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Modeling Business Process: Analysis of Goal-Oriented Approaches

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Abstract: A crucial management issue for most corporations is the effective design and implementation of their business process. However, existing approaches describe an enterprise in terms of activities and tasks view without offering sufficient guidance towards a process-centric description of the organization.

Goals have long been recognized to be essential components involved in the business process. Business process engineering research has increasingly recognized the leading role played by goals in the business process. Such recognition has led to a whole stream of research on goal-oriented approaches. The study of goal-oriented methodologies indicates that modeling of organizational goals constitutes a central activity of the business process.

In this paper we advocate the use of goal-oriented approaches to business process modeling. Some systematic approaches to developing and documenting business processes on the basis of the explicit or implicit business objectives are discussed. From the representation view of model, the way that models are expressed is demonstrated.

Keywords: Business process modeling, Goal-oriented approaches, Representation

I. Introduction

The traditional practice of managing an enterprise adopts a functional view in which the business is organized along individual types of work performed, resulting in organizational structures which reflect the particular functional view adopted by the business. The main reason for adopting a functional organization is the achievement of maximum performance of individuals or business functions. Nevertheless, this inward focus 'internal' performance rather than 'global' efficiency suffers from a number of drawbacks, especially when business improvement is sought. In particular, improvements occur piecemeal and independently of one another, while concentration on the symptoms of one function ignores causes in important cross-functional interdependency.

Current business challenges such as deregulation, mergers, globalization and increased competition, have given rise to a new philosophy of business management that organizes an enterprise in terms of processes rather than functional and tasks. The basic characteristic of this approach is the re-orientation of business from performing

as a cluster of functions or divisions to integrating activities within a limited number of core processes. Each core process captures cross-functional interdependencies and concentrates on few strategic objectives that determine competitive success. Therefore, a process-centric approach links improvement efforts in different functions to a shared set of strategic objectives.

Adopting a process view however, requires suitable tools for identifying, modeling and measuring business processes. Existing business modeling approaches describe enterprise in term of activities and tasks offering little or no guidance towards a process-centric description of the organization. In this paper we advocate the use of the goal-oriented approach whereby a business is seen as a purposeful system aiming to achieve defined objectives which add value to its customers.

The paper is organized as follows. Section2 introduces the notion of business process in term of its defining characteristics and presents a critique of existing process modeling techniques. Section3 briefly introduces some goal-oriented approach to business process modeling. Section4 discusses the relation between the existing goal-oriented approaches. In addition, from the representation view, the way that models are expressed is demonstrated. Finally, section 5 concludes goal-oriented approaches can be used by an enterprise that wishes to develop a new business process, or alternatively model, document and analyze an existing process.

II. Business Process Modeling

The concept of business process is a key issue in the process-centric paradigm. However, there is a considerable controversy around the numbers and types of process appropriate to a given organization [33]. The difficulty derives from the fact that there exists no explicit way for determining business processes. There is a lack of a coherent and universally accepted definition of business process definition of what a business process actually is. Nevertheless, there are some common features of business processes should be defined in the literature [33] [28] [24] [27] that provide guidance as to how business process should be defined. In summary a business process in the process-centric organization demonstrate the following characteristics.

- A business process has well identified products and customers, such that business objectives are matched through the (product offering) business process and delivered in form of the product; customers may be external or internal to the organization; products may

include finished goods or services

- A business process has goals, i.e., it is intended to achieve defined business objectives aiming to create value to customers
- A business process involves several activities which collectively achieve defined business process goals and create value to customers
- A business process crosses functional and organizational boundaries; it concerns the collaboration between organizational actors that are contributing to (or constraining) the satisfying of business objectives

In these terms a business process constitutes the manifestation of what organizational actors do in order to achieve business objectives. Organizational actors include individuals or groups which may be internal or external to the organization (e.g., company employees, organizational departments, customers, suppliers etc.) and influence the realization of business objectives. Business objectives aim at creating value to customers in other words they concern customer value goals.

Business process modeling is a generic name that refers to a collection of techniques which are used to model the behavior of business systems. Existing process modeling approaches mainly originate from the software engineering field and fall in one of three categories:

- Activity-oriented approaches describe a process as a set of ordered activities (SADT[7], IDEF0[18], DFD[34], Workflows[22], the F3 process[19]). The emphasis is on what activities take place. Each of these activities is decomposed in smaller tasks corresponding to smaller steps in the process. In addition to a collection of tasks activity-oriented models define the order of task invocation or condition(s) under which tasks must be invoked, task synchronization, and information flow.
- Agent-oriented (or role-oriented) approaches specify and analyze the role of the agents that participate in the process (e.g., Role Activity Diagrams[27]), Role Interaction Nets[4], the ORDIT approach[21]). The focus is on the entity that performs a process element. Roles represent the sequences activities carried out by agent engaged in a co-operative behavior.
- Product-oriented approaches represent a process through the evolution of its product (e.g., [31], [23]). Product-oriented models do not put forward the activities involved in a process but rather the result of these activities. The focus is on products and transformations made on them. Each product entity has a defined a sequence of states and triggers that cause state transformations.

All the above approaches promote a view of a process that is based on the notion of activity. Activity-oriented approaches focus solely on description of activities. In addition to product-oriented approaches couple activities to their output (the product), while agent-oriented approaches establish an explicit link between the activities and the agent

responsible for these activities.

Existing approaches offer little guidance for identifying business processes. In activity-oriented approaches the main mechanism for grouping activities into processes is that of composition/decomposition. This mechanism however, does not offer a unique way to identify a process. The difficulty derives from the fact that processes are almost indefinitely divisible; the activities involved in fulfilling a customer order, for example, can be viewed as one process or hundreds. Agent-oriented approaches on the other hand, group activities into processes according to the organizational agent that performs these activities. Yet a process may cut across the organization involving several organizational agents. Finally, product-oriented approaches group activities based on the product that they manipulate and this notion of a process is in accordance with the suggested business process definition as the delivering of products to customers. However this focus on product rather than organizational behavior fails to describe other important components of a business process such as the business goals the process intends to achieve and the collaboration of the agents that contribute to realization of process goals[9].

III. Goal-Oriented Approaches to Business Process Modeling

Business processes, unlike processes that are executed by machines, exist in social organizational settings. Organizations are made up of social actors who have goals and interests, which they pursue through a network of relationships with other actors. A richer model of a business process should therefore include not only how work products (entities) progress from process step to process step (activities), but also how the actors performing these steps relate to each other intentionally, i.e., in terms of concepts such as goal, belief, ability, and commitment. When an organization seeks new ways for organizing work, actors who have goals and interests are likely to evaluate these proposals strategically, e.g., in terms of potential opportunities and threats [11].

Therefore, it becomes obvious that taking a single modeling perspective (product, activity or role) is not sufficient for expressing business processes. A business process model is a description of the main constituents, purpose, processes, etc. of an organization and how they relate to each other. It is essentially a representation (on paper or on a computer) of the organization's knowledge about itself or what it would like to become. Here 'organization' can mean anything from a large corporation or government department to a small team or a one-man company. Similarly, the level of detail represented in the model can vary depending on its purpose[25]. As a result, a business enterprise is described as a network of related business processes which collaboratively realize business goals.

From the above analysis, goal plays an important role. This area has received increasing attention over the past few

years.

During the goal-oriented business process modeling approaches, EKD[9][30] is a systematic approach to developing and documenting enterprise knowledge, helping enterprise to consciously develop schemes for implementing changes. The approach is part of a larger enterprise knowledge modeling framework, known as the Enterprise Knowledge Development (EKD) approach. EKD advocates a goal-oriented view to business process modeling. Instead of imposing a single modeling criterion EKD offers a more general modeling framework that follows several modeling views (or rather modeling components), using the notion of business goals to structure business components in coherent business process. The above are summarized in Fig 1 which presents an concepts.

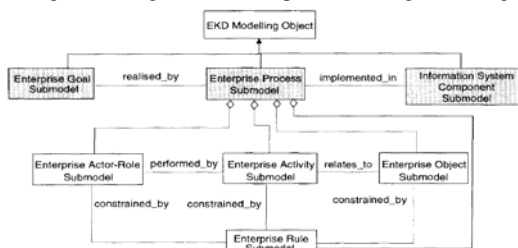
The EKD framework integrates three complementary views (submodels), namely: the enterprise goal view, the enterprise process view and the information systems components view.

The enterprise goal submodel uses a ‘network’ of goals that are used to express the casual structure of an enterprise, in terms of the goals-means relations from the ‘intentional’ objectives that control and govern the system operation to the actual ‘physical’ enterprise processes and activities available for achieving these objectives. The enterprises process submodel represents the organizational and behavioral aspects of an enterprise. An ‘enterprise process’ is a composite of four key enterprise components:(a)the roles that are played by enterprise actors in order to meet the process goals;(b)the activities involved in each role;(c)the objects that are involved together with their evolution from creation to extinction(within the context of the enterprise process);and(d) the rules that determine the process components. Finally, the information system component submodel focuses on the information systems components that support enterprise processes.

In using EKD modeling concepts one may start at any enterprise knowledge submodel (enterprise goals, processes or systems) and move to other levels, depending on the situation.

The totality of the EKD concepts form the enterprise knowledge ontology, i.e., the enterprise knowledge metamodel(EKM). This defines the logical form of the enterprise knowledge. The metamodel includes information about the semantics of the enterprise knowledge; it identifies the enterprise entities their attributes and explicit relationships between them.

Fig1 Modeling views in enterprise knowledge modeling



In addition to the above approach the i* framework (Distributed Intention, pronounced i-star) for modeling intentional, strategic actor relationships is another goal-oriented approach. The framework consists of two main components. The Strategic Dependency (SD) model describes a business organization in terms of the dependencies that actors have on each other in accomplishing their work. It is used to represent a particular design for a business process. The Strategic Rationale (SR) model provides a more detailed level of modeling by looking “inside” actors to model internal intentional relationships. Intentional elements (goals, tasks, resources, and softgoals) appear in SR models not only as external dependencies, but also as internal elements arranged into (mostly hierarchical) structures of means-ends, task-decompositions and contribution relationships.

Earlier versions of the framework has been presented in the context of requirements engineering [12], business process reengineering[13][14], software process modeling[15], and analysis of the organizational impact of computing[16]. Yu extends his earlier work by defining the features of the SR model and giving the highlights of its formalization. It also further clarifies how the framework assists in the understanding of business processes, and the generation and evaluation of alternatives.

The i* approach provides a description of work organization in terms of dependency relationships among actors. This approach acknowledges the fact that actors have freedom of action, within the social (inter-actor) constraints, called strategic dependencies. An actor is an active entity that carries out actions to achieve goals. Intentional components i.e., goals to be achieved, tasks to be accomplished, resources to be produced and softgoals (non-functional requirements) to be satisfied, are made specific embedded in the dependencies between actors [10].

In the goal-based workflow approach proposed in [5] an organization is seen as a tuple [G, A, R] where G is a set of goals, A is a set of actors, and R is a set of resources. Actors act collaboratively using resources in order to attain their goals.

Similarly, Lee's Goal-based Process Analysis (GPA) is also goal-oriented approach[20]. GPA can be used to analyze existing processes in order to identify missing goals, ensure implementation of all goals, identify non-functional parts of a process, and explore alternatives to a given process.

The GEM model and methodology[3] is another goal-oriented approach of business process modeling. According to GEM business processes are collections of suitably ordered activities, enacted by individual persons, depending on their role within an organization. Every process has a purpose which is to achieve a goal or react to an event. GEM offers a number of models that can be used for specifying processes: the role interaction model, the purpose model, the procedure model, the internal data model and the corporate data model. The GEM methodology consists of three steps: defining the scope of the business process, doing process analysis and doing system design. The process analysis step

consists of the following stages: goal hierarchy analysis, basic procedure analysis, detailed procedure analysis, input/output data analysis and performance metrics specification.

IV. Discussion

The need for developing an overall view of goal concepts and goal-oriented approaches has also been argued in [17] and [2]. The former investigates the use of goal analysis in terms of different activities. On the other hand, the latter compares different goal-oriented methodologies on the basis of their goal modeling and specification approaches. In addition it provides an overview of different goal modeling strategies (goal refinement, goal decomposition, analogical reuse, goal operationalization, goal conflict management, and selection between alternatives). Rather than providing a comprehensive framework for analyzing the contribution of alternative approaches, the objective of these works has been mainly to stress the significance of goal concepts in business process and to draw the attention of the research community to goal-oriented business process. It also assists us to understand and accordingly select the best fit for goal-oriented modeling method.

For example, let us consider a BPR project concerning the reorganization of an electricity distribution company due to market deregulation. In order to meet the conditions in the competitive market the company needs to re-examine and improve the way of servicing its existing customers as well as to adopt new ways of working for servicing eligible customers. The implications of these forces on this organization is that any reform, requires, prior to (re-) designing business processes and support information systems, a clear understanding (and a sharing of this understanding between many stakeholders) of the current enterprise situation. Thus, a goal modeling approach such as the *i** strategic dependency modeling method or EKD, that focus on understanding the current organizational situation should be used [10].

We should also pay attention to other situational factors that affect the applicability of a method may include the use of appropriate tools that facilitate method execution and the familiarity of engineers with the applied strategies and supporting technologies. The selection of a particular method cannot be fully prescribed. Furthermore, even when one follows a certain goal-oriented modeling method the situational factors dominating the project may cause a number of adaptations to it.

Another observation is that additional benefits can be gained by integrating different methods. The combination of the two approaches can lead to a more complete methodology. An example of this type of integration is found in [8].

It should be noted that any type of integration should also take into consideration the system and representation views in order to ensure compatibility between different methods and consistency between the different goal representation formalisms. Initial analysis of the goal

concepts used in different approaches [1][29] shows that integration of goal models resulted from different methods is feasible, additional work is required however, in order to efficiently manage different formalisms and notations used in different approaches for expressing goal concepts.

From the representation view concern the way models are expressed. Models can be expressed in a variety of formats, using more or less formally defined notations. We differentiate between informal, semi-formal and formal approaches. Informal approaches generally use natural language text to express models; semi-formal use mostly box and arrow diagrams; finally, in formal approaches goals are expressed as logical assertions in some formal specification language [10].

In general, formal approaches use specification language to formally define model: Telos, Temporal Logic, Structured, Situation Calculus and ConGolog language, etc.

The vast majority of business process modeling efforts lack formal methods for modeling business processes. EKD uses entity-relationship models to represent structural information and Role-Activity Diagrams [26] to represent roles and their activities. EKD is a semi-formal approach.

*i** use the Telos language to formally define their models. The popularity of Telos is due to its ontological extensibility. This allows the capture of the semantics of one level at upper meta-levels inside Telos itself, thus allowing the definition of a customized conceptual language [32].

Rao [3] gives only a short informal description of the models and methodology. A methodology for developing multi-agent systems based on concepts similar to the ones in GEM appears in [6].

Semi-formal is the most widely used technique for model representation. Semi-formal models are imprecise in the sense that: (a) the meaning of modeling entities is described solely by the name given to it in the diagram and (b) the relationships between entities are loosely defined. Nevertheless, these models do provide an adequate basis for discussion between stakeholders and they also establish a framework for further analysis. Using these models stakeholders can confirm their shared view of the situation and agree the boundary within which a more detailed analysis will be performed.

Formal approaches offer more expressive languages and are therefore more amenable to formal reasoning. The main advantage of formal methods is that they can be used by sophisticated business analysts to capture business knowledge in an intuitive and unambiguous way. They can also be used to analyze processes in a formal way; this would have been impossible if the business analyst used an informal approach. However, they lack the freedom necessary to adequately support goal elicitation (e.g., to allow conflicts and inconsistencies among goals), and they lack the simplicity, flexibility and ease of use of semi-formal representations. Thus, semi-formal and formal representations are best seen as complementary contributing to an evolving framework for expressing models.

V. Conclusion

In this paper we have presented some typical goal-oriented approaches for modeling business process. In contrast to traditional business process modeling approaches which focus on business activities, the paper advocates the concept of business goal in order to describe the collaboration between business actors.

The paper has discussed some methodologies that enable business analysts to go from high-level enterprise objectives, to detailed and specifications of business processes for reasoning these objectives. The methodologies can be used by an enterprise that wishes to develop a new business process, or alternatively model, document and analyze an existing process.

References

- [1]A. Anton, Goal-based requirements analysis, Paper presented at the ICRE '96, Colorado Springs, Colorado USA, 1996.
- [2]A. van Lamsweerde, Goal-oriented requirements engineering: a guided tour, Paper presented at the 5th IEEE International Symposium on Requirements Engineering, RE'01, Toronto, Canada, 2001.
- [3]A. Rao, Modelling the service assurance process for optus using GEM, Technical Note 69, Australian Artificial Intelligence Institute, 1996.
- [4]B. Singh, G.L. Rein, Role interaction nets (RINS): a process definition formalism, MCC: Austin, TX, Technical Report, CT-083/92, 1992.
- [5]C.A. Ellis, J. Wainer, Goal-based models of collaboration, Collaborative Computing, 1:61-86, 1994.
- [6]D. Kinny, M. Georgeff, and A. Rao, A methodology and modelling technique for systems of BDI agents, In Proceedings of MAAMAW-96, 1996.
- [7]D.T. Ross, K.E. Schoman, Structured analysis for requirement definition, IEEE Transactions on Software Engineering, SE-3(1):1-65, 1997.
- [8]E. Dubois, E. Yu, M. Petit, From early to late formal requirements: a process-control case study, Paper presented at the Ninth IEEE International Workshop on Software Specification and Design (IWSSD-9), Isobe, Japan, 1998.
- [9]E. Kavakli, P. Loucopoulos, Goal-driven Business process analysis-application in electricity deregulation, Information Systems, 24(3), 187-207, 1999.
- [10]E. Kavakli, P. Loucopoulos, Goal modeling in requirements engineering: analysis and critique of current methods, Information Modeling Methods and Methodologies 2005: 102-124.
- [11]E. Yu, J. Mylopoulos, From E-R to 'A-R' - modelling strategic actor relationships for business process reengineering, Int, Journal of Intelligent and Cooperative Information Systems, vol. 4, no. 2 & 3, pp. 125-144, 1995.
- [12]E. Yu, Modelling organizations for information systems requirements engineering, Proc. 1st IEEE Int. Symp. Requirements Engineering, San Diego, Calif., pp. 34-41, 1993.
- [13]E. Yu, J. Mylopoulos, An actor dependency model of organizational work - with application to business process reengineering, Proc. Conf. Organizational Computing Systems (COOCS 93), Milpitas, Calif., Nov. 1-4, pp. 258-268, 1993.
- [14]E. Yu, J. Mylopoulos, Using goals, rules, and methods to support reasoning in business process reengineering, Proc. 27th Hawaii Int. Conf. System Sciences, Maui, Hawaii, , vol. IV, pp. 234-243, 1994.
- [15]E. Yu, J. Mylopoulos, Understanding "Why" in software process modelling, analysis, and design, Proc. 16th Int. Conf. Software Engineering, Sorrento, Italy, pp. 159-168, 1994.
- [16]E. Yu, An organization modelling framework for multi-perspective information system design, Requirements Engineering 1993 - Selected Papers, J. Mylopoulos et al., eds., Tech. Rpt. DKBS-TR-93-2, Dept. Comp. Sci., Univ. of Toronto, pp. 66-86, 1993.
- [17]E. Yu, J. Mylopoulos, Why goal-oriented requirements Engineering, Paper presented at the Fourth International Workshop on Requirements Engineering: Foundation for Software Quality (REFSQ'98), Pisa, Italy, 1998.
- [18]IDEF0, Integration definition for function modelling (IDEF0), Computer Systems Laboratory, National Institute of Standards and Technology, FIPS Pub 183, 1993.
- [19]Bubenko, The F3 reference manual, Deliverable F3, version 0.4, 1994.
- [20]J. Lee, Goal-based process analysis: a method for systematic process redesign, In Proceedings of the Conference on Organisational Computing Systems (COOCS'94), 1994.
- [21]J.S. Dobson, A.J.C. Blyth, J. Chudge, and R. Strens, The ORDIT approach to organizational requirements, In Requirement Engineering: Social and Technical Issues, M. Jiroka and J.A. Goguen, editors, pp. 87-106, Academic Press, London, UK, 1994.
- [22]K.D. Swenson, K. Irwin, Workflow technology: trade offs for business processes re-engineering, In Conference on Organisational Computing System COOCS'95, pp. 22-29, ACM, CA, 1995.
- [23]M. Franckson, C. Peugeot, Specification of the object and process modelling language, ESF Report D122-OPML-1.0, 1991.
- [24]M. Hammer, J. Champy, Reengineering the corporation - a manifesto for business revolution, Harper Business, NY, US, 1993.
- [25]M. Koubarakis, D. Plexousakis, A formal model for business process modeling and design, Proceedings of CAiSE'00, Stockholm, Sweden, June 5-9, 2000.
- [26]M. Ould, Modelling business processes for understanding, improvement and enactment, Tutorial Notes, 13th International Conference on the Entity Relationship Approach (ER'94), Manchester, U.K., 1994.
- [27]M. Ould, Business process: modelling and analysis for re-engineering and improvement, Chichester, John Wiley & Sons, 1995.
- [28]N. Alderman, D. Maffin, and A. Twaites, Providing customer value: a business analysis approach, In Managing Enterprises-Stakeholders, Engineering, Logistics and Achievement, Loughborough, pp. 203 - 209, Mechanical Engineering publications Ltd, LONDON, UK, 1997.
- [29]N. Pratt, goal formalisation and classification for requirements engineering. Paper presented at the 3rd International Workshop on Requirements Engineering: Foundations of Software Quality (REFSQ'97), Barcelona, Spain, 1997.
- [30]P. Loucopoulos, V. Kavakli, Enterprise knowledge management and conceptual modelling, Conceptual Modeling, Current Issues and Future Directions, Selected Papers from the Symposium on Conceptual Modeling, (ER'97), P. P. Chen et al. (ed), Lecture Notes in Computer Science, Vol. 1565, pp. 123-143, Springer, 1999.
- [31]S. Easterbrook, B. Nuseibeh, Managing inconsistencies in an evolving specification, In RE'95, York, England, pp. 48-55, IEEE Computer Society Press, Los Alamitos, California, 1995.
- [32]S. Greenspan, J. Mylopoulos, A. Borgida, On formal requirements modeling languages: RML Revisited. Paper presented at the 16th International Conference on Software Engineering (ICSE-94), Sorrento, Italy, 1994.
- [33]T. Davenport, The process innovation, Harvard University Press, Cambridge, MA, 1993.
- [34]T. Demarco, Structured analysis and system specification, Yourdon Inc., New York 352, 1978.