I*PROMS: Innovative Production Machines and Systems

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*Das Institut für Maschinenwesen (IMW) ist stellvertretend für die Technische Universität Clausthal (TUC) Mitglied im Europäischen Exzellenznetzwerk Innovative Produktionsmaschinen und Systeme (I*PROMS). Dort arbeiten 30 Partner aus 14 Ländern an Forschungsaufgaben der Fertigung und Produktion. Die Vision einer wissensbasierten Fabrik der Zukunft wird in vier unterschiedlichen Teilgruppen (Cluster) untersucht. Außerdem wird die Möglichkeit der Teilnahme an den Forschungsaktivitäten vorgestellt.*

*Manufacturing is important to the European Union. Solving problems of fragmentation and lack of co-ordination of research concerning manufacturing within the EU, the Commission of the European Community has adopted Networks of Excellence (NoEs) as an instrument for promoting integration in its Sixth Framework Programme. One of this NoEs is called I*PROMS-Innovative Production Machines and Systems. It aims to address many of the challenges facing the manufacturing sector in the 21st century. The paper discusses the strategy this NoE is pursuing to achieve.*

1 Introduction

Manufacturing in the EU is increasingly being challenged by global competition /1/. Experts acknowledge that, for the EU to attain and sustain a leading role in the global market, radical measures are necessary to stimulate restructuring of the European Research Area and closer collaboration in manufacturing research. The newly enlarged EU comprises over 25 million enterprises employing more than 120 million people. The number of manufacturing businesses is calculated as being about 10% of this total, i.e. some 2.5 million /1/. European manufacturing activity today represents approximately 22 % of the EU GDP and 18-20% of the workforce.

An interesting characteristic of European enterprises is that the majority of them are SMEs, with 93% being micro-enterprises employing fewer than 20 people. Such a characteristic can be positive in relation to opportunities, as SMEs tend to be more flexible in operation and innovative in nature, but can also be a weakness. For instance, micro enterprises have smaller export impacts: SMEs export only 13% of turnover, whereas large enterprises gain 21% of their total turnover from abroad. Furthermore, SMEs are more concerned with short-term 'fire-fighting' rather than longer-term RTD commitments /1/. However, as SMEs are at the very heart of manufacturing within the European Union, it is essential that they participate in research or at least that the results of RTD activities are passed onto them so the full benefit to the EU economy can be derived.

In most sectors, global comparisons show that European manufacturing industry continues to be successful in maintaining its leadership. However, this position is challenged on two fronts. On the one hand, EU industry faces continuing competition from other developed economies, particularly in the high-technology sector. On the other hand, low-wage economies are increasingly threatening the more traditional manufacturing sectors /1/.

The European manufacturing sector has strengths that it needs to build upon. In many respects, industry throughout Europe is modern and competitive and most sectors have made significant efforts to upgrade their production infrastructures and integrate new forms of organisation /1/. However, European industry cannot afford to be complacent and needs to adapt its production systems and methodologies to meet the challenges of the 21st century.

Europe has embraced the sustainable development dimension with significant investments in environmental protection, clean technologies and environmentally friendly production processes having led to new manufacturing and consumption paradigms. This could give a strong impetus to EU industries, offering the potential to expand and/or create new markets /1/.

Advanced manufacturing research holds the key to the future competitiveness of Europe. European industry needs to concentrate on innovation, high technology, high-value adding processes and high knowledge-content products to maximise its future potential.

However, research investment in the EU is considered to be too low. These raises many potential problems linked to the sustainable competitiveness of the European manufacturing sector in a complex and globalise environment /1/. Significant investment in relevant research would help to sustain not only competitiveness but also employment. Evidence of this comes from the Netherlands where, between 1994 and 1998, 8% of fast-expanding firms created 60% of employment growth /2/.

Research within the EU also has a tendency to be highly fragmented with research being conducted by thousands of organisations with little co-ordination and with duplication of resources and efforts. This is compounded by duplication of funding for research at regional, national and EU levels.

2 Networks of Excellence (NoE)

Networks of Excellence (NoEs) are a new 'instrument' introduced to FP6 by the European Commission. NoEs are aimed primarily at overcoming fragmentation of European research. The main deliverable of a NoE is durable structuring and shaping of the way that research in Europe is carried out on particular topic /3/.

NoEs are designed to strengthen scientific and technological research excellence in particular subjects in a cost-effective way. Through integration, NoEs can eliminate duplication of efforts and maximise resource utilisation. This is to be achieved by assembling at the European level the critical mass of human and material capital needed to provide European leadership in the chosen spheres of activity. Central to a NoE is a joint work programme aimed principally at creating progressive and long-term integration of the research capacities of the network members. At the same time, the programme also includes joint research activities to advance the state-of-the-art in the particular field.

The sizes of NoEs can vary. However, they are all characterised by being virtual centres of excellence with strong governance. Their common driving factor is to pursue ambitious research objectives and mobilise the resources needed to achieve their targets and to meet the primary goal of integrating research within the European Union. In addition, part of their mission is also to spread excellence well beyond their own boundaries.

This paper outlines a Network as example of FP6 NoEs designed to help integrate research in advanced manufacturing in the EU. The Innovative Production Machines and Systems (I*PROMS) NoE is an umbrella network covering the whole area of knowledge-based production technology and organisation, an area critical to manufacturing competitiveness.

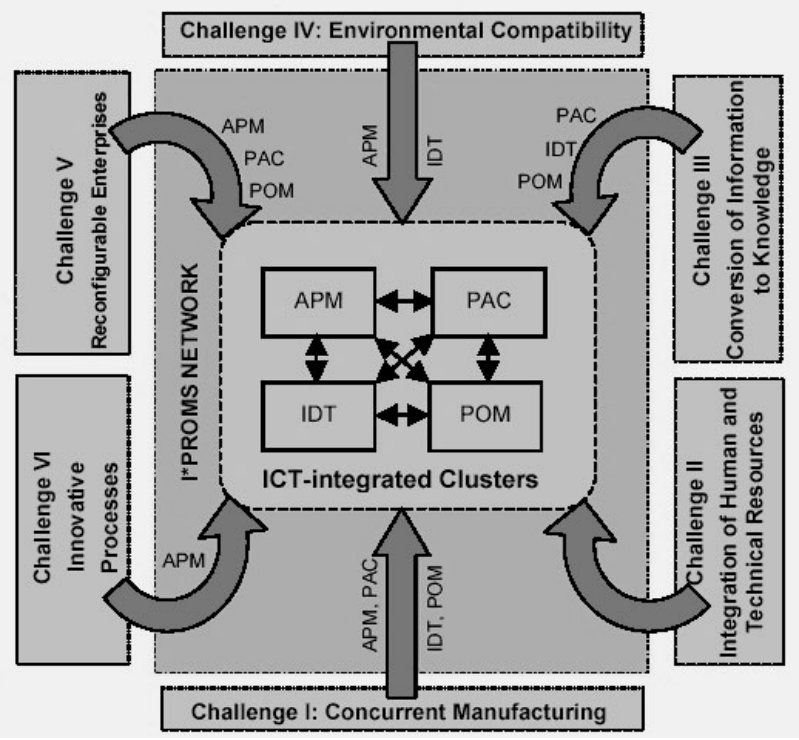

Fig. 1: I*PROMS and the Six Manufacturing Challenges /6/.

3 Innovative Production Machines and Systems (I*PROMS)

I*PROMS NoE integrates the activities of 30 like-minded research institutions and companies in the field of production research from 14 European countries. It seeks to achieve the goal of strengthening the European research base in the umbrella area of Innovative Production Machines and Systems. Like other FP6 NoEs, I*PROMS focuses on integration but also includes joint research and dissemination activities to advance the re-search frontier in the area and spread excellence widely.

3.1 Research Challenges

Addressing the NMP (Nanotechnologies and Nanosciences, Knowledge-based Multifunctional Materials and New Production Processes and Devices) thematic area /4/, I*PROMS aims to facilitate the development of common concepts, tools and techniques enabling the creation and operation of flexible, re-configurable, fault-tolerant and eco- and user-friendly production systems that can react to changing customer needs, environmental requirements, design inputs and material, process and labour availability to manufacture high quality, cost-effective products.

I*PROMS will address the six 'Visionary Manufacturing Challenges for 2020' published by the National Academy of Sciences /5, 6, 7/, namely,

- Concurrent Manufacturing,
- Integration of Human and Technical Resources,
- Conversion of Information to Knowledge,
- Environmental Compatibility,
- Re-configurable Enterprises,
- Innovative Manufacturing Processes and Products.

Research on the above challenges will be pursued by four interconnected research clusters (s. Fig. 1): Advanced Production Machines (APM), Production Automation and Control (PAC), Innovative Design Technology (IDT) and Production Organisation and Management (POM).

The APM cluster is concerned with machines for processing new/nano/smart/high-performance materials, micro-manufacture machines, rapid manufacturing machines, and manufacturing robots. The PAC cluster includes self-adaptive control, flexible/re-configurable manufacturing, adaptive quality systems, agent-based distributed architectures, (machine) knowledge management, and human-machine interaction. IDT relates to the designers of the factory and products of the future, designing the innovative, customisable, value-added products of the future, and the factory machines and systems required to produce them. POM represents the management of the factory of the future. It includes advanced process control, enterprise and manufacturing simulation, (human) knowledge management

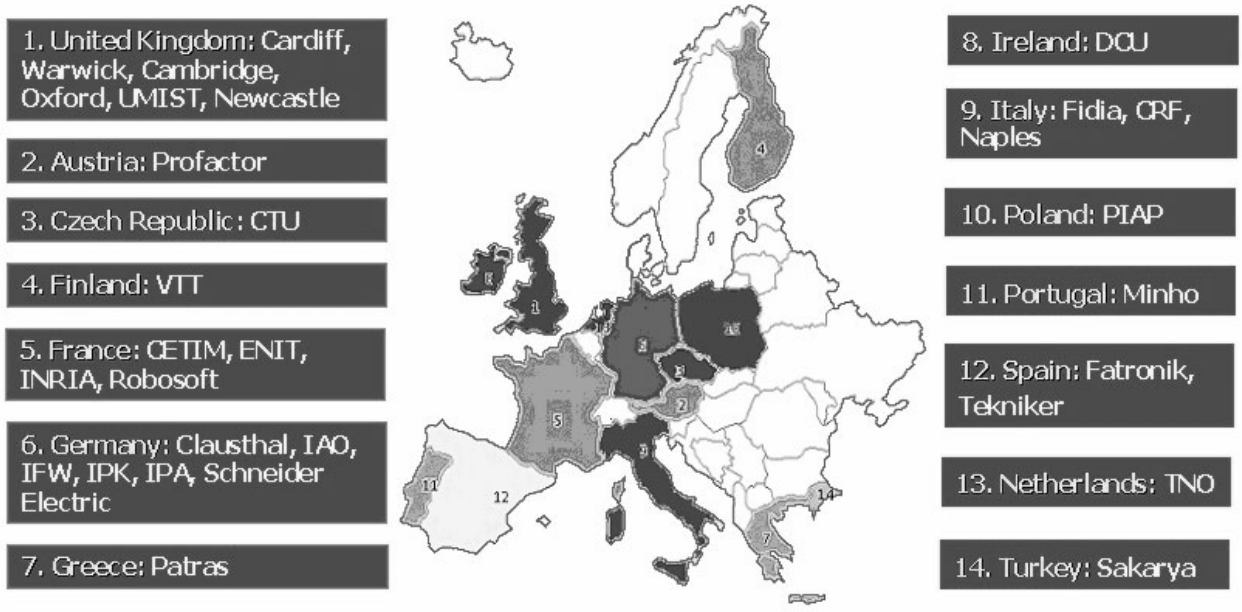

Fig. 2: Core team from different expertise inside Europe.

and human-computer interaction at the organisational, enterprise level.

3.2 Activities

Under I*PROMS umbrella the four research clusters will undertake the following activities:

- Integration, I*PROMS aims to integrate its operations within 5 years to become a globally recognised and industrially effective Virtual Centre of Excellence, with its own management structure and vision for delivering increased competitiveness and value for manufacturing.
- Joint Research Activities, I*PROMS's jointly executed research will address the six Manufacturing Challenges for 2020 /8/ through the above mentioned I*PROMS clusters - achieved through collaborative research.
- Spreading of Excellence, I*PROMS will exploit results produced through its activities, disseminating knowledge, both to those outside and inside the net-work.
- First Virtual International Conference /9/ on Intelligent Production Machines and Systems was held in July 2005. This activity was organised in a way that participants can meet and discuss themes of common interest through the use of communication tools at a central location on the Internet.

4 Possible Opportunities

With this NoE, enterprises interested in the field of innovative production machines and systems (as well as universities) can be connected through associate membership of the NoE. This allows cooperation and new research assignments with some of the thirty core partners (s. Fig. 2) supported by the European Commission. Moreover, through this partnership every activity in I*PROMS NoE can be benefited from, first access to published documents about results is available and international scientific relations with experts can be established. Therefore, I*PROMS can be considered a platform for everybody who attaches importance to future tasks in European manufacturing /10, 11/.

5 Acknowledgement

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