AUGUST-WILHELM SCHEER
MARKUS NÜTTGENS
Institut für Wirtschaftsinformatik (Iwi)
Universität des Saarlandes
Saarbrücken

BUSINESS PROCESS (RE-)ENGINEERING: ARCHITECTURE, REFERENCE MODELS AND TOOLSET

Abstract: *Information system requirements are increasingly determined by the (re-)engineering of business processes. Thus, and in respect to the dynamic organization customized reference models of business processes will be the basis for a lean information system. This paper describes the ARIS-concept (Architecture of Integrated Information Systems) as a methodological framework for the development of organization wide information systems. This comprises the implementation of the ARIS-methodology in a computer supported toolset for modeling, analysis and navigation including a reference model based repository.*

Introduction

Nowadays, scientists and practitioners have to deal with the paradigm-shift from a primarily functional and data-driven approach towards the management of dynamic organizations *(Drucker 1988, Hammer/Champy 1993)*. Thus, the main issue is focusing on methodologies of business process (re-)engineering in order to handle the increasing complexity of information systems development. Thereby, new proposals of frameworks argue with the weaknesses of existing approaches that turned out with less conceptual basis as well as a less theoretical background *(Lyytinen 1987, Jarke et al. 1993)*. Resulting from this, IS architectures are necessary which are not only reducing complexity but also sufficient to meet this complexity. Dealing with those objectives, approaches in theory and practice are for instance:

- IRDS - Information Resource Dictionary System *(ANSI 1989, ISO 1990)*,

- ISM - Information Systems Methodology *(Olle et al. 1991)*,
- IEM - Information Engineering Method *(Martin 1989, Martin 1990a, Martin 1990b)*,
- ESF - Eureka Software-Factory *(Fernström 1991)*,
- ASEM - ATMOSPHERE System Engineering Model *(Obbink 1991)*,
- AD/Cycle - Application Development Cycle *(Mercurio et al. 1990)*,
- CIMOSA - Open System Architecture for CIM *(ESPRIT Consortium AMICE 1993)*,
- CC RIM - Referenzmodell *(Gutzwiller 1994)*,
- BOS Engineering Method *(Barengo et al. 1994)*.

Besides those primarily methodological concepts, technical approaches transforming these concepts into computer supported tools are required *(Hruschka 1985, Wasserman 1989, NIST 1991, Merbeth 1991, Schefström/van den Broek 1993)*. The multiplicity of concepts, which often differ marginally from each other, has led to considerable difficulties in surveying these concepts and the development of computer supported tools based on those concepts. However, the essential problem is that those concepts do not meet the real needs of all target groups in the organization of change. The system developers' view of today ignores more or less the requirements of new management philosophies focusing on business processes and their 'owners'.

The ARIS-concept (Architecture of Integrated Information Systems) discussed in the following, is a modeling methodology for business process (re-)engineering in order to meet the requirements. It includes an adequate tool support for the business process owner.

Architecture of Integrated Information Systems (ARIS)

Business process (re-)engineering involves a variety of collaborators in the organization including people from specialist departments, computer scientists, external advisers and business experts. They need clear rules and limits within which they can process their individual subtasks in order to ensure the logical consistency of the entire project. Therefore, an architecture needs to be established to determine the components, which make up the information system, and the methods to be used.

The ARIS-concept constitutes a framework in which business processes can be modeled, optimized and converted into technical implementation concepts. It differs three main aspects (*Scheer 1992*):

- Abstraction level: reducing complexity by considering only those facts which are relevant from the information perspective on the meta level.
- Building views: grouping elements of the remaining business process model to more comprehensive views together.
- Lifecycle model: subdividing these views into stages which are derived from the proximity to the technical information resources.

The ARIS-concept is described in concrete terms as an information model within the entity-relationship approach (see Fig. 1) *(Chen 1976)*. This information model provides the basis for the systematic and rational application of methods to the development life cycle of information systems. Furthermore, it is also the basis for a repository in which the enterprise's application-specific data, organization and function models can be stored. Abstraction levels are the basis to classify objects on the individual, modeling or meta-modeling level *(ANSI 1989, ISO 1990)*. The modeling level aims at the semantic representation of a business application domain, whereas the meta-modeling level aims at the syntactical rules for the modeling process. This concept enables an explicit differentiation between application models and the corresponding methods. The fundamental objects of a business process on the meta-modeling level are functions, events, conditions, users, organizational units and information technology resources.
In order to reduce the complexity of business process models, the meta-model is divided into views which collect meta-objects with similar characteristics. A common understanding of the business process model divides it into data view, function view, organization view and resource view *(ESPRIT Consortium AMICE 1993)*. In each view, the resources are treated at the level of the design specification and the implementation description. The lifecycle model replaces the resource view as the independent descriptive object. The division of the business process model into these views reduces its complexity, but encompasses the loss of the relationships between the components. For this reason, a control view was introduced *(Olle et al. 1991)*. In the context with the organizational view, the control view is an essential characteristic of the ARIS-concept

and distinguishes it from other proposed architectures. Using the EPC-Method (Event-Driven Process Chain), an adequate method was developed, validated and verified to model business processes *(Keller et al. 1992, Nüttgens et al. 1992, Scheer 1994)*.

In the ARIS-concept, the lifecycle model does not have the significance of a procedural model for developing an information system. Rather it defines the different stages depending on their proximity to the information technology. These stages are: business process analysis, requirements definition, design specification and implementation description. The run time version of the information system and its tool environment will not be further considered in the following.

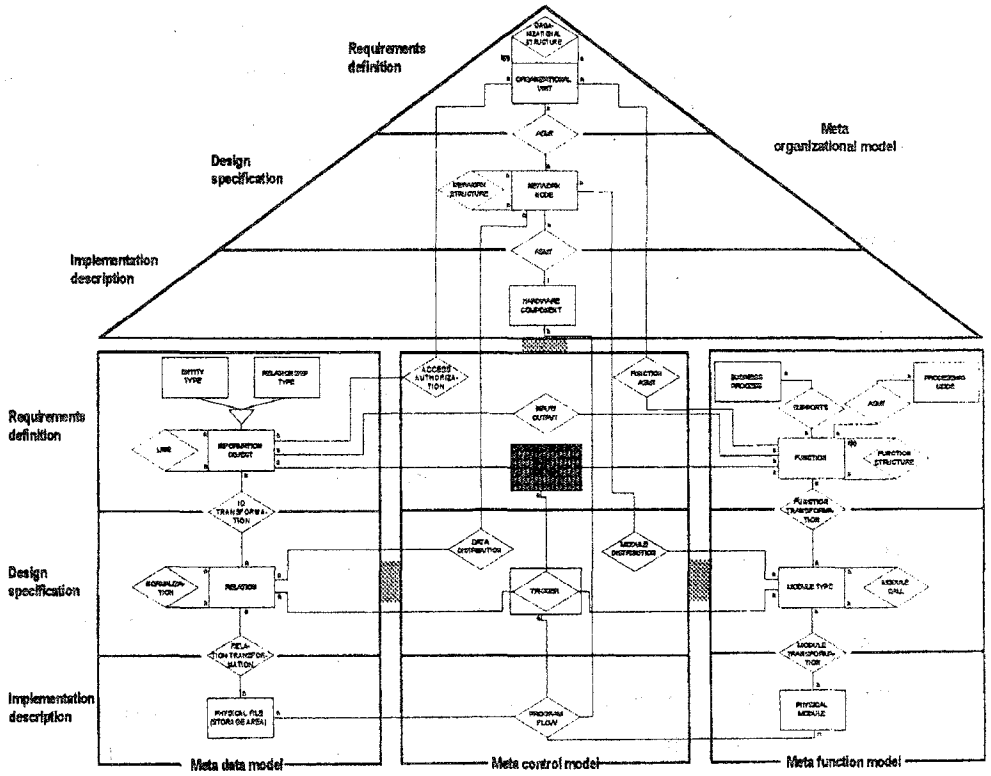

Fig. 1: High-level ARIS information model *(Scheer 1994, p. 679)*

Reference Models for Business Process (Re-)Engineering

Nowadays, the increasing market of sophisticated and powerful standard software products and the short innovation cycles on the IT-market are changing the role of system requirements. The experience in practice have shown that the costs of system requirements including the organizational implementation and the technical implementation tend to a relation of 5:1.

This leads to the fact that business process (re-)engineering is the key issue for a successful and economical 'management of change'. Terms like 'time to market' or 'cutomer focus' are consequently inherent drivers of the underlying business process models.

The specific business process models of an organization can be stored in a model library where from reference models for different application domains can be derived. Those reference models themselves are reusable components for the modeling of further organizations. This can be summarized as the approach of business process (re)engineering based on reference models and primarily focusing on the aspects of costs and quality *(Scheer 1994)*. These models have to differ for branches, such as manufacturer or chemical industry as well as banks, trade or non-profit organizations.

In order to meet the different requirements of organizations, the reference models have to be customized in regards to their environment *(Hars 1994)*. A further usage with an increasing importance is the computer supported configuration of standard software components *(Scheer et al. 1994, SAP AG 1994)*. Starting with lean business processes, lean information systems can be designed. Furthermore, reference models can be used to train employees or students on selected application domains *(Nüttgens/Scheer 1993)*.

ARIS-Toolset for Business Process (Re-)Engineering

The ARIS-Toolset is a business process (re-)engineering environment system comprising a reference model based repository *(IDS Prof. Scheer GmbH 1994)*. The tool's components enable the modeling, the navigation and the analysis of organization wide IS architectures using the framework and meta-structure of the ARIS-concept. The ARIS-Toolset mainly supports aspects like:

- Method independent repository structure,
- Management of reference models and rule-based model adaptation,

- Perform of model comparisons and flexible reporting,
- Consistency of multilingual models,
- Comprehensive navigation functions.

Despite of the large number of modern software development tools, such as CASE Tools and 4GL languages, the modeler and analyzer components focus on the 'business process owners view' and the decision support for standard software selection. E.g., the FI-2-System by IDS-Prof. Scheer GmbH *(Loos 1992, Hoffmann et al. 1993)* and the R/3-System by SAP AG *(Keller/Meinhardt 1994)* are completely documented in the ARIS-Toolset and can be analyzed by process selection matrices in which the individual processes of the system are arranged in integration processes.

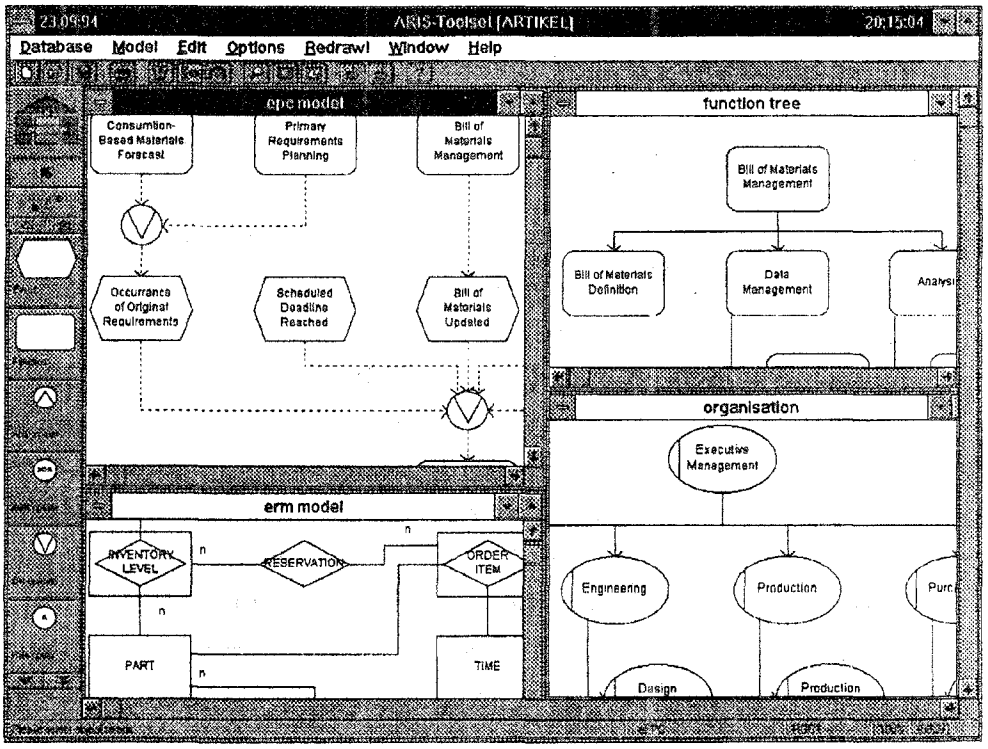

Fig. 2: Graphical user interface of the ARIS-Toolset

The navigation component of the ARIS-Toolset offers a number of functionalities to support the presentation of models in particular for training purposes. In addition to the option of tracing hierarchy relationships between objects and related detail diagrams, the

integration thinking of the ARIS architecture is emphasized in particular by navigation between different views. Figure 2 shows the graphical user interface of the ARIS-Toolset.

References

ANSI (ed.): (ANSI X3.138-1988) American National Standard for information systems - "information resource dictionary system (IRDS)", CHAPTER (Module) 1-7, approved version (October 19, 1988) New York 1989.

Barengo, L.; Breu, M.; Leonardi, G.; Meyer-Wachsmuth, H.; Percie du Sert, B.; Richter, H.; Pfeiffer, M.; Utter, J.-C.: Definition of the BOS Engineering Method - A Method for the Development of Trans-European Information Systems, Version 1 (13/04/94), European Methodology & Systems Center Methodology Group, o.O. 1994.

Chen, P.P.-S.: The Entity-Relationship Model: Towards a Unified View of Data, in: ACM Transactions on Database-Systems, 1 (1976) 1, pp. 9-36.

Drucker, P.F.: The coming of the new organization, in Harvard Business Review, 66 (1988) 1, pp. 45-54.

ESPRIT Consortium AMICE (eds.): CIMOSA: Open System Architecture for CIM, 2nd ed., Berlin-Heidelberg-New York 1993.

Fernström, C.: The EUREKA Software Factory: Concepts and Accomplishments, in: Lamsweerde, A.v.; Fugetta, A. (eds.): Proceedings of the 3rd European Software Engineering Conference, ESEC'91 (21.-24. October, Mailand), Berlin-Heidelberg-New York 1991, pp. 23-36.

Gutzwiller, T.A.: Das CC-RIM-Referenzmodell für den Entwurf von betrieblichen, transaktionsorientierten Informationssystemen, Heidelberg 1994.

Hammer, M.; Champy, J.: Reengineering the Corporation, New York 1993.

Hars, A.: Referenzdatenmodelle - Gestaltung und Nutzung von Bibliotheken für semantische Datenmodelle, Wiesbaden 1994.

Hoffmann, W., Wein, R, Scheer, A.-W.: HP OpenCAM - Offene Strukturen mit der ARIS-Architektur, in: CIM Management, 9 (1993) 2, pp. 52 - 55.

Hruschka, P.: Integrierte Systemproduktionsumgebung, in: Elektronische Rechenanlagen, (1985) 2, S. 60-68.

IDS Prof. Scheer GmbH (ed.): ARIS-Toolset for Business Reengineering, Saarbrücken 1994.

ISO (ed.): ISO/IEC 10027: Information Technology - Information Resource Dictionary System (IRDS) framework, 1990.

Jarke, M.; Pohl, K.; Jacobs, S.; Nissen, H.W.; Bubenko, J.; Assenova, P.; Holm, P.; Wangler, B.; Rolland, C.; Plihon, V.; Schmitt, J.-R.; Sutcliffe, A.; Jones, S.; Maiden, N.; Till, D.; Vassiliou, Y.; Constantopoulos, P.; Spanoudakis, G.: Requirements Engineering: An Integrated View of Representation, Process, and Domain, in: Nature Report Series No. 93-07 (ESPRIT Projekt 6353), Lehrstuhl für Informatik V, Aachen 1993.

Keller, G.; Nüttgens, M.; Scheer, A.-W.: Semantische Prozeßmodellierung auf der Grundlage "Ereignisgesteuerter Prozeßketten (EPK)", in: Scheer, A.-W. (ed.): Veröffentlichungen des Instituts für Wirtschaftsinformatik, Heft 89, Saarbrücken 1992.

Keller G.; Meinhardt, S.: DV-gestützte Beratung bei der SAP-Softwareeinführung, in Handbuch der modernen Datenverarbeitung (HMD) - Theorie und Praxis der Wirtschaftsinformatik, 31 (1994) 175, pp. 74-88.

Loos, P.: Datenstrukturierung in der Fertigung, München-Wien 1992.

Lyytinen, K.: A Taxonomic Perspective on Information Systems Development: Theoretical Constructs and Recommendation, in: Boland, R.J.; Hirschheim, R.A. (eds.): Critical Issues in Information Systems Research, Chichester-et al. 1987, pp. 3-41.

Martin, J.: Information Engineering, Book I: Introduction, Englewood Cliffs 1989.

Martin, J.: Information Engineering, Book II: Planning and Analysis, Englewood Cliffs 1990.

Martin, J.: Information Engineering, Book III: Design and Construction, Englewood Cliffs 1990.

Merbeth, G.: On the Functional and Architectural Integration of CASE Systems, in Endres, A.; Weber, H. (eds.): Software Development Environments and CASE Technology, Proceedings of the European Symposium (June 1991, Königswinter, Germany), Berlin-Heidelberg-New York 1991, p. 31.

Mercurio, V. J.; Meyers, B. F.; Nisbet, A. M.; Radin, G.: AD/Cycle strategy and architecture, in: IBM Systems Journal 29 (1990) 2, pp. 170-188.

NIST (eds.): ECMA. A Reference Model for Frameworks of Software Engineering Environments (Version 2). ECMA Report Number TR/55 (Version 2), NIST Report Number SP 500-201, Dezember 1991.

Nüttgens, M., Keller, G.; Scheer, A.-W.: Informationsmodelle als Grundlage integrierter Fertigungsarchitekturen, in: CIM Management, 8 (1992) 4, pp. 12-20.

Nüttgens, M.; Scheer, A.-W.: ARIS-Navigator - hypermediabasierte Dokumentation unternehmensweiter Informationsmodelle für Beratung und Einführungsunterstützung, in: Information Management 8 (1993) 1, pp. 20-26.

Obbink, H.: System Engineering Environments of ATMOSPHERE, in: Endres, A.; Weber, H. (eds.): Software Development Environments and CASE Technology, Proceedings of the European Symposium (June 1991, Königswinter, Germany), Berlin-Heidelberg-New York 1991, pp. 1-17.

Olle, T.W.; Hagelstein, J.; Macdonald, I.G.; Rolland, C.; Sol, H.G.; Van Assche, F.J.M.; Verrijn-Stuart, A.A.: Information Systems Methodologies: a framework for understanding, 2nd ed., Workingham-Reading-Menlo Park et. al., 1991.

SAP AG (ed.): SAP R/3 Analyzer - Business Process Reengineering Based on the R/3 Reference Model, Walldorf (Baden) 1994.

Scheer, A.-W.: Architecture of Integrated Information Systems - Foundations of Enterprise-Modelling, Berlin-Heidelberg-New York et al. 1992.

Scheer, A.-W.: Business Process Engineering - Reference Models for Industrial Companies, 2nd ed., Berlin-Heidelberg-New York et al. 1994.

Scheer, A.-W.; Hoffmann, W.; Wein, R.: Customizing von Standardsoftware mit Referenzmodellen, will be published in: HMD - Theorie und Praxis der Wirtschaftsinformatik, 31 (1994) 180.

Schefström, D.; van den Broek, G.(eds.): Tool Integration, Environments and Frameworks, Chichester-New York-Brisbane et. al. 1993.

Wasserman, A.I.: Tool Integration in Software Engineering Environments, in: Long, F. (ed.): Software Engineering Environments, Proceedings of the International Workshop on Environments (Chinon, France, September 1989), Berlin-Heidelberg-New York 1989, pp. 137-150.

STUDIA
INFORMATYKI GOSPODARCZEJ

II Międzynarodowa Konferencja Informatyki Gospodarczej

INFORMATION TECHNOLOGIES IN BUSINESS REENGINEERING

Redakcja naukowa: prof. dr hab. Tadeusz Kasprzak
Opracowanie techniczne: mgr Renata Sąpór

Institut für Wirtschaftsinformatik
Universität des Saarlandes
Saarbrücken

Katedra Cybernetyki
i Badań Operacyjnych
Wydział Nauk
Ekonomicznych
Uniwersytet Warszawski

Rynia, maj 1995