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A Framework for Situating Business Process Engineering Approaches: An Illustration with ARIS and EKD-CMM

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ABSTRACT

The process-oriented business management requires an appropriate engineering environment for the design and organization of the business processes and their supporting systems. Support systems should be integrated in order to avoid the discontinuity in business processes they support in a changing environment. In other words, enterprise computing requires appropriate methods to implement flexible business process solutions and agile information system to support them. The aim is to design and control the organizational structures in a very flexible way so they can rapidly adapt to changing conditions. The best way, from our point of view, is to ensure the modelling of business processes from organizational objectives they allow to reach to the software components included in their support systems. In this paper, we propose a framework that allows us to evaluate capacities of methods to facilitate the engineering of changing business processes.

1. INTRODUCTION

In a competitive and evolving environment, only the organizations which can react quickly to environment demands can survive [2], [5]. That capacity of quick reaction is often due to the ability of handling the support systems in favor of the business evolution requirements. In all management challenges, information systems should be continuously adapted to changing business practices and needs. This can be achieved by developing process-centric solutions. The paradigm of Business Process Management stresses the importance of integrating entire processes rather than simply integrating data or applications [2], [21].

In dynamic business environments, enterprises need to build flexible Business Process models to offer active, adaptable and competitive behavior to their customers and shareholders [21]. Flexibility is becoming an essential principle in the (re)design of business processes. There are actually many tools, techniques and conceptual approaches for analyzing, creating and maintaining an aligned level of flexibility in business processes and their support systems.

In this paper, we propose a framework that allows us to evaluate capacities of methods to facilitate the engineering of changing business processes. We discuss also on two Business Process Modeling and Development environments whose aims are to fill up actual needs of enterprises: Enterprise Knowledge Development – Change Management Method (EKD-CMM) and ARchitecture of Integrated information Systems (ARIS). Our research objective is to provide a benchmarking framework for business process engineering and management approaches.

2. PURPOSES OF THE STUDIED APPROACHES

2.1. EKD-CMM

The Enterprise Knowledge Development – Change Management Method (EKD-CMM) is a systematic and formulated approach to documenting an enterprise, its objectives, business processes and support systems, helping enterprises to consciously develop schemes for implementing changes.

From the method engineering point of view, EKD-CMM satisfies two requirements: (i) assisting Enterprise Knowledge Modeling and (ii) guiding the organizational change process. The EKD-CMM *enterprise knowledge modeling* component [10], [12], [13], recognizes that it is advantageous to examine an enterprise from multiple and inter-connected perspectives. EKD-CMM models describing an enterprise are structured in three layers of concern, *Enterprise Goals*, *Enterprise Processes* and *Enterprise Information System*. The first two layers focus on intentional and organizational aspects of the enterprise, i.e. the organizational objectives and how these are achieved through the co-operation of enterprise actors manipulating such enterprise objects. The third layer allows defining the requirements for the information system supporting the enterprise.

Regarding to the *guidance component*, EKD-CMM provides a methodological environment [1], [18], for considering the current enterprise functions and structures, the requirements and reasons for change, the alternatives devised to meet the requirements and the criteria and arguments for evaluating these alternatives. The EKD-CMM *process model* contains a finite number of paths, each of them prescribing a way to develop an enterprise scheme using an EKD-CMM modeling component. Therefore, the EKD-CMM (development) process model is a *multi-model*. It embodies several process models, providing a multi-model view for modeling a class of EKD-CMM processes. None of the finite set of paths is recommended 'a priori'. Instead the method suggests a dynamic construction of the actual path by navigating in the process model. In this sense the method is sensitive to the specific situations as they arise during the modeling and development process.

2.2. ARIS

The ARchitecture of Integrated information Systems (ARIS) is an approach to document the whole life cycle range of the enterprise, from business design to information technology deployment, leading to completely new process-oriented software concepts. At the same time, the architecture bridges the gap between business process modeling and workflow-driven application, from Business Process Reengineering to Continuous Process Improvement [19]. ARIS framework is structured in four levels: process engineering (I), process planning and control (II),

workflow control (III) and application system (IV). At level I, business processes are modeled. At level II, business process owners plan and control the 'current' business processes. In modern organizations, it is unrealistic to support the entire business with a unique software system. To answer this problem, to allocate the responsibility for comprehensive process control to an explicit system level rather than distributing it across multiple systems became a useful solution during nineties; this is supported at level III. The application components belong to the level IV. In fact, the four levels are interdependently connected.

ARIS has been successfully accepted by companies because (i) the modeling environment is supported by a software tool which seems well adapted to individually satisfy various needs of enterprises (ii) a large number of enterprise modeling formalisms are available to represent an organization according to multiple points-of-view and a meta-scheme is also provided integrating all those product models, enterprises are not forced to use all of them (iii) all enterprise models specified using the available formalisms are stored in a business process repository and changes on a given enterprise model are automatically reflected on all others which should be impacted.

Nevertheless, ARIS does not provide a systematic and formalized methodological guidance to develop those enterprise models. Furthermore, there is not any navigation mechanism provided in ARIS to help in using this tool and the underlying models.

3. THE FOUR VIEWS FRAMEWORK

The four views framework for analyzing 'system engineering approaches' is helpful in understanding the field of business process engineering which consists of applying engineering approaches, techniques, and tools to the construction of business process models. It has been first proposed for system engineering [7], and then proved its efficiency in other domains such as information systems engineering [8], requirements engineering [9], [17], method engineering [16].

In our work, the framework is composed of four complementary views supporting the analysis and comparison of Business Process Modeling, Development and Support approaches (Fig.1.). The *subject view* is identified as the view of an organization in a changing environment. The *system view* deals with the representation of business processes through business process models. In the *usage view*, we investigate the reasons, the rationale for business process engineering and management and relate the objectives of the users to the business process models that can best meet these objectives. The *development view* deals with the process of developing business process models. The way the development process might be supported by a tool is also a concern of this view.

Each view is characterized by a set of facets which facilitates the understanding and the classification of the studied approaches. This approach using facets was first proposed in [15] for classifying components which could be reused.

This framework helped us to analyze the two approaches (see section 2) according to multiple points of view and to get a comparative view. It allowed us to discuss the different concerns of business process engineering and management in a focused manner: business processes, their representations, the way of developing these representations and the rationale for using these representations. Our work extends the comparison frameworks proposed in [3], [6], [14]. We are actually extending this comparison to other business process modeling/management approaches.

3.1 The Subject View

In the evolving environments of modern organizations, the principal characteristic which seems mandatory for those organizations is the *flexibility*. Flexibility is the ability of the organization to quickly adapt its business process support systems to the organizational and environmental changes. Accordingly, we identified the subject view as the view of *evolving business processes* [11]. Table 1 shows the three facets we defined in this view and the values of their attributes, respectively for ARIS and EKD-CMM.

The *ability of business processes to change* is detailed using three attributes.

The *nature of flexibility* defines if the capacity of taking into account the environmental change should be incorporated in the business process model during the design-time or not [11]. This attribute characterizes the modeling power of the formalism which is used to specify business process models. *Flexibility by adaptation* is offered by modifying business process models or some of their instances. Approaches which offer only this kind of flexibility, adopt prescriptive modeling formalisms1 to specify business process definitions. It could be considered that these approaches are not really flexible but rather adaptive or evolutionary. *Flexibility by selection* requires modeling formalisms which offer the capacity to take into account the environmental change without any evolution of the process definition. This means that this capacity should be incorporated in the business process models during the design (built-time). The business process model should be specified in a sufficiently flexible way so that "it will yield under the influence of the environment without breaking".

The *nature of impact* defines if the organizational change will impact the business process definition or some process instances. It is only applicable when the flexibility is *by adaptation*. This attribute characterizes the impact of the organizational change on business processes. It is *local* if transformations concern only instances. It is *global* if transformations concern business process models.

The *nature of transformation* defines why the business process transformation is required. It is only applicable when the flexibility is *by adaptation*. This attribute concerns more directly the change of business process models. An *ad hoc* transformation is dynamically performed on one or several process instances when the process definition is not convenient for the execution conditions of those instances [22]; it has thus a local impact. An *evolutionary* transformation is required due to the redesign or reconfiguration of a business process. The old process definition is than considered as inappropriate with regard the new management objectives. The evolutionary change has a total impact. A *corrective* transformation aims to correct a design error on the process definition or to react to an exception which happens during the execution of a process instance; it can have local or total impacts.

The *perspective of change* sets the level of representation where the adaptability is required in the organization. It is described by a unique attribute with the same name which can take five values (see Table 1).

The *type of business processes* is also described by an attribute of same name which can take three values (see Table 1).

Figure 1. Four views of business process engineering and management

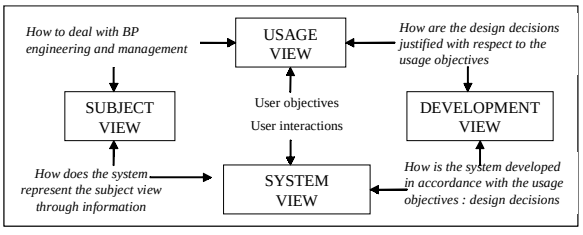

Table 1. Comparison according to the subject view

Metho-dologies	Facets				
	Ability of business processes to change			Perspective of change	Type of BPs
	Nature of flexibility	Nature of transformation	Nature of impact	Perspective of change	Type of business processes
ARIS	by adaptation	evolutionary corrective, ad-hoc	local, global	domain, process, activity, resources, application components	control, operational, support
EKD-CMM	by selection by adaptation	evolutionary corrective	local, global	domain, process, activity, resources, application components	control, operational, support

ARIS supports changes *by adaptation* during the exploitation of the business process models stored in the repository. The software support offers three platforms (design, implement and control) which provide possibilities for supporting change processes in *ad hoc*, *evolutionary* and *corrective* ways. Those change processes can cause *local* or *global* impacts and require various representation perspectives as *domain*, *process*, *activity*, *resource* and/or *application* components.

EKD-CMM offers the two types of flexibility. A software tool for the design and the execution of the business processes according to the MAP model is under construction. The meta-model (MAP) which allowed also to us to define the EKD-CMM development process model [1], [11] has the ability to support *evolutionary* and *corrective* transformations of the process models.

3.2 The Usage View

The usage view allows us to set the questions on (i) the manner of dealing with business process engineering and management (subject) supported by the system which was constructed for this purpose, and (ii) the justification of the design decisions with respect to the usage objectives. Table 2 shows the four facets we defined in this view and the values of their attributes, respectively for ARIS and EKD-CMM.

The facet *goal* defines the objectives of the stakeholders which push them to develop flexible business process management systems. It is described by a unique attribute with six possible values (see Table 2).

The change management is often driven using three principal intentions: *define*, *implement*, and *consolidate*. The *definition of change* consists of exploring, analyzing and understanding the need of change in the context of the organization and accordingly, specifying and evaluating possible solutions. The *implementation of change* consists of implementing the solution selected in the previous stage according to the strategies, tactics and processes which have specified. The *consolidation of change* is the stage during which the new way-of-working, way-of-doing and even way-of-being are assimilated by all members of the organization and are integrated in the enterprise culture.

Currently, EKD-CMM is limited to the *define* intention which consists to defining enterprise models (*As-Is* and *To-Be* states and the *change process model* representing multiple ways to move from the *As-Is* to the *To-Be* state). EKD-CMM provides a well-defined methodological guidance during the definition stage and the enactment of the resulting process maps. While, ARIS Toolset provides a toolkit for supporting the implementation and consolidation stages of the organizational change process.

User's understanding measures the simplicity of the representation formalisms provided by the methodological environment or, possibly, the capacity to extend the existing formalisms with new concepts in order to capitalize specific business knowledge.

The *knowledge management policy* defines if users and stakeholders require that the system includes knowledge about organizational structures, abilities of actors to perform tasks, business rules, etc. During the process planning and control activities in ARIS Toolset, business process owners can plan and control the 'current' business processes. The toolset allows enterprises to build a proper knowledge management policy to organize their business processes according to their professional rules. In a different way, EKD-CMM allows to represent the organizational knowledge for a given state of the enterprise or, more specifically (absent in ARIS), the knowledge corresponding to the change process.

Table 2. Comparison according to the usage view

Methodologies	Facets			
	Goal	Life cycle	User's understanding	KM policy
ARIS	build, innovate, improve, react, personalize, obtain guidance	implement, consolidate	Yes	Yes
EKD-CMM	build, innovate, improve,react personalize, obtain guidance	define	Yes	Yes

Table 3. Comparison according to the system view

Metho-dologies	Facets						
	Modeling formalism		Description		Content		Abstraction
	Modeling paradigm	Principal concepts	Form	Notation	Point of view	Argumen-tation	Abstraction
ARIS	product, activity	actor, role, resource activity, object, event business rule	text, graph, script	semi-formal, informal	functional	No	model, instance
EKD-CMM	decision, intention, product, activity	actor, role, resource activity, object, event business rule	graph script	semi-formal,	functional, intentional	qualitative, quantitative	model, instance

3.3 The System View

The system view deals with the representation of evolving business processes through models. Table 3 shows the four facets and the values of their attributes for ARIS and EKD-CMM.

The *modeling formalism* defines the nature of the process model adopted to specify the business process definitions. It is defined using two attributes as shown in Table 3. The *paradigm* could be *decision*, *intention*, *product*, *activity* or *communication* oriented.

The *description* qualifies how business processes are represented. The attribute *form* allows qualifying the formalization level of the underlying concepts (*graph*, *text*, *script*, *formula*). The *notation* represents the type of language used to represent business process models (*formal*, *semi-formal*, *informal*).

The *content* allows capturing the capacity of the modeling formalisms (product models) to represent, using the underlying concepts, the knowledge related to the business processes. The attribute *point of view* characterizes the way of modeling (*intentional*, *functional*). Some methods give to the users the possibility to *argument* their design choices using qualitative and/or quantitative criteria.

The *abstraction* describes the level of representation where the methodological environment allows to deal with business processes.

ARIS framework and its toolset offer a large number of models to represent an organization. A meta-scheme of all product models is also provided integrating all those modeling formalisms. The business behavior and the enterprise functioning can be specified using these models. Representations of business processes make use of concepts such as *actor*, *resource*, *activity*, *product*, *event*, *business rules* and *role*. In addition, EKD-CMM offers a *modeling paradigm* and a *point of view* on business processes which are *intention* oriented.

3.4 The Development View

The development view deals with the process of constructing the business process models of the system view. The development process described in this view aims to guide the development of any support system for business process management.

In EKD-CMM, a *formally defined* way-of-working guides requirement engineers or system engineers to define change process models, to define transformations from old business models to new ones. The major difference between these two approaches is that EKD-CMM has a well-defined development process model offering *guidance* during the development of the enterprise knowledge and the definition of the organizational change. By opposition, ARIS offers an implementation platform and a control platform. This is the main reason for which ARIS has been successfully accepted by companies. Nevertheless, the *way-of-working* of the underlying approach is not formally defined and users which use it are not guided.

Table 4. Comparison according to the development view

Metho-dologies	Facets							
	Way-of-working	Evolution technique (by adaptation)	Flexibility technique (by selection)	Guidance			Support of execution	
	Way-of-working	Evolution technique	Flexibility technique	Nature	Granularity	Contingency	Software support	Simulation
ARIS	ad hoc	ad hoc, derivation, rule, heritage, introduction, reflection	—	No	—	—	automated, manual, mixed	Yes
EKD-CMM	formally defined	ad hoc, heritage, introduction, derivation, rule	late modeling, late allocation	flexible	macro	Yes	No	No

Evolution techniques define how the evolution of process definitions or instances is performed. This property is only applicable when the flexibility is *by adaptation.*

Flexibility techniques define the modeling techniques applied during business process definition. This facet is only applicable when the flexibility is *by selection*. They allow implementing descriptive business process definitions which could be refined during the execution.

The *guidance* defines if a systematic assistance is provided during the development process. The *nature* allows classifying the development process model; it could be *rigid* or *flexible*. The *granularity* characterizes the level of precision for representing the activities of the development process. The *contingency* characterizes the ability of the development process model to be adapted to the project situations.

4. CONCLUSION

By making a clear distinction between various aspects of methods, application engineers and business process pilots will be able to find criterions for evaluating the capacity of a method to be used for business process engineering in a changing environment. The proposed framework can be considered as a decision support for the benchmarking of design methods. An extension can be considered by associating metrics to the criterions that can be exploited in simulations.

In this article, we studied two Business Process Modeling and Development environments according to the proposed framework.

EKD-CMM assists Enterprise Knowledge Modeling and guides organizational change processes. Its development process model is a multi-model which embodies several process models. EKD-CMM is limited the *definition* stage of the enterprise knowledge development during the change modeling.

The ARchitecture of Integrated information Systems (ARIS) provides an approach to document the whole life cycle range of the enterprise, from business design to information technology deployment. ARIS has been successfully adopted by companies thanks to a rich modeling toolkit, a large number of enterprise modeling formalisms and a business process repository. Nevertheless, ARIS does not provide a systematic and formalized methodological guidance to develop the supported enterprise models. The modeling and development process is thus based on the experience of process engineers or software engineers using the ARIS toolset.

Our purpose is not to put one to be against the other, but rather to propose a development process model to the ARIS ToolSet. This is motivated by the lack of a methodological guidance of process development in the ARIS framework. This methodological guidance can capture and than can allow reusing professional experiences of senior consulters and thus help to master the ARIS development environment more easily. This can be done using the same set of concepts (process meta-model) which have been adopted for the definition of the EKD-CMM multi-method. In a parallel way, we plan to provide a supporting tool to EKD-CMM and also to extend it for being applied during *implement* and *consolidate* stages of the change management life cycle.

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FOOTNOTES

1 A *prescriptive process model* pre-defines "how things must/should/could be done" before the enactment of the *process definition*. Remind that, in opposite, a *descriptive process model* aims at recording and providing a trace of what happens during the business process [4], [20].