pp. 221-231.

Mansar S. Limam and Reijers H.A., 2007 "Best practice in business process redesign: use and impact", Business Process Management Journal, Vol. 13, No. 2, pp. 193-213.

Mentzas, Gregoris, Halaris, Christos, and Kavadias, Stylianos, 2001. Modelling business processes with workflow systems: an evaluation of alternative approaches. *International Journal of Information Management*, 21, pp.123-135.

Morgan, Tony, 2003. Business Rules and Information Systems. Addison-Wesley publications.

Odeh, M., et al, 2002. Modelling Processes Using RAD and UML Activity Diagrams: an Exploratory Study. In proceeding of ACIT Conference, Doha Qatar, International Arab Conference on IT, Doha Qatar, Dec. 16th –19th.

Odell, James J., 1998. Advanced objective-oriented analysis & design using UML. SIGS Books & Multimedia and Cambridge University Press.

Palmberg Klara, 2009 " Exploring process management: are there any widespread models and definitions? ", the TQM Journal, Vol. 21, No.2, pp.203-215.

Rau, Barbara L., and Hyland, Maryanne M., 2002. Role conflict and flexible work arrangements: the effects on applicant attraction. *Personnel Psychology*, 55(1), pp.111-136.

Sauer, Chris, and Willcocks, Leslie, August 2003. Establishing the business of the future: The Role of Organizational Architecture and Information Technologies. *European Management Journal*, 21(4), pp. 497-508.

Shaw Duncan R., Holland Christopher P., Kawalek Peter, Snowdon Bob and Warboys Brian, 2007 "Elements of a business process management system: theory and practice", Business Process Management Journal, vol.13, No.1, pp.91-107.

Sila, I. and Ebrahimpour, M, 2003 "Examination and comparison of the critical factors of total quality management (TQM) across countries", International Journal of Productivity Research, Col.41, No. 2, pp. 235-268.

Smart, P.A., Maddern, H. and Maull, R.S., 2007 "Understanding business process management: implications for theory and practice", Working paper series, School of Business and Economics, University of Exeter, Exeter.

Steinke, Gerlard, and Nickolette, Colleen, 2003. Business Rules as the basis of an organisation's information systems. *Industrial Management & Data Systems*, 103(1), pp. 52-63.

Succi, Giancalo, Predonzani, Paolo, and Vernazza, Tullio, 2000. Business Process Modeling with Objects, Costs, and Human Resources. System Modeling for Business Process Improvement, Artech House, Inc., Norwood, MA, pp. 47-60.

Sutcliffe, Alistair, G., 2000. Business Modeling, interprocess relationships. System Modeling for Business Process Improvement, Artech House, Inc., Norwood, MA, pp. 117-134.

Terry Richardson, 2007 "Why focusing on processes is the Holy Grail of business management", Management Services, 5(3), pp.34-37.
The Business Rule Group. 2009 [Online]. Available from: http://www.businessrulesgroup.org/ [accessed 4/2009].

Tiwari A. and Turner C. J., 2008 "A review of business process mining: state of the art and future trends", Business Process Management Journal, Vol. 14 No. 1, pp.5-22.

Tubre, Travis C., and Collins, Judith M., 2000. Jackson and Schuler (1985) Revisited: a meta-analysis of the relationships between Role Ambiguity, Role Conflict, and Job Performance. *Journal of Management*, 26(1), pp.155-169.

Tyler Cedric, 2008 " What's going on in my organisation?", Strategic Finance, Mar, Vol. 89, No.9, p.49.

Vat, Kam Hou, 2003. Toward an actionable framework of knowledge synthesis in the pursuit of learning organization. *Informing Science*, pp. 1085-1100.

World commission on Environment and Development (WCED), Oxford University Press, 1987.

Xu Ke; Liu Lianchen and Wu Cheng, 2007 "A three-Layered method for business processes discovery and its application in manufacturing industry", Computers in Industry, Vol. 58, pp.265-278.