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ARIS-based Framework for Enhancing Reference Models: Experience in Simultaneous Bid Preparation

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Abstract

The paper presents a strategy for enterprise modelling within Business Process Re-engineering. Adopting the ARIS methodology, the strategy is based on the idea that the business process models developed by means of a given technique within a certain BPR-project could be reused in other BPR-initiatives. The feasibility of the approach is proven within two case studies taken from the ESPRIT Project No. 7131 "BIDPREP – An Integrated System for Simultaneous Bid Preparation".

Keywords

ARIS, BPR, Benchmarking, Bid Preparation, Enterprise Modelling

1 INTRODUCTION

Enterprise modelling is an important prerequisite for a successful Business Process Re-engineering (BPR) project [1]. To facilitate this first step in any BPR initiative, the business process engineering community has developed different modelling approaches. However, only a few of them are capable in coping with the true bottlenecks in business process representation. Although the awareness of enterprise modelling has increased significantly over the past few years, there still remain practical problems in:

- identifying the essential points of the universe of discourse to be modelled.
- balancing process-orientation and ability to create process visions on the base of models.
- handling the complexity of the models.
- introducing reuse into modelling processes.

The present paper addresses these issues and proposes a systematic and feasible solution anchored on the concepts of ARIS [3], reference models [4] and benchmarking [5]. Our objective is to create a sound and consistent basis to capture process expertise, to document it properly, and to integrate all relevant aspects of the process to be modelled. Firstly, we explain our strategy. Secondly, we describe its application by setting up two case studies.

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2 THE SOLUTION STRATEGY

2.1 Preliminaries

Our solution is based on the idea that the business process models developed by means of a given technique within a certain BPR-project could and should be reused in other BPR-initiatives which may preview other modelling methods. We also account several constraints that the efficient modelling process should satisfy. These are derived from the above mentioned bottlenecks:

1. The modelling team have to be capable to concentrate on the essentials.
2. The emphasis on process dynamics should be explicated.
3. Modelling approaches supporting different views to the universe of discourse should be prioritised.
4. The modelling team have to be able to capture knowledge about the processes and structures typical for a set of enterprises that might be classified according to common characteristics [4].

As these criteria require a holistic view to process engineering, the concept of ARIS (Architecture of Integrated Information System) proposed by [3, 6] comes into focus. It is a general methodology that facilitates the specification and implementation of information systems supporting business processes. The ARIS framework predefines four descriptive views (data, function, organisation, and control view) and three levels (requirement definition, design and implementation) as depicted in Figure 1. Thus, it consists of 12 components. For each component a set of suitable and integrated description methods is previewed. The languages used for enterprise modelling at requirements definition level are: extended Entity-Relationship Model (ERM) for describing the data view, hierarchy diagram for the function view, organisational charts for the organisation view, and extended process chain (EPC) diagrams for the control (process) view.

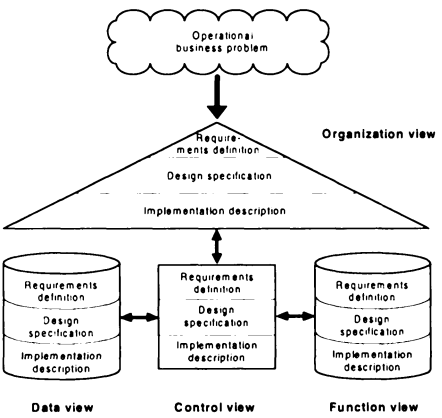

Figure 1 The ARIS Methodology

Finally, we were lead to the present solution due to the modelling experience within the project entitled "BIDPREP – An Integrated System for Simultaneous Bid Preparation". It aimed at developing a computerised system capable of supporting the bid preparation process by applying the concurrent engineering concept [2]. One of the problems within this project was the development of reference model for bid preparation and its customisation to the needs of the industrial partners (multi-national companies from Norway, Denmark and Germany). The reference model as one of the project results should serve as a basis for discussions in companies intending to re-engineer their bid preparation processes.

2.2 Deriving holistic enterprise models

Establishing translation rules between two representation languages is not a trivial task [6]. However, since ARIS supports a function views and IDEF0 is a function-based formalism, it is quite simple to map IDEF0-functional hierarchies onto ARIS's function trees.

IDEF0 element	ARIS-ERM element	Interpretation
Input		Map an Input-element into an Entity
Output		Map an Output-element into an Entity
Control		Map a Control-element into an Entity, if the Control is an abstraction of the attribute values of an object (for example: *project info*).
Control		Map a Control-element into a Relation, if the Control is a condition, i.e. a Boolean function of object values (for example: *offer is delivered*).
Control		Map a Control-element into a ER, if the Control is a link between objects (for example: *resources for the bid preparation*)

Table 1 Some mapping rules

By analogy, the ARIS organisation charts could be relative easily derived from IDEF0-schemes. The problems that still remain open concern the development of the data and the processes views, i.e. the derivation of ERM and EPC from IDEF0-hierarchies. Due to the limitation in paper size the discussion on model conversion is narrowed down to ERM. Although there are many ARIS-ERM features, we will deal with only these features which are directly related to the issues addressed in the paper.

Let an IDEF0-schema be expressed as a set of functions F_s, where F_i in F_s has the form $<Inp_i, Control_i, Mech_i, Out_i>$. Let an ARIS-ERM be a set comprising entities E_p , relations R_q and associated objects ER_t [6]. The letter are objects with a dual interpretation, i.e. they could be considered as both entities and relations. Given the set F_s, we will show how the sets E_p , R_q, ER_t can be generated. For clarity of presentation, the formal specification of the transformation rules is omitted. An extracted part of the mapping rules is given in Table 1.

2.3 Case Study I

Within the BIDPREP project, three multinational companies, ABB, Krüger A/S and Guehring Automation, formed a consortium together with three research institutes and a software developer in order to develop both an efficient methodology as well as a computer-based system supporting the preparation of bids. Significant is the fact that - although the ABB subdivision in Strømmen, Norway, produces rolling stock for railways and tramways; Krüger Engineering, Copenhagen, is engaged in environmental protection; and Guehring Automation in Frohnstetten, Germany, manufactures grinding machines - the anticipated bottlenecks were similar and thereby independent of the product.

Considering this, the strategy for optimising their bid preparation processes was to analyse their state-of-the-art proceeding, identifying bottlenecks as well as proven methods and thereby forming a generalised methodology to be implemented in the final phase.

In order to prepare a generic reference model, enterprise modelling was performed by applying IDEF0 [2], a technique based on the SADT approach. The main elements of IDEF0 are boxes representing activities and arrows replacing the transfer between the activities. For each activity the *Input, Control, Output,* and *Mechanisms* supporting the execution have to be identified. The diagrams in a model are organised in a hierarchical and modular „top-down" manner, showing the breakdown of the system into its components parts.

Based on the context described, the solution strategy we are presenting in the following solves two problems: (1) how to derive holistic ARIS-models from IDEF0-models, and (2) how to control the modelling and the customisation process. These points are briefly discussed in the next subsections.

The mapping rules from Table 1 were applied to derive an ARIS-bid preparation model. Figure 3 depicts the top level of the (simplified) IDEF0-reference model (note: in order to ease its understanding, control arrows were not displayed), Figure 4 shows the ARIS-ERM which we obtained after following the established system of mapping rules.

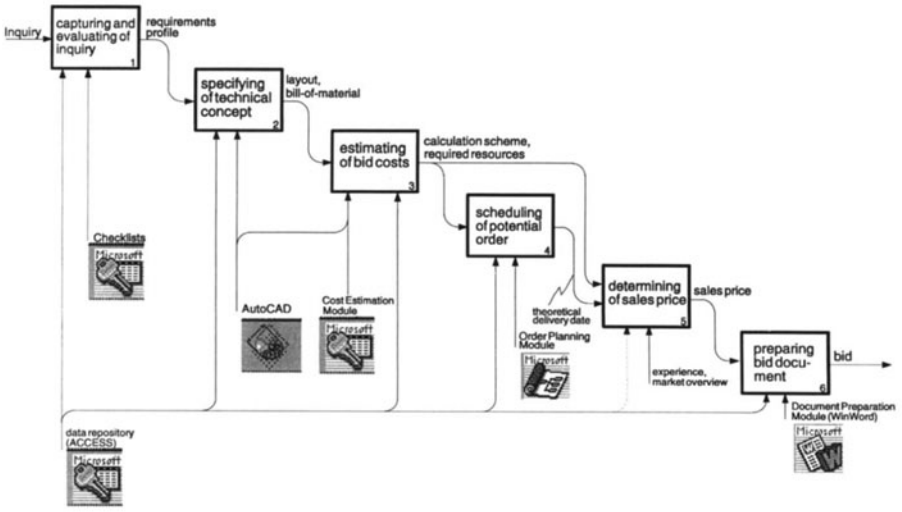

Figure 3 (Simplified) IDEF0 reference model for bid preparation

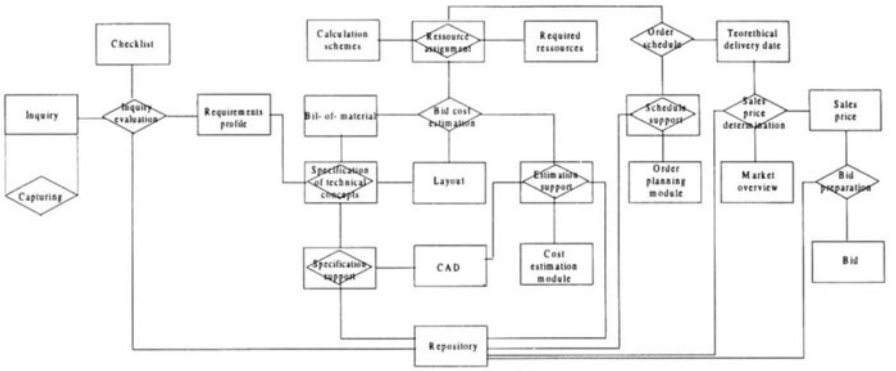

Figure 4 ARIS data view: an entity-relationship model

2.4 Enhancing reference models by benchmarking

Once the ARIS-view is developed, the enterprise models should be refined or customised to the needs of a particular enterprise. Generally, this process implies the deletion, insertion and modification of modelled objects. To control the customising process, we introduced a documented and a disciplined quality assurance procedure based on benchmarking. It comprises five basic steps:

1. *Define model quality metrics.*
2. *Construct a benchmark. This can be a standardised reference model or a representation that describes the level of model quality that should be achieved.*
3. *Evaluate the studied models on the quality metrics.*
4. *Compare the assessed model against the preliminary established benchmark.*
5. *Formulate corrective actions about the enhancement of the studied models.*

The procedure was used to investigate the following qualities of produced models: complexity, size, modularity and correctness. A summary of the case study on the complexity of ERM is reported bellow.

2.5 Case study II

Goal: To establish to what extent the companies' models exceed the complexity of the reference model for the bid preparation process.

Benchmarked Models: ERM of the bid preparation process at companies-participants in the BIDPREP-project.

Quality Metrics: Relation complexity, association density [4].

Benchmark: Reference model for the bid preparation process.

ERM Models	Relation Complexity	Association Density	Average
ABB Strømmen	0.64	0.09	0.37
Krüger A/S	0.53	0.11	0.32
Guehring Automation	0.38	0.14	0.26
Reference model	0.40	0.04	0.22

Table 2 Ranking of ERM

3 MAJOR RESULTS

The main contribution of this paper is the fact that we have developed a feasible solution framework to enhance enterprise modelling. We have discussed and demonstrated how the enterprise models developed by a functional-oriented formalism can be expressed in holistic ARIS-terms, and how the process of producing and customising business models can be controlled according to a disciplined and documented procedure. Moreover, by applying the approach to the models from the BIDPREP project, the power of its features to capture subtle enterprise modelling issues are fully illustrated.

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5 BIOGRAPHIES

Maya Daneva is research scientist at the Institut für Wirtschaftsinformatik at the University of Saarland. She received her M.Sc. degree in Computer Science from the University of Sofia in 1991. In 1994, she successfully finished her PhD Dissertation at the Institute of Mathematics in Sofia. Her scientific interests comprise Benchmarking, Software Engineering, Software Marketing Modelling and Knowledge-based Marketing Systems.

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