Factories of the Future 2020 Roadmap

PPP Info Days – 9 July 2012
Rikardo Bueno
Anirban Majumdar
EFFRA Roadmap: ‘Factories of the Future – Beyond 2013’

RD&I roadmap 2014-2020

• roadmap will cover R&D and innovation activities

• guiding principles: industry competitiveness, from research to industrial application and market uptake

• ambition: key impact on industrial application fields
MEGATRENDS

PARADIGMS

TIME

VALUE and SUSTAINABILITY

TECHNOLOGIES AND ENABLERS

MANUFACTURING CHALLENGES AND OPPORTUNITIES

Advanced manufacturing processes
Mechatronics for advanced manufacturing systems
ICT for manufacturing enterprises
Manufacturing strategies
Modelling, simulation and forecasting methods and tools
Knowledge workers

Knowledge in the global Information Society

Ageing
Urbanisation
Disruptive events

Factories as a good neighbour Close to the customer
Factories and Humans Human-centered
Factories in the value chain Collaborative

Economic sustainability
Social sustainability
Environmental sustainability
Manufacturing the products of the future
EFFRA Roadmap: ‘Factories of the Future – Beyond 2013’

Baselines

Challenges & opportunities

- Manufacturing future products
- Economic
- Social
- Environmental

Technologies & enablers

- Advanced manufacturing processes
- Mechatronics for advanced manufacturing systems
- Information and Communication Technologies
- Manufacturing strategies
- Knowledge workers
- Modeling, simulation and forecasting
EFFRA Roadmap: ‘Factories of the Future – Beyond 2013’
Impact through focus:

The right technologies for the right challenges or opportunities = the right research priorities

Challenges & opportunities
- Manufacturing future products
- Economic
- Social
- Environmental

Research & innovation priorities

Technologies & enablers

+ Measuring the (potential) impact of technologies
EFFRA Roadmap: ‘Factories of the Future – Beyond 2013’
Manufacturing Challenges & Opportunities (2)

- **Manufacturing the products of the future**
  - creation of value through design and production of the products of the future
    - which satisfy ever changing needs of society
    - offer the potential of opening and creating new markets in Europe and abroad
  - driving force for new products will be at the same time
    - global (consumer electronics, connectivity, telecommunications, mobility, solid state lighting…)
    - local, where local regulations and local market needs will push for products with specific requirements in a specific geographic area.
  - service provisioning and enhanced functionalities in future products
    - increased product smartness, such as the increased use of embedded mechatronics in components, requiring the design and production methodologies to evolve as a consequence.
EFFRA Roadmap: ‘Factories of the Future – Beyond 2013’

Sustainable manufacturing for future products and markets

Production requirements

Engineering of manufacturing systems

Manufacturing system integration and ramp-up

Adaptive Efficient Manufacturing

Product requirements

Product development

Manufacturing engineering

Product operation and servicing

Re-use – Recycle manufacturing equipment

Re-use – Recycle products
EFFRA Roadmap: ‘Factories of the Future – Beyond 2013’
Manufacturing Challenges & Opportunities

• **Economic sustainability**
  - Realising reconfigurable, adaptive and evolving factories capable of small scale production in an economically viable way
  - High performance production, combining flexibility, productivity, precision and zero-defect while remaining energy-efficient
  - Economic impact of resource efficiency in manufacturing, including the end-of-life of products.

• **Social sustainability**
  - Increasing human achievements in manufacturing systems
  - Safe and attractive workplaces
  - Care and responsibility for employees and citizens along global supply chains

• **Environmental sustainability**
  - Reducing the consumption of energy, while increasing the usage of renewable energy
  - Reducing the consumption of water and other process resources.
  - Near to zero emissions in manufacturing processes.
  - Optimising the exploitation of materials in manufacturing processes
  - Co-evolution of products-processes-production systems or ‘industrial symbiosis’ with minimum need of new resources
  - Enabling resource efficient, sustainable products
EFFRA Roadmap: ‘Factories of the Future – Beyond 2013’

Technologies and enablers

• **Advanced manufacturing processes**
  - Photonics-based materials processing technologies
  - Shaping technology such as forming and machining
  - High productivity and “self assembly” technologies development of conventional (joining, forming, machining) and new micro/nano-manufacturing processes
  - Methods for handling of parts, metrology and inspection
  - Flexible Sheet-to-Sheet (S2S) and Roll-to-Roll (R2R)
  - Integration of non-conventional technologies (e.g. laser, ultrasonic)

• **Mechatronic technologies for advanced manufacturing systems**
  - Control technologies will be further exploiting the increasing computational power and intelligence in order to come forward to the demands of increased speed and precision in manufacturing.
  - Continuous monitoring of the condition and performance of the manufacturing system on component and machine level, also introducing autonomous diagnosis capabilities and context-awareness.
  - Intelligent machinery components will enable the deployment of safe, energy-efficient, accurate and flexible or reconfigurable production systems.
ICT for Manufacturing
In the EFFRA Roadmap

• ICT enablers derived from “technology megatrends” of the ‘ActionPlanT Vision for Manufacturing 2.0’
• ICT Research Priorities derived from R&D Clusters and priorities of the ‘ActionPlanT Roadmap for Manufacturing 2.0’
• 40 ActionPlanT Research Priorities collected through ‘expert workshops’ – 9 workshops over a period of 2 years with 100+ experts participating
• ActionPlanT Priorities & Recommendations validated through ‘continuous validation process’
ActionPlanT
Some Quick Facts

Goals of the project
Cross-sector and cross-industry dialogue
Understanding of ICT impact on European manufacturing
New ICT-based business models in manufacturing

Impacts
Increased awareness of “ICT for Manufacturing” in Europe
ActionPlanT Vision & ActionPlanT Roadmap
ActionPlanT Workshops
Contribute to EFFRA Roadmap & help prioritize topics for Horizon 2020
ICT for Manufacturing
The Need for Lean & Agile services

- Fast Development
- Instant Use
- Real-time Data
- Exciting User Experience
- On any Device
4 ICT Enablers
From a Technology Push Perspective

**Collaboration**
- OEM – subcontractor collaborating through cloud
- Trends of contract manufacturing and ‘product as a service’
- Customer involvement in product design

**Mobility**
- Proliferation of mobile devices
- ‘On-the-go’ and ‘Always-on’ users
- New businesses (manufacturing apps & manufacturing app store)

**Connectivity**
- Sensors, controllers, embedded devices a commonplace
- ‘Intranet of Things’ to ‘Internet of Things’
- Bidirectional interaction with real-world objects

**Intelligence**
- Data analytics and forecasting on-the-fly
- Leveraging cheaper storage and low cost processors
- Better visualization & intelligence on manufacturing data

---

**Human–centric Manufacturing**
EFFRA Roadmap: ‘Factories of the Future – Beyond 2013’
Technologies and enablers (2)

• **ICT for manufacturing enterprises**
  Considering ICT trends:
  Collaborative manufacturing – Connectivity – Mobility – Manufacturing intelligence

• **Manufacturing strategies**
  ▪ From delocalisation to Globalisation 2.0
  ▪ Services through Product (solution oriented approach)
  ▪ From User-centric design to user well-being design
  ▪ Virtualisation and digitalisation of the interrelation between manufacturing and new business models.
  ▪ Finally, innovation should become a business model in itself and a continuously run business process (the factory innovation)

• **Modelling, simulation and forecasting**
  ▪ For integrated product-process-production system
  ▪ Strategically support the manufacturing-related activities during all the phases of the real factory life-cycle

• **Knowledge-workers**
  ▪ Future factory workers are key resources for industrial competitiveness
MEGATRENDS
- Ageing
- Urbanisation
- Disruptive events

PARADIGMS
- Knowledge in the global Information Society
- Factories as a good neighbour Close to the customer
- Factories and Humans Human-centered
- Factory and nature Green Sustainable
- Factories in the value chain Collaborative

VALUE and SUSTAINABILITY
- Economic sustainability
- Social sustainability
- Environmental sustainability
- Manufacturing the products of the future

TECHNOLOGIES AND ENABLERS
- Advanced manufacturing processes
- Mechatronics for advanced manufacturing systems
- ICT for manufacturing enterprises
- Manufacturing strategies
- Modelling, simulation and forecasting methods and tools
- Knowledge workers

MANUFACTURING CHALLENGES AND OPPORTUNITIES
- Advanced manufacturing processes
- Mechatronics for advanced manufacturing systems
- ICT for manufacturing enterprises
- Manufacturing strategies
- Modelling, simulation and forecasting methods and tools
- Knowledge workers

TIME

EFFRA
EUROPEAN FACTORIES OF THE FUTURE RESEARCH ASSOCIATION
a MANUFACTURE initiative
EFFRA Roadmap: ‘Factories of the Future – Beyond 2013’
Impact through focus:

The right technologies for the right challenges or opportunities = the right research priorities

+ Measuring the (potential) impact of technologies

Technologies & enablers
- Advanced manufacturing processes
- Mechatronics for advanced manufacturing systems
- Information and Communication Technologies
- Manufacturing strategies
- Knowledge workers
- Modeling, simulation and forecasting
EFFRA Roadmap: ‘Factories of the Future – Beyond 2013’
Impact through focus:

The right technologies for the right challenges or opportunities = the right research priorities

Challenges & opportunities
- Manufacturing future products
- Economic
- Social
- Environmental

Research & innovation priorities

Technologies & enablers
- Advanced manufacturing processes
- Mechatronics for advanced manufacturing systems
- Information and Communication Technologies
- Manufacturing strategies
- Knowledge workers
- Modeling, simulation and forecasting

+ Measuring the (potential) impact of technologies
Domain 1: Advanced Manufacturing processes
Innovative processing for both new and current materials or products

Domain 2: Adaptive and smart manufacturing systems
Innovative manufacturing equipment at component and system level, including mechatronics, control and monitoring systems

Domain 3: Digital, virtual and resource-efficient factories
Factory design, data collection and management, operation and planning, from real-time to long term optimisation approaches

Domain 4: Collaborative and mobile enterprises
Networked factories and dynamic supply chains

Domain 5: Human-centric manufacturing
Enhancing the role of people in factories

Domain 6: Customer-focused manufacturing
Involving customers in manufacturing value chain, from product-process design to manufacturing associated innovative services
Roadmap: ‘Factories of the Future 2020’

Considering the ActionPlanT Roadmap

**ActionPlanT ICT**

Research Priorities

- Domain 1: Advanced Manufacturing Processes
- Domain 2: Adaptive and Smart Manufacturing Systems
- Domain 3: Digital, virtual, and resource efficient factories
- Domain 4: Collaborative and mobile enterprises
- Domain 5: Human-centric manufacturing
- Domain 6: Customer-focused manufacturing

**Figure 2: Manufacturing 2.0 Enterprise**

- New seamless factory lifecycle management: Product lifecycle management is well understood but, manufacturers struggle to put factory lifecycle management into practice. Enhanced information management will be applied for control and holistic planning in future factories. In Manufacturing 2.0 enterprises, assets and inventories together with assembly lines and machinery would be dynamically monitored, configured and maintained. As a prerequisite for advanced factory lifecycle management, visibility, real-time tracking and predictive maintenance information would be made available to plant managers and operators. Furthermore, managers would be able to drill down into any production area and observe throughout, use and consumption through intuitive key performance indicators (KPI) even when on the move.

- People at the forefront: Human-centric ambition will become a reality in Manufacturing 2.0 enterprises with workers and managers alike given more opportunity for continuous development of skills and competences through...
**ICT for Manufacturing**

**Example: Domains 3 & 4**

**Collaborative and mobile enterprises**
- Cloud-based services for collaboration
- Hosted mobile manufacturing app store
- Quick response in supply chain planning, tracking and total visibility
- New paradigms such as “products as a service” for closing information gap in EoL products

**Digital, virtual, and resource efficient factories**
- Controlling and holistic planning of future factories
- Intelligent maintenance, HPC, and energy management in factories
- On-demand/mobile KPI monitoring through mobility suite for comprehensive factory management

**SUPPLIERS & SUBCONTRACTORS**

**CUSTOMER**

**SALES**

**FIELD SALES**

**MANUFACTURING**

**SALES & MARKETING**

**CEO**

**VP Sales**

**VP Manuf.**

**Planners**

**CIO**

**Digital, virtual, and resource efficient factories**

- Controlling and holistic planning of future factories
- Intelligent maintenance, HPC, and energy management in factories
- On-demand/mobile KPI monitoring through mobility suite for comprehensive factory management
Innovation through dissemination and demonstration

- FoF PPP FoF: Going from research activities to exploitation
  - long, non-linear process that can be described in a simplified way using the Technology Readiness Level (TRL) scheme
- Closing the gap through two complementary levels
  - Industrial Lab
  - Industrial Production
    (These play a significant role as education and training environments)
- Also important:
  - Understanding the context within which the technology operates
    - regulations, standards, barriers to adoption and just simply market awareness of the value the technology will deliver.
  - User driven Innovation should therefore become a business model in itself and a continuously run business process (*the factory innovation*).
  - More effective ways of monitoring and evaluating projects and programmes results and impacts, especially after their financial execution.
Timeline

- 9-10 July, PPP info days: launch of public consultation