

Markus Rabe • Peter Mihók (Hrsg.)

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**New Technologies for the Intelligent Design  
and Operation of Manufacturing Networks**



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# **New Technologies for the Intelligent Design and Operation of Manufacturing Networks**

**Results and Perspectives from the  
European AITPL Project Cluster**

Fraunhofer IRB Verlag, Stuttgart

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## Foreword

The Networked Enterprise is of utmost importance to realize the Lisbon goal of a world leading knowledge economy, as it represents a development that allows the bundling of the capacities and capabilities of the multitude of small and medium-sized enterprises, which are a major root of Europe's competitive strength in the global market. Networks enable the provision of products and services to the customers, especially to the large "global players", within Europe and towards the world. Information and communication technologies (ICT) are the backbone that renders such cooperation possible within regions and across Europe's inner borders. ICT enables the exchange of product and service requests in real-time and the bundling of information with products and activities. It also makes easier the follow up of workflows in complex and highly-interconnected environments.

The European Commission identified these challenges as crucial and has therefore fertilized a number of dedicated research activities in its 6<sup>th</sup> Framework Programme. Major activities in the domain have been bundled in "clusters" of projects in order to facilitate effective dissemination, to exploit synergies in research topics and to structure the demands for future research. The clusters most relevant for the addressed topic are the Interoperability Cluster, the Cluster of European RFID Projects (CERP) and the Ambient Intelligence Technologies for the Product Lifecycle (AITPL) Cluster, which is the main originator of the book in hand.

The European Commission especially appreciates the concerted work of the projects in the AITPL cluster, which during the last three years has brought significant results in improving the flexibility of manufacturing units, simplifying collaborative design and production, exploring new ways to short-term customization of mass products, and integration of service providers in manufacturing networks. Especially, the cluster has gained extensive visibility, e.g. by its regular presence at the International Conference on Concurrent Engineering (ICE) since 2006, by organizing workshops and forums, and – of course – by publishing this book.

I express my confidence that the research conducted in this context will further contribute to the success of Europe as a flourishing economy as well as an outstanding research area.

*Gérald Santucci,  
December 2007*

*European Commission  
Head of Unit "Networked Enterprise & Radio Frequency Identification (RFID)"*



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# Introduction

Markus Rabe, Fraunhofer IPK, Berlin (Germany)

## 1 Context

When setting up the 6<sup>th</sup> Framework Programme, the European Commission faced the need to reinforce European strengths in areas where it has established industrial and technological leadership. Information and communication technology (ICT) is seen as a key to this goal, enabling European workers and companies, in particular small and medium-sized enterprises (SMEs), to increase their competitiveness in the global marketplace.

One of the major strengths of Europe's industry is seen in the multitude of highly efficient and innovative SMEs that cooperate in order to leverage their chances on the global marketplace. Therefore, "Networked Business" has been declared a strategic objective for the European research area. ICT for networked business will enable networked organisations to build up partnerships faster and more effectively, to develop value-added products and services, and to efficiently share knowledge and experience.

A significant number of research projects and support actions are co-funded by the European Commission in this domain. In order to gain visibility and mutual profit, three clusters have been initialised, starting in late 2004:

- The *Interoperability Cluster*, aiming at technologies that allow the seamless collaboration of enterprises and enterprise units. For this purpose, new ICT is investigated to share data, services, processes, and business. Thus, the conceptual, technological, and organisational barriers of interoperability are addressed. This includes the development of meta-models which accelerate the targeted exchange of partial business processes, thus allowing for smooth set-up of collaboration.
- The "*Ambient Intelligence Technologies for the Product Lifecycle*" (AITPL) cluster, with the major intent to facilitate the cooperation in exemplary fields, with a specific focus on collaboration among SMEs. The cluster projects cover ICT technologies for different sections of the product lifecycle, from collaborative design up to shared control of distributed supply chains. This cluster also exploits the "Internet of Things" with respect to mobile devices or on-product information storage (AITPL 2007).
- In order to bundle the increasing research activities around radio frequency devices (RFID) as a specific technology of the "Internet of Things" framework, the European Cluster of RFID projects (CERP) was added in early 2006. This cluster mainly addresses basic issues of the communication, e.g. contributions to the standardization, in general as well as for specific application domains (CERP 2007).

The work presented in this book is mainly from the AITPL cluster, but also includes further related results, especially direct contributions from the CERP projects.

## 2 AITPL Activities

At its foundation in December 2004, the AITPL cluster elected Markus Rabe from Fraunhofer IPK as the chairman, who since then guided the cluster's work towards concerted research and dissemination activities. In detail, the cluster has defined the following destinations for its operation:

- Exchange knowledge for mutual support of the research work
- Bundle standardization requests in order to identify major needs for normative activities
- Identify future challenges that will need consideration in the European research area
- Enhance the visibility and promote the results of the cluster's projects

The *exchange of knowledge* was made operational by a number of meetings and workshops where the cluster projects presented research aims and results that could be of mutual interest. In addition, three "special interest groups" (SIG) have been initiated that follow topics which are of interest to a limited number of cluster projects. The topics of the SIGs are business process modelling (with a focus on distributed systems and distributed modelling), flexibility of production lines, and flexibility of supply chains including SME.

*Pre-normative activities* have been started in late 2006, targeting to identify the deficits in standards that became visible during the project's research work. This work, driven by Tayyab Abbas Shamsi from TEAM, has collected the related activities and deliverables (available and to be done) and is now structuring the field of gaps and insufficiencies in terms of available standards in the addressed domain.

A broad community was sought after in order to contribute to the formulation of future research needs, and thus also contribute to the shaping of future research programmes. The major activities to *identify and structure research challenges* have been a workshop organized by the European Commission in Brussels on 27<sup>th</sup> February 2006 (Frederix et al. 2006) and a forum organized by the FLUID-WIN project on 28<sup>th</sup> June 2006 in Milan. A summary of the outcome of these events can be found in this book ("Challenges in Advanced ICT Technology for the Product Lifecycle").

A specific focus of the cluster's activities was set on dissemination. In order to name only a few highlights:

- A book was prepared which summarized early results from the cluster projects (European Commission 2005),
- a forum was organized at the International Conference on Concurrent Engineering 2006 (ICE'06) in Milan, presenting research results to the public, and
- a specific session on AITPL was conducted at the ICE'07 in Sophia Antipolis, with six accepted papers, two posters, and one keynote from the AITPL research community.

This book contains contributions given at the ICE'06 in Milan, which have been updated, enriched and also amended by additional contributions. Together with ab-

stracts that give an overview on additional activities in the domain it demonstrates the significant research results that are being achieved by the projects.

### 3 Structure of this Book

The goal of this book is to give an overview on the research work conducted by the cluster, to provide detailed results for selected domains, and to give an outlook on work to be addressed in the future. According to these aims, the book is structured into three major parts.

First, ten *research papers* are given resulting from the eight projects CODESNET, E4, FLUID-WIN, ILIPT, MAPPER, PABADIS’PROMISE, SPIDER-WIN and X-CHANGE. These papers cover a wide scope, addressing

- adaptive product and process engineering,
- approaches to enhance and measure flexibility in complex environments,
- new methods to set up and operate efficient supply chains, both for large enterprises as well as for SME networks,
- Web-based integration of financial and logistics services into networked manufacturing, and
- methods for the management and performance analysis of enterprise networks.

Second, a summary of the two major events that have been driven by the AITPL cluster in order to explore the future requirements in the related research domain has been added. This part identifies the *challenges in advanced ICT technology for the product lifecycle*.

Finally, further research initiatives from the AITPL cluster and the related research clusters are given in the form of two-page abstracts in part III of this book. The abstracts cover research goals and first results from the projects AMI-4-SME, BRIDGE, CE RFID, COBIS, DYNAMITE, Indisputable Key, Net-WMS, SMART, STOLPAN, and TRASER.

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**PART I**

**Selected Results  
from Cluster Projects**

