

1 Publishable final activity report

1.1 Project execution

The specific support action "Manufacturing Visions – Integrating Diverse Perspectives into Pan-European Foresight (ManVis)" (Contract No NMP2-CT-2003-507139) started early 2004. The aim of ManVis was to accompany the ongoing policy process of enhancing European competitiveness in manufacturing industries and to include views of European manufacturing experts.

The project was launched in response to the following factors:

- Results from previous foresight activities and empirical surveys indicated that manufacturing in Europe needs to strengthen its innovation capacity and to get into a more proactive position in the face of the increasing pace of product innovation
- Increasing debate on relocation of manufacturing outside Europe
- Commission activities in support of manufacturing (Manufacturing Action Plan – MATAP)
- Need to define research priorities for NMP in FP7.

Objectives of ManVis

In order to develop strategies for maintaining and improving the competitive strength of the manufacturing industries in Europe, both industry and politics need a convincing vision of the future for the European production sector. The goal of the project was to develop innovative and creative visions for the European manufacturing industry for the upcoming decades. In contrast to previous national and international studies on the manufacturing industry based mostly on individual aspects of the manufacturing sector such as technology development or materials research, ManVis aimed to develop holistic visions of the future of manufacturing. The declared objective was not to limit considerations of the future of manufacturing to individual topics, but rather to examine the widest possible spectrum of content from various research perspectives and from different interest representatives. The ManVis consortium consisted of scientists from 27 research institutes in 22 European countries (Austria, Belgium, Bulgaria, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, the Netherlands, Norway, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, Turkey, the United Kingdom).

ManVis approach

In order to develop this vision of the future, a core team of researchers from eight European institutes had conceptualised and conducted the Delphi survey. All these institutes possess a solid background in research on manufacturing foresight issues, each of them focussing on particular aspects needed for a holistic view on manufacturing. Furthermore, 22 workshops in all partner countries were held throughout Europe with a total of over 300 production experts from industry, research and academia. The objective of these workshops was to bring the particular national

views into the generating of statements about the future manufacturing sector which were then integrated in a widely deployed Delphi survey. In addition to European experts, additional stakeholders such as international production experts, consumers and users were included in the discussion process so that the most comprehensive and widely varied statements could be developed.

The derived 101 statements on the future of manufacturing covered all relevant areas of the manufacturing sector: manufacturing technologies, strategy, organisation and management, product features and concepts, logistics and supply chain, as well as working conditions. In addition, specific statements were developed for selected industry sectors and countries with the objective of capturing and analysing sector- and country specificities. The research has analysed the experts' assessments with regard to four categories. First, manufacturing experts estimated the importance of particular statements for the future of the European manufacturing industry and their time of realisation respectively whether they will be realised at all. Second, the data set provides an evaluation of the effects of each statement on European employment, competitiveness, living and working conditions, regional differences and environmental quality. Finally, possible barriers for the implementation of each statement such as the European level of education and qualification, economic viability, social acceptability and their technical feasibility were assessed by the manufacturing experts. Over 3,000 manufacturing experts from companies, political institutions and research facilities in 22 European countries participated in the subsequent Delphi surveys.

Final conference of ManVis

The international project completion conference "European Manufacturing – Quo Vadis?", was held on October 24 and 25, 2005 in Bled, Slovenia, to present and discuss the results of the ManVis project. The conference's primary objective was to reflect on the formulated development trends and visions with manufacturing experts of different national and career backgrounds in a joint session. Discussions covered results and visions as well as paths towards the long-term security of the manufacturing industry in Europe. A total of approximately 180 representatives from industry and academia as well as from European and national political institutions involved in the manufacturing industry participated in the conference.

Results of ManVis

Several possible trajectories for developments of the manufacturing of tomorrow came out of the ManVis findings:

- The struggle on labour cost competition will prevail in the next years. Basically there are two dimensions: the loss of operations to countries outside the European Union and the movement within the European Union. The strategies emerging from the ManVis expert consultation are mainly reactive i. e. cost reduction through automation and enhanced labour productivity. The New Member States will exploit in the very near future an existing cost advantage but will lose it faster than competitors outside Europe. Without own innovation capacities for absorption and enhancement, this foreign direct investment will just

pass through these Member States in a decade. In any way, outside Europe and intra Europe labour-cost competition are characterised by losses of employment in manufacturing.

- Local manufacturing operations and local R&D excellence – as general options – are reactive patterns as well. Very often based on concepts originating from the sustainable development debate this vision is characterized by local operations and development based upon very close interaction with local users – who still have to have purchasing power. The consulted manufacturing experts were quite sceptical on the prospects of this option because of their assessments on the weak ties of modern manufacturing into its environment, contrary to the consulted stakeholders who value this concept as feasible and competitive.
- Eco-sustainable manufacturing based on new products, new materials, energy efficiency, and last but not least on advanced product service systems could be developed into a competitive advantage for Europe – in the view of both experts and stakeholders. Regulations creating a demand pull, e. g. as outlined in the FutMan policy scenarios could be successfully mastered because of the excellent R&D position in this field.
- High end manufacturing will be based on the efficient use of sophisticated manufacturing technologies, which will enable world class highly automated operations for new products. This high ambition requires an exploitation of the expected potentials for micro electro-mechanical systems, related nano-technologies, closing gaps in automation, and research on manufacturing with new materials. But this high efficiency approach will reduce or only maintain existing employment in European manufacturing.
- The most ambitious and far-reaching vision is the European best practice in competing all over the individual firm's innovation system. This comprises user interaction, product development, production, supply chain, and logistics. The successful mastering of this "system" is considered the most promising way to ensure long-term competitiveness. But innovative and adaptive lead markets have to give European companies the chance to be the first to learn if they have effective user/customer interaction mechanism in order to exploit this advantage. Nonetheless, high-end manufacturing with sophisticated technologies is a prerequisite for any employment creating option.

In order to move along the different paths and create employment severe challenges have to be mastered:

- creating manufacturing based on sophisticated technology,
- developing knowledge based and learning companies and industries,
- competing through the firms individual innovation systems,
- re-defining and innovating demand through lead markets,
- keeping Europe economically united.

Because the science base is of growing importance in manufacturing, topics and issues have to be included into the funding mechanism of the planned European Science Council. Other existing mechanisms on transfer and mobility of researchers have to be maintained as well as international cooperation.

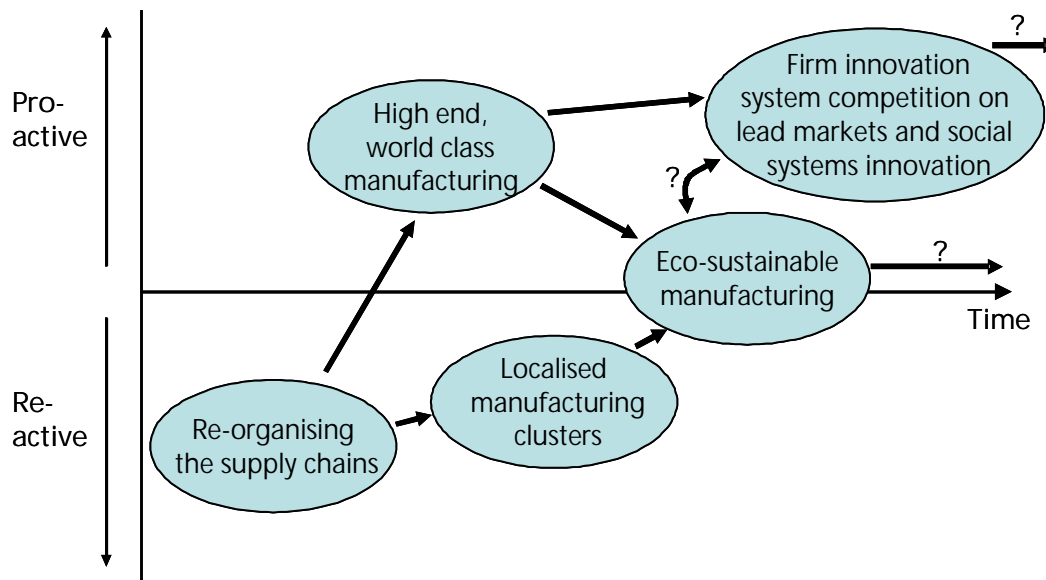


Figure 1: The ManVis trajectories for Manufacturing of Tomorrow

High-end manufacturing will not –in the view of the consulted experts– create new employment but safeguard existing jobs. Further, it is a necessary condition for the more advanced and employment creating overall trajectories. E.g. a successful and economically prevailing strategy on eco-sustainability requires high technology and professional organisation of product-service concepts.

Excellent research projects in manufacturing topics are needed (see box below). It is important not to concentrate on technological developments alone but the whole system of innovation in the firms has to be considered. This implies tools, strategies, methods, procedures etc. for product development, logistics, innovation management, business concepts etc. had to be added to the technological research agenda. The main challenge towards more pro-active strategies lies in the implementation of successfully learning companies which can adapt their innovation system fast.

Enhanced funding mechanisms should focus on the integration of user-interaction mechanisms. Accompanying measures should ensure the transfer of the R&D results e.g. by feeding them into other policies (e. g. standards, regulation) as well as preparing diffusion.

A harmonized policy approach is absolutely necessary if societal requirements and existing competences should converge into a lead market. First mover advantages could be only obtained if quick and decisive moves in demand development and shaping as well as competence building are made. In order to be successful, a thorough analysis of long-term demand and interactive participation of stakeholders and users is decisive for policy makers and industry, both. Hence, while closing the loop, exercising these practices in the R&D projects and efforts in manufacturing becomes of crucial importance.

The results of the ManVis Delphi survey have been

- integrated into the long-term planning of the European research funding for manufacturing,

- included in the debate on the Manufacture Technology Platform which is currently being developed (www.manufacture.org), and
- published and dispersed among potential users in government, industry and the general public.

Imminent technological research needs

Paving the way for new technologies in manufacturing

- roadmapping and foresight on manufacturing relevance of nano- and (white) bio-technology
- measurement, workplace safety for nano-technology and bio-technology
- applied basic research for white bio technology and nano-manufacturing

Industrialising technologies

- processing and manipulation of new materials
- incorporating smart materials into components for process technologies
- combining new materials with micro electrical mechanical systems (adaptronic)
- exploring new modelling knowledge and high power computing for simulation of product development, of material behaviour, and of virtual experiments

Exploiting technology advantages

- micro-systems in machine tools and products
- intelligent mechatronic systems for automation and robotics (e.g. self adapting components)
- new automation technologies using advanced human-machine interaction by considering diverse workers capabilities
- ICT-tools for traditional sectors

Technologies for customising products/services

- Tagging and labeling technologies
- Approaches towards product customisation via software or electronic components that allow for maximum flexibility and user integration
- Technologies and concepts facilitating user integration into innovation processes
- Technologies and concepts facilitating personalisation and build to order concepts
- SME appropriate tools for networks and logistics

Publications and use of results

The extensive results of the whole project are presented in the following **publications**: "Delphi Interpretation Report", "Overseas Report", "Scenario Report" and "Policy Paper" which are available for downloading at the project web-site.

The data sets of the ManVis Delphi survey containing the assessments of over 3000 manufacturing experts from all over Europe will be further exploited. They are used as a basis for future pro-

jects, research and consultancy work, such as foresight projects on a regional, national or cross-national level or European policy counselling projects. Moreover, ManVis results will serve as input for different groups such as industry, academics, EU and national authorities.

Finally, the activities of the ManVis project have established valuable contacts with more than 3000 manufacturing experts from industry, research and policy throughout Europe. Bring together manufacturing actors and stakeholders from all over Europe including the new member and candidate states, and jointly developing a vision and possible paths for securing the future of manufacturing in Europe can be stressed as a particular achievement of ManVis. This large and valuable manufacturing knowledge community can be also consulted in further research or policy actions.

Coordinators contact details

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Link to project web-site

<http://www.manufacturing-visions.org/>

Involved contractors in the ManVis project

Partic. No.	Participant short name	Participant name	Country
1	ISI (Coordinator)	Fraunhofer Institut for Systems and Innovation Research	Germany
2	UCAM	University of Cambridge, Institute for Manufacturing	UK
3	JRC-IPTS	Institute for Prospective Technological Studies	Spain
4		Ascam Foundation	Spain
5	OPTI	Fundación Observatorio de Prospectiva Tecnológica Industrial	Spain
6	IVF	IVF Industrial Research and Development Corporation	Sweden
7	UL-DEIP	University of Lodz: Department of Entrepreneurship and Industrial Policy University of Lodz	Poland
8	Cranfield	Cranfield University – School of Management	UK
9			
10	TNO	TNO-Institute for Strategy, Technology and Policy STB	The Netherlands
11	Logotech	LOGOTECH SA, Innovation & Development	Greece
12		FR Fondazione Rosseli	Italy
13	Tubitak	The Scientific and Technical Research Council of Turkey	Turkey
14		ARC-S ARC Seibersdorf Research	Austria
15	Uni Zagreb	University of Zagreb, Faculty of Economics Department of Organisation and Management	Croatia
16	LAPOM	University of Maribor, Faculty of Mechanical Engineering	Slovenia
17	Sintef	Stiftelsen for industriell og teknisk forskning ved Norges Tekniske Høgskole	Norway
18		DTI Danish Technological Institute	Denmark
19	VTT	Valtion Teknillinen Tutkimuskeskus (VTT Technical Research Centre of Finland)	Finland
20	Agoria	The multisector federation for the technology industry	Belgium
21			
22		FME Foundation for Market Economy	Hungary
23			
24	KVS SJF STU	Department of manufacturing systems, Faculty of manufacturing systems, Slovak University of Technology	Slovakia
25		AES Academy of Economic Studies	Romania

Partic. No.	Participant short name	Participant name	Country
26	BAMDE	Bulgarian Association for Management Development and Entrepreneurship	Bulgaria
27	IBATTU	Institute of Business Administration at Tallinn Technical University	Estonia
28			
29			
30	b-wise	b-wise GmbH – Business Wissen Information Service	Germany
31	CMI	CM International	France

1.2 Dissemination and use/ publishable results

1. The **project web-site** www.manufacturing-visions.org includes the description of the project, the list of all project partners, the online data base and an overview of all results published within the project.

2. **Online database** contains average values across all European experts for every of 101 statements of the Delphi survey. For each statement the results on Importance to the European Manufacturing industry, Time of realisation as well as Highest level of R&D in Europe are presented. There is a free access to the Online-Database over the ManVis web-site: www.manufacturing-visions.org.

3. **CD-Rom** with the proceedings of the ManVis Final conference "European Manufacturing – Quo vadis" took place in Bled, Slovenia from 24th to 25th of October 2005. The proceedings contain the conference program and all presentations which were supported by power-point including the main conference conclusion on each discussed topic. Furthermore there are numerous conference photos and the list of participants. CD-Rom was published by Fraunhofer ISI and can be obtained there (see contact below).

4. **ManVis Reports** (All reports listed below are available for downloading on the ManVis-web-page: www.manufacturing-visions.org)

4.1 **Delphi Interpretation Report** contains extensive results and interpretations of the Delphi survey as well as the main policy conclusions on all important aspects of the manufacturing covered by the survey. It is structured as follows:

1. Introduction
2. Dynamics and Foresight of Technological Developments in Manufacturing