

## CORE COMPETENCE MANAGEMENT IN VIRTUAL INDUSTRY CLUSTERS

Nathalie Galeano, Arturo Molina

*Centro de Sistemas Integrados de Manufactura (CSIM),  
Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM),  
Avenida E. Garza Sada 2501 Sur, C.P. 64849, Monterrey, NL, México  
ngaleano@itesm.mx, armolina@itesm.mx*

**Abstract:** Nowadays small and medium enterprises try to develop new competitive advantages in order to access global markets. Virtual Industry Clusters (VIC) are an alternative for these companies, in such a way, that the companies can joint forces and competencies in the development of Virtual Enterprises (VE). Once the VICs are created, a structured process that manage the members' core competencies, allows the identification of the business opportunities, and impulse the creation of VE is needed. This article presents a model to manage VIC core competences. Results of the use of this model in the Mexican-Industry.com case are also described. *Copyright © 2005 IFAC*

**Keywords:** Industry Clusters, Virtual Enterprises, SMEs Practical Experiences, Core Competences.

### 1. INTRODUCTION

Virtual Industry Clusters (VIC) are an important business entity in the Framework for Global Virtual Business (Molina et. Al, 1998), they are the source of core competencies that will be used during the exploitation of a business opportunity and the creation of a Virtual Enterprise (VE). In this way, is important the VIC management process of its core competencies in order to assure that all the enterprises members have the necessaries resources, processes, methods and technologies to compete in a global collaborative networking virtual environment.

This paper presents a Model for Manage Core Competences in VIC, developed based on the Mexican-Industry case study. Mexican-Industry is a three-year project effort in the CSIM (Manufacturing Integrated System Centre) at ITESM University, for the development of VIC in metal-mechanic and plastic industrial sector in Monterrey, Mexico.

In this work, the questions that arise during the management of VIC core competences will be

responded: How to select and qualify enterprises around the world for the VIC? How to ensure that core competencies of the VIC are maintained and extended? What information about the members is needed? How to collect and structure this information? How to develop an information model to define members' competencies and hence the core competences of the VIC?

### 2. VIC FRAMEWORK AND CORE COMPETENCES MANAGEMENT

#### *2.1 Global Virtual Business Framework and Virtual Industry Clusters.*

The Global Virtual Business Framework describes how a VE is formed, run and dissolved (Molina, et al., 1998). In the framework, the VE is created when a business opportunity can be exploited by the Virtual Enterprise Broker (VEB), through the selection of the appropriate competencies from members of a Virtual Industry Cluster (VIC). A VEB

will search for partners in VIC for the best combination of competencies that, as a whole, will meet customer requirements for a product or service. Once a member of a VIC is selected, it becomes a partner of the VE.

The VE formation is influenced thus, by the existence and operation of VICs, which are aggregations of companies from diverse industries, with well-defined and focused competencies, with the purpose of gaining access to new markets and business opportunities by leveraging their resources and therefore their competencies (Molina, et al., 1998). VICs should provide enterprises' core competencies information in a structured way that can be used by VEB to search and select partners for the VE. The commercial success of VIC depends on: how well defined and focused is the cluster, how it will offer core competence information to the VEB, and how this information is going to be used to support strategic decision-making in managing the VIC core competencies.

According to the VIC Life Cycle Phases defined in its Reference Model (Carrasco et. al, 2004) is proposed a framework for VIC development, which includes four key processes (Figure 1):

- Analysis: identification of the industrial sector, economic aspects and all its characteristics that influence the VIC during its operation. The Strategic Plan is the final result of this phase.
- Design: definition of action plans, management and operational structure, ICT, and VIC services.
- Creation: implementation of the plans and ICT defined in the design phase.
- Management: VIC administrative management, ICT management and core competence management.

VIC LIFE CYCLE PHASES	VIC FRAMEWORK
1. Identification What / Why / Who	1. Analysis • Economic and Environmental analysis • Technological analysis • Strategic Plan
2. Concept Mission, Vision / Strategies, Policies, Values / Business Plan	2. Design • Implementation Plan • Cluster Definition • VIC structure • VIC services • ICT • Cluster Organization • VIC organizational structure • VIC business process, methods, practices
3. Requirements Operational requirements / Definition of the VIC elements: business entity, enterprises members, methodologies, human resources, ICT	3. Creation • Cluster Implementation • ICT installation
4. Preliminary Design Identify Industrial Sector / VIC Definition / VIC organization	4. Management • Core Competence Management • ICT Management • Administrative Management
5. Detailed Design Design of: Organizational Structure / Human roles / Business Process / ICT	
6. Implementation Training VIC staff / Program and install ICT / Creation of the VIC	
7. Operation & Decommission Management Methodology (Core Competence selection, development, deployment and protection) / VIC disintegration	

Fig. 1. Virtual Industry Cluster Life Cycle Phases (Carrasco et. al, 2004) and VIC Framework.

### 2.3 Core Competencies Representation.

According to Molina et al (1997) the core competencies in the Virtual Global Business Framework are the matching of fulfilling the tasks provided by a market need (identified by a VEB)

with the constituent skills or capabilities provided by the enterprises (members of the VIC), this mean that:

- The VEB are looking for core competencies in VIC to: make products, perform a set of business process to deliver a product, or to apply or have access to a technology (human, practices/methods, and resources) for a product.
- The VIC should be able to respond to these tasks based on constituent skills (capabilities) that it owns. Therefore constituent skills (capabilities) in the VIC should represent: what type of products the VIC can do, what business process can perform, and what technologies can be used.

In section 3.2 a core competence database is proposed for supporting the VIC operation.

### 3. VIC CORE COMPETENCE MANAGEMENT

The main process during the Cluster Management is the Core Competencies Management. Four main activities are performed during this process: Deployment, Selection, Development and Protection. These processes form a cycle that defines a VIC operation (as show in figure 2). The sequence of these processes depends on the situation presented:

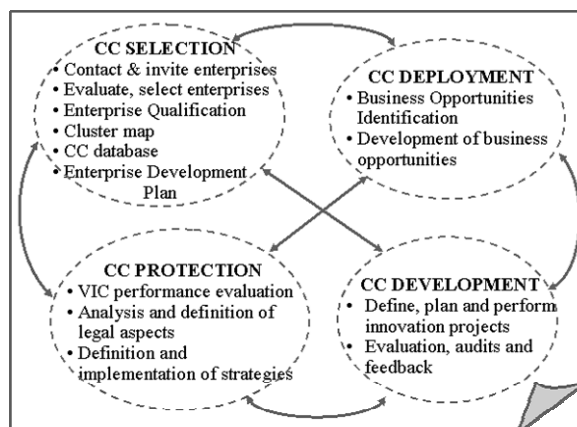


Fig. 2. VIC Core Competence Management.

- Once the VIC is created the next activity to be performed during the VIC operation is the CC Deployment, which aims to support the process of business opportunities development for the enterprises members.
- CC Development process can be performed at the same time that the CC Deployment process. During the selection of the VIC members, an Enterprise Development Plan is defined; this plan is the input for the CC Development process. The plan encourages the development of innovation projects in order to improve enterprise's competencies.
- Once a need of a competency inside the VIC is identified (CC Development), the CC Selection process initiate.
- CC Deployment can also trigger the CC Development process, when a company does not fulfil the requirements of a business opportunity, the related competency should be developed.

- In the same way, the CC Selection triggers the CC Deployment and the CC Development. When a new enterprise member becomes part of the VIC these two processes (deployment and development) start.
- Finally, if a new CC of one enterprise member is developed, a business opportunity can be identified and the CC Deployment process begins.

The methodology to perform each process and its tools will be detailed in next paragraphs.

### 3.1 Core Competence Deployment.

In the Core Competence Deployment new business opportunities between VIC members and potential customers are concreted according to each company core competencies. Two main activities are performed: business opportunities identification and development.

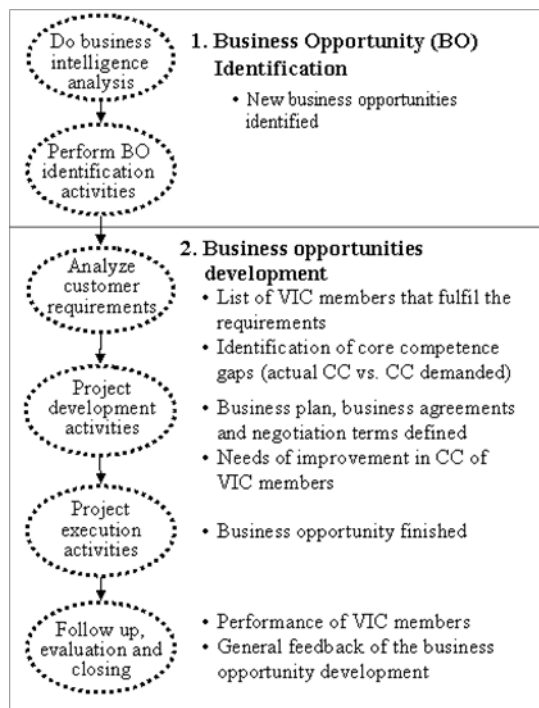


Fig. 3. Core Competence Deployment Process.

During the business opportunities identification, market demands and business opportunities are identified and analyzed. If the core competencies of the enterprises members match with the requirements of the customer, the business might be concreted, and the product or service should be delivered to the customer (Figure 3). This process can also be performed by the VEB, as the agent that coordinates the business opportunity exploitation. Mejia and Molina (2002) define a methodology to perform this process which was adapted to define the VIC CC Deployment process. The match-making processes between offer and demand can be done manually, or computer-supported with tools such as intelligent agents and decision support tools.

### 3.2 Core Competence Selection

In the Core Competencies Selection the companies with the required core competencies for the VIC are identified, evaluated and qualified. The cluster map and manufacturing capabilities database of the VIC are also complemented with the information of the new enterprises (Figure 4).

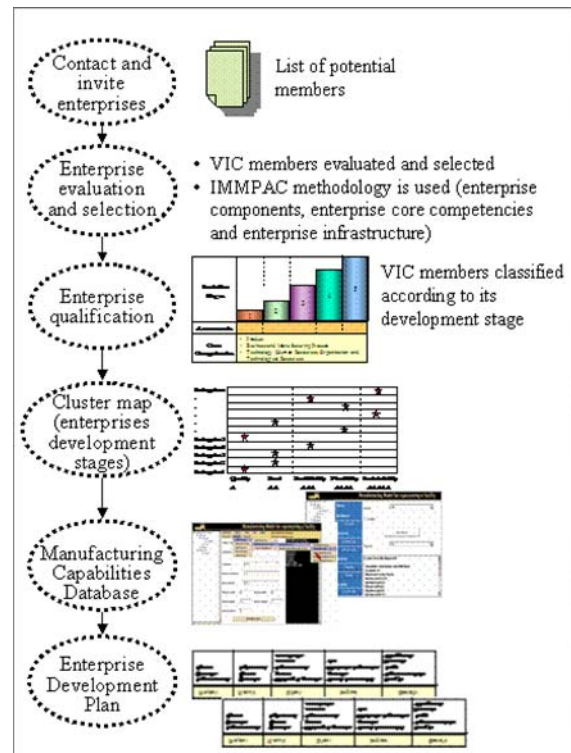


Fig. 4. Core Competence Selection Process.

To verify that the enterprises invited have the core competencies needed, different evaluations could be done: enterprise components, enterprise core competencies and enterprise infrastructure. IMPAC Diagnostic Methodology (Molina and González 1997) covers the enterprise components to be evaluated: products, processes and capabilities (human, technology and practices/procedures). IMMPAC is divided in four phases: Competitive Position, Productivity Indicators, Best Practices and Enterprise Development Plan.

In the Enterprise Development Plan of each enterprise main innovation projects are detailed according to “Logic Models” methodology (Caballero, 2000). This methodology defines how to describe innovation projects in order to achieve benefits for the company. A Logic Model of an innovation project should contain: activities, results, effects, impacts and benefits, which are the final achievements of the project in terms of its main objectives.

With the results of IMMPAC evaluation each enterprise is identified in the Cluster Map, which is the classification of the members according to the enterprise’s development stages (quality, trust, profitability, flexibility and sustainability).

The core competencies of the new members should then be aggregated to the manufacturing capabilities database: the Manufacturing Model (Molina and Bell, 199). This information model identifies, represents and captures the data, information and knowledge that describe the manufacturing resources, processes and strategies for a particular enterprise (Figure 5). This information is the input needed for the VBE in order to identify the best suppliers in a VO business opportunity development.

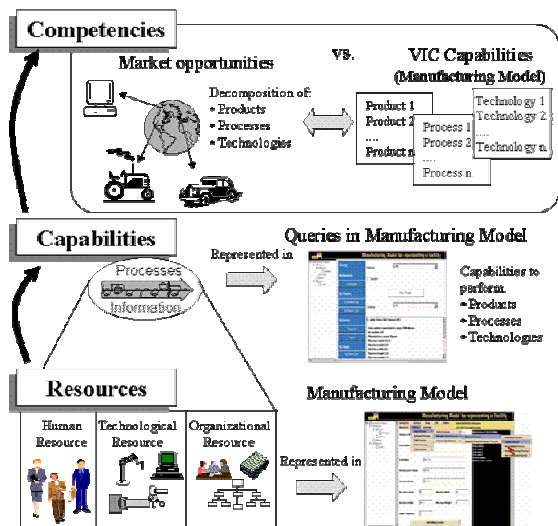


Fig. 5. Core Competence Database Representation.

### 3.3 Core Competence Development.

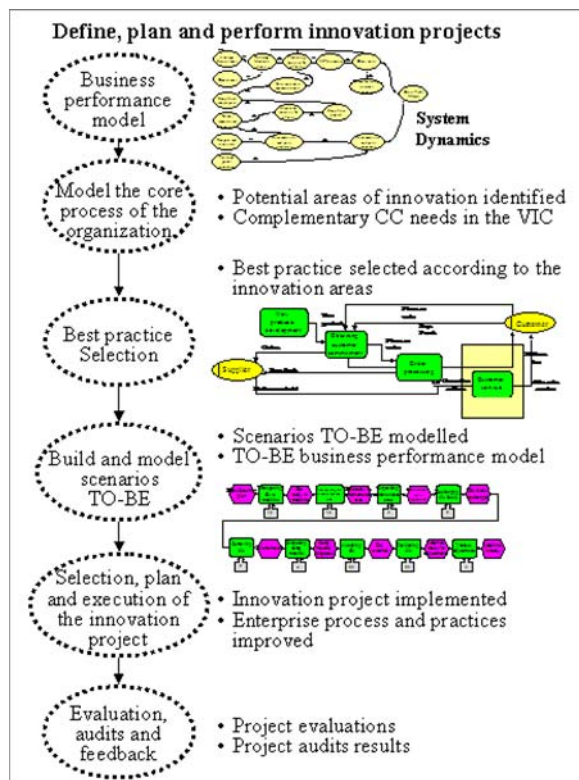


Fig. 6. Core Competence Development Process (Adapted from Molina and Medina 2001).

In the Core Competence Development, the core competencies of the enterprises members are improved and new core competencies are developed. The input of this process is the Enterprise Development Plan, which defines the projects that the companies should execute for its improvement. The output of the Core Competence Development process are the innovation projects developed in the VIC enterprises (new core competencies) and the identification of complementary core competencies to strengthen the VIC (triggering the Core Competence Selection process).

Molina and Medina (2001) proposes a methodology for develop innovation projects in enterprises, this methodology is used during the CC Development process. The methodology uses simulation tools software which helps in the definition of the Business Performance Model (based on system dynamics) and in the modelling of the actual processes and the improved processes (To-be model). In Figure 6, the activities of this process are described.

The innovation of the VIC business processes as a whole is also an important aspect of the CC Development process; the activities performed during the VIC management can also be improved with this methodology, the differential point is that instead of analyze individual enterprises, the analysis should be focus on the VIC entity and its business process.

### 3.4 Core Competence Protection

The main objective of the Core Competence Protection is to maintain the VIC in operation. The CC Protection includes the evaluation of different aspects during the VIC operation (Figure 7):

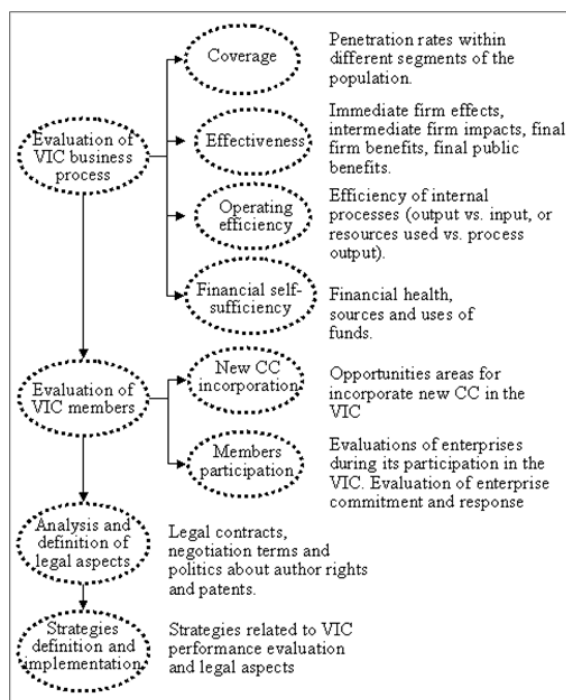


Fig. 7. Core Competence Protection Process.

- Analysis of the Cluster entity performance in terms of: operating efficiency, financial self-sufficiency, coverage and effectiveness.
- Analysis of enterprises performance: enterprises member participation, commitment and response during VIC operation.
- Financial and legal aspects analysis (which should be analyzed in order to work within law regulations).

After the analyses, the definition and implementation of strategies should be done in order to improve the operating efficiency, financial self-sufficiency, coverage and effectiveness of the VIC.

#### 4. INDUSTRIAL CASE: MANAGEMENT OF MEXICAN-INDUSTRY.COM

Mexican-Industry.com is a project that develops VIC in Monterrey, Mexico. The mission of this project is to: “Develop the competitive capabilities of SME through the aggregation of enterprises in VIC, providing better goods and services to OEM (Original Equipment Manufacturers) and to the subcontracting (maquila) industry”. Mexican-Industry clusters have been evolving since 2000, now there are 7 Clusters in operation, formed by 23 small and medium enterprises in the metal-mechanic and plastic sector ([www.mexican-industry.com](http://www.mexican-industry.com)).

##### 4.1 Core Competence Deployment.

Diverse business opportunities have been developed under the schema described in this process. For the first phase, Business Opportunities Identification, the Mexican-Industry management staff performed different activities: personal visits to potential customers, chambers of commerce, participation in trading shows and events for suppliers’ development programs. The performance measures that evaluate this process were: number of companies contacted and visited, number of business opportunities detected and number of contracts closed.

Once the business opportunities were identified, the execution of the project was performed. The VEB support the match making between the demand and supply, and the coordination of the business opportunity development. Through the experiences of Mexican-Industry, a new enterprise that performs the activities of the Broker was created in 2001, named IECOS (Integration Engineering and Construction Systems S.A. de C.V.). IECOS ([www.iecos.com](http://www.iecos.com)) supports the Mexican-Industry CC Deployment process.

Products transfers from OEMs to VIC’s member and new product development process are the more common business opportunities developed under this schema. A product transfer for an Aerospace Tool Manufacturer is exemplified: The client is a French aerospace tool manufacturer company, whose

suppliers are around the world. As an international enterprise, is looking for suppliers that offer differentiator factors such as: cost and response time. The customer sends the parts specifications (drawings) to IECOS including target prices. IECOS find the best suppliers inside the Mexican-Industry that can produce the parts (usually machined parts), and makes a quotation. If the client agrees, sends the purchase order to IECOS, who is responsible of the project execution. IECOS gives engineering support to the suppliers, performs quality control to final products, and is in charge of the outbound logistics. Finally an evaluation of the suppliers’ performance is done and feedback to the VIC members is given.

##### 4.2 Core Competence Selection.

In order to select new enterprises for Mexican-Industry, management staff performs diverse activities. First contact with potential members is through a formal invitation, then, a formal visit to the facility is done with the aim to present VIC entity and identify the capabilities and resources of the company. An initial profiling of the enterprise is done during this visit.

If the enterprise is a potential member of the VIC (the company has the CC needed), and if they are interested in become a member, a quantitative evaluation is done according to IMMPAC Diagnostic Methodology finalizing with the Enterprise Development Plan where the innovation projects for each enterprise are defined. The new member profile is published in Mexican-Industry web page. Companies’ capabilities are fill-in in the Manufacturing Model capabilities database of Mexican-Industry, this database is under development. A database of members’ manufacturing resources (made in Excel) is used instead.

##### 4.3 Core Competence Development.

During Core Competencies Development process each enterprise member is responsible of the innovation project realization. Mexican-Industry does not have a specific policy to develop this process among members. Once the Enterprise Development Plan is defined, the company can or cannot develop its or new core competencies. This is because the development of core competencies implies investment (human, technological and financial resource), and in some cases the VIC members cannot afford it. Nevertheless, Mexican-Industry consultants can help the enterprises during the development of innovation projects. The majority of the projects coordinated by Mexican-Industry are special offers services to the VIC members. One example of these projects is the implementation of a Cost System for a member of the stamping cluster.

#### 4.4 Core Competence Protection.

Each year the VIC manager and its staff evaluate the performance of the VIC entity according to the VIC model of core business process (operating efficiency), incomes and operating cost (financial self-sufficiency), members range and type (coverage). A questionnaire is applied to the enterprises members to evaluate the effectiveness of the VIC. Although the evaluation of Mexican-Industry performance is developed, some other issues related to core competence protection such as evaluation of new members, analysis and definition of legal aspects, and strategy definition and implementation are missing. There only exists a contract that defines the relation between the enterprises members and the VIC entity.

#### 5. DISCUSSION AND CONCLUSIONS

The Core Competencies Management Process presented in this research is a standardized and structured process that guides the administration of VIC's core competencies for exploiting market business opportunities. CC Selection, Development, Deployment and Protection form part of VIC main operations, which are supported by ICT.

Core Competencies Management Process responds four main questions related to VIC:

- How is it that enterprises around the world should be selected and qualified to become part of VIC? Process of CC Selection.
- How is it that the VIC core competencies should be maintained and extended? Processes of CC Development and CC Deployment.
- What information is needed about the members? It is defined by the VIC's manufacturing capabilities database description (resources, capabilities and competencies).
- How information is collected and structured? How the information model to define member's competencies and hence the core competencies of the VIC should be developed? VIC manufacturing capabilities database.

Mexican-Industry is a Cluster that demonstrates the applicability of the CC Management Process. However there are some activities that Mexican-Industry did not perform, due to economic, cultural or technological issues. Economic issues involve lack of funding; technological issues involve lack of human resource, organizational practices or physical resources. Cultural aspects involve issues such as enterprise commitment and responsibility.

Mexican-Industry enterprises members showed a high interest in the exploitation of business opportunities, they expect the VIC entity to detect and give them these kinds of opportunities in order to deploy its core competencies. This factor shows the need of Virtual Enterprise Broker that supports these processes; otherwise, VIC structure should provide the resources necessary to perform these activities.

Diverse barriers affect the development of the Core Competencies Management Process in Mexican-Industry, some of them are: Lack of structured information in the enterprises members, limitation of human and financial resources for develop new core competencies, long lead time and little flexibility of the VIC members, especially when quotations are requested.

#### 6. ACKNOWLEDGEMENTS

The research presented in this document is a contribution for the ECOLEAD Project (European Collaborative Networked Organizations Leadership Initiative), funded by the European Community, FP6 IP 506958. A special thankfulness to the Centre for Integrated Manufacturing Systems (CSIM) of ITESM University for support this research

#### 7. REFERENCES

- Caballero, D. (2000) *Aplicación de la Metodología de Modelos Lógicos para Evaluar Proyectos de Mejora en Empresas de Manufactura*. Thesis work presented to obtain the title of Master in Science with the specialty of Manufacturing System (in Spanish). ITESM, Campus Monterrey, México. Diciembre.
- Carrasco R., Galeano N., Molina A. (2004). The use of GERAM in the formalization of the Global Virtual Business Framework, 7th IFAC Symposium on Cost Oriented Automation, Preprint, Ottawa, Canada, June 6-9, pp. 159-164.
- Molina A., and Bell R. (1999). "A manufacturing model representation of a flexible manufacturing facility", *Proc Instn Mech Engrs* Vol 213 Part B, pp. 225-246.
- Molina, A., González, D., (1997). IMM PAC: A Methodology for the Implementation of Enterprise Integration Programmes in Mexican SMEs, in *Enterprise Engineering and Integration: Building International Consensus*, K. Kosanke and James G. Nell (Editors), Springer, pp. 431-438.
- Molina, A, Pongutá, S, Bremer, C. (1997). Information Model to represent the Core Competencies of Virtual Industry Clusters. WZL RWTH-Aachen.
- Molina A. Ponguta S., Bremer C.F., Eversheim W. (1998). Framework for Global Virtual Business. *Agility & Global Competition*, Vol. 2, No. 3, pp. 56-69.
- Molina A. and Medina V. (2003), Application of Enterprise Models and Simulation Tools for the evaluation of the impact of best manufacturing practices implementation, *Annual Reviews in Control*, Vol 27/2, pp 221-228.
- Mejia R., Molina A. (2002). Virtual Enterprise Broker: processes, methods and tools, in *Collaborative Business Ecosystems and Virtual Enterprises*, L. Camarinha-Matos (Ed.), Kluwer Academic Publishers, pp. 81-90.