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K. Kosanke J. G. Nell (Eds.)

Enterprise Engineering and Integration:

Building International Consensus

Proceedings of ICEIMT '97,
International Conference on Enterprise
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Introduction

1 Enterprise Engineering and Integration

Enterprise Integration (EI) has been an R&D subject for a long time and has been addressed by many organizations around the world. However, people have recognized rather late that enterprise integration is a process rather than a permanent state of the enterprise. Enterprises are evolving over time and their state of integration has to be continuously updated by adapting and re-engineering business processes, adjusting organizations, and modifying supporting operational systems.

Industrial Engineering (IE) has traditionally been responsible for engineering efforts relating to enterprise operation and organization. However, the field of enterprise integration has grown beyond the boundaries of industrial engineering, involving many scientific disciplines that have not been recognized before in the work of IE. For example, socio-technical aspects have become more relevant in the engineering of enterprises. Management science, computer science, linguistics, and many others also contribute to the work required in the design and re-engineering of enterprise operations and systems. This implies not that the role of industrial engineering is no longer needed, but that a new engineering discipline is necessary which complements the traditional IE work and harnesses all the newly required contributions.

The term *enterprise engineering* was coined in the final session of the ICEIMT conference in 1992 [1]. The curriculum of this new discipline has still to be established and we hope that the ICEIMT'97 will make a significant contribution to Enterprise Engineering.

2 The ICEIMT[1] Initiative

Application of enterprise-integration technologies has been hampered by a lack of business justification, by a plethora of seemingly conflicting solutions and terminology, and by an insufficient understanding of the technology by the end-user community. These barriers inhibit, or at least delay, the use of relevant methods and tools in the industry, especially in small-to-medium-sized enterprises. At the

[1] ICEIMT = International Conference on Enterprise Integration and Modeling Technology

same time, the need is intensifying to operate agilely, to form and dissolve partnerships rapidly, and to integrate business discourse globally. These needs can be satisfied only with a very good knowledge of the capabilities and constraints of the partners involved.

Standards organizations, users, application-specific consortia, and computer suppliers, are addressing these needs by developing enterprise architectures, methodologies, models, and associated modeling/execution technologies. Sometimes these emerging efforts both overlap and complement each other. In other cases, the results of these activities are very different and even conflicting. There is little common technical ground for comparison and evaluation, and much less consensus and co-ordination. Yet without some mechanism to help converge on agreement, these multiple efforts will only make the EI problem more difficult to solve.

With these challenges in mind, the United States and the European Commission are jointly supporting an international initiative on consensus building in enterprise integration. NIST in the USA and the CIMOSA Association in Europe have organized and convened a series of workshops followed by the ICEIMT'97 conference. This international co-operation is identifying the barriers, developing solutions to problems, communicating results, and helping to justify the technology to industry so that enterprise-integration technology can be moved profitably from the international R&D community to broadly based implementation.

2.1 ICEIMT Objectives

The ICEIMT objectives are to achieve international consensus on selected issues, and to:

- Broaden the consensus of harmonized enterprise-integration technology solutions in the international R&D community,
- Establish an international forum to identify and eliminate barriers to enterprise integration technology utilization and to communicate successful implementations.
- Support and plan for harmonization of enterprise integration related technology and standards to eliminate barriers.
- Increase public awareness and recognition of enterprise integration benefits through information dissemination about consensus results with a focus on the industrial community.

2.2 ICEIMT Process

Using the experience gained in the previous EC/USA collaboration project in 1991/92 the initiative has again invited international experts in the field to workshops with the goal to lessen the impact of issues and thereby increase international consensus on enterprise integration and enterprise modeling.

The ICEIMT workshop model comprises 3 days of plenary and working group sessions. A plenary session at the beginning serves to familiarizing the invited

experts with each other and with the goals of the particular workshop. The working groups reconvene in plenary sessions periodically for mutual updates and necessary redirection of the working group discussions. Each workshop has concentrated on a different topic and a set of issues relevant to enterprise integration.

The workshops have been held in the USA and Europe:

Workshop 1: *Enterprise Organization and Human Issues,* Gaithersburg MD, USA, 1997-04-16/18,

Workshop 2: *Enterprise Metrics and Strategic Standardization Policy,* Gaithersburg MD, USA, 1997-04-21/23,

Workshop 3: *Enterprise Integration Application,* Brussels, Belgium, 1997-06-11/13,

Workshop 4: *Enterprise Integration Principles and Fundamentals,* Brussels, Belgium, 1997-06-16/18,

Workshop 5: *Vendor Support for Users of Enterprise Integration,* Gaithersburg, MD, USA, 1997-06-30/07-02,

The results from the workshops are presented in the concluding conference, conference proceedings, publication of papers, and subsequent workshops for information dissemination.

2.3 Technical Committee

Technical guidance to help define technical issues, workshop contents, and workshop participants has been provided by the technical committee established for the ICEIMT initiative. The following people are members of the technical committee:

P. Bernus, Griffith University, Australia
C. Bremer, EESC - University of Sao Paulo, Brazil
M. Fox, University of Toronto, Canada
G. Doumeingts, LAP GRAI, University of Bordeaux, France
G. Segarra, Renault DIO-EGI, France
F. B Vernadat, LGIPM, ENIM/University of Metz, France
W. Eversheim, RWTH Aachen - WZL, Germany
D. Solte, FAW Ulm, Germany
M. Zelm, CIMOSA Association, Germany
J. Browne, CIMRU, Ireland
F. Naccari, FIAT Servizi per l'Industria SPA, Italy
F. Kimura, University of Tokyo, Japan
A. Molina, ITESM Campus Monterrey, Mexico
N. D. du Preez, University of Stellenbosch, South Africa
A. Goldschmidt, IBM, USA
H.T. Goranson, Sirius-Beta, USA
M.L. Hitchcock, United States Air Force, USA
A. Kusiak, University of Iowa, USA
J. G. Nell, NIST, USA
S. Ricketts NCMS, USA
B.N. Snodgrass, D. Appleton Company, USA

Members of the Technical Committee have been actively involved in both the workshops and in the ICEIMT'97 conference.

2.4 ICEIMT Results

The initiative has been carried out as an Esprit project in Europe and as part of a NIST program in the USA. The two organizing parties have arranged five workshops with a total of 64 participants from 14 countries and 4 continents. Issues in enterprise engineering and integration have been discussed in 13 working groups and these have resulted in a similar number of proposals for new projects in research, product development, and standardization.

The results from the workshops are presented in the ICEIMT'97 conference in Turin, Italy, and are contained in Part I of these proceedings. This conference provides an overview on the state of the art in enterprise engineering and integration as seen by the different communities of users, vendors, and research. In addition, papers on ongoing world-wide research projects and relevant standardization activities are presented.

2.5 ICEIMT History

The ICEIMT began in the early 1990s when governments and users in Europe and in the USA realized that we all need a better way to manage, more productively, the flow of information within and among our enterprises. In fact, the problem was growing faster than our ability to solve it. The first international ICEIMT conference, convened in 1992, spawned many useful concepts that have been converted to successful consortia and products. The results are reported in the conference proceedings [1].

Then, starting in 1996, the United States and the European Commission, jointly, initiated ICEIMT'97, an international initiative on consensus building in enterprise integration. NIST in the USA and the CIMOSA Association in Europe have organized and convened the workshops and the ICEIMT'97 conference.

3 The ICEIMT Proceedings – An Overview

The papers presented in the proceedings have been organized in two parts. Part I contains the papers presented at the ICEIMT'97 conference itself. Part II collects all papers prepared by the workshop participants and presented in the plenary session of each workshop. Each part is organized into sections that will help the reader to select enterprise engineering and integration topics of interest.

3.1 Part I: The Conference

The conference papers are distributed among 11 sessions that cover the five major areas of enterprise integration and the ICEIMT initiative:

In the *Opening Session* the two supporting organizations, the European Commission and the USA National Institute of Standards and Technology (NIST), present their views on enterprise integration and standardization.

Current State and Vision of enterprise integration as seen by the different communities involved, is the subject of the four papers in this section. Presentations are made by representatives of academia and the ICT[2] user and vendor industry.

ICEIMT and Workshop Results: Following an overview of the ICEIMT initiative the results from the different working groups are presented. Most results have been defined as proposals for projects. Such projects are in the research domain, the standardization domain, or in the product development domain. One conference segment is a recess to provide time for discussions about organizing teams to prepare more detailed proposals.

Basic Concepts: Consensus on enterprise engineering and integration requires a common framework for the domain of discourse. GERAM[3], the result of work by the IFAC/IFIP Task Force, is being proposed as the common framework and has been presented in all the workshops. GERAM is currently the input to the ISO standardization work on enterprise-reference architecture and methodology. Following a presentation of GERAM the remaining papers in this area relate to such GERAM components as methodologies, languages, ontologies, and infrastructures.

International Projects: There are numerous projects around the world on national, regional and even global level which involve industry (users and vendors) and research institutions. A selection of projects from Europe (Esprit), the USA (NIIIP[4] and NGM[5]) and world wide (IMS[6]) presents some of the current efforts on advancing the state of the art in enterprise engineering and integration.

Future Challenges: The papers in the closing session address the future of enterprise engineering and integration. Besides research, standardization, and product developments, a major challenge in enterprise engineering and integration is the creation of awareness and acceptance in the industry. Only with a significant accompanying effort on education and training will enterprise integration technology be moved into the user operation.

3.2 Part II: The Workshops

All participants in the ICEIMT workshops have introduced themselves to their colleagues by a presentation of their work relevant to the theme of the particular workshop. Most of these papers have been prepared for publication and are collected in this part of the proceedings. The structure proposed to guide the reader through the subject matter has the following seven categories (the papers in each section are arranged in alphabetical order of the author's name):

---

2 ICT = Information and Communication Technology
3 GERAM = Generalised Enterprise Reference Architecture and Methodology
4 NIIIP = National Industrial Information Infrastructure Protocol
5 NGM = Next-Generation Manufacturing
6 IMS = Intelligent Manufacturing Systems

Enterprise Integration: The papers in this section are concerned with general aspects of enterprise integration ranging from the need of a specific discipline for enterprise integration –business architects – to the subjects of distributed and agile enterprises.

Principles and Fundamentals: This section reports on ontology-related work that addresses the issue of common semantics in enterprise representation. The work has been exploited in the working group 2 of workshop 2 leading to a proposal for projects.

Methodologies: The papers collected in this section show the need for multiple solutions on methodologies. A rather wide range of applications is covered, each one using a different methodology for achieving the desired results. Clusters of applications are in workflow management, SME[7]-type, and distributed or decentralized systems. Design of shop floor systems is addressed as well.

Human Aspects: One of the major results of the first workshop was the consolidation of the technology-centered and the human-centered enterprise engineering and integration approaches. The papers in this section focus on either human or organization aspects of enterprise integration.

Applications: Papers in this section are concerned with particular applications of enterprise integration (most of the papers in the methodology section report on application for their methodology as well), ranging from industry sector (aerospace and automotive) applications, and the use of modeling tools in shop-floor control to a very specific application in the organization of a metro system.

Modeling Quality: The two papers, both by the same author, address a very specific, but highly important aspect of enterprise modeling. The quality of model simulation results depends on the design of the simulation experiments as much as it depends on the design of the model itself. The author reports on findings that indicate insufficient recognition of this aspect in the set-up of simulation experiments.

Standardization: Relevant efforts in standardization on national (DIN), European (CEN), and international level (ISO) are described in the papers of this section. A potential strategy for standardization for enterprise integration is presented as well. This proposal tries to relate the current work and to propose extensions into areas like human-oriented models and information-technology support for enterprise-model engineering and use.

Reference

[1] Petrie, C.J. (Ed.), Enterprise Integration Modeling, Proceedings of the First International Conference, MIT Press, 1992

[7] SME = Small-to-Medium-sized Enterprises

Acknowledgements

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We hope that these proceedings offer a useful tool in achieving further international consensus in enterprise integration and modeling technology. The intentions are to keep the ICEIMT initiative going through organization of further workshops, seminars, and conferences. We ask all readers of the proceedings to contribute to these efforts by disseminating the information and to participate in the ICEIMT continuation by means of contributions and/or direct involvement in any of the forthcoming events.

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