

Preface

This book addresses meta-enterprise organizations and infrastructures as emerging and (now we are positive) indispensable organizational models, concepts or approaches for assuring, or enabling, effective and efficient implementation and management of agile and virtual enterprises (or Agile/Virtual Enterprises). In particular, the concrete meta-enterprise organization and/or infrastructure model presented in the book is called, by the authors, the *Market of Resources* (MR).

An Agile/Virtual Enterprise (A/VE) is seen as a new organizational paradigm, virtually the most advanced enterprise organizational paradigm of today's, expected to serve as a "vehicle" towards, in the limit, a seamless "perfect" alignment of the enterprise with the market. A/VE is characterized in different ways, ranging from simple subcontracting networks to dynamic reconfigurable agile networks of independent enterprises sharing all resources, including knowledge, market, customers, and so forth, using specific architectures, not only of software and data systems, but primarily the organizational architectures that introduce the enterprise's true virtual environments, in order to be permanently aligned with the highly demanding and global dynamic market. Obviously, when we, the authors, address Agile/Virtual Enterprises as a new organizational paradigm, we consider primarily and exclusively, the Agile/Virtual Enterprises as *highly dynamic reconfigurable agile networks of independent enterprises sharing all resources, including knowledge, market, customers, etc., and*

using specific organizational architectures that introduce the enterprise's true virtual environments.

Thus, in this book, the form of *agility* addressed is primarily the dynamic reconfiguration of the organization, or structure, of networks of independent enterprises, while the *virtuality* is addressed as specific organizational architectures.

However, despite the Agile/Virtual Enterprise as seen by many authors as one of the most promising organizational approaches, only the relatively most simple models, as simple subcontracting networks or supply chains (if we consider them as A/VE models), are implemented, while we could easily observe that, in fact, we do not have implemented Agile/Virtual Enterprise models that correspond to the earlier-mentioned definition which is considered in this book (and by many other authors).

Among several reasons for this situation, probably the most important is that the concept of A/VE as *“highly dynamic reconfigurable agile networks of independent enterprises sharing all resources, including knowledge, market, customers, etc., and using specific organizational architectures that introduce the enterprise's true virtual environments”* introduces several new features that the “traditional” approach to the implementation and management can not manage. These are, in fact, the reasons why we can talk about the new paradigm. Some of these features are:

1. the nature of inter-enterprise relations, in the context of sharing all resources, and
2. the dynamic reconfiguration of the enterprise, or new networked enterprise, organizational structure.

Concerning the nature of inter-enterprise relations, the context of sharing all resources introduces new factors to be managed not present in the “traditional” “self-centered” enterprise, which are trust assurance and management, knowledge and intellectual rights protection, legal issues, communication phenomena, among others.

Concerning the dynamic reconfiguration of the enterprise, or new networked enterprise, organizational structure, the new phenomena is that the production operation “chain” or “network” under the same (fixed) organizational structure, as it is in the “traditional” enterprise, becomes shorter and shorter as the (organizational structure) reconfiguration dynamics become higher and higher. In the limit, an organizational instance (fixed) structure is characterized by only one operation. The consequence is that the focus of management is moving from the (production) operations management to (organizational structure) reconfiguration management. In other words, we could say that while in the

“traditional” enterprise the importance of (production) operations management is high, in A/VE the importance of (production) operations management is low. In this sense, for example, the role of operation scheduling in A/VE is no longer one of the most important functions for operations management but, rather, could be seen as a network design tool. Therefore, the A/VE management and design (reconfiguration is in fact a network, or enterprise, structure design, or, redesign, process) are coupled.

A/VE dynamic reconfiguration brings other important phenomena. If we could say that coupled network management and design just imply another operation management model, the new factor is transaction cost. Actually, each (organizational structure) reconfiguration implies some costs. These costs are called *transaction costs*. The problem is that if you have a high (organizational structure) reconfiguration dynamics you will have higher and higher *transaction costs*. This, in fact, makes A/VE agility (i.e., dynamics) not sustainable.

There are two main enterprise dynamic networking, or A/VE, implementation and management disabling factors that follow the theory of firm models:

1. transaction cost, and
2. preservation of firm’s knowledge on organizational and management processes, as it is the firm’s competitive factor when relating, or networking, with other firms.

To control these factors, it was necessary to have a completely different approach than the “traditional” one, as, the “traditional” approach to enterprise implementation and management cannot deal with these problems.

It is recognized that the new approach should imply special environments for network (re)configurations and operations, the role of which is exactly to control two main factors against dynamic networking. As the role of these environments is not the management or implementation of the A/VE themselves, as it is the task of the A/VE owners, but rather to support these processes (implementation and management), these environments represent a kind of *meta-enterprises*, as they, in fact, are managing the dynamic reconfiguration factors that manage the “production” of (A/VE) enterprises. In this sense, this book presents a model of *a meta-enterprise organizations and infrastructures as emerging and indispensable organizational models, concept or approach for assuring, enabling, or supporting effective and efficient implementation and management of Agile and Virtual Enterprises (or Agile/Virtual Enterprises), assuring low transaction costs and the partners’ knowledge protection (or preservation). The model presented in the book is called, by the authors, the Market of Resources (MR).*

This approach (i.e., the need for such environments, as external meta-enterprise organizations and/or infrastructure) is getting more and more recognition in the last few years by the research and theoretician community. In the literature, we can find references to other *Market of Resources* alike concepts, services and products, for example: *the new generation of high value-added electronic marketplaces, e-alliances, breeding environments, electronic institutions, virtual clusters, “guilds”*.¹

However, this is the first book on the market, of the authors’ best knowledge, that *presents comprehensively a model* of such a meta-enterprise organization, infrastructure or environment for A/VE as dynamically reconfigurable network of enterprises, that share virtually all resources.

Actually, it is expected that these environments will be the regular environments for A/VE integration, reconfiguration dynamics and operation. (This expectation has been already expressed within the EU FP6 project, Network of Excellence I*PROMS — *Innovative Production Machines and Systems*, <http://www.iproms.org/>, N° NMP2-CT-2004-500273, whose partner is University of Minho, that considered the “*Meta-enterprise organizational structures*”, with the *Market of Resources* as an example, as one of the “*Key Enabling Features*” for future developments of the Production Organization and Management area.)

The authors think that it would be useful to mention that this book is in a way a continuation of the authors’ previous book (Putnik & Cunha, 2005a) in the sense that this book is a comprehensive presentation of the Market of Resources, already presented in a much shorter way, as one of the main tools for enabling A/VE as dynamically reconfigurable enterprise networks. The structure and philosophy of the previous book (Putnik & Cunha, 2005a) presented, besides its content, a number of valuable contributions on particular “object” topics, an example of a new view on A/VE integration (and operation), for which the *Market of Resources* is one of the fundamental tools, which is a view through the lens, or framework, of Organizational Semiotics, more precisely, the Virtual Enterprise Integration Semiotics [see the Preface and Chapter I of the book (Putnik & Cunha, 2005a; Putnik et al., 2005b, 2005c)].

Also, the authors think that it would be interesting to mention that this book is a result of the work developed within the larger project on Virtual Enterprises that is on course at the University of Minho, Centre for Production Systems Engineering. The project on Virtual Enterprises in the Centre for Production Systems Engineering of the University of Minho has started as early as 1994, and has resulted up to date in 4 PhD and 5 MSc Thesis concluded, while three PhD projects are on course (at the moment of writing this Preface). The project on *Market of Resources* has started as early as 1999 as a PhD project, which was concluded in 2003. After that period, the concept was regularly revised.

Organization of This Book

The book's 11 chapters are organized into three parts that addresses three global issues of the A/VE implementation and management support. These are:

1. **Section I:** Business Requirements and Virtual Enterprise Model Needs, Chapters I to IV.
2. **Section II:** Functional or Activity-Based Model of the Market of Resources, Chapters V to IX.
3. **Section III:** Market of Resources and Agile/Virtual Enterprise Implementation and Management Support: Validation and Potential, Chapters X and XI.

Section I of the book addresses *Business Requirements and Virtual Enterprise Model Needs*. Through four chapters, Section I contains a discussion on the actual enterprise environment (i.e., market, its characterization from the perspective of the needs for new organizational models, some constraints and directions to overcome these constraints).

When talking about the actual enterprise environment the book focuses on its dynamics and unpredictability as the major challenge to competitiveness. From the other side, the question is: which are the A/VE models for which we should develop the management and implementation models? Actually, what are specific functional characteristics that should be satisfied?

In other words, Section I aims at presenting an answer to the question: meta-enterprise organizations and infrastructures, in particular Market of Resources, why?

This section contains four chapters. They are:

Chapter I presents a business requirements' analysis to help understand the actual economical and organizational context we live in, and to justify the emergence of new organizational models, in particular the A/VE models. This chapter starts with a brief introduction of the role of enterprises and the market, followed by a characterization of the actual economic context of strong competition, and the evolution of product life cycle in this context, and concludes with the identification of the requirements for competitiveness and a business alignment requirements analysis.

Chapter II presents a discussion on the emergence of the virtual enterprise concept, as well as presents the most relevant and most frequently discussed virtual enterprise models, namely, Supply Chain, Extended Enterprise, Agile Enterprise/Manufacturing, Virtual Enterprise/Virtual Organization, the BM_Virtual Enterprise Architecture Reference Model (*BM_VEARM*) Agile/

Virtual Enterprise reference model and OPIM (One Product Integrated Manufacturing). At the end of the chapter, a discussion is presented.

Chapter III presents the BM_Virtual Enterprise (BM_VE) model, as an Agile/Virtual Enterprise, in total or partial conformance with the BM_Virtual Enterprise Architecture Reference Model (BM_VEARM) (i.e., as a dynamically reconfigurable network integrated over the global domain, satisfying the requirements for integrability, distributivity, agility and virtuality as the competitiveness factors). In other words, a virtual enterprise (VE), according to BM_VEARM, is “... an optimized enterprise, synthesized over a universal set of resources, with a real-time replaceable physical structure, and when the synthesis and control are performed in an abstract or virtual environment.” The importance of presenting the BM_VE is in fact that Virtual Enterprise (VE), or Agile/Virtual Enterprise (A/VE), implementation and management is not possible without *Market of Resources* (MR), and similarly defined meta-enterprise structures and/or organizations. BM_Virtual Enterprise uses three main mechanisms, or tools: Broker, Virtuality, and Market of Resources.

As a consequence of the BM_VE model, an “inverse” definition (i.e., the *Resource centered Virtual Enterprise Definition*) of VE is presented. Because of this consequence, it follows that BM_VE is a ubiquitous enterprise, too. Ubiquitous enterprise, and VE as a ubiquitous enterprise, could be considered as the next generation (enterprise) organizations.

Chapter IV introduces the requirements for Agile/Virtual Enterprise (A/V E) integration, discuss reconfigurability dynamics and business alignment and propose a Virtual Enterprise Extended Life Cycle. The Virtual Enterprise Extended Life Cycle is the crucial result, as it introduces the fundamental process, or phase, to make an A/VE effective and efficient, and it is the phase of contractualization of a Market of Resources. This A/VE life cycle model actually makes a distinction between the A/VE models as relatively static organizations and A/VE models as dynamically reconfigurable organizations.

Section II addresses *Functional or Activity-Based Model of the Market of Resources*. It contains five chapters through which the model of a *Market of Resources*, as a meta-enterprise organizations and infrastructures, is presented in detail. The representation technique used is IDEF0. This representation technique is chosen because it presents the main elements of a system in general, that is, presents the system’s inputs (I), outputs (O), processes or activities (P or A), tools or mechanisms (M) and control or management (C). IDEF0 represents a correctly defined semi-formal graphical language, with data associated, providing an easy way to understand complex organizational models and facilitate the model implementation and control. The particular chapters are dedicated to present the supporting IC technologies.

This part is innovative in terms of the existing literature as the authors did not find any detailed description of these kinds of A/VE environments or infrastructures. What is important to notice is that the model is not a purely ICT solution (e.g., a kind of a set of Web services or an electronic market solution), but a true organizational model that is human-based and ICT-supported.

In other words, Section II aims at presenting an answer to the question: meta-enterprise organizations and infrastructures, in particular Market of Resources, how?

Chapter V introduces the concept of a Market of Resources as an environment to cope with the A/V E model requirements (i.e., an environment for Agile/Virtual Enterprise integration and business alignment), identifying the relevant requisites related with A/V E design and integration, and defining its participants. Also, the technical requirements to support the Market of Resources are presented and how existing technologies support the main processes of the Market of Resources.

Chapter VI presents some of the main ICT and some of the most relevant technologies that can contribute to support the A/V E models. It addresses as well the impact of the new information and communication technologies and the issue of information integration, considering recent developments.

Chapter VII explains how “traditional” Internet-based tools (WWW search engines, WWW directories, electronic mail and e-marketplaces) can be used to support some of the functionalities required by the A/VE models. It introduces as well the costs of subcontracting analysis and a cost-and-effort model that traduces the activities of A/VE integration that can be undertaken with the support of these traditional tools.

Chapter VIII presents a complete specification of the Market of Resources, to allow a complete understanding of how this environment is able to support the implementation and management of Agile/Virtual Enterprises.

The model of the Market of Resources includes three views:

1. The functional specification of the service provided, its processes structure and data structure using IDEF0 and IDEF1x modeling techniques;
2. The definition of a regulation regarding the operation and management procedures of the Market of Resources; and
3. A cost-and-effort model to allow a further analysis of the model performance.

In addition to the model presentation, an overall data architecture to support the Market of Resources is presented, based on IDEF1x diagrams, and finally the cost-and-effort model developed are introduced, traducing the operation of the

Market of Resources, with the purpose to allow the comparison of performance between the Market of Resources and the traditional Internet-based technologies in the support of activities of A/V E integration.

Chapter IX introduces some technologies that can support the development of the Market of Resources and discusses its utilization, as well as presents a prototype developed to demonstrate the operation of some functions of the Market of Resources. This prototype is used later in Chapter IX in the analytical simulation of the Market of Resources performance.

Finally, **Section III** addresses *Market of Resources and Agile/Virtual Enterprise Implementation and Management Support: Validation and Potential*.

Chapter X presents a validation of the approach. As validation criteria, time and cost functions are used. The method of validation is a simulation. It is important to notice that the validation clearly shows that if we want to implement agility in the form of A/VE dynamic reconfiguration, then the meta-enterprise organizations and infrastructures, in particular Market of Resources, are indispensable in order to control the networking dynamics disabling/enabling factors. Actually, the conclusion is that without these kinds of meta-enterprise organizations and infrastructures the A/VE reconfiguration dynamics is not possible, and therefore, the required enterprise's (A/VE) alignment with the market, and consequently the enterprise's competitiveness, is not reachable. In other words, we would say, without these kinds of meta-enterprise organizations and infrastructures the A/VE, as a concept, is losing attractiveness as it is reduced to the variant of a "traditional" enterprise or a "traditional" subcontracting network. At the end, **Chapter XI** addresses some usability and implementation issues as well as some future work.

In other words, Section III aims at presenting an answer to the questions: meta-enterprise organizations and infrastructures, in particular the Market of Resources, *is it valid, when is it valid, how to use it, and what else?*

Chapter X discusses the ability of the Market of Resources to cope with the requirements of Agile/Virtual Enterprises and compares its performance with the performance of traditional Internet-based technologies. It starts with the explanation of the cost-and-effort analysis undertaken, based on the cost and effort models introduced in **Chapter VII** and **Chapter VIII**, followed by the parameterization of this models by identifying its time constants. Subsequently, it is presented as a comparative study of performance between the traditional Internet-based tools and the Market of Resources, based on the results of an analytical simulation of the cost-and-effort of the Market of Resources compared with the utilization of traditional tools in the support of A/V E integration. Finally, it is identified as a solution space where the Market of Resources presents more efficiency in A/VE integration.

Chapter XI analyzes the context in which the Market of Resources appears, identifying favorable existing conditions and reviewing forecasts by credible analysts and consultancy houses, presents a SWOT² analysis, presents some critical success factors associated to the exploitation of the Market of Resources, identifies the targeted users, and finally explores some potential opportunities and expected benefits. The opportunities for the Market of Resources are identified, and the e-marketplace's evolution, the failure of the first generation of e-marketplaces and some research forecasts for B2B Internet-based transactions are presented. The main strengths and weaknesses of the Market of Resources' ability to support the A/VE model requirements and the main opportunities and threats associated to its exploitation, using a SWOT analysis, are highlighted. Also, it presents the set of critical success factors for the Market of Resources, their definition or explanation and the competitive advantage that each critical success factor confers. Finally, the target users of the Market of Resources, expected benefits by the creation of the Market of Resources to its targeted users and some future trends are discussed.

Expectations

This book is expected to be read by academics (i.e., teachers, researchers and students), technology solutions developers and enterprise managers (including top-level managers).

This book is expected to give incentives for and guide the creation of indispensable environments, as well as the Market of Resources as a particular one proposed in this book, for enabling more advanced and emerging organizational models, namely A/VE, as their meta-organizational structures. Looking from a future perspective and more advanced social needs, this book is expected to give incentives for and guide the creation of the meta-organizational structures (or infrastructures) as a part of the paradigm shift in organizational sciences. As we have said, it is expected that these environments will be the regular environments for A/VE integration, reconfiguration dynamics and operation.

Related with the earlier-mentioned "global" expectations, this book is expected as well to raise awareness of the A/VE implementation and management needs for supporting environments. Actually, the awareness that is expected is about indispensability of these environments for implementation and management of emerging highly dynamic networked organizations. That is, the implementation and management of these highly dynamic networked organizations is practically impossible without Market of Resources or like environments.

On the other hand, the book is expected to raise awareness of the new business opportunities and new business approaches, namely the establishment of these

environments (Market of Resources) as a new service that companies and managers could, and should, exploit.

This book is expected to help and support teachers of several graduate and post-graduate courses, from Management to Information Technology, and in particular the emerging new courses on Agile/Virtual Enterprise concept itself, for the topics of A/VE enablers, providing a basis for qualitative and quantitative analysis of concrete solutions (Section II and Section III).

Also, the book provides a base for further study and research definition as well as solutions development.

The authors are also expecting that the book will contribute to the diffusion of the A/VE concept in other parts of the world, not only in the most developed countries.

At the end, the authors will be grateful to the readers for any constructive criticisms and indication of errors, conceptual, omissions or in typing.

Maria Manuela Cunha

Goran D. Putnik

Guimarães, March 2006

References

- Putnik, G., & Cunha, M. M. (Eds.). (2005a). *Virtual enterprise integration: Technological and organizational perspectives*. Hershey, PA: Idea Group Publishing.
- Putnik, G. D., & Cunha, M. M. (2005b). Preface. In G. Putnik & M. M. Cunha (Eds.), *Virtual enterprise integration: Technological and organizational perspectives*. Hershey, PA: Idea Group Publishing.
- Putnik, G. D., Cunha, M. M., Sousa, R., & Ávila, P. (2005c). Virtual enterprise integration: Challenges of a new paradigm. In G. Putnik & M. M. Cunha (Eds.), *Virtual enterprise integration: Technological and organizational perspectives* (pp. 1-30). Hershey, PA: Idea Group Publishing.

Endnotes

- ¹ “Guilds” is the MR-like concept identified as a possible scenario for the virtual organizations by the MIT 21st Century Manifesto Working Group in their discussion paper, “What we really want? A manifesto for the organizations of the 21st Century,” within the “MIT Initiative on Inventing the Organizations of the 21st Century.”
- ² Strengths, Weaknesses, Opportunities and Threats.