EUREKA Umbrella 4090 PRO-FACTORY

The SCOPE of PRO-FACTORY 2007

Proposal by Hubert van Belle (26.06.2007)

EXECUTIVE SUMMARY

The new EUREKA umbrella PRO-FACTORY[1] focuses on advanced manufacturing technology and replaces the highly successful FACTORY umbrella[2]. The technological scope of PRO-FACTORY has been updated and restructured in order to more clearly communicate issues of strategic importance for SMEs .

Threats and opportunities for EU Manufacturing.

Although highly successful in many important sectors, European manufacturing businesses will continue to suffer strong competition from countries such as India and China. To prosper in the long-term, European companies need to develop new business strategies which combine innovation, research and technology, a highly skilled workforce and their overall operational effectiveness in ways which competitors find hard to copy.[3]

Production in Europe is expensive because of high labour and energy costs. Globalisation means that outsourcing becomes cost-effective. Despite this, Europe can compete successfully in the globalised markets. It has a large, sophisticated and increasing unified home market which creates demand for well-designed, high value-added innovative products. Investment in research and technology is rising, as is the level of business skills.

Objectives of PRO-FACTORY.

The PRO-FACTORY umbrella will help deliver the necessary technological expertise for Europe to create the next generation of advanced and innovative products and processes for global markets. The strategic aim of the PRO-FACTORY umbrella is to increase European manufacturing competitiveness by providing an application-oriented, bottom-up, collaborative R&D support mechanism primarily focused on “new added value products and related services” and “innovative production”.

PRO-FACTORY will achieve this overall objective by bringing forward more than 50 manufacturing projects mainly in the above priority area, with more than half including one or more SMEs and disseminating the results throughout the EUREKA countries, using seminars, case-studies, and a high-visibility website.

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1 Acronym PRO-FACTORY: Production, Research and Opportunities for FACTORY.

2 A EUREKA Umbrella is a thematic network with the overall objective to generate European (EUREKA) R&D projects within a specific thematic area clearly defined in its objectives.

3 See for example Michael Porter “What is Strategy”, HBR November-December, 1996.

Focus on Manufacturing Technologies for SMEs.

Europe's major manufacturing industries have successfully adapted their business operations to the new globalised environment and their R&D activities to the large and ambitious European Union Framework Programme. SMEs in traditional and established industry have found it more difficult to take part in these larger structures and often look for more bottom-up funding instruments.

The technological scope of the restructured PRO-FACTORY umbrella aims directly at SMEs and so complements the more top-down programmes. The proposed core technologies are important for the majority of manufacturing SMEs. The supporting technologies should also interest many SMEs and should also create opportunities for greater co-operation between big companies and their SME suppliers.

Therefore, PRO-FACTORY will place its focus primarily on SMEs in the manufacturing sectors because FP7 provides adequate support for longer-term, pre-competitive research involving larger companies. Nevertheless, projects which bring together large and small businesses will also be welcomed. Generally R&D with substantial technical or commercial risks but capable of rapid commercialisation will receive priority.

Technology Focus on New Value-Added Products, Innovative Production and Support Services.

PRO-FACTORY focuses on following core and supporting technologies:

Core Technologies

New or improved production technologies	Flexible and robust manufacturing systems	Environmentally friendly and sustainable production processes

Supporting Technologies

Integrated services close to products and production	Application of advanced ICT technologies in manufacturing	Improving the product development process	Business process improvement

Although the EUREKA PRO-FACTORY umbrella is focused on manufacturing technology, it will encompass all aspects of manufacturing. PRO-FACTORY must give special consideration to environmental sustainability, minimisation of materials waste and energy, re-cycling and re-use. Other technologies may also be included in so far as related to or applied to the manufacturing process, for example, design, simulation and modelling and the validation of such models.

Duration

Start date: 01.07.07 End date: 30.06.11

Participating Countries

The following EUREKA member countries participate in PRO-FACTORY[4].

Austria	Italy
Belgium	Luxemburg
Cyprus	Norway
Finland	Portugal
Germany	Spain
Greece	Sweden
Hungary	Switzerland
Ireland	Turkey
Israel	United Kingdom

[4] Further countries to be added on request

1. Situation of production and production research in Europe

The manufacturing sector in the EU is under increasing pressure.

Manufacturing activities are relocated to low wage countries and disruptive technologies have a dramatic impact on products and production processes in most industrial sectors. New competitors in China, India and Brazil are serious threats for the industry in Europe. How to compete and in which sectors with countries where the salaries are a fraction of the salaries in Europe, with a very limited social protection and almost no environmental regulations? A new global industrial revolution is underway and a in depth transformation of the European industry is needed. The transformation towards a knowledge based manufacturing which competes by high value added should be supported.[5]

The globalisation trend implies not only threats but creates also opportunities.

The new industrial countries are also growing markets and offer European companies possibilities for the outsourcing of low value-added production. If European companies want to compete then it has to be done in ways that potential competitors overseas find difficult to duplicate. Opportunities are created by the almost unlimited potential for innovation in the production sector and linked into that the interplay between the good produced and the associated services. An evolution to a full service economy and a complete de-industrialisation as proposed since the eighties of the previous century is not realistic and not desired for economic and social reasons.

2. Challenges for European manufacturing industries and their manufacturing research

Retaining control over key aspects of their operations.

A major challenge for manufacturing in Europe comes as more and more components are outsourced and manufacturing operations relocated outside of Europe. The danger facing Europe is that if manufacturing leaves Europe sooner or later also manufacturing planning will follow suit, and in the end, product development, - design, research and development will move out of Europe altogether. Major European companies have clearly realised the threats and opportunities of globalisation and responded by retaining control over key aspects of their operations, increasing rates of R&D and innovation within their overall business strategies, as demonstrated recently by the stellar performance of the German economy[6].

Long term strategy and planning has to be taken more into account.

Major European companies have developed business strategies which focus less on the lowest price but emphasis other competitive factors such as quality, design and value-for-money. Those companies, which have no long term planning within their company strategy and which fail to invest in technology and innovation are unlikely to survive.

Pay more attention to technology and innovation management.

Developing new technology is time-consuming and expensive and does not necessarily confer long-term competitive advantage as Porter has shown. However, companies which invest in technological innovation as part of a well-constructed business strategy are more likely to prosper. Strategic management of technology is indispensable in order to identify and evaluate future opportunities.

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5 ManuFuture and the 7th FP, DG Research, June 15th, 2006

6 See London Financial Times ‘Overhauled: why Germany is again the engine of Europe’ Friday 30 March 2007.

Capacities for research and development to be strengthened.

A sufficient capacity for R&D supports strategies based on technological innovation. In the past R&D expenditure in manufacturing have grown in line with increasing GDP, but have tended to stagnate in the recent years. This trend is disturbing.

Manufacturing related research to be strengthened.

Research expenditure for manufacturing businesses has not reflected the importance of this sector to the European economy, especially the more established and traditional industry. In the traditional industries existing technologies have found insufficient application so as to maintain and improve overall productivity, competitiveness and profitability. Indeed, European productivity has stagnated in recent years and the productivity gap with the US widen still further. In particular, Europe appears less good in using ICT in our business processes.[7] Clearly, Europe must make a greater commitment to adopt advance manufacturing technologies including ICT.

3. Opportunities for European manufacturing

Globalisation creates new market and networking opportunities for European companies.

The relocation of industrial activity creates purchasing power outside Europe and new customers for European products. Outsourcing of low value-added products outside Europe can also be a means to open local markets and to sustain high value-added activities in our manufacturing industry.

European manufacturing should re-assess its position in an open and world-wide market.

Areas where Europe should aim to secure competitive advantage are characterised by:

- high added value products, sophisticated and sustainable products and processes, tailor-made products, fast-changing products, knowledge-intensive products, product-service combinations;
- customer focus, manufacturing close to the customer, short time-to-market, small series, even one-of-a-kind production;
- extremely productive and/or flexible production, very fast (high speed) or rapid (time to market, lead time) production processes, high level of automation or flexibility;
- knowledge-intensive production, complicated production processes and production systems, lean and agile manufacturing;
- integrated approaches, continuous improvement and optimisation of all relevant aspects.

Particular attention should be given to creativity, originality, intellectual property rights (IPR), branding, and new and emerging market opportunities (e.g. sustainability, needs of the aging population).

Critical Success Factors (CSFs) for European manufacturing include: “high quality”, “innovative design”, “value-for-money”, “customised” for products and “fast”, “lean”, “agile” and “flexible”, “integrated”, “efficient and sustainable” in manufacturing operations.
A competitive advantage depends on the development and implementation of new technologies, methods, methodologies and systems which look to these CSFs.

Business strategies embracing technological innovation in these domains must receive our highest priority. But the next generation of advanced manufacturing and processing technologies will be expensive to realise, and no single organisation has all the resources needed. Collaborative R&D involving several organisations to share costs, risks, knowledge and expertise can overcome the

[7] i2010-First Annual Report on the European Information Society

problem of inadequate resources but left to itself markets fail to bring together the necessary combinations to succeed. Governments can facilitate the process of collaboration and it is here that PRO-FACTORY can perform an essential role by supporting collaborative research and disseminating results and information.

4. The Scope of PRO-FACTORY

Based on the challenges and opportunities described earlier, the FACTORY Working Group proposed a restructured and refocused umbrella, called PRO-FACTORY to replace the existing FACTORY umbrella. The new project is more clearly aimed at SMEs, with core subjects that are vital to the competitiveness of manufacturing business.

PRO-FACTORY will support collaborative R&D and demonstration across the broad field of manufacturing with priority given to the future development and implementation of manufacturing related technologies and processes. Since services related to products and production have become increasingly important, PRO-FACTORY will include such topics under as “supporting technologies”. In addition, the new umbrella will also cover environmental, organisational and social aspects when they contribute to the competitiveness of the manufacturing industry.

The European manufacturing industry faces major challenges as the trend towards globalisation leads to world-wide competition and outsourcing to low wage countries. This harsh new economic environment requires an in-depth transformation of the manufacturing sector for high-added-value and knowledge-based production. PRO-FACTORY will promote and support creativity and innovation in manufacturing to meet these challenges.

4.1 Critical Success Factors for the Manufacturing Industry

In different studies, authors have made interesting statements about Critical Success Factors (CSFs) for the manufacturing industry. Such CSFs have helped guide the PRO-FACTORY umbrella scope and activities. CSFs for today following EUREKA FACTORY are differentiation of products and services, combination of products and support services, “smarter" products, alliances with selected customers, market focus and strategic agility.[8]

For example, IBM recommended in the conclusions of an industrial benchmark to concentrate on core competencies, mass customisation, focus on market requirements, early supplier involvement, early manufacturing involvement, cross functional teams, simultaneous engineering, parallel development processes, Design For Manufacturing/Assembly, de-coupled development, complexity reduction, reduction of engineering changes, structured plan (Work Breakdown Structure), project management, gateway management, partnership with customers, knowledge management, etc. These CSFs are related to best practices in the automotive and rolling stock industry.[9]

The GartnerGroup noted that the successful enterprise works well with others, is aware of the environment, learns from experience and information, develops innovative solutions, adapts to changing situations, builds on growing knowledge base, understands diversity, selects and uses resources. The successful enterprise of the 21st century will be enabled by information, knowledge and technology (“the technology-enabled enterprise”).[10]

[8] Factory of the Future, EUREKA FACTORY.
[9] International Benchmarking Study Engineering Processes.
[10] The Successful Enterprise of the 21st Century. Technology Is Its Lifeblood.

4.2 Domain of PRO-FACTORY

The global manufacturing landscape changes continuously. Globalisation combined with the ever more rapid development of new technologies increases the pace at which new goods and services appear in the market place. Yet, in some ways, the industrial manufacturing challenges and R&D topic areas have remained essentially unchanged compared with those when FACTORY was first introduced.

However, the breadth and depth of those challenges and R&D areas have changed radically over the past decade. Technology has advanced with even greater leaps especially regarding manufacturing technologies. Advances in science and computer technologies have resulted in physical processes becoming better understood, so that their simulation and modelling have brought about for their more effective utilisation in manufacturing. The use of ICT in almost every part of the manufacturing process has not only transformed product development and manufacturing systems including better cognitive systems, human-machine interaction but in managing the operations of the business itself. None of these changes have taken place in isolation; other important drivers for change revolve around increased environmental awareness and the need for sustainability in a world of finite resources.

A competitive manufacturing industry means a holistic approach to manufacturing where a deep understanding of the core manufacturing processes must combine with a real appreciation of the economic, social and ecological environments. Europe's future success will depend not just on the ability to rapidly implement new processes, technologies and other R&D results but to do so in the context of sustainability, energy efficiency and environmental sensitivity.

The restructured scope of PRO-FACTORY has been done in order to address better these core issues, especially to SMEs. Improved production technologies and robust manufacturing systems may lie at the heart of the manufacturing process and will continue to be a critical factor for the European manufacturing industry, but European business most look further to sustainability and environmental concerns. The new PRO-FACTORY research agenda is set out in the next section.

4.3 Core and Supporting Technologies of PRO-FACTORY

Core Technologies

New or improved production technologies	Flexible and robust manufacturing systems	Environmentally friendly and sustainable production processes
Examples are high-speed cutting, laser manufacturing, new technologies for rapid prototyping, tooling and manufacturing. Modelling and simulation tools are useful for the optimisation of these new technologies. Nanotechnologies, Micro- and precision mechanics are a promising field	*Post-mass-production requires tools, machines, production-systems and work-structures which are flexible and robust. In order to create flexible and robust manufacturing systems, modular and adaptable machines and appropriate organisational principles must be developed and tried out. Production logistics has to deal with planning and control of material flows in disturbed environments.*	*Environmentally-friendly production processes will be stimulated by environmental rules and regulations. The complete life cycle from raw material to recycling has to be considered. Methods to assess the Life Cycle Cost and Environmental Engineering approaches need more attention.*

Other technologies while still important and within the scope of PRO-FACTORY are assigned to the "Supporting" category. Responsibility for many of these technological areas reside with large companies and with other R&D initiatives albeit often together with SMEs in a supplier capacity.

Supporting Technologies

Integrated services close to products and production	Application of advanced ICT technologies in manufacturing	Improving the product development process	Business process improvement
Customers increasingly expect complete problem solutions meeting their specific requirements. Services close to production, which are economically viable, in this way become major items in the product portfolios of equipment manufacturers. Additionally the planning, development and control processes for products and services close to production are to be integrated.	*Advanced modelling and simulation tools are needed for design, manufacturing, process planning, production planning or more general enterprise resource planning. ICT enables also virtual organisations, extended factories, digital manufacturing, virtual collaborative workgroups and network engineering.*	*Product designers have to deal with different and even conflicting objectives: technical specifications, reliability, availability, maintainability and safety requirements (RAMS), product cost, life cycle cost (LCC), design budget, project planning, quality requirements, environmental issues, etc. Appropriate design methods, methodologies, tools and systems to cope with these demands must be further developed*.	*Further research concerning enterprise architectures and best practices is required. Organisation of "knowledge work" is a neglected topic. Management of engineering and R&D departments, management of creative processes, organisation of teamwork, international co-operation and networking, project management and budget control need more attention.*

The detailed scope of each technology is described more fully in *appendix A*.

The themes mentioned in this chapter should not unduly limit the range of research topics and project ideas, but represent an attempt to indicate the priority technologies for PRO-FACTORY projects.

4.4 Important approaches and concepts

A successful manufacturing industry will rely heavily on the following approaches and concepts which in turn form vital components of the PRO-FACTORY umbrella.

Advanced industrial engineering

Manufacturing engineering (or sometimes industrial engineering), is fundamental to the future of European manufacturing industry. Methods, time study, ergonomics, work organisation, factory layout, etc. should be revisited and adapted to the new industrial environment. ManuFuture considers advanced manufacturing engineering as the core of manufacturing development and "the way that processes and production are organised in novel production patterns within factory units able to

respond flexibly to global demand (…) in the future world of customised products"[11]. The ability to implement new manufacturing R&D results together with the ability to adapt existing processes to the new environment will be a critical factor for many companies.

Integrated technology approaches.

Multidisciplinary and integrated approaches such as mechatronics, environmental engineering, CIM, IRM, the "digital factory" and "virtual enterprise" are necessary for a more optimal functioning of products and/or production organisations. In addition, the integration of different length scales in products and components (nano-micro-meso-macro) will become an important theme following the recent developments in micro and nano technology. These topics demand simultaneous technical development with interactive integration of different technology disciplines and subjects.

Collaborative manufacturing.

Collaborative manufacturing or networked and integrated manufacturing is considered as an important RTD target by ManuFuture.[12] With globalisation, complex manufacturing networks operating across multiple companies and countries will supersede the conventional linear sequencing of processes of today. Many manufacturing companies face challenges connected to working in collaborative and networked teams, primarily, but not only, in technology, organisation and communication.

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[11] Strategic Research Agenda. ManuFuture Platform, December 2005.
[12] Strategic Research Agenda. ManuFuture Platform, December 2005.

Appendix A: Technological scope of PRO-FACTORY

Listed here are the core and supporting subjects that together form the technical scope of the PRO-FACTORY umbrella. Projects may treat one or more areas; however some countries will not finance projects without core subjects.

A. New or improved production technologies

Product innovation is not sufficient in an international competition. Highly productive and flexible production processes, methods, tools and machines should be developed and implemented. Important aspects are: speed, lead time, precision, miniaturisation, environmental constraints. The future's machine tool will be extremely productive, autonomous, with combined processes, flexible, re-configurable and/or modular. Important research themes are: new machine configurations, advanced and open CNC-controllers, more natural human-machine interfaces.

Technical and methodological aspects of post-mass-production require special attention. Production of small series with short time to market and even "one-of-a-kind" production has to be considered. Rapid prototyping, rapid tooling and rapid manufacturing technologies become more and more important. New methods for flexible, productive and human oriented assembly with many product variants must be introduced.

Opportunities offered by new materials and non-conventional production processes have to be explored. Examples are nanotechnologies, high-speed cutting, laser manufacturing, new technologies for rapid prototyping, tooling and manufacturing. Modelling and simulation tools are useful for the optimisation of these new technologies. Micro- and precision mechanics are a promising field. Important research themes are: micro-production technologies, micro-assembly, machines for the production of (micro-) electronic devices.

B. Flexible and robust manufacturing systems

Today manufacturers have to deal with a great number of variants, a strongly fluctuating demand and small lot sizes. Planning departments have to cope with a very dynamic situation, certainly if lean manufacturing approaches are implemented. Existing planning systems are often not able to control the fluctuating, disturbed and increasingly random order flow in an appropriate way. Post-mass-production requires tools, machines, production-systems and work-structures which are flexible and robust. In order to create flexible and robust manufacturing systems, modular and adaptable machines and appropriate organisational principles must be developed and tried out. Self-controlling working groups using the latest technologies and tools, can lead to highly productive and flexible human-machine systems.

C. Environmentally friendly and sustainable production processes

Sustainability becomes a major concern for manufacturers. Environmentally-friendly production processes will be stimulated by environmental rules and regulations. There are also economic reasons for the implementation of new environmentally friendly production processes. Resources such as energy get scarcer and wastage becomes problematic. Minimisation of resource expenditures and optimisation of material flows becomes an economic necessity. The complete life cycle from raw material to recycling has to be considered. Methods to assess the Life Cycle Cost (LCC) and Environmental Engineering (EE) approaches need more attention. Environmental Engineering is dealing with all environmental influences of machines and equipment. Pollution, heat dissipation, noise, vibrations and Electro-Magnetic Interference (EMI) are included.

D. Integrated services close to products and production

In industry, in the capital goods sector in particular, companies need not only excellent technologies but also an attractive line of services. Customers increasingly expect complete problem solutions meeting their specific requirements. Services close to production, which are economically viable, in this way become major items in the product portfolios of equipment manufacturers. Due to the increasing complexity of machines and facilities the costs which are related to failures are continuously raising. Manufacturers are required to ensure efficient operation without any downtimes. Furthermore, new ways of division of labour in the value adding chain linking suppliers, manufacturers, and customers shift performance packages to the nearest preceding stages of this chain.

Technological lead alone is no longer sufficient in global competition when it comes to meeting customers' requests for tailor made problem solutions. It is necessary to integrate services close to production, as permanent components of a company's strategy, into processes of innovation and adding value in the capitals goods industry. In this way, a basis is established for increasing the profit contribution made by services close to production. This integration of services into the production system, and the associated supplements to the product portfolios of companies, require a large measure of information, know-how, and harmonisation.

Additionally the planning, development and control processes for products and services close to production are to be integrated. Organisational solutions, methods and tools for managing and controlling services close to production, starting from development and design, must be developed especially for SMEs. The immaterial character and pronounced customisation of services close to production make the workforce of a company the most important resource. Correspondingly, concepts, methods and supporting tools must be developed which integrate human resources requirements and competence development planning, as a critical parameter determining the success of services offered close to production, into the management and control systems of companies.

E. Application of advanced information and communication technologies in manufacturing

Information and communication technologies (ICT) are more than ever an important driver of innovation in manufacturing. Advanced modelling and simulation tools are needed for design (Computer Aided Design or CAD), manufacturing (CAM), process planning (CAPP), production planning or more general enterprise resource planning (ERP), etc. Systems for "computer aided everything" (CAX) that support the workforce on all levels have to be provided. Integrated product and process models should be developed to enable a description of the full product life cycle. New and powerful simulation tools for the optimisation of complex production situations are required. Agent based technology for instance, creates new opportunities for production planning and control in a continuous changing production environment.

ICT enables also virtual organisations, extended factories, digital manufacturing, virtual collaborative workgroups and network engineering. Integration of islands of automation, processing of non-structured information and knowledge management are important issues for the future of manufacturing. Concepts and systems such as Computer Integrated Manufacturing (CIM), Information Resource Management (IRM), Engineering or Product Data Management (EDM or PDM), workflow management and groupware should be revisited, updated and integrated. ICT-standards, modular open systems and Open System Architectures (OSA) are conditions for the enhancement of the integration process. Support of co-operation through new user-friendly forms of knowledge storage, processing and exchange is vital in the "New Network Economy" (NNE).

F. Improving the product development process

Engineering departments are under increasing pressure today. Innovation needs and opportunities, reduced product life, many versions and releases, short time to market, more complex products, mass customisation and modularization requirements, customer orientation, co-engineering, concurrent engineering, etc. have an important impact on the product development process. Product designers have to deal with different and even conflicting objectives: technical specifications, reliability, availability, maintainability and safety requirements (RAMS), product cost, life cycle cost (LCC), design budget, project planning, quality requirements, environmental issues, etc.

Appropriate design methods, methodologies, tools and systems to cope with these demands must be further developed. Advanced Computer Aided Engineering (CAE) tools, virtual product development approaches (digital mock-up's), change and configuration management systems are indispensable in engineering departments. New Computer Aided Design and Manufacturing (CAD/CAM) systems should allow for co-operative work within a company and between enterprises, even on a global scale. Systemic and integrated approaches and methods such as mechatronics (integration of mechanics, electronics, control engineering, information and communication technologies), environmental engineering, concurrent engineering are needed to improve the product development process and to optimise the product design. Methods and systems to stimulate creativity and for knowledge management are important too.

G. Business process improvement

The ideal "Factory of the future" or "Factory For the Future" (FFF) should be designed and build with an optimum level of performance in all areas of the value chain: design, procurement, manufacture, distribution and after sales service. To reach this goal the successful FACTORY of the future has not only to operate on a "lean" basis but must also be "agile". Agility means that in today's turbulent business environment companies must be able to shift their focus as market needs change (this is also called strategic agility). Such an organisation must also be able to adjust itself to external conditions that can radically change within relatively short time spans. Achieving this level of agility clearly focuses on human as well as managerial and technological aspects.

The ICT-systems, enterprise architectures, work structures and technical-organisational methodologies should be aligned to the business and adapted to the industrial environment. Further research concerning enterprise architectures and best practices is required. Organisation of "knowledge work" is a neglected topic. Management of engineering and R&D departments, management of creative processes, organisation of teamwork, international co-operation and networking, project management and budget control, etc. need more attention. Strategic thinking, technology foresight and roadmapping are methods which provide ideas for the "Factory with a future" concept. As simple as possible approaches are preferred.

Innovative business models need to be developed which implement new ways of division of labour between equipment providers and customers. New revenue and benefit models for the integration of services close to production into the production system are also required. Networking of enterprises and product-service combinations offer new business opportunities. Models of organisation and co-operation for value adding networks must be developed which take into account global operations, the geographic and cultural distances between the partners, the changed roles in the value adding chain and the specific characteristics of small and medium-sized enterprises. Instruments for the management and control of the corporate partnerships beyond the bounderies of each individual company are required. Methodologies to implement these new business models are also needed. As resources and possibilities to build up the appropriate competence's are limited in SMEs, the limits to the acquisition of external competences must be considered. It should be avoided e.g. that lean

manufacturing approaches shift the logistic problems to the subcontracting SMEs without any attention for their planning difficulties.