IMS 2020

Supporting Global Research for 2020 Manufacturing Vision

Shape the future of manufacturing with us !

Contribute to our research via www.ims2020.net

SEVENTH FRAMEWORK PROGRAMME

www.ims2020.net

Project Overview

Join the Community!

How do manufacturing companies meet the challenges of global change in their industry? As clearly stated by many experts, for these companies it is essential to develop new manufacturing strategies based on research and innovation. The international manufacturing sector calls for a deep industrial transformation in order to meet the needed competitive, environmental and social challenges.

IMS2020 is a project conducted by an international consortium of 15 core partners and a large group of supportive members from Europe, Japan, Korea, Switzerland and the USA. The project focuses on the creation of roadmaps towards Intelligent Manufacturing Systems (IMS) in the year 2020. The roadmaps highlight the main milestones of innovation activities (research and development, management and policy actions) needed to achieve the desired vision.

IMS2020 identifies relevant research topics and supporting actions to shape the future of intelligent manufacturing through international cooperation. It is a coordination and support action for strengthening international and interregional co-operation in Intelligent Manufacturing Systems under the IMS initiative. In particular, the project has five main scientific and technical objectives:

Objective 1:
Prepare a roadmap for future manufacturing research in the five IMS Key Areas.

Objective 2:
Identify new schemes & frameworks to support MS research.

Objective 3:
Stimulate small and medium enterprise's participation in international cooperative research and development projects.

Objective 4:
Establish international and inter-regional communities in the five IMS Key Areas.

Objective 5:
Prepare the ground for new IMS proposals and manufacturing projects.

IMS2020 wants to attract interested people and organisations to have the worldwide most qualified actors in the five IMS Key Areas to discover common innovations and potential in manufacturing.

These Five Key Areas are:

- Sustainable Manufacturing, Products and Services
- Energy Efficient Manufacturing
- Key Technologies
- Standardization
- Innovation, Competence Development and Education

With the support of a wide Roadmapping Support Group, made of experts coming from enterprises, research centers and universities worldwide, the project will discover new destinations for developing Intelligent Manufacturing Systems in the forthcoming decade.

If you are interested in sharing the IMS community's knowledge, and have the chance to shape the future of manufacturing with us, join us. To contact us write to:

Project Coordinator:
Prof. Marco Taisch
Professor of Operations and
Supply Chain Management,
Phone: +39 (02) 2399-4815
Email: marco.taisch@polimi.it

Project Manager:
Dr. Ing. Jacopo Cassina
Department of Management,
Economics and Industrial Engineering
Phone: +39 (02) 2399-3951
Email: jacopo.cassina@polimi.it

Politecnico di Milano, Department of Management,
Economics and Industrial Engineering

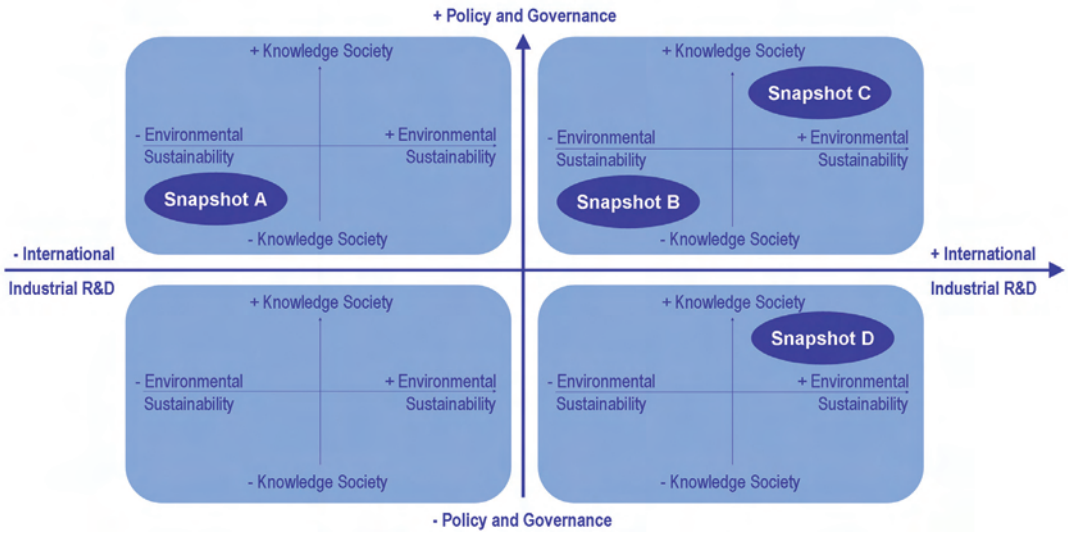
The IMS2020 Vision

Definition of a Desirable Future

The IMS2020 Roadmaps depart from the research topics and supporting actions identified in each of the five Key Area Topics (KAT) under analysis. The IMS2020 Roadmaps show the possible impacts and benefits that the implementation of research topics through international collaboration between could deliver 2011 and 2013, leading thus to the achievement of the defined IMS2020 Vision.

The IMS2020 Vision is based on inputs from the mapping activity, the first online survey, the industrial workshops and interviews with industry representatives. The first step in devising the IMS2020 Vision was to develop scenario snapshots on how the future of manufacturing could look like by 2025.

A framework outlining the main IMS dimensions influencing all five KATs under consideration was designed according to the following figure and used to define, which snapshots to develop.



All features within each snapshot were then assessed on their likelihood and desirability by 2020. The results of this exercise were used as an input for the development of the IMS2020 Vision. During a vision building workshop inputs from each of the five KATs where gathered on how manufacturing and the world would look like in 2020, if all research topics identified within each KAT become real. The IMS 2020 Vision can be summarised through three main statements:

1. Rapid and adaptive user-centred manufacturing, which leads to customised and ‚eternal' life cycle solutions
2. Highly flexible and self-organising value chains, which enable different ways of organising production systems, including infrastructures, and which reduce the time between engaging with end users and delivering a solution
3. Sustainable manufacturing possible due to cultural change of individuals and corporations supported by the enforcement of rules and a regulatory framework co-designed between governments, industries and societies

Methodology

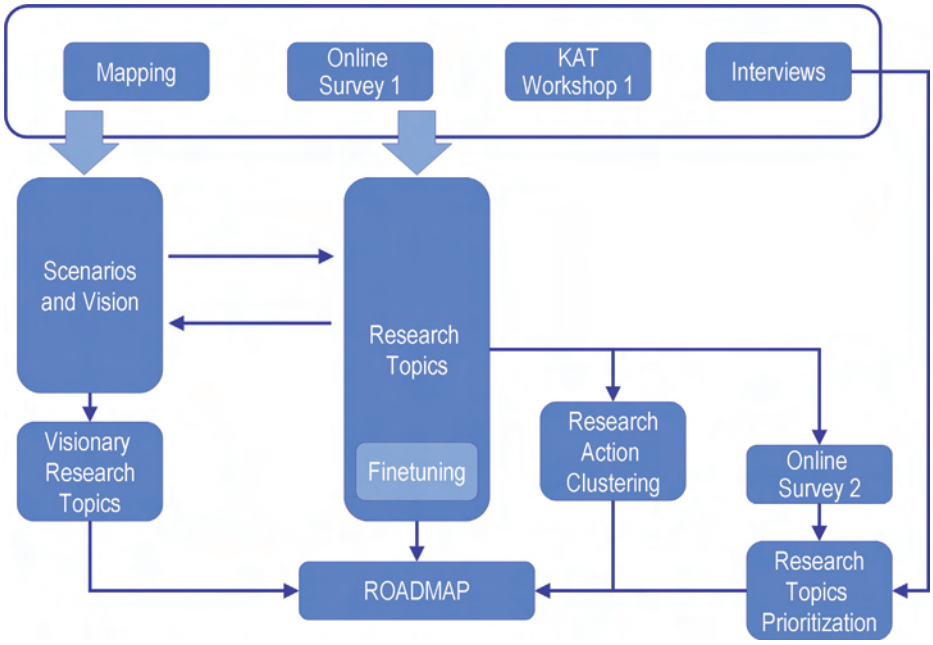
Roadmapping work structure

The methodology for the IMS2020 roadmapping process has been designed in order to ensure the highest relevance to input coming from the industrial community as well as to ensure the international relevance to the results. Moreover, the work has kept into high consideration the work already and recently done both at European and International level on proposing roadmaps in the field of manufacturing.

Most of the development has been done through collaborative tools shared with all the Roadmapping Support Group, a growing community that, at the moment, counts about 350 international participants from ca. 150 mainly industrial organizations.

Starting from the mapping of the existing roadmaps and ongoing researches, an open online survey, two brainstorming workshops and 106 interviews, the IMS2020 team has developed some possible future scenarios for the 2020 manufacturing and a set of over 80 research topics to be proposed to the European Commission and the IMS Initiative.

The figure below summarises the approach of the roadmapping process.



On the following pages, you can find results from the five Key Area Topics (KAT).

KAT1

Sustainable Manufacturing, Products and Services

This vision of sustainable development and sustainable manufacturing is, nowadays, after years of pure speculations, growing into importance. Concrete application of sustainability issues are ongoing, while the market and the consumers are more and more asking and taking care of eco and sustainable issues. At the same time, the regulation work done in these years is being applied and is under continuous development to fit the growing requests and requirements for sustainable measure and rating, which starts being a competitive advantage. Moreover, with the increase of resource and energy prices, it is a key aspect manage correctly their shortage.

The sustainable manufacturing vision, is still far to be achieved, but has to be the basis of future researches and developments. Moreover, due to globalization, the sustainability issues have to be analyzed and developed not only at national or regional level, but guidelines and regulations have to be done at worldwide level. For this reason, sustainability has a great role for the future of manufacturing, aiming at improving the sustainability of the technologies, the products and production systems, as well as the businesses behind them.

According to this vision and this focus, the main areas for concerted Research Actions are:

1. Technologies for Sustainability

Holistic view of product cycles in the manufacturing industry and life-cycle-optimisation of manufacturing systems, products and services

2. Scarce Resources Management

Material reuse optimization, reducing global consumption of engineering materials (i.e. hydrocarbon fuels; metals and polymers)

3. Sustainable Lifecycle of products and production systems

Performance and Quality of products, services and processes, and safety of people, but also of the related facilities and infrastructure

4. Sustainable Product and Production

Contribution towards the modernisation of industry by improving the quality of product information and ease of access to information at the design, production, utilization and end of life stages

5. Sustainable Businesses

Managing all the conflicting aspects of sustainability in an integrated manner, focusing not only on environmental or social performances but also on sustainability of business

List of Research Topics

The before mentioned Research Actions are furthermore split up into the following Research Topics:

1.1 Technologies for Sustainability

Quality Embedded Manufacturing
Additive Forming Processes for Manufacturing
Sustainable Data Management
Integrative Logistics Tools for Supply Chain Improvement

1.2 Scarce Resources Management

Material Re-Use Optimization
Resource Recovery from Alternative Fuels and Raw Materials

1.3 Sustainable Lifecycle of products and production systems

Real-time Life Cycle Assessment
Cost Based Product Lifecycle Management (PLM)
Maintenance Concept for Sustainability
Predictive Maintenance

1.4 Sustainable Product and Production

Green Controller for Machining
Sustainability Metrics
Sustainability Workshops
Sustainable Packaging
Optimization of Electronic Sustainability
Materials Re-Use Optimization
Sustainable Supply Chain Design
Management of Hazardous Substances in Manufacturing
EOL Management Supporting Technologies

1.5 Sustainable Businesses

Sustainable Small and Medium Enterprises
Exploiting Disruptive Innovation for Sustainability
Integrated Service Supplier Development
Product-Service Engineering
Alignment of IT and Business Strategies
Multi-Dimensional Inventory Management
Lean Management for Service Industries
New Workplaces for Aging and Disabled Workers

KAT2

Energy Efficient Manufacturing

Manufacturing is playing a core role when it comes to green house gases and final energy consumption. With 33% of final energy consumption and 38% of direct and indirect CO2 emissions (IEA 2008), manufacturing industry has the biggest share in both.

From the companies' point of view the importance of energy efficient manufacturing has various reasons, for example customers changing their purchasing behaviour with regard to "green" products and services, rising energy prices, or emerging of new environmental regulations. Using the available energy more efficiently is a way to meet ever-rising energy needs and secure energy supplies.

The IMS2020 Key Area "Energy Efficient Manufacturing" aims for reducing the scarce resource depletion as well as the carbon footprint by considering innovative methods and technologies. Products and processes are no longer just subject to cost and quality.

According to this vision there are four major areas for Research and Action.

1. Energy Sources for Factories

In order to cope with rising energy prices, risk of unavailability and customers' environmental awareness, adapted sourcing strategies help to become independent from external energy suppliers and to use available energy in factories

2. Efficient Production Processes

Reducing energy consumption whilst increasing the output of the manufacturing processes by increasing the efficiency and productivity; novel technological approaches in manufacturing equipment to the specific energy consumption

3. Energy Utilization in Collaborative Frameworks

Dissipating energy in form of heat or by products is in many cases perceived as waste output; however, an economically viable reuse is often possible in another production process or industrial sector

4. Management and Control of Energy Consumption

Measurement and control systems as an integral part of the manufacturing system; new energy management systems form a basis for deciding about energy efficiency improvement measures

List of Research Topics

The before mentioned Research Actions are furthermore split up into the following Research Topics:

2.1 Energy Sources for Factories

Energy Autonomous Factory

Using Energy Harvesting for Powering Electrical Sensors and Devices in Manufacturing Processes

2.2 Efficient Production Processes

Energy Efficient Particle Size Reduction

Green Manufacturing for Future Vehicles

Emission Reduction Technologies

2.3 Energy Utilization in Collaborative Frameworks

Technological Access to Wastes for Enhanced Utilization

Intelligent Utilization of Waste Heat

Framework for Collaboration in the Alternative Fuel and Raw Material Market

2.4 Management and Control of Energy Consumption

Energy-Aware Manufacturing Processes – Measurement & Control

Integrating Energy Efficiency in Production Information Systems

Product Tags for Holistic Value Chain improvements

KAT3

Key Technologies

In the manufacturing sector the main technological driver has been the productivity growth while reducing costs. In the next decade, in a view of global markets and networking manufacturing communities, state-of-the-art technologies will continue playing that key role, because this time manufactures will demand value-adding, competitive and sustainable manufacturing systems and processes along their entire lifecycle, so that appropriate enabling technologies will be required for that ambitious goal.

Indeed, technologies such as e.g. intelligent cognitive elements, adaptive systems, diagnostic features and multi-disciplinary simulations will establish the basis for allowing system builders to deliver to customers customised configurable systems at reduced costs and minimised lead-times, and in turn, will allow the users of said systems to embed value into their manufactured final products along highly efficient production processes.

Within this vision, the IMS2020 Key Area "Key Technologies for Manufacturing" aims at developing the technologies for allowing system builders to produce value-adding systems at minimised costs and environmental impacts and for allowing the users of said systems to produce value-adding customised products with increasingly shorter delivery times and of high technological content.

In particular, four areas are proposed for that research:

1. Flexible Manufacturing Systems

Support the ability to adapt quickly to market challenges and to take advantage from market changes, flexible production systems, knowledge for the creation of new products and processes

2. Cost-Saving Manufacturing Systems

Minimisation of costs as a new approach to reduce systems' downtime and maximising efficiency, aiming at conceiving, designing, producing and using cost-effective, value-adding and sustainable manufacturing systems to minimise total life-cycle costs

3. Energy-Saving Manufacturing Systems

Innovative solutions with reduced consumption of energy and material resources to assure a competitive position and a sustainable development of the manufacturing sector, introducing new parameters for energy efficiency and raw-material efficiency

4. Key Technologies embedded in manufactured products

Products, services and processes, as a means for increasing the value that customers perceive when using said technological products, focusing on solution thinking

List of Research Topics

The before mentioned Research Actions are furthermore split up into the following Research Topics:

3.1 Flexible Manufacturing Systems

Modular Assembly /Disassembly Production Systems
Control for Adaptability
Mutable Production Systems
Model Based Engineering and Sustainability
Cooperative & Mobile Manufacturing Systems
Mechanical MicroMachining Enhancement
Forthcoming „Brown Fields“ Re-Engineering
Extracting Higher Potential from Regional Cluster Based on Professional Virtual Collaboration Platforms
Ontology Based Engineering Asset Management

3.2 Cost-Saving Manufacturing Systems

Lower Labour and Energy Cost Performance
Interoperable Products and Production data exchange
High Resolution Total Supply Chain
Build-to-Order - New Production Planning and Control Models for Complex Individualized Products
High Performance (High Precision, High Speed, Zero Defect)
Model-based Manufacturing
Knowledge Generation Systems
High Accuracy Modelling
Semantic Business Processes
Dealing with unpredictability

3.3 Energy-Saving Manufacturing Systems

Efficient Use of Raw Materials
Advanced Automation for Demanding Process Conditions

3.4 Key Technologies embedded in manufactured products

Business concept B2C-communities
Knowledge Embedded Products

KAT4

Standardisation

It is necessary that innovations like new products or optimized processes arising from the proposed research topics in IMS 2020 quickly spread into practice. While the research topics mainly stimulate the innovations, they have to be supported by a suitable tool ensuring the efficient diffusion of these innovations into the market. Standardisation can serve as such a tool.

Because of the strong relationship between innovation and diffusion into practice, early standardisation activities should be already implemented in the innovation process. This approach would as well reduce the time lag between innovations and their macroeconomic impact. Furthermore, standardisation can optimally fulfil its duty to enhance this diffusion, if technology leaders in research and industry support the standardisation process.

The proposals coming from the Key Area Topic Standardisation are embedded in the Research Topics of the other Key Areas as a "Specific Feature". The „Standard Vision" for each Research Topic identified in the previous pages is given below:

Standard Visions for KAT 1 - Sustainable Manufacturing, Products and Services

1.1 "Communication and semantic standards enable technologies to support sustainable manufacturing"
1.2 "Closed loop approaches based on product-, component- & material standards preserve scarce resources"
1.3 "Electronic information & data standards facilitate the integration of Sustainable Lifecycle Production Systems"
1.4 "Sustainability in products and production requires standardization activities to a wide extent"
1.5 "Interface paired with business process standards pave the way for sustainable businesses"

Standard Visions for KAT 2 - Energy Efficient Manufacturing

2.1 "Efficiency measurement standards enable the efficient use of companies' energy sources"
2.2 "Development of closed loop management standards and product and component standards fosters the efficiency of production processes"
2.3 "Interface standards are a precondition for the recovery of energy in collaborative frameworks"
2.4 "Standardized measurement approaches are a prerequisite for energy consumption management and control"

Standard Visions for KAT 3 - Key Technologies

3.1 "Standardized data and processes allow high level flexibility in manufacturing systems"
3.2 "Interface and process standards open up cost saving potential in manufacturing systems"
3.3 "Energy saving in manufacturing systems grounds on standardized interfaces"
3.4 "Communication standards provide a basis for innovative Community-concepts and enable knoledge embedded production-processes"

List of Research Topics

The before mentioned Research Topics on innovation, education etc, have been used also as basis for specific activities within Research Topics from KAT1-3. The relations between KAT4 and KAt1-3 are displayed below:

4.1 Interface standards

Electronic information and data standards (format)
Communication and semantic standards (content)
Physical interface standards

4.2 Measurement standards

Measurement standards for process efficiency
Measurement standards for production efficiency
Measurement standards for manufacturing efficiency
Measurement standards for waste detection
Measurement standards for emission detection

4.3 Process standards

Design process standards
Manufacturing process standards
Business process standards
Closed loop management standards

4.4 Safety standards

4.5 Product and component standards

4.6 Material standards

KAT5

Innovation, Competence Development and Education

Manufacturing has moved from a pure technology view to a view integrating technology, business and management. The extended view on manufacturing reflects a need for a new competence for the industry. The future manufacturing engineer must be trained for the integrated view and must at the same time manage the societal needs for sustainability and environment protection.

Human resources and competence for science and technology are vital to innovation and economic growth, because highly skilled people create and diffuse innovations. The demand for skilled workers is expected to increase owing to real growth in research and development, and the growing application of advanced technologies. This reflects an increasing need for highly skilled workers across the economy as a whole.

The identified respective Research Topics (not clustered in Research Areas) are:

1. Teaching Factories
Real production facilities developed for education and training purposes for students and workers, reducing the gap between academia and industry, and improving life long learning

2. Cross Sectoral Education
Efficiently acquiring cross sectoral competence on a continuous basis, particularly in small and medium enterprises, where individuals need to stay up-to-date in many disciplines

3. Communities of Practice
Understanding of the important processes, in which individuals develop, use and communicate innovative and dynamic knowledge, outside of the traditional knowledge management systems

4. From Tacit to Explicit Knowledge
Research into how emerging technologies (unstructured tagging, weblogs, wikis, etc.) may help to capture tacit knowledge, in conjunction with understanding, how this knowledge may be socialized

5. Innovation Agents
Development of global innovation agents finding and developing innovation and ideas globally, and implementing the latest and most innovative ideas to the manufacturing industry

6. Benchmarking
Investigations how benchmarking can be converted into a systematic approach for learning, identifying the necessary infrastructure to attain this, as well as undertaking pilot implementations to evaluate the effects

7. Serious Games
Use of serious games for game-based learning, empowering enterprises with greater agility

8. Personalized and Ubiquitous Learning
Flexible and targeted training of individuals, permitting individuals to choose when and where to learn with the help of digitalized course module repositories for manufacturing, supported by tutoring systems

9. Accelarated Learning
Development of a problem based learning approach, experience exchange and cooperation, and the development of inter-company exchange programs for stimulating collaborative learning

List of Research Topics

The before mentioned Research Topics on innovation, education etc, have been used also as basis for specific activities within Research Topics from KAT1-3. The relations between KAT5 and KAt1-3 are displayed below:

5.1 Teaching Factories
KAT 1: Maintenance Concept for Sustainability, Lean Management for Service Industries
KAT 3: Cooperative and Mobile Manufacturing Systems

5.2 Cross Sectoral Education
KAT 2: Green Manufacturing for Future Vehicles
KAT 3: Model Based Engineering and Sustainability, Engineering Asset Management

5.3 Communities of Practice
KAT 1: Sustainability Workshops, Sustainable Packaging
KAT 2: Intelligent Utilization of Waste Heat, Framework for Collaboration in the Alternative Fuel and Raw Material Market, Emission Reduction Technologies
KAT 3: Semantic Business Processes, Semantic Based Engineering

5.4 From Tacit to Explicit Knowledge
KAT 1: Predictive maintenance based on embedded information devices, Integrated Service Supplier Development
KAT 3: Model-Based Manufacturing, Semantic Business Processes, Semantic Based Engineering

5.5 Innovation Agents
KAT 1: Cost-Based Product Lifecycle Management (PLM), Remanufacturing for Sustainable Resource Management
KAT 2: Energy Autonomous Factory

5.6 Benchmarking
KAT 1: Alignment of IT and Business Strategies, Integrative Logistics Tools for Supply Chain Improvement
KAT 2: Green Manufacturing for Future Vehicles

5.7 Serious Games
KAT 1: Sustainable SMEs, Sustainable Supply Chain Design, Multi-dimensional Inventory Management
KAT 3: Lower Labour and Energy Cost Performance, High Resolution Total Supply Chain Management

5.8 Personalized and Ubiquitous Learning
KAT 1: New Workplaces for Aging and Disabled Workers

5.9 Accelarated Learning
KAT 1: Exploiting Disruptive Innovation for Sustainability
KAT 2: Integrating Energy Efficiency in Production Information Systems

Supporting Global Research for 2020 Manufacturing Vision

Politecnico di Milano, Department of Management,
Economics and Industrial Engineering

Project Coordinator:
Prof. Marco Taisch
Professor of Operations and
Supply Chain Management,
Phone: +39 (02) 2399-4815
Email: marco.taisch@polimi.it

Project Manager:
Dr. Ing. Jacopo Cassina
Department of Management,
Economics and Industrial Engineering
Phone: +39 (02) 2399-3951
Email: jacopo.cassina@polimi.it

Join the community!

Partners