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INTEGRATED PROCESS MODELING: AN ONTOLOGICAL EVALUATION

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Abstract — Process modeling has gained prominence in the information systems modeling area due to its focus on business processes and its usefulness in such business improvement methodologies as Total Quality Management, Business Process Reengineering, and Workflow Management. However, process modeling techniques are not without their criticisms [13]. This paper proposes and uses the Bunge-Wand-Weber (BWW) representation model to analyze the five views - process, data, function, organization and output - provided in the Architecture of Integrated Information Systems (ARIS) popularized by Scheer [39, 40, 41]. The BWW representation model attempts to provide a theoretical base on which to evaluate and thus contribute to the improvement of information systems modeling techniques. The analysis conducted in this paper prompts some propositions. It confirms that the process view alone is not sufficient to model all the real-world constructs required. Some other symbols or views are needed to overcome these deficiencies. However, even when considering all five views in combination, problems may arise in representing all potentially required business rules, specifying the scope and boundaries of the system under consideration, and employing a "top-down" approach to analysis and design. Further work from this study will involve the operationalization of these propositions and their empirical testing in the field. © 2000 Elsevier Science Ltd. All rights reserved

Key words: Process Modeling, Ontology, Architecture of Integrated Information Systems

1. INTRODUCTION

Methodological issues surrounding information systems development - the analysis, design, construction and implementation tasks – have long been central to the interest of information systems professionals, practitioners and researchers alike. Hirschheim *et al.* [21], Hirschheim *et al.* [22], and, most recently, Iivari *et al.* [23] and Mylopoulos [29] have reviewed rigorously many methodologies and their underlying philosophies as applied to information systems development. Researchers in information systems development have for years lamented the fact that little theoretical guidance only has been provided to practitioners on several areas involved in IS development [2, 15]. Consequently, methodologies, techniques, and grammars have proliferated over time [25, 30][†]. This situation has contributed to what Banville and Landry [3] describe as the "fragmented adhocracy" of the state of theoretical development in the IS discipline. By contrast, Benbasat and Weber [6, p. 398] implore the IS community to "not mix up the notions of the core of the IS discipline and the body of knowledge for the IS discipline". Moreover, Benbasat and Weber [6] go on to advocate that diversity (adhocracy) clearly has its place in IS research but not as an excuse for shirking the fundamental responsibility of a community to build its own theories to account for those **core** phenomena that differentiate the IS discipline from other disciplines.

In an attempt to address this situation, Wand and Weber [47, 48, 49, 50, 51, 52, 53] have developed and refined a set of models that specify what they believe are a set of core phenomena for the IS discipline. These models are based on an ontology defined by Bunge [7] and are referred to as the Bunge-Wand-Weber (BWW) models. These models, in particular their representation model, provide a theoretical basis on which information systems modeling grammars and the scripts prepared using such grammars can be

[†]The terms methodology, technique, and grammar are distinguished in the following way in this paper. A *methodology* provides a comprehensive approach to systems planning, analysis, design, and construction such as Andersen's Method/1. It may include one or more techniques. A *technique* such as data flow diagramming designates a set of concepts and a way of handling them. Within a technique, these concepts are represented typically by formal graphical symbols. In this paper, the set of symbols together with its construction rules is called a *grammar*.

evaluated. As Weber [54] argues, this evaluative aspect of the models persists irrespective of the philosophical assumptions under which the models are applied. His and Wand's central concern is with the goodness of the *representation* of the perception of that portion of the real world that is being modeled. Various researchers have demonstrated the applicability and usefulness of these models in relation to such grammars as data flow diagrams, entity-relationship diagrams, object-oriented schemas, the relational model, NIAM, and structured grammars in CASE tools [17, 32, 44, 46, 48, 52, 53, 54, 55]. Using a similar approach to these researchers, this paper extends the analysis into the area of integrated process modeling. Accordingly, this work is restricted to the BWW theoretical base and it does not include other bases such as those articulated in Iivari *et al.*'s [23] paradigmatic framework *viz.*, epistemology, research methodology, and ethics of research.

For many years now, there has been an increased recognition in information systems modeling of the dynamic behavior of organizations. Process modeling has been embraced as an appropriate approach to describe the behavior and as a mechanism by which many of the related concerns with the traditional modeling grammars can be overcome [10]. Moreover, process modeling focuses on understanding the underlying business processes which many IS professionals believe is fundamental to the successful implementation of technology-based change in organizations [13]. As Becker *et al.* [5, p. 821] explain, "process models are ... images of the logical and temporal order of functions performed on a process object. They are the foundation for the operationalization of process-oriented approaches".

The popularity of concentrating on business processes through process modeling has been fuelled over the last ten years by the prominence of such organizational improvement approaches as Total Quality Management (TQM), Time-based Management, Business Process Reengineering (BPR), and Value-based Performance Measurement (VBPM). Furthermore, the rapid worldwide take-up over the last five years of Enterprise Resource Planning (ERP) software such as SAP R/3 or BaanERP that rely heavily on reference process models to describe the software functionality and to guide and document implementation has added significantly to the interest and perceived usefulness of process modeling. In particular in conjunction with the success of software specific reference models [9, 14, 28], integrated process modeling that provides various *views* of the process to users has received much attention. However, process modeling is not without its critics who point to such deficiencies as an emphasis on the "hard" factors (who, what, when, and where) to the detriment of the "soft" factors (norms, beliefs, and motives) in the examination and modeling of the business processes [13].

The aim then of this study is to analyze as an example the integrated process modeling grammar within the ARIS framework popularized by Scheer [39, 40, 41] using the BWW theory base to determine the ability of this grammar to provide "good representations of the perceptions" of business analysts. Accordingly, this work is motivated by several factors. First, through such an analysis, potential weaknesses of integrated process modeling grammars can be identified. Such an analysis can then potentially contribute to the theoretical development of integrated process modeling. Second, the results of the analyses in this paper may be useful to the implementers and users of comprehensive process-based software systems such as SAP R/3 or BaanERP. SAP has stated that in subsequent versions of its product it intends the implementation/customization process to be driven directly by modifications made to the relevant reference process models supplied in the product. In BaanERP it is already possible to derive from the tailored reference model the information necessary for system customization and authorization [45]. In such a situation, potential weaknesses in integrated process modeling identified in this analysis may give useful information to the implementers of such software systems. Third, this study provides an opportunity to extend the existing work on the application of the BWW models. To date, these models have in the main been applied to "traditional" information systems analysis and design (ISAD) grammars. This paper extends their application into the dynamic area of process modeling. Fourth, this study will add to the development of the BWW models by extending their application to a different modeling environment. By such a further application, the robustness of the BWW ontological constructs can be examined. Finally, the implications of the analyses can be articulated as hypotheses and empirically tested with a base of integrated process modeling users. The results of such a step will contribute also to the development of the BWW models and integrated process modeling.

Consequently, this paper proceeds in the following manner. First, some background on the development of the BWW models and their application in related work is given. This section is followed by an introduction to integrated process modeling. Included in this section is a discussion of why Scheer's [39, 40, 41] Architecture of Integrated Information Systems (ARIS) was selected as the integrated process

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