Programme
Factories of the Future PPP
Strategic Objective
Objective ICT-2010-10 Smart Factories: ICT for agile and environmentally friendly manufacturing
Support Action / Project Title
European Forum for ICT in Factories of the Future
Acronym
ActionPlanT
Project No
258617
Roadmap Validation
WP 3.2

D3.2.: Roadmap Validation Report

Leading Partner: Fraunhofer IPK

Contributing Partners: All

Security Classification: PUBLIC

<06.06.2012>

Version <1.0>

Versioning and contribution history

Version	Description	Editor
0.1	Draft Deliverable	Sonja Pajkovska Goceva (IPK)
0.2	Document Review; Next Steps	Anirban Majumdar (SAP)
0.3	Implementation of comments and feedback	Sonja Pajkovska Goceva (IPK)
0.4	Document Review and Feedback	Anirban Majumdar (SAP)
0.5	Implementation of comments and suggestions	Sonja Pajkovska Goceva (IPK)

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1 Executive Summary

This report describes the methodology, the process and the summary of the results of the continuous roadmap validation activities that were performed in parallel with the refinement and finalisation of the different versions of the draft roadmap (deliverable D3.1) titled “ActionPlanT: ICT for Manufacturing – A Roadmap to Horizon 2020”. The results and suggestions resulting from this exercise were considered in the Final Version of the Roadmap (deliverable D3.3) titled “The ActionPlanT Roadmap for Manufacturing 2.0”.

The report has been compiled by Sonja Pajkovska Goceva (Franhofer IPK) of the ActionPlanT project based on contribution and the activities from the consortium members: Giacommo Tavola (POLIMI), Ahmed Burfadi (EPFL), Bojan Stahl (POLIMI), Anirban Majumdar (SAP), Marco Taisch (POLIMI), Dimitris Kiritsis (EPFL), Jon Agirre Ibarbia (TECHNALIA), Hadrien Szigeti (Dassault Systèmes), Chris Decubber (AGORIA).

2 Introduction and Context

To boost European competitiveness and expedite the recovery from the current financial crisis, Europe's manufacturing sector must fundamentally change its attitude and approach to business. Better use of information and communication technology (ICT) offers the key to meet the challenges by enhancing end-to-end manufacturing processes from shop floor to customer engagement and all along the supply chain. 'ICT for manufacturing' is a specific research domain that merits public investment in the design and development of software facilitating shop-floor processes and connecting enterprises to each other and to customers. The overall objective is to use ICT to make manufacturing more efficient and user friendly, while enabling all European enterprises, irrespective of their location or size, to find opportunities beyond their borders through innovative business models.

The objective of ActionPlanT is to first come up with an ICT-enabled manufacturing vision and a detailed roadmap paving the way for a detailed roadmap which will prioritize and schedule most promising topics for the upcoming Framework Programme for Research and Innovation (Horizon 2020, covering the period 2014-2020). ActionPlanT also liaises with EFFRA, the Factories of the Future Research Association, as a key industry representing body. The ActionPlanT Roadmap for Manufacturing 2.0 provides a major contribution to the consultations for Horizon 2020 in respect to research activities in this area. The involvement of European-wide experts in the area of manufacturing and ICT is a key instrument for fulfilling the requirements on a common roadmap. A set of 9 expert workshops initiated by ActionPlanT served to bring together more than 90 experts from diverse areas to propose and discuss diverse ideas, opinions and to develop knowledge on the future contribution of ICT in manufacturing and how ICT can be used gainfully to overcome current and future manufacturing challenges.

3 ActionPlanT Roadmap and the Continuous Roadmap Validation

3.1 The ActionPlanT Roadmap for Manufactuirng 2.0

The ActionPlanT Roadmap for Manufacturing 2.0 outlines a bold vision, where key ICT megatrends in collaboration, connectivity, mobility and intelligence can act as game changers for European manufacturing. It also paves the way for implementation of the vision by identifying how the megatrends and key ICT innovations can fulfil 5 underlying ambitions for European enterprises: on-demand; optimal; innovative; green; and human centred. This vision goes beyond the shop-floor and focuses on manufacturing enterprises and their collaborating stakeholders in the holistic supply chain.

Taking a technology-push approach, the roadmap derives a set of 15 key ICT recommendations from the four ICT megatrends that can bring about disruptive changes in European manufacturing industry and open up new channels of revenue generation for large enterprises and SMEs. They are linked to the concept of the Manufacturing Business Web (MBW) – a cloud-enabled future platform for European manufacturing. While future software developments for manufacturing should be cloud ready, they should not be cloud only. This means manufacturing software and applications which implement these recommendations can easily be adapted to any future public or private cloud-computing platform while still being applicable in existing in-house systems.

Pursuing a market-pull perspective, the identified research priorities are grouped into five Manufacturing 2.0 and R&D clusters. These research clusters are implementing recommendation for ICT developments, which cover either ICT breakthroughs needed to overcome an existing problem in the manufacturing domain or generate new revenue possibilities by introducing a new ICT recommendation in the manufacturing value chain. These priorities follow a coherent template with an impact assessment and technology readiness level estimation for each. The ActionPlanT roadmap provides implementation timescales for these priorities under Horizon 2020.

3.2 Scope of the Continuous Roadmap Validation

This activity, termed as ‘continuous roadmaping validation’, was conducted in parallel to the roadmap development. It gave the ActionPlanT consortium an opportunity to brainstorm research topics and research clusters with targeted expert groups during the preparation of the roadmap. The aim of these interactions was to obtain objective feedback from the following three perspectives:

- Customer View: providing feedback on the identified manufacturing needs, challenges, and ambitions
- Enabler View: providing feedback on the identified ICT enabling technologies and platforms
- Consolidated View: where the manufacturing challenges meet the ICT enabling technologies and ensure the convergence of technology push and market pull approaches.

The continuous roadmap validation process delivered feedback and additional recommendations on the content and the form of the defined research priorities and clusters, by challenging the roadmap with the following questions:

- What is the relevance of the suggested research areas and topics related to the objectives of the Factories of the Future?
- Are the manufacturing challenges, aspiration relevant to the customer needs and the ActionPlanT Vision?
- Do topics utilize the ICT state-of-the-art enablers and visions?
- What are the present and the targeted Technology Readiness Levels (TRL) of the proposed Research clusters/topics?

The ActionPlanT consortium performed the validation exercise through the following online and offline means: validation gap analysis performed internally within the consortium; validation workshops with targeted experts and validation online survey.

3.3 Validation Gap Analysis

Validation gap analysis was the first step of the activities under the continuous validation process. Within these activities, the ActionPlanT consortium reviewed the collected ideas for future research topics leveraging the brainstorming sessions of the first three expert workshops. The suggestions were then compared with predefined manufacturing challenges and IT Domains (as part of WP1 activity). The gap analysis has helped the ActionPlanT consortium to identify the gaps and the redundancies in the set of defined research topics defined in the first draft of the roadmap, from the perspectives of the:

- Customer – by analyzing the completeness of the considered manufacturing challenges within the research priorities;
- IT Enabler – through mapping of the research topics according to the components of the IT Domains – Infrastructure, Software, Methodologies and Processes as well as Services against the manufacturing domains: Environment, Society, Market, Enterprise, Plant, Shop Floor, Line and Workplace (Field).

3.4 Validation workshops with targeted expert groups

While the first set of three expert workshops (Dresden 2011, Cernobbio 2011, and Paris 2011) were primarily used to identify gaps in research topics as an answer to the predefined manufacturing challenges, the second set of three expert workshops featured dedicated sessions on validating roadmap research priorities. These workshops were:

- Advanced Computing Workshop – Enabling forecasting, simulation and analytics for European enterprises, October 2011, Brussels;
- UK Interest Workshop, October 2011, Coventry; and
- Validation Session during the PlantCockpit Project Meeting, February 2012, Darmstadt.

The validation exercise was focused on discussions in two stages. During the first stage, participants were encouraged to think out of the box, identify application scenarios, and propose research needs as well as estimate the present and the expected Technology Readiness Levels (TRL) of their proposed topics. The presentations obtained from the experts were used by the consortium to compare and update existing research topics in the draft roadmap.

The second part of the workshops was used for validation purposes. The experts were presented key roadmap clusters, where the outline of the outstanding problems, cluster definition, and ICT Requirements (related to Collaboration, Mobility, Connectivity, and Intelligence) were discussed.

The set of the validation workshops were attended by experts from ICT and Manufacturing Industry, as well as from academic and research organizations. Workshop agenda, list of participant and workshop content are summarized in *Deliverable 6.4: Workshop Documentation*.

3.5 Online validation survey

As part of the continuous roadmap validation process, the ActionPlanT consortium has performed an online survey with the aim of collecting feedback on the draft roadmap (D3.1) with a set of initial research priorities and their corresponding TRL levels. The survey covered questions regarding the application of the ICT for Manufacturing Vision into the draft roadmap, as well questions regarding the relevance of the research priorities and suggested ICT solutions with respect to respondents' organizational plan and vision for future research actions.

The survey was opened during the period of 15 of March until the 15 of April 2012, giving the opportunity to 40 experts to provide feedback based on their knowledge, experience, and foresight. The participation in the online questionnaire can be summarized with the following:

- A balanced participation between representatives from manufacturing and ICT suppliers;
- A balanced involvement between developers and users of ICT in Manufacturing;
- More than 60% of the survey participants have more than 10 years of experience in the field of ICT for Manufacturing;

- Participants are associated with the following technology platforms, associations, groups and initiatives: Manufuture, IDEE, EFFRA, SIF (Sociedad de Ingeneria de Fabrication), ERTRAC, MINAM, European Concept, NanoMedicine, Future Textile and Clothing, ESTEP (European Steel Technology Platform), NESSI
- Participants are representing different companies, including: Robert Bosch GmbH, PSA-Peuguet Citroen, Siemens AT, TNO, Fest AG & Co. KG, ProFactor, ArcelorMittal, Tacit Connections ltd, SAP AG, etc.

The main interest in participating in the on-line questionnaire is the fact that ICT is being seen as a vital component in the manufacturing and automation technology development. The main drivers for research in the ICT for Manufacturing are to create smarter knowledge based ICT systems, increase profitability of the ICT solutions in manufacturing as well as providing new and innovative ICT solutions to the manufacturing, as well as collaborative working, monitoring and optimization of manufacturing processes.

The result of the online survey is summarized in the next chapter. Detailed survey report is included in the Annex of this Deliverable.

4 Main Outcomes and Feedback Collection

The following sections summarize the comments and the feedback that were collected during the stages of the continuous roadmap validation.

The first steps of the continuous validation, the gap analysis, showed a comprehensive coverage of the manufacturing challenges within the research topics (Figure 1). Some of the manufacturing challenges are being addressed by more research topics (incl. adaptive and flexible factories, knowledge based production networks and cross hierarchical manufacturing business intelligence). On the one hand, this the high level of relevance, but also the necessity for their further specification or clustering in order to avoid redundancy.

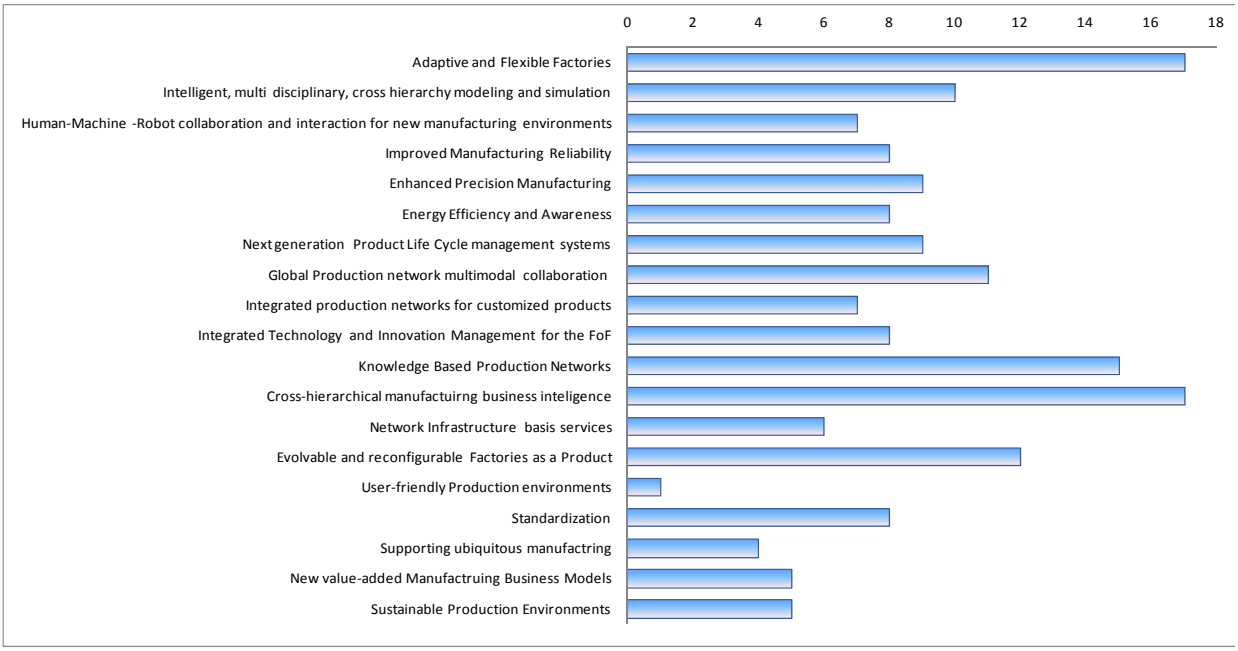

Figure 1: Coverage of Manufacturing Challenges within Research Topics

The gap analysis of the identified ICT enablers to solve the manufacturing challenges pointed out some significant gaps on the innovative ICT recommendation. These include:

- Novel Operating Systems for manufacturing specific operations, hardware and communication Infrastructures;
- Expectation from ICT to deliver end-to-end (off-the-shelf) solutions to the end users which do not require significant customization;
- ICT Infrastructures supporting interoperability between several IT domains and solutions in manufacturing;
- Software development, system deployment solutions, and change management tools; and
- ICT services (Support and Outsourcing).

The three expert workshops including a validation session have asserted the predefined manufacturing challenges. The salient outcomes were the following:

- New definition of the Supply Chains should be beyond the traditional view on a relation between an OEM and the Supplier. It should include a higher level of integrity between the OEM and the suppliers, sharing risk, decision making about product design, manufacturability and financial feasibility along the complete product life cycle. Furthermore, while collaboration and connectivity within the supply networks are playing a

significant role in the identified research priorities, the Integration of financial and risk assessment aspects as a decision factor through the entire product life cycle needs to be also included;

- Innovative ICT should contribute to the strengthening of the human factor within the value chain and focusing on the ability of the human to interact with the machine in a more sophisticated way;
- Better usability and human-centric design should be considered in the new research priorities, especially for people with disabilities;
- Instead of the expensive expert systems then “freeze” the expertise and information, dynamic and collaborative knowledge systems are preferable;
- Apart from considering a manufacturing of small scale products, the manufacturing challenges should also consider the production of a large scale/investment products;
- Integration of the machinery reconfiguration within the manufacturing processes should be included; and
- The aspect of mobility challenges manufacturing operations nowadays; Information systems needs to deliver information independently from the physical location;

In order to improve and complete the description of the ICT as an enabling technologies for ICT for Manufacturing, it was decided to organize an additional expert workshop called “Advanced Computing Workshop”, which was organized to identify innovative ICT and their applications for manufacturing. The workshop outlined forecasting, simulation and analytics technologies beyond the state-of-the-art for streamlining manufacturing operations and enterprises. Moreover, methods and technologies for design, visualization, (real-time) analytics and prediction were highlighted, as well as the readiness of those technologies in long and medium term. The validation workshop in the UK has also contributed to the revision and enrichment of the roadmap with ICT aspects resulting in the following three outcomes:

- Important aspects of energy efficiency in the ICT in manufacturing were challenged by the need for improved energy efficiency. “Before we run out of money, we will run out of power stations” and the call for “stop spending energy on screen-savers”, proposing a better energy-efficiency through an use of low-power desktops enabled through mastering parallelization, concurrency and virtualization;
- It is important to use the “right tools for the job”, using a higher-level infrastructure which orchestrate the services; and
- Data protection and privacy, considering that a partial view in data can give a wrong picture stressing that: “If you do not have the full insight in data, they can be misinterpreted”.

The results of these workshops were considered and included in the refinement of the research topics listed in the first draft of the roadmap.

The online survey was structured in three parts, questioning the draft roadmap (D3.2) on the:

- impact of the main aspect of the “ICT for Manufacturing Vision”,
- relevance of the definition of the research cluster and identified research priorities,
- relevance of the key ICT takeaways.

4.1 Impact of the main aspects of the “ICT for Manufacturing Vision”

The online survey questioned the impact of the identified socio-economic and technology megatrends on the further development of ICT for Manufacturing. The majority of the survey participant quoted a *very high impact* or a *high impact* of the Demographic and Consumption, Global Competition and Innovation, all-round sustainability, dynamic collaboration, enterprise mobility, real-world connectivity on the development and use of ICT for Manufacturing (Figure 2). Some of the notable comments are:

- “Innovate or die” is the mantra for European companies. There is a need for innovations in all levels such as technology, products, processes, supply chains and business models;
- The design of a “smart value chain” can answer to the challenge of the global competition and Innovation. Specifically this means humans coming up with a better way of cooperation, requesting tools that fit this purpose and using them intelligently. This will not

be the faster computer of a bank that reacts even faster to stock market moves than its competitor. Production is already today coming back to Europe where the present practices for just in time, outsourcing and getting value by right purchasing strategies are operating at their limit;

- Japanese companies have recognized this long time ago, and they have undertaken huge efforts to counteract by means of organization, by means of underlying IT, by means of striving for sustainable processes. In Europe ecological sustainability is recognized, economic sustainability in some areas is becoming profitable, social sustainability has not really reached the agenda. All three "versions" together are the form of agenda we need; and
- The Dynamic Collaboration needs to be supported by solution beyond the social media and web tools. The creation of eco-systems of supplier being able to create a collaborative value chain rapidly is needed.

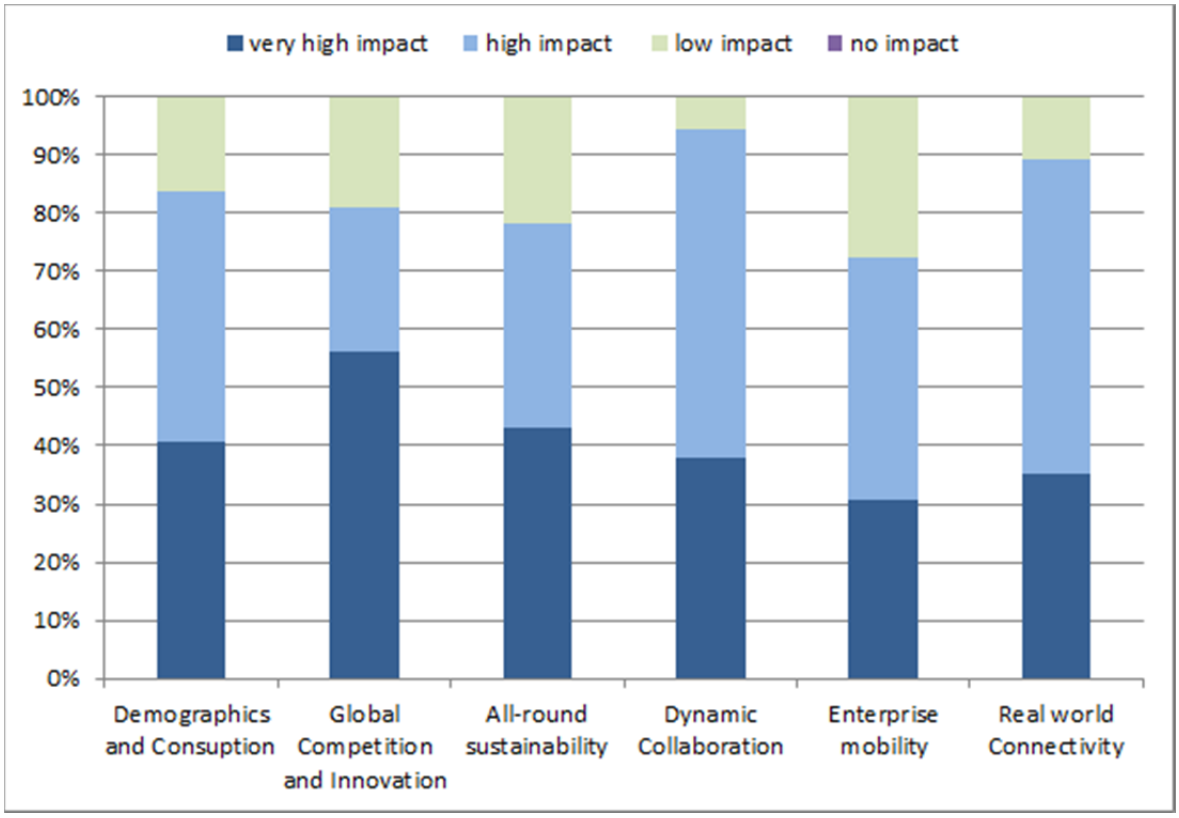

Figure 2: Impact of the main aspects from the "ICT for Manufacturing Vision"

Concerns were expressed related to the transfer of tacit knowledge into the ICT systems, as well as recognizing the importance of the transfer of knowledge from experienced workers to the younger employees.s Furthermore, sustainability is being associated with high costs for the SMEs, aiming for new business models incorporating sustainability factors. The dynamic collaboration is burdened by outstanding ICT security and legislative issues. Short life-cycle of consumer devices and rapid change of interfaces and hardware is a challenge for the application of the ICT in Manufacturing.

4.2 Relevance of the definition of the research cluster and identified research priorities

4.2.1 Towards agile manufacturing systems and services

To counter the turbulent markets characterised by frequent economic downturns and dynamic consumer behaviour, Manufacturing 2.0 enterprises need to minimise time to market of customised and value-adding products. This R&D cluster deals with value generation at the shopfloor level of manufacturing enterprises, addressing issues such as systems integration, better manufacturing execution systems, collaborative robots and enhanced human-machine interaction.

The results of the validation on-line survey can be summarized as the following:

- 87% of the participants agreed with the statement of this cluster, adding that this will result in the generation of large quantities of data that need to be better stored and analysed.
- The majority (more than 80%) of the survey participants have agreed with the statements of the detailed research priorities from this cluster;
- The majority of the participants has recognized the need for the research described within this cluster in their own organization (Figure 3)

37. The need for further development of the above research priorities are recognized in your organisation

	Fully agree	Somewhat agree	Somewhat disagree	strongly disagree	Not applicable	Response Count
RP1.1 – Flexible and reconfigurable Machinery and Robots	**40.0% (4)**	30.0% (3)	20.0% (2)	0.0% (0)	10.0% (1)	10
RP1.2 – Professional Service Robots and Multimodal Human-Machine-Robot	**40.0% (4)**	30.0% (3)	20.0% (2)	0.0% (0)	10.0% (1)	10
RP1.3 – Adaptive Process Automation and Control	**63.6% (7)**	27.3% (3)	9.1% (1)	0.0% (0)	0.0% (0)	11
RP1.4 – Manufacturing Execution Environment for Smart Factory	**72.7% (8)**	27.3% (3)	0.0% (0)	0.0% (0)	0.0% (0)	11
RP1.5 – Monitoring, Perception & Awareness on Manufacturing	**72.7% (8)**	27.3% (3)	0.0% (0)	0.0% (0)	0.0% (0)	11

Figure 3: Industrial relevance of the research priorities within the research cluster "Towards agile manufactuirng systems and services"

4.2.2 Seamless Factory Lifecycle Management

Factories are becoming increasingly complex, expensive to run, distributed and faster evolving than in the past. European manufacturers are struggling to cope with dynamically changing factory lifecycle requirements. New paradigms in the way plants are designed and managed are required to cope with competition and sustainability-related issues.

In Manufacturing 2.0 enterprises, assets and inventories together with assembly lines and machinery would be dynamically designed, configured, monitored and maintained. A prerequisite for advanced factory lifecycle management is the availability of an integrated and scalable factory model with multi-level semantic access to features, aggregation of data with different granularity, zoom in and out functionalities, and real-time data acquisition from all the factory resources – assets, machines, workers and objects. Stakeholders should be able to drill down into any production area and observe throughput, use and consumption using correlated key performance indicators accessible via user-friendly interfaces adaptable for varying user roles and mobile consumption platforms. Some of the notable outcomes are:

- 89% of the survey participants have agreed to the statement of this cluster, quoting that a predictive information has the highest value for this research cluster, requiring a “cross platform communication with standards for machine start-ups and interpretation of the content”;
- More than 80% of the participants agree with the identified research priorities of this cluster, pointing out to the importance of the involving the customer perspective in the decision making and considering the role of the renewable energy sources; and
- The majority of the survey participants have already recognized the need for research on these research priorities in their organisations (Figure 4).

46. The need for further development of the above research priorities are recognized in your organisation

	Fully agree	Somewhat agree	Somewhat disagree	strongly disagree	Not applicable	Response Count
RP2.1 – Integrated factory models for evolvable Manufacturing Systems	**42.9% (3)**	28.6% (2)	14.3% (1)	0.0% (0)	14.3% (1)	7
RP2.2 – Intelligent maintenance systems for increased reliability of production system	**57.1% (4)**	28.6% (2)	0.0% (0)	0.0% (0)	14.3% (1)	7
RP2.3 – Integrated High-performance Computing in Factory Life Cycle Management	**57.1% (4)**	0.0% (0)	14.3% (1)	14.3% (1)	14.3% (1)	7
RP2.4 – ICT supported energy consumption optimisation in Manufacturing 2.0 entreprises	28.6% (2)	**57.1% (4)**	0.0% (0)	0.0% (0)	14.3% (1)	7
RP2.5 – Multi-level simulation for enhanced factory modelling	**42.9% (3)**	**42.9% (3)**	0.0% (0)	14.3% (1)	0.0% (0)	7
RP2.6 – Services for continuous evaluation and mitigation of manufacturing risks	**71.4% (5)**	0.0% (0)	28.6% (2)	0.0% (0)	0.0% (0)	7
RP2.7 – On-demand modular "replicative" factory models	14.3% (1)	28.6% (2)	**42.9% (3)**	0.0% (0)	14.3% (1)	7

Figure 4: Industrial relevance of the research priorities within the research cluster "Seamless Factory life-cycle management"

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4.2.3 People at the Forefront

The human-centred ambition needs to become a reality in Manufacturing 2.0 enterprises with knowledge and factory workers given more opportunity for continuous development of their skills and competences through novel knowledge-delivery mechanisms. Future enterprises should not only be better equipped at transferring skills to a new generation of workers but also proficient in assisting older and disabled workers with easy-to-use touchscreen user interfaces, intuitive user-experience-driven workflows and new technologies such as mobile and service robots – *dynamic collaboration* and *enterprise mobility* megatrends. Furthermore, improving the productivity of the manufacturing workforce through the adoption of the ambient-intelligence paradigm in the working environment is one of the promising trends to achieve growth and competiveness in European manufacturing. Some of the notable outcomes are:

- 85% of the survey participants agree with the statement in this cluster. Most importantly, the capture of knowledge and transfer of skills will contribute to a better motivation of the employees and the importance of the development of user–friendly and intuitive interfaces and learning tools;
- The majority of the survey participants have already recognized the need for research on these research priorities in their organisations (Figure 5).

52. The need for further development of the above research priorities are recognized in your organisation

	Fully agree	Somewhat agree	Somewhat disagree	strongly disagree	Not applicable	Response Count
RP3.1 – Enhanced Visualisation of complex Manufacturing data	**71.4% (5)**	14.3% (1)	0.0% (0)	0.0% (0)	14.3% (1)	7
RP3.2 – Teenage-awareness for Manufacturing	14.3% (1)	**42.9% (3)**	14.3% (1)	0.0% (0)	28.6% (2)	7
RP3.3 – Advanced Information Models for knowledge creation and learning	**71.4% (5)**	28.6% (2)	0.0% (0)	0.0% (0)	0.0% (0)	7
RP3.4 – ICT support to the worker-process interaction and collaborative competence development	**57.1% (4)**	28.6% (2)	0.0% (0)	0.0% (0)	14.3% (1)	7

Figure 5: Industrial relevance of the research priorities within the research cluster "People at the forefront"

4.2.4 Fostering Collaborative Supply Networks

Efficient collaboration between all stakeholders in the extended Manufacturing 2.0 value chain is becoming increasingly crucial. Both large enterprises and SMEs stand to gain from service and operational collaboration activities. As part of the extended collaboration paradigm, OEMs will be able to sell products as a service and certified suppliers or subcontractors will be able to offer value-added services – such as maintenance or upgrades – to customers. Through concepts such as capability-based contracts, manufacturing service providers will be able to offer use-based billing instead of requiring upfront investments in machinery by subcontractors. Some of the notable outcomes are:

- 92% of the survey participants agree with the statement in this cluster. The research under this priorities is seen as a key technology for the "product as a service" and for establishing new and innovative business models; and
- The majority of the survey participants have already recognized the need for research on these research priorities in their organisations (Figure 6).

61. The need for further development of the above research priorities are recognized in your organisation

	Fully agree	Somewhat agree	Somewhat disagree	strongly disagree	Not applicable	Response Count
RP4.1 – Cloud-based Manufacturing Business Web for Supply Network Collaboration	**66.7% (2)**	0.0% (0)	0.0% (0)	0.0% (0)	33.3% (1)	3
RP4.2 – ICT-supported remanufacturing across the supply network	33.3% (1)	**66.7% (2)**	0.0% (0)	0.0% (0)	0.0% (0)	3
RP4.3 – Leveraging mobility for an agile and intelligent supply network	**66.7% (2)**	0.0% (0)	0.0% (0)	0.0% (0)	33.3% (1)	3
RP4.4 – Internet-of-Things in networked value chain	**66.7% (2)**	0.0% (0)	0.0% (0)	0.0% (0)	33.3% (1)	3
RP4.5 – Complex Event Processing (CEP) for state detection and query processing in supply networks	**100.0% (3)**	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	3
RP4.6 – Property Rights Management of products and code in supply networks	**33.3% (1)**	**33.3% (1)**	0.0% (0)	0.0% (0)	**33.3% (1)**	3
RP4.7 – Multi-Enterprise Role-Based Access Control (mRBAC) in manufacturing supply networks	**66.7% (2)**	0.0% (0)	0.0% (0)	0.0% (0)	33.3% (1)	3

Figure 6: Industrial relevance of the research priorities within the research cluster "Fostering collaborative supply networks"

4.2.5 Aiming at Customer-Centred Design, Manufacturing and Services

Previously considered solely as a marketing target, the customer in the recent years has earned a special status in Manufacturing 2.0 enterprises. Nowadays, customers are best placed to assess and influence product development across different functional units of manufacturing enterprises. If the end product meets customers' requirements and expectations, it has every chance of making an impact in the market. Manufacturing enterprises which design and develop products without involving customers in the loop are likely to end up with commercially unsuccessful products. User-centred design requires that product development should be led by the user rather than technologists and developers.

The integration of the customer will be through the identification of their requirements and interpretations during the design phase. Manufacturing 2.0 enterprises would collect customer requirements, analyse them and make the right model. They would extract customer feedback from social media and incorporate it into engineering and manufacturing processes. Furthermore, Manufacturing 2.0 enterprises are also expected to offer a comprehensive range of after-sales product services once the customer has bought a product. Some of the notable outcomes are:

- 93% of the survey participants agree with the statement in this cluster, commenting that "the customer centric aspect will only go as far as ensuring that the customers do not defect to other product and brands. There will have to be a serious incentive, verifiable by analysing customer behaviour for truly individualised manufacturing". Furthermore, it was stated that the "application of knowledge capture from social media and the internet is far from precise and the speed of change in "mood music" is not currently possible in manufacturing systems. The speed of development and redevelopment of manufacturing process needs to be made faster with better control systems."; and
- The majority of the survey participants have already recognized the need for research on these research priorities in their organisations (Figure 7).

68. The need for further development of the above research priorities are recognized in your organisation

	Fully agree	Somewhat agree	Somewhat disagree	strongly disagree	Not applicable	Response Count
RP5.1 – Manufacturing Intelligence for informed Product Design	**83.3% (5)**	16.7% (1)	0.0% (0)	0.0% (0)	0.0% (0)	6
RP5.2 – ICT for energy-efficient product life cycles	**66.7% (4)**	33.3% (2)	0.0% (0)	0.0% (0)	0.0% (0)	6
RP5.3 – Collaborative Design for global Manufacturing of Product-Service Systems	**83.3% (5)**	16.7% (1)	0.0% (0)	0.0% (0)	0.0% (0)	6
RP5.4 – Crowd sourcing for highly personalized human-centric innovative product	33.3% (2)	**50.0% (3)**	16.7% (1)	0.0% (0)	0.0% (0)	6
RP5.5 – Product Value and Impact Simulation	**50.0% (3)**	33.3% (2)	16.7% (1)	0.0% (0)	0.0% (0)	6

Figure 7: Industrial relevance of the research priorities within the research cluster "Aiming at customer –Centred Design, Manufacturing and Services"

4.3 Relevance on the key ICT takeaways

The ActionPlanT consortium performed an analysis on 28 Research Priorities in the draft roadmap to find out the most promising ICT breakthroughs needed for enhancing European manufacturing. As a result, the draft roadmap included the following recommendations for most promising ICT core areas:

- All is connected: ICT solutions for factory floor and physical world inclusion
- From massive data to lean information: ICT solutions for next generation data storage and information mining
- Cloud's the word: ICT solutions for implementing secure, high performance and open services platforms
- To know, understand, and forecast: modelling and simulation tools for systems analysis, forecasting and knowledge management
- Everywhere and everyone on-demand: advanced human/machine interaction through ubiquity of mobile devices
- Cross-boundary applications for the global enterprises: collaborative and decentralized application architectures and development tools

4.3.1 All is connected

ICT solutions for factory floor and physical world inclusion

Real-world resources such as machinery, robots, lines, items and operators are an integral part of the information structure of production processes. All of them need to be connected to each other and to back-end systems and at the same time to be self-aware of the surrounding environment. New ICT solutions should allow such resources to easily plug in the network and seamlessly exchange information required to play their role in the manufacturing system.

- 91% of the participants agreed with this statement (Figure 8), where the present solutions available on the market are not achieving this goal.
- Concerns were expressed related the capability of the ICT to provide a "holistic understanding" of the factory organization and operation inclusive sociological aspects.

23. Takeaway #1: All is connected ICT solutions must bridge the gap between the physical world (shop floor) and the enterprise world (business systems)

	Response Percent	Response Count
Fully agree	**60.0%**	**21**
Somewhat agree	31.4%	11
Somewhat disagree	5.7%	2
Strongly disagree	0.0%	0
Do not know	2.9%	1

Figure 8: Relevance of the ICT Takeaway: All is Connected

4.3.2 From massive data to lean information

ICT solutions for next generation data storage and information mining

Copious amount of data from the field and supply chain needs to be stored in a fault-tolerant way. Information embedded within these data needs to be elicited and made available. New ICT solutions will allow complex queries on distributed and heterogeneous data sources to be run in fractions of a second. Business intelligence tools for complex data stream analysis facilitate real-time decision making across all tiers of the enterprise.

- 94% of the survey participants agree with this statement, noticing that data safety and data privacy should also be considered (Figure 9). This was taken up in the recommendation for the final roadmap.

24. Takeaway#2: From massive data to lean information ICT solutions must facilitate storage and processing of copious production data

	Response Percent	Response Count
Fully agree	**73.5%**	**25**
Somewhat agree	20.6%	7
Somewhat disagree	5.9%	2
Strongly disagree	0.0%	0
Do not know	0.0%	0

Figure 9: Relevance of the ICT Takeaway: From massive data to lean information

4.3.3 Cloud's the word

ICT solutions for implementing secure, high performance and open services platforms

Distributed and collaborative applications will be implemented through mash-ups of services implemented by different small and large ICT and manufacturing vendors. The cloud will be the "agora" for provisioning customized functionalities through services that are reliable, secure, and guarantee performance. Open standards will ensure the full interoperability in terms of data and applications.

- 94% of the participants have agreed to this statement. As the "trend is already taking off", this takeaway is seen as relevant for both large companies and SMEs (Figure **10**).
- Concerns are being raised regarding "serious restrictions due to large enterprise governance" and the importance of the "private clouds or intra-factory clouds, network availability and security. This concern was taken up and explicitly addressed as an ICT key recommendation in the final roadmap.

25. Takeaway#3: Cloud's the word ICT solutions must implement secure, high performance and open services platforms for large, medium, and small enterprises.

	Response Percent	Response Count
Fully agree	40.0%	14
Somewhat agree	**54.3%**	**19**
Somewhat disagree	5.7%	2
Strongly disagree	0.0%	0

Figure 10: Relevance of the ICT Takeaway: Cloud is the world

4.3.4 To know, understand, and forecast

Modeling and simulation tools for systems analysis, forecasting and knowledge management

Complex environments need to be consistently described by semantic models in order to correlate information, describe the dynamics, and forecast their behavior. Knowledge from different sources (e.g. human, experience, research) will be made available and fully exploited by dedicated modeling and simulation tools.

- 89% of the participants agree to this statement (Figure **11**).
- Some overlapping was reported between this and the Takeaway#2. The redundancy was eliminated through revised 15 key ICT recommendations in the final roadmap.

26. Takeaway#4: To know, understand, and forecast ICT solutions must make sense out of the stored and streamed production data through modelling, simulation and analytics.

	Response Percent	Response Count
Fully agree	**62.9%**	**22**
Somewhat agree	25.7%	9
Somewhat disagree	8.6%	3
Strongly disagree	0.0%	0
Do not know	2.9%	1

Figure 11: Relevance of the ICT Takeaway: To know, to understand and forecast

4.3.5 Everywhere and everyone on-demand

Lack of information or their inadequate interpretation will no longer be acceptable by Manufacturing 2.0 enterprises of the future. Users will receive relevant production and enterprise-specific information regardless their geographical location and tailored to the context and the skills/responsibilities they own. Interactions with ICT infrastructures and equipment will be natural language-like.

- Although 97% of the participants agree with this statement, this takeaway is seen as "too general" and further specification is needed (Figure **12**).
- To address the concern, the on-demand nature of ICT and applications were specified in the 15 ICT key recommendations in the final roadmap.

27. Takeaway#5: Everywhere and everyone on-demand ICT solutions must integrate the human element – workers and customers – to a greater degree in their day-to-day functioning.

	Response Percent	Response Count
Fully agree	**50.0%**	**17**
Somewhat agree	47.1%	16
Somewhat disagree	2.9%	1
Strongly disagree	0.0%	0
Do not know	0.0%	0

Figure 12: Relevance of the ICT Takeaway. Every where and everyone on demand

4.3.6 Cross-boundary applications for the global enterprises

Collaborative and decentralized application architectures and development tools

In extended enterprises and globalized markets, applications (e.g. Life Cycle Management, Supply Chain Management, Monitoring & Control, and Customer Relationship Management) will no longer operate in closed monolithic structures. Stakeholders and customers collaborating on a common application platform implemented with the cloud approach will bank on new software development and testing environments more oriented towards non-technical users and support development of business processes. Distributed applications with low footprints targeting large user base would be supported by enhanced Business Process Re-engineering tools for rapid development and deployment.

- 85% of the participants have agreed to this statement (Figure **13**).
- However, this statement is also seen as too general and "not manufacturing oriented". Improvement should be made on improvement of the description of the research topics through further specification and emphasis related to the world of manufacturing. This concern was addressed in the final roadmap where the MBW was showcased as an enablement of cloud-enabled decentralized and distributed platform for future development of manufacturing applications. However, it was also highlighted that future ICT for manufacturing research should build up on the advances of other ICT-focused platform development project such as FI-WARE and only build services that are relevant for the manufacturing industry.

28. Takeaway#6: Cross-boundary applications for the global enterprises Agile and lightweight applications are the key for innovation in European enterprises

	Response Percent	Response Count
Fully agree	**50.0%**	**17**
Somewhat agree	35.3%	12
Somewhat disagree	5.9%	2
Strongly disagree	0.0%	0
Do not know	8.8%	3

Figure 13: Relevance of the ICT Takeaway: Cross-boundary applications for the global enterprises

4.4 Convergence of the technology push and the market pull strategies

The convergence of the technology pushes and market pull perspectives of the roadmap was an important goal of the Roadmap. 87% of the survey participant quoted that they agree that the roadmap presents coherence between the ICT innovative development and the manufacturing challenges (Figure **14**). To further bolster this observation, the final roadmap's Chapter 3 takes a technology push approach of innovation and Chapter 4 presents a market pull approach for improvement of the current state of play in European manufacturing enterprises.

29. The ActionPlanT Roadmap presents a coherence between the ICT development needs and future manufacturing challenges

	Response Percent	Response Count
Fully agree	**55.9%**	**19**
Somewhat agree	32.4%	11
Somewhat disagree	2.9%	1
Strongly disagree	0.0%	0
Do not know	8.8%	3

Figure 14: Convergence of the technology push and market pull strategies for "ICT for Manufacturing"

4.5 Conclusion

This report delivers a summary of the process and results of the continuous roadmap validation. The key finding can be summarized as following:

- The gap analysis showed an extensive coverage of the identified manufacturing challenges. However, the definition of some manufacturing challenges was generic, in which cases further specification and clustering were required to avoid ambiguity;
- The gap analyses showed an insufficient description of innovative ICT trends and paradigms that could not only address one or more manufacturing challeges but could also drive innovation through new products and businesses in Europe;
- Most of the research topics were rated at the level of "Proof of Concept" in the Technology Readiness Level – this highlights that technologies and priorities in the roadmap were mostly novel and had not been applied/thought of in the context of manufacturing industry;
- A positive feedback on the impact of the main direction in the ICT for Manufacturing Vision;
- A positive feedback on the relevance of the research clusters and research priorities; and
- Although the six "ICT Key Takeaways" are seen as important and relevant fields of investment in the future, the content is seen as very general a need further specification. This was improved through the introduction of a more thorough and specific chapter on technology push ICT recommendations in the final roadmap.

4.6 Next Steps and actions implemented in D3.3 (Final Roadmap)

Combining the positive feedback received in the validation of the ActionPlanT Vision for Manufacturing 2.0 and the encouraging expert comments obtained during the different continuous validation stages, the ActionPlanT consortium transformed the draft roadmap (D3.2) into the final roadmap (D3.3) by incorporating:

- A tighter integration between the ActionPlanT vision and the Research Priorities that lead from it;
- A stronger focus on ICT by incorporating a “technology push” approach to the roadmap; and
- Inclusion of a chapter for outlining strategic alignment with Horizon 2020 policy objectives and future sustainability steps for the document.

A stronger alignment and integration with the vision (Chapter 2 of D3.3) was implemented by combining the technology megatrends and key ICT recommendations of the draft roadmap (D3.2) and deriving a set of 15 key ICT recommendations that drive a technology push approach for facilitating innovation in Manufacturing 2.0. These 15 key ICT recommendations were linked to the 40 Research Priorities in the final ActionPlanT roadmap (D3.3) by mapping one or more ICT recommendation to the corresponding Research Priorities. The ICT recommendations were included as Chapter 3 in the final roadmap D3.3.

The final roadmap also enhanced and refined the 28 draft Research Priorities (Chapter 4) by incorporating expert feedback. Following the recommendations obtained at two validation workshops earlier this year, 12 more Research Priorities that increase ICT impact and innovation of the roadmap were added. The Research Priority definition templates were harmonized by refining the following template components:

- Better topic descriptions that succinctly outline the manufacturing problem (market pull) at hand and/or novel innovation brought about by introduction of a new ICT paradigm (technology push);
- Consistent reflection of existing industrial challenges and proposed potential outcomes;
- Salient ICT research requirements necessary for implementing the corresponding Research Priority –care was taken to reduce redundancy and outline technologies that fulfil the ICT megatrends of collaboration, connectivity, mobility, and intelligence; and finally
- A refined impact section that incorporates an ambitions radar, impact factor, TRL, and proposed Horizon 2020 implementation timeline.

Lastly, a concluding chapter was added to the ActionPlanT roadmap for Horizon 2020 to outline the direct impact to the Horizon 2020 policy objectives. Focus was given drawn on the ‘Green Paper’ consultation feedback and different market analyst reports that reiterated the ICT megatrends and recommendations promoted in the roadmap. A collaboration plan with the European Factories of the Future Association (EFFRA) and specific input to the ‘ICT for manufacturing’ aspects of the ‘Factories of the Future – Beyond 2013’ were also discussed in the concluding chapter. Finally, the roadmap readers were made aware of the fact that their comments and suggestions are still solicited through the ActionPlanT project website even though the project has officially finished.

5 Annex 1 – ActionPlanT Online Survey Report

ActionPlanT- ICT for Manufacturing

1. Your first name

	Response Count
	40
answered question	40
skipped question	1

2. Your last name

	Response Count
	40
answered question	40
skipped question	1

3. Your e-mail address

	Response Count
	40
answered question	40
skipped question	1

4. Your organisation

	Response Count
	40
answered question	40
skipped question	1

5. Organisation type - Please select from:

	Response Percent	Response Count
ICT - supplier	45.0%	9
Manufacturing equipment-supplier	35.0%	7
Manufacturer	**60.0%**	**12**
Other (please specify)		20
answered question		**20**
skipped question		**21**

6. In case you are associated to a technology platform, association or grouping, please specify:

	Response Count
	25
answered question	**25**
skipped question	**16**

7. Please describe the interest and the role of your organization in the “ICT for Manufacturing” in context of your product(s) and organization:

	Response Count
	35
answered question	**35**
skipped question	**6**

8. For each of the below activities, please outline your personal involvement in the context of ICT for Manufacturing

	1 - not involved	2 - medium activity	3 - very active	Response Count
ICT development	37.8% (14)	**40.5% (15)**	21.6% (8)	37
ICT for manufacturing development	10.5% (4)	**44.7% (17)**	**44.7% (17)**	38
Use of ICT in Manufacturing	5.4% (2)	32.4% (12)	**62.2% (23)**	37
			Additional comments	5
			answered question	**39**
			skipped question	**2**

9. Please, specify the duration of your involvement in the field of ICT for Manufacturing:

		Response Percent	Response Count
less than 5 years		10.5%	4
less than 10 years		26.3%	10
more than 10 years		**63.2%**	**24**
		answered question	**38**
		skipped question	**3**

10. Please outline the main drivers for research and development in the domain of ICT for Manufacturing in your organization

	Response Count
	35
answered question	**35**
skipped question	**6**

11. Demographics and consumption Urbanisation with the development of megalopoles and a growing middle class in developing countries are fuelling demand for niche industrial products. Purchase decisions are being made based on brand perception of safety, quality and personalised/customisable products. Within Europe, the problem of an aging workforce is becoming critical and action must be taken to facilitate transfer of knowledge from the aged workforce to the younger workers, and to assist their daily work with user-friendly ICT tools.

		Response Percent	Response Count
very high impact		40.5%	15
high impact		**43.2%**	**16**
low impact		16.2%	6
no impact		0.0%	0
		Additional comment	13
		answered question	**37**
		skipped question	**4**

12. Global competition and Innovation Globalisation has led to the emergence of smaller dynamic enterprises able to put innovation into practice more rapidly than their bigger – and slow-moving – counterparts. The urge to be innovative is taking the global market by storm, putting pressure on large European enterprises once market leaders in their own domains but now losing out to smaller and more agile companies. To cope with growing competition, European enterprises must acknowledge the importance of innovation and put it to practice faster.

		Response Percent	Response Count
very high impact		**67.6%**	**25**
high impact		29.7%	11
low impact		2.7%	1
no impact		0.0%	0
		Additional comment	9
		answered question	**37**
		skipped question	**4**

13. All-round sustainability Sustainability has become a key topic on the agenda of politicians and corporate executives. It is necessary to transition from a wasteful to a frugal economy. This requires awareness and transformation of industrial processes towards low carbon footprints and energy efficiency. From a business point of view, the benefits of sustainability must be outlined to manufacturers without which enterprises would merely be sustainable on paper but not in practice.

		Response Percent	Response Count
very high impact		**43.2%**	**16**
high impact		35.1%	13
low impact		21.6%	8
no impact		0.0%	0
		Additional comment	10
		answered question	**37**
		skipped question	**4**

14. Dynamic collaboration Efficient and secure collaboration between many different stakeholders will become crucial for day-to-day operations of European manufacturers. Large companies as well as SMEs stand to gain from collaborative manufacturing, service management and customer engagement via social media and other Web 2.0 tools. The trend of offering value-added services or even 'products as a service' will replace conventional business practices within Europe.

		Response Percent	Response Count
very high impact		37.8%	14
high impact		**56.8%**	**21**
low impact		5.4%	2
no impact		0.0%	0
		Additional comment	7
		answered question	**37**
		skipped question	**4**

15. Enterprise mobility The exponential proliferation of mobile devices presents an attractive proposition to ‘on-the-go’ and ‘always-on’ users. While mobile technologies have permeated the consumer market, enterprise applications are still relatively limited. To leverage the potential of next-generation smart phones and handhelds, manufacturing enterprises are looking beyond conventional desktop solutions and focus on new opportunities and businesses in the mobile world.

		Response Percent	Response Count
very high impact		30.6%	11
high impact		**41.7%**	**15**
low impact		27.8%	10
no impact		0.0%	0
		Additional comment	9
		answered question	**36**
		skipped question	**5**

16. Real-world connectivity Sensors, automation controllers and embedded systems are already commonplace in personal life as well as in industrial applications. However, so far few companies have been deploying more than their own 'Intranet of Things' focused on local, isolated and closed-loop scenarios. The trend is to seamlessly and bi-directionally interact with real-world objects and systems on a global scale, across a variety of application domains and stakeholders in a secure way thus realising the 'Internet of Things'.

		Response Percent	Response Count
very high impact		35.1%	13
high impact		**54.1%**	**20**
low impact		10.8%	4
no impact		0.0%	0
		Additional comment	11
		answered question	**37**
		skipped question	**4**

17. Manufacturing intelligence Collaboration and connectivity will give rise to copious amounts of context and data which will have to be analysed on-the-fly and rendered on mobile devices of decision makers at both management and plant levels. Manufacturing enterprises will have a competitive advantage over their peers if they are able to perform real-time analysis over a large volume of data from processes, products and business systems.

		Response Percent	Response Count
very high impact		**51.4%**	**19**
high impact		40.5%	15
low impact		8.1%	3
no impact		0.0%	0
		Additional comment	8
		answered question	**37**
		skipped question	**4**

18. Towards agile manufacturing systems & processes Real-world ressources such as connected objects, devices and advanced robots would leverage advances in the Internet of Things domain to communicate, collaborate and organise themselves autonomously. Furthermore, manufacturing processes would react in real-time to changes within an enterprise ecosystem – such as availability of equipment, assembly lines and dynamic configuration of process parameters. To achieve this, Manufacturing 2.0 enterprises would be capable of applying advanced computing operations to process large volumes of real-time manufacturing data, perform analyses and forecasting on productivity, throughput and downtime. Lastly, these real-time changes and decisions would be executed by plant managers on their smart phones which will process enterprise and manufacturing data to facilitate efficient management-by-exception.

	Response Percent	Response Count
Fully agree	**60.6%**	**20**
Somewhat agree	27.3%	9
Somewhat disagree	9.1%	3
Strongly disagree	0.0%	0
Do not know	3.0%	1
	Additional comment	8
	answered question	**33**
	skipped question	**8**

19. New seamless factory lifecycle management 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.

		Response Percent	Response Count
Fully agree		**68.6%**	**24**
Somewhat agree		31.4%	11
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	4
		answered question	**35**
		skipped question	**6**

20. 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 novel knowledge-delivery mechanisms. Future enterprises will not only be better equipped for transferring skills to a new generation of workers but also proficient in assisting older workers with better user interfaces, intuitive user-experience-driven workflows and other aids, such as mobile and service robots. Furthermore, Manufacturing 2.0 enterprises would be equipped with interactive e-learning tools to facilitate students, apprentices and new workers gaining understanding of advanced manufacturing operations involving new ICT paradigms.

		Response Percent	Response Count
Fully agree		**44.1%**	**15**
Somewhat agree		41.2%	14
Somewhat disagree		14.7%	5
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	9
		answered question	**34**
		skipped question	**7**

21. Fostering collaborative supply network Manufacturing 2.0 enterprises will define a new collaboration paradigm between stakeholders in the manufacturing supply chain, including but not limited to original equipment manufacturers (OEM), suppliers and subcontractors. Manufacturing processes will run across organisational boundaries of OEMs and subcontractors with complete visibility of production, inventory and materials available while guaranteeing security and privacy for all stakeholders. As part of the extended collaboration paradigm, OEMs will be able to sell 'products as a service' and certified suppliers or subcontractors will be able to offer value-added services – such as maintenance or upgrades – to customers.

		Response Percent	Response Count
Fully agree		**47.1%**	**16**
Somewhat agree		**47.1%**	**16**
Somewhat disagree		2.9%	1
Strongly disagree		0.0%	0
Do not know		2.9%	1
		Additional comment	6
		answered question	**34**
		skipped question	**7**

22. Aiming at customer centric design and manufacturing Another level where Manufacturing 2.0 enterprises would excel is in customer engagement. Manufacturing 2.0 enterprises would extract customer feedback from social media and incorporate it into engineering and manufacturing processes. Manufacturing 2.0 enterprises would be able to attain the quality-price-sustainability trade-off by intelligent product design through customer collaboration. Furthermore, Manufacturing 2.0 enterprises would be able to mitigate barriers in 'make-to-order' production and deliver individualised products with increased complexity and variability to customers.

		Response Percent	Response Count
Fully agree		38.2%	13
Somewhat agree		**55.9%**	**19**
Somewhat disagree		5.9%	2
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	4
		answered question	**34**
		skipped question	**7**

23. Takeaway #1: All is connected ICT solutions must bridge the gap between the physical world (shop floor) and the enterprise world (business systems)

	Response Percent	Response Count
Fully agree	**60.0%**	**21**
Somewhat agree	31.4%	11
Somewhat disagree	5.7%	2
Strongly disagree	0.0%	0
Do not know	2.9%	1
Additional Comment		3
answered question		**35**
skipped question		**6**

24. Takeaway#2: From massive data to lean information ICT solutions must facilitate storage and processing of copious production data

	Response Percent	Response Count
Fully agree	**73.5%**	**25**
Somewhat agree	20.6%	7
Somewhat disagree	5.9%	2
Strongly disagree	0.0%	0
Do not know	0.0%	0
Additional Comment		3
answered question		**34**
skipped question		**7**

25. Takeaway#3: Cloud’s the word ICT solutions must implement secure, high performance and open services platforms for large, medium, and small enterprises.

		Response Percent	Response Count
Fully agree		40.0%	14
Somewhat agree		**54.3%**	**19**
Somewhat disagree		5.7%	2
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional Comment	7
		answered question	**35**
		skipped question	**6**

26. Takeaway#4: To know, understand, and forecast ICT solutions must make sense out of the stored and streamed production data through modelling, simulation and analytics.

		Response Percent	Response Count
Fully agree		**62.9%**	**22**
Somewhat agree		25.7%	9
Somewhat disagree		8.6%	3
Strongly disagree		0.0%	0
Do not know		2.9%	1
		Additional Comments	3
		answered question	**35**
		skipped question	**6**

27. Takeaway#5: Everywhere and everyone on-demand ICT solutions must integrate the human element – workers and customers – to a greater degree in their day-to-day functioning.

		Response Percent	Response Count
Fully agree		**50.0%**	**17**
Somewhat agree		47.1%	16
Somewhat disagree		2.9%	1
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional Comments	3
		answered question	**34**
		skipped question	**7**

28. Takeaway#6: Cross-boundary applications for the global enterprises Agile and lightweight applications are the key for innovation in European enterprises

		Response Percent	Response Count
Fully agree		**50.0%**	**17**
Somewhat agree		35.3%	12
Somewhat disagree		5.9%	2
Strongly disagree		0.0%	0
Do not know		8.8%	3
		Additional Comment	4
		answered question	**34**
		skipped question	**7**

29. The ActionPlanT Roadmap presents a coherence between the ICT development needs and future manufacturing challenges

	Response Percent	Response Count
Fully agree	**55.9%**	**19**
Somewhat agree	32.4%	11
Somewhat disagree	2.9%	1
Strongly disagree	0.0%	0
Do not know	8.8%	3
	Additional Comments	3
	answered question	**34**
	skipped question	**7**

30. The detailed technical recommendations of the ICT for Manufacturing - Roadmap für Horizon 2020 is concentrated within the five Research Clusters defining Research Priorities. The Research Priorities are described in terms of industrial challenges which are facing the European manufacturing and identifying the potential outcomes from the implementation of the identified ICT research requirements. In the following section of this survey, you have the opportunity to give your opinion about the recommended Research Priorities in detail.

	Response Percent	Response Count
I would like to take part in the detailed part of this survey, giving my opinion about the recommendations within the Research Clusters	**67.9%**	**19**
I will not take part in the detailed part of this survey	32.1%	9
	answered question	**28**
	skipped question	**13**

31. Please choose one of the following Research Cluster:

		Response Percent	Response Count
Towards agile manufactuirng systems and processes		**27.8%**	**5**
New seamless factory lifecycle management		22.2%	4
People at the forefront		16.7%	3
Fostering collaborative supply network		5.6%	1
Aiming at customer centric design and manufacturing		**27.8%**	**5**
		answered question	**18**
		skipped question	**23**

32. RP1.1 – Flexible and reconfigurable Machinery and Robots Development of innovative ICT tools for supporting the reconfiguration of machinery and robots, as basis for supporting mass customized and highly personalized products and fast reactions to shifts of market demands. Expected tools will address challenges related to simulation, control, integration and networking among reconfigurable machines, aiming at a significant impact of changeover time/cost, tooling, programming and energy usage.

		Response Percent	Response Count
Fully agree		**63.6%**	**7**
Somewhat agree		27.3%	3
Somewhat disagree		9.1%	1
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**11**
		skipped question	**30**

33. RP1.2 – Professional Service Robots and Multimodal Human-Machine-Robot Collaboration Immersive collaboration between human workers and robots leads to a more efficient, safer and flexible manufacturing environment. Cognition-based intelligent features within machinery and robots will radically change their interfacing towards human operators in manufacturing environments in a manner, that the human-robot-system will be dynamic, will safely act in a shared working space, will follow an intuitive cooperation and will be aware of the work and of its environment.

		Response Percent	Response Count
Fully agree		36.4%	4
Somewhat agree		**54.5%**	**6**
Somewhat disagree		9.1%	1
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	1
		answered question	**11**
		skipped question	**30**

34. RP1.3 – Adaptive Process Automation and Control Intelligent plug-and-play systems will feature sensing and actuator structures integrated with adaptive control systems and with active compensation features for fully optimizing the performance of the manufacturing systems in terms of autonomy, reliability and efficiency along their lifecycle.

		Response Percent	Response Count
Fully agree		**60.0%**	**6**
Somewhat agree		40.0%	4
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	1
		answered question	**10**
		skipped question	**31**

35. RP1.4 – Manufacturing Execution Environment for Smart Factory Current Manufacturing Execution Systems are static and do not adapt adequately to the dynamic and agility of evolvable production systems. The highly dynamic of future manufacturing systems require a constant optimization of quality and resource usage. In addition, the amount of knowledge extracted from automation level should be fully exploited by manufacturing execution systems. A new MES generation is foreseen to deal with this highly dynamic environment and more sustainable manufacturing through optimization of knowledge-based systems and synchronization with supply chain management systems. This new generation should behave condition-based, exploit experience, self-organisation of production systems and have suitable ICT architecture supporting these features.

		Response Percent	Response Count
Fully agree		**72.7%**	**8**
Somewhat agree		27.3%	3
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**11**
		skipped question	**30**

36. RP1.5 – Monitoring, Perception & Awareness on Manufacturing Within a view of high value adding manufacturing processes, it becomes essential to monitor the actual state of components and machines in a continuous manner, as means for assuring diagnosis and context-awareness capabilities in the associated systems. In this regard, ubiquitous sensing approaches will actively support engineers in their aim of detecting, measuring and monitoring the variables, events and situations which affect the performance and reliability of these manufacturing systems.

		Response Percent	Response Count
Fully agree		**72.7%**	**8**
Somewhat agree		27.3%	3
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	1
		answered question	**11**
		skipped question	**30**

37. The need for further development of the above research priorities are recognized in your organisation

	Fully agree	Somewhat agree	Somewhat disagree	strongly disagree	Not applicable	Response Count
RP1.1 – Flexible and reconfigurable Machinery and Robots	**40.0% (4)**	30.0% (3)	20.0% (2)	0.0% (0)	10.0% (1)	10
RP1.2 – Professional Service Robots and Multimodal Human-Machine-Robot	**40.0% (4)**	30.0% (3)	20.0% (2)	0.0% (0)	10.0% (1)	10
RP1.3 – Adaptive Process Automation and Control	**63.6% (7)**	27.3% (3)	9.1% (1)	0.0% (0)	0.0% (0)	11
RP1.4 – Manufacturing Execution Environment for Smart Factory	**72.7% (8)**	27.3% (3)	0.0% (0)	0.0% (0)	0.0% (0)	11
RP1.5 – Monitoring, Perception & Awareness on Manufacturing	**72.7% (8)**	27.3% (3)	0.0% (0)	0.0% (0)	0.0% (0)	11
					answered question	**11**
					skipped question	**30**

38. Thank you for giving your opinion on this cluster. Would you like to:

		Response Percent	Response Count
Continue this survey and select another Research Cluster?		**63.6%**	**7**
Complete this survey		36.4%	4
		answered question	**11**
		skipped question	**30**

39. RP2.1 – Integrated factory models for evolvable Manufacturing Systems Factories are becoming more complex, expensive, distributed and faster evolving than in the past. The integration and interoperability of current IT applications makes the possibility of a holistic representation, monitoring and management of the factory difficult. The development of integrated scalable and semantic factory models with multi-level access features, aggregation of data with different granularity, zoom in and out functionalities, real-time data acquisition from all the factory resources (i.e. assets, machines, workers and objects) will enable the implementation of support decisionmaking processes, activity planning and operation controlling of the Manufacturing 2.0 factories.

		Response Percent	Response Count
Fully agree		28.6%	2
Somewhat agree		**71.4%**	**5**
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	1
		answered question	**7**
		skipped question	**34**

40. RP2.2 – Intelligent maintenance systems for increased reliability of production systems Complex and expensive production assets in conjunction with market requests for high quality products require novel maintenance approaches which are able to ensure required capacity and production quality. Intelligent maintenance systems based on condition prediction mechanisms, RUL (Remaining Useful Life) estimation, and analysis of machines' behaviour or operational parameters and self-learning capabilities will lead to increased reliability, availability and safety in the entire production system. Furthermore, the improvements in the equipment health state will entail significant energy savings. Maintenance will more and more take place before the failure occurs and when its impact is at minimum. Analysis is carried out utilizing the massive amount of data captured by intelligent devices from the field and through specific algorithms able to define the optimal approach.

		Response Percent	Response Count
Fully agree		**71.4%**	**5**
Somewhat agree		28.6%	2
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	1
		answered question	**7**
		skipped question	**34**

41. RP2.3 – Integrated High-performance Computing in Factory Life Cycle Management Increasing complexity, stronger market competition and higher investments for green plants are forcing factories to be considered as complex long-life products where different lifecycle phases such as factory design, engineering, operation and decommissioning need to be carefully managed in a consistent manner. Such holistic factory lifecycle phases have to be addressed using appropriate distributed, interoperable, and high performance ICT tools which make use of advances in parallel and distributed computing to deal with simulations and forecast computing on large amount of data originating from shop floors, plants, business systems, worker inputs and variable business factors.

		Response Percent	Response Count
Fully agree		**71.4%**	**5**
Somewhat agree		28.6%	2
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**7**
		skipped question	**34**

42. RP2.4 – ICT supported energy consumption optimisation in Manufacturing 2.0 enterprises Reduced energy consumption in future Manufacturing 2.0 enterprises is an environmentally challenging issue which also makes business sense to the enterprise by resulting in cost savings. Energy savings areas in the production environment have to be considered from different perspectives: component level, field level, machine level, process and plant level. The development of software-based decision-support systems as well as consumption monitoring and planning systems will lead to overall reduced energy consumption, more efficient utilization and optimized energy sourcing.

		Response Percent	Response Count
Fully agree		**71.4%**	**5**
Somewhat agree		28.6%	2
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	1
		answered question	**7**
		skipped question	**34**

43. RP2.5 – Multi-level simulation for enhanced factory modelling Distributed simulation systems offer good local optimization outcomes but lack interoperability and holistic modelling options, especially for complex manufacturing systems. Integrated multi-level simulation systems will facilitate enhanced factory modelling by enabling views and interpretations from different perspectives which aimed at providing stakeholders with different representations of relevant information. IoT-based continuous data collection (i.e. assets, resources, products) from the field and along the value chain in conjunction with appropriate simulation and analysis tools will identify deviations between expected and actual results allowing early management of factory and production issues

		Response Percent	Response Count
Fully agree		**71.4%**	**5**
Somewhat agree		28.6%	2
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	1
		answered question	**7**
		skipped question	**34**

44. RP2.6 – Services for continuous evaluation and mitigation of manufacturing risks Complex production environments and pressure from social and statutory organisations require that risks (internal risks as production process or machinery failure and external risks as environmental or natural calamity) are properly identified, ranked, managed and mitigated. Dimensions of production facilities, types of processes and materials call for specific attention to avoiding accidents that could have dramatic consequences for human lives and for the environment. Prevention and risk mitigation are also desirable options compared to recovery after damage.

		Response Percent	Response Count
Fully agree		**57.1%**	**4**
Somewhat agree		42.9%	3
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**7**
		skipped question	**34**

45. RP2.7 – On-demand modular “replicative” factory models Easy and cost effective design, engineering and deployment of new production facilities is a necessity for competing on a global scale such that enterprises are able to cope with the growing market demand and customisation requests from customers. The definition of consistent description model of the production resources, their relationships and logistics flow are key enablers for achieving this objective.

		Response Percent	Response Count
Fully agree		28.6%	2
Somewhat agree		**71.4%**	**5**
Somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**7**
		skipped question	**34**

46. The need for further development of the above research priorities are recognized in your organisation

	Fully agree	Somewhat agree	Somewhat disagree	strongly disagree	Not applicable	Response Count
RP2.1 – Integrated factory models for evolvable Manufacturing Systems	**42.9% (3)**	28.6% (2)	14.3% (1)	0.0% (0)	14.3% (1)	7
RP2.2 – Intelligent maintenance systems for increased reliability of production system	**57.1% (4)**	28.6% (2)	0.0% (0)	0.0% (0)	14.3% (1)	7
RP2.3 – Integrated High-performance Computing in Factory Life Cycle Management	**57.1% (4)**	0.0% (0)	14.3% (1)	14.3% (1)	14.3% (1)	7
RP2.4 – ICT supported energy consumption optimisation in Manufacturing 2.0 entreprises	28.6% (2)	**57.1% (4)**	0.0% (0)	0.0% (0)	14.3% (1)	7
RP2.5 – Multi-level simulation for enhanced factory modelling	**42.9% (3)**	**42.9% (3)**	0.0% (0)	14.3% (1)	0.0% (0)	7
RP2.6 – Services for continuous evaluation and mitigation of manufacturing risks	**71.4% (5)**	0.0% (0)	28.6% (2)	0.0% (0)	0.0% (0)	7
RP2.7 – On-demand modular “replicative” factory models	14.3% (1)	28.6% (2)	**42.9% (3)**	0.0% (0)	14.3% (1)	7
					answered question	**7**
					skipped question	**34**

47. Thank you for giving your opinion on this cluster. Would you like to:

		Response Percent	Response Count
Continue this survey and select another Research Cluster?		**57.1%**	**4**
Complete this survey		42.9%	3
		answered question	**7**
		skipped question	**34**

48. RP3.1 – Enhanced Visualisation of complex Manufacturing data As development of data volumes continue to increase and manufacturing systems become more integrated, maintaining situation awareness and coping with information overload become a serious challenge. Future ICT solutions should focus on novel visualization techniques that will abstract relevant data from real-world resources and business systems and display relevant information to knowledge workers and decision makers.

	Response Percent	Response Count
Fully agree	**100.0%**	**7**
somewhat agree	0.0%	0
somewhat disagree	0.0%	0
Strongly disagree	0.0%	0
Do not know	0.0%	0
Additional comment		0
answered question		**7**
skipped question		**34**

49. RP3.2 – Teenage-awareness for Manufacturing Jobs in manufacturing are not seen attractive enough from a wide part of the new generation and this can create serious challenges for the competitivene

	Response Percent	Response Count
Fully agree	**71.4%**	**5**
somewhat agree	28.6%	2
somewhat disagree	0.0%	0
Strongly disagree	0.0%	0
Do not know	0.0%	0
Additional comment		0
answered question		**7**
skipped question		**34**

50. RP3.3 – Advanced Information Models for knowledge creation and learning Increasing amount of data in manufacturing environments is not kept in appropriate forms for capitalization and further expl

		Response Percent	Response Count
Fully agree		**71.4%**	**5**
somewhat agree		14.3%	1
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		14.3%	1
		Additional comment	1
		answered question	**7**
		skipped question	**34**

51. RP3.4 - ICT support to the worker-process interaction and collaborative competence development Increasing complexity of manufacturing processes creates the needs for knowledge workers to be supported by appropriate tools providing them assistance for operations along the life cycle and further development of their competences. Interfaces and assistance tools for knowledge communication will assist workers while performing manufacturing operations, including assembly, operation of machines, maintenance activities, ramp-up procedures, trouble-shooting and remote guidance.

	Response Percent	Response Count
Fully agree	**71.4%**	**5**
somewhat agree	14.3%	1
somewhat disagree	0.0%	0
Strongly disagree	0.0%	0
Do not know	14.3%	1
	Additional comment	0
	answered question	**7**
	skipped question	**34**

52. The need for further development of the above research priorities are recognized in your organisation

	Fully agree	Somewhat agree	Somewhat disagree	strongly disagree	Not applicable	Response Count
RP3.1 – Enhanced Visualisation of complex Manufacturing data	**71.4% (5)**	14.3% (1)	0.0% (0)	0.0% (0)	14.3% (1)	7
RP3.2 – Teenage-awareness for Manufacturing	14.3% (1)	**42.9% (3)**	14.3% (1)	0.0% (0)	28.6% (2)	7
RP3.3 – Advanced Information Models for knowledge creation and learning	**71.4% (5)**	28.6% (2)	0.0% (0)	0.0% (0)	0.0% (0)	7
RP3.4 – ICT support to the worker-process interaction and collaborative competence development	**57.1% (4)**	28.6% (2)	0.0% (0)	0.0% (0)	14.3% (1)	7
					answered question	**7**
					skipped question	**34**

53. Thank you for giving your opinion on this cluster. Would you like to:

		Response Percent	Response Count
Continue this survey and select another Research Cluster?		**57.1%**	**4**
Complete this survey		42.9%	3
		answered question	**7**
		skipped question	**34**

54. RP4.1 – Cloud-based Manufacturing Business Web for Supply Network Collaboration The Manufacturing Business Web (MBW) is envisioned as a cloud-based real-time and easy access middleware that will facilitate stakeholders in the Manufacturing 2.0 supply network to perform end-to-end manufacturing services encompassing domains of customer collaboration, collaborative service management, and collaborative manufacturing. It will be a manufacturing service delivery framework which at the same time is secure, robust, and interoperable.

		Response Percent	Response Count
Fully agree		**66.7%**	**2**
somewhat agree		33.3%	1
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**3**
		skipped question	**38**

55. RP4.2 – ICT-supported remanufacturing across the supply network One of the key issues deterring the uptake of remanufacturing is the information gap which is created when products leave the OEM. The information gap is the result of the lack of data on product usage, repair, service, and refurbishment history. This, in turn, results in the fact that the input to the remanufacturing process is of unknown quality. The lack of reliable information for remanufacturing leads to missed opportunities with respect to increased economic or environmental impact.

		Response Percent	Response Count
Fully agree		**66.7%**	**2**
somewhat agree		33.3%	1
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**3**
		skipped question	**38**

56. RP4.3 – Leveraging mobility for an agile and intelligent supply network Responsiveness of stakeholders within a supply network can be increased and new business opportunities could be availed if the right kind of data is made available to the decision makers at the right time “on-the-fly” and “on-the-go”. Next generation of computing research should avail the combined power of the internet and mobile devices to render data from shop floor, production systems, as well as disparate business systems across to supply network to human stakeholders in the supply network.

		Response Percent	Response Count
Fully agree		**66.7%**	**2**
somewhat agree		33.3%	1
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional ocomment	0
		answered question	**3**
		skipped question	**38**

57. RP4.4 – Internet-of-Things in networked value chain Manufacturing 2.0 enterprise assets and products of the future will leverage the concept of the "Internet of Things" where objects carry information about themselves, communicate with each other and the world around them. In order to harness the potential of connected objects and perform meaningful data analytics, future research should bridge the gap between different abstractions of objects operating at the shop floor level, business systems level, and at the level of supply networks.

		Response Percent	Response Count
Fully agree		**66.7%**	**2**
Somewhat agree		33.3%	1
Somewhat disagree		0.0%	0
strongly disagree		0.0%	0
Not applicable		0.0%	0
		Additional Comment	0
		answered question	**3**
		skipped question	**38**

58. RP4.5 – Complex Event Processing (CEP) for state detection and query processing in supply networks Connected objects representing “Internet of Things” in supply chain networks will give rise to copious amount of data generated in the form of events. These events will be distributed in nature displaying the characteristics of nondeterminism and asynchrony which will be a challenge for global state/predicate detection as well as discrete/continuous query processing. Future ICT research in Complex Event Processing (CEP) should devise solutions for detection of meaningful conditions in networks.

		Response Percent	Response Count
Fully agree		**100.0%**	**3**
somewhat agree		0.0%	0
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**3**
		skipped question	**38**

59. RP4.6 – Property Rights Management of products and code in supply networks Although strict laws for Intellectual Property Rights (IPR) are a commonplace, enforcement seems to be an issue in the absence of well established ICT mechanisms for piracy detection and tracking. To counter the threat of piracy and counterfeiting of products, ICT research should apply and advance the latest advances made in Digital Rights Management (DRM) for music, video, photographic images, and software to products that are manufactured in Europe and the software code embedded therein

		Response Percent	Response Count
Fully agree		33.3%	1
somewhat agree		**66.7%**	**2**
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**3**
		skipped question	**38**

60. RP4.7 – Multi-Enterprise Role-Based Access Control (mRBAC) in manufacturing supply networks One of the greatest obstacles in the acceptance and adoption of cloud platforms in productive environments is the inability to manage and prevent threats originating from unauthorised access of enterprise data. For Manufacturing 2.0 enterprises of the future to effectively cooperate and collaborate in ecosystems comprising trusted as well as un-trusted vendors, it is important that the notion of RBAC be extended and successfully applied in the context of manufacturing supply networks.

		Response Percent	Response Count
Fully agree		**66.7%**	**2**
somewhat agree		33.3%	1
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**3**
		skipped question	**38**

61. The need for further development of the above research priorities are recognized in your organisation

	Fully agree	Somewhat agree	Somewhat disagree	strongly disagree	Not applicable	Response Count
RP4.1 – Cloud-based Manufacturing Business Web for Supply Network Collaboration	**66.7% (2)**	0.0% (0)	0.0% (0)	0.0% (0)	33.3% (1)	3
RP4.2 – ICT-supported remanufacturing across the supply network	33.3% (1)	**66.7% (2)**	0.0% (0)	0.0% (0)	0.0% (0)	3
RP4.3 – Leveraging mobility for an agile and intelligent supply network	**66.7% (2)**	0.0% (0)	0.0% (0)	0.0% (0)	33.3% (1)	3
RP4.4 – Internet-of-Things in networked value chain	**66.7% (2)**	0.0% (0)	0.0% (0)	0.0% (0)	33.3% (1)	3
RP4.5 – Complex Event Processing (CEP) for state detection and query processing in supply networks	**100.0% (3)**	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	3
RP4.6 – Property Rights Management of products and code in supply networks	**33.3% (1)**	**33.3% (1)**	0.0% (0)	0.0% (0)	**33.3% (1)**	3
RP4.7 – Multi-Enterprise Role-Based Access Control (mRBAC) in manufacturing supply networks	**66.7% (2)**	0.0% (0)	0.0% (0)	0.0% (0)	33.3% (1)	3
					answered question	**3**
					skipped question	**38**

62. Thank you for giving your opinion on this cluster. Would you like to:

		Response Percent	Response Count
Continue this survey and select another Research Cluster?		**66.7%**	**2**
Complete this survey		33.3%	1
		answered question	**3**
		skipped question	**38**

63. RP5.1 – Manufacturing Intelligence for informed Product Design In order to face with global competition companies are increasing the number of new products introductions (NPI) on the market and therefore shortening the life cycle of the product itself. To fulfil this trend time-to-market is decreasing, designer are pressured to accelerate the development phase and use more expertise coming from the manufacturing field. A more frequent feedback loop without media breaks between product engineering and the manufacturing phases is envisioned to ensure high quality products at low production costs. ICT for manufacturing intelligence should enable the integration between engineering and manufacturing phases of products.

		Response Percent	Response Count
Fully agree		**100.0%**	**6**
somewhat agree		0.0%	0
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
	Additional comments		0
	answered question		**6**
	skipped question		**35**

64. RP5.2 – ICT for energy-efficient product life cycles It considers new ICT-enabled methods to monitor and improve the energy efficiency of products throughout their lifecycles benefiting from the emergence of new technologies such as smart embedded devices, new sensing technologies and IoT-based technology in the manufacturing and maintenance. Real-time measured data will allow the creation of detailed models of product energy consumption thus going beyond traditional Life Cycle Assessment approaches. The methods encompass those considering the whole product lifecycle, as well as those focusing on specific lifecycle phases.

		Response Percent	Response Count
Fully agree		**66.7%**	**4**
somewhat agree		33.3%	2
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comments	0
		answered question	**6**
		skipped question	**35**

65. RP5.3 – Collaborative Design for global Manufacturing of Product-Service Systems Companies are faced with increasing complexity of design changes and need to collaborate as a single virtual organization. It supports local companies in global collaboration, especially SMEs, while protecting each company's intellectual property. The objective is to increase reactivity to demand and deliver quickly new products leveraging business relationships and local expertise. It will enable SMEs to participate in large collaborative projects.

		Response Percent	Response Count
Fully agree		**50.0%**	**3**
somewhat agree		33.3%	2
somewhat disagree		16.7%	1
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comment	0
		answered question	**6**
		skipped question	**35**

66. RP5.4 – Crowd sourcing for highly personalized human-centric innovative product The 2.0 paradigm has proved the ability to activate and motivate people to participate in social networks. Future manufacturing will depend on rapid conversion of the customer individual requirements (personalization) and collective requirements (human-centric) into a product opportunity that will be managed by manufacturing enterprises with the ability to collaborate to meet those requirements. Yet the languages of customer requirements and of product manufacturing competences and collaboration capabilities are divergent, so there is need for specialized social networks that can source new implicit expectations and convert them into innovative functional requirements for personalized solution design.

		Response Percent	Response Count
Fully agree		33.3%	2
somewhat agree		**66.7%**	**4**
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comments	1
		answered question	**6**
		skipped question	**35**

67. RP5.5 – Product Value and Impact Simulation While designing or improving a new product or service many possible scenarios need to be explored from choice of specifications, design, materials, “make or buy” and suppliers, to manufacturing strategy (produce to order or make to stock), product usage (profiles of customers), product servicing (type of maintenance services proposed), and product recycling. This research aims at developing a framework for digital mock-ups of product & services in their environment in order to optimize product & services value and impact from a financial, environmental and social point of view.

		Response Percent	Response Count
Fully agree		**50.0%**	**3**
somewhat agree		**50.0%**	**3**
somewhat disagree		0.0%	0
Strongly disagree		0.0%	0
Do not know		0.0%	0
		Additional comments	0
		answered question	**6**
		skipped question	**35**

68. The need for further development of the above research priorities are recognized in your organisation

	Fully agree	Somewhat agree	Somewhat disagree	strongly disagree	Not applicable	Response Count
RP5.1 – Manufacturing Intelligence for informed Product Design	**83.3% (5)**	16.7% (1)	0.0% (0)	0.0% (0)	0.0% (0)	6
RP5.2 – ICT for energy-efficient product life cycles	**66.7% (4)**	33.3% (2)	0.0% (0)	0.0% (0)	0.0% (0)	6
RP5.3 – Collaborative Design for global Manufacturing of Product-Service Systems	**83.3% (5)**	16.7% (1)	0.0% (0)	0.0% (0)	0.0% (0)	6
RP5.4 – Crowd sourcing for highly personalized human-centric innovative product	33.3% (2)	**50.0% (3)**	16.7% (1)	0.0% (0)	0.0% (0)	6
RP5.5 – Product Value and Impact Simulation	**50.0% (3)**	33.3% (2)	16.7% (1)	0.0% (0)	0.0% (0)	6
					answered question	**6**
					skipped question	**35**

69. Thank you for giving your opinion on this cluster. Would you like to:

		Response Percent	Response Count
Continue this survey and select another Research Cluster?		28.6%	2
Complete this survey		**71.4%**	**5**
		answered question	**7**
		skipped question	**34**

Page 2, Q6. In case you are associated to a technology platform, association or grouping, please specify:		
1	Manufuture	Apr 20, 2012 1:57 AM
2	Manufuture	Apr 13, 2012 12:18 AM
3	EU FP6 Pegasus programme - IDEE	Apr 11, 2012 4:40 AM
4	Manufuture, EFFRA	Apr 3, 2012 3:47 AM
5	Manufuture, Europ	Apr 2, 2012 11:31 PM
6	Manufuture; EFFRA	Apr 2, 2012 4:02 AM
7	EFFRA	Apr 2, 2012 12:59 AM
8	SIF (sociedad de Inganieria de Fabricacion)	Mar 30, 2012 8:45 AM
9	Member of EFFRA	Mar 30, 2012 4:39 AM
10	MANUFUTURE, EFFRA, ERTRAC, MINAM	Mar 30, 2012 4:22 AM
11	MANUFUTURE, European Concept,	Mar 16, 2012 1:42 AM
12	At European level: Manufuture, Factories of the Future, Future Textiles and Clothing, NanoMedicine, Construction, Forestry, Industrial Safety. At Spanish level: Health, Automotion, Railroad, Sports, Embedded Systems, Materials.	Mar 15, 2012 8:28 AM
13	ESTEP (European Steel Technology Platform)	Mar 15, 2012 3:05 AM
14	Manufuture	Mar 13, 2012 2:57 AM
15	SAP ERP	Mar 12, 2012 7:59 AM
16	ManuFuture, EFFRA	Mar 11, 2012 1:05 PM
17	EFFRA, MANUFUTURE	Mar 6, 2012 9:30 AM
18	Manufutre	Mar 5, 2012 3:03 AM
19	EFFRA	Mar 5, 2012 1:52 AM
20	EFFRA	Mar 4, 2012 9:31 AM
21	Manufuture & EFFRA	Mar 4, 2012 7:33 AM
22	EFFRA	Mar 2, 2012 2:48 PM
23	MnuFuture	Mar 2, 2012 12:57 PM
24	ESTEP	Mar 2, 2012 12:52 AM
25	NESSI	Feb 19, 2012 8:57 AM

Page 2, Q7. Please describe the interest and the role of your organization in the "ICT for Manufacturing" in context of your product(s) and organization:		
1	R&D in the field of Manufacturing	Apr 27, 2012 12:55 AM
2	ICT is a vital component in most of our activities such as manufacturing and automation technology development, product development and manufaccturing processes development	Apr 20, 2012 1:57 AM
3	As every semiconductor manufacturing company, we collect a very large amount of datas of production activity. We also have a logistic structure very complex due to our job shop organisation, the large quantity of tools and the complexity of our products manufacturing. Therefore operators need both of an advanced MES and a very particular scheduling system in order to make the better choice of their priorities.	Apr 19, 2012 12:46 AM
4	not defined	Apr 16, 2012 2:09 AM
5	Applying Knowledge Technologies to the creation of smarter knowledge-based ICT systems	Apr 11, 2012 4:40 AM
6	Application of Knowledge Technologies to the developement of smarter KBE solutions.	Apr 11, 2012 3:03 AM
7	R&D and Tech transfer to industry	Apr 5, 2012 6:18 PM
8	We develop ICT solutions for new manufacturing technologies and we use new ICT solutions in our R&D projects	Apr 3, 2012 3:47 AM
9	Research and implementation of ICT technologies in Manufacturing	Apr 2, 2012 11:31 PM
10	We are very interested because we are developmenting a tool that includes simulation of factories, in a frame o lean&Green manufacturing with efficency energy	Apr 2, 2012 12:41 PM
11	Establishing a vision for the role of ICT in manufacturing of the future,projects ideas and develop future ideas	Apr 2, 2012 4:02 AM
12	Suppoting manufacturing industry in the implemantation of ICT solutions	Apr 2, 2012 12:59 AM
13	Reseach, development and innovation in manufacturing technologies and pocesses	Mar 30, 2012 8:45 AM
14	High participation in Research projects in all Research Framework Programmes in Europe as well as National and Regional programmes.	Mar 30, 2012 4:39 AM
15	Our company works closely with machine tool OEMs providing them new solution in terms of machine structure, components, processes, simulation, monitoring and manufacturing data management	Mar 30, 2012 4:22 AM
16	The activities of our resear group are mainly focused in the research and development of ICT technologies for control, monitoring and optimization of manufacturing processes.	Mar 29, 2012 2:46 PM
17	I represent the PlanetHPC Support Activity which is generating a roadmap for HPC research.	Mar 29, 2012 1:27 AM
18	Researcher	Mar 21, 2012 12:56 AM
19	Manufacturing of products: Dataexchange over complete valuechain incl.	Mar 16, 2012 7:09 AM

Page 2, Q7. Please describe the interest and the role of your organization in the "ICT for Manufacturing" in context of your product(s) and organization:		
	supplier and customers Engineering of special machines and control technics for our manufacturing: cost savings and TTM	
20	The Instituto de Biomecánica de Valencia (IBV) focuses its activity on person-oriented products and services. IBV activities integrate users as the indispensable source of information, and address to those services and products with strong functional and emotional dimensions and where IBV's know-how as technological and research centre provides a greater added value: medical devices, footwear, clothing, sports, transport, furniture, workplace or personal protective equipment, among others. R+D activities include personalization, usability testing, or functional and emotional assessment of products and services.	Mar 15, 2012 8:28 AM
21	I am in charge of an European WG "Process Factory of the Future" which is dealing with ICT for process industries	Mar 15, 2012 3:05 AM
22	Providing ME and ERP solutions	Mar 12, 2012 7:59 AM
23	We are supplying and producing components and systems that are linlked to and based upon ICT tools.	Mar 11, 2012 1:05 PM
24	Participation in research projects, standardisation and demonstration activities in the following areas: - seamless integration of manufacturing equipment - realtime process and product data collection and analysis for transparency, traceability, condition monitoring and predictive maintenance - connectivitiy of automation equipment and mobile devices for visualisation, monitoring and analysis - usability for HMIs	Mar 10, 2012 7:13 AM
25	enhancing own production world-wide building special machinery for in-house use provider of industrial controls, components, services and systems (Bosch Rexroth)	Mar 6, 2012 9:30 AM
26	As described above I'm concerned with ICT for Manufacturing in my day-to-day business. Additional I'm a member of an internal steering committee for standardizing IT in manufacturing and make use of synergies.	Mar 5, 2012 8:05 AM
27	Smart Factories, Intelligent Systems, Virtual Realitiy	Mar 5, 2012 3:03 AM
28	Looking for upcoming topics/requirements from ICT perspective. Give input from Manufacturer's point of view.	Mar 5, 2012 1:52 AM
29	general Interest	Mar 4, 2012 9:31 AM
30	Rapid/Additive Manufacturing needs ICT	Mar 4, 2012 7:33 AM
31	Energy Tracking and Monitoring research in manufacturing	Mar 2, 2012 2:48 PM
32	We want to fasten the digitalisation development in metals and engineering industries	Mar 2, 2012 12:57 PM
33	Solution Provider for Process Control and Supervision	Mar 2, 2012 12:52 AM
34	Share and define the main orientations regarding the development of ICT for our factoris in the future.	Feb 27, 2012 4:29 AM
35	virtual factory: TXT is providing advanced IT solutions for supply chain planning in distributed networks.	Feb 19, 2012 8:57 AM

Page 2, Q8. For each of the below activities, please outline your personal involvement in the context of ICT for Manufacturing		
1	Special interest areas: * capture and transfer of knowledge from the aged workforce to younger workers by means of user-experience-driven workflows, for example * assisting all workers in their daily work with the introduction of smarter ("intelligent") tools, including mobile platforms for wider collaborative and field deployments * automating, where possible, the integration of ICT systems to ensure interoperability between systems, particularly in the ERP, MES and production scheduling environments	Apr 11, 2012 3:03 AM
2	At Cranfield University we do 70% of our activities with indusrial projects. Many project is realted to ICT for Manufacturing	Apr 5, 2012 6:18 PM
3	PlanetHPC has taken strong consideration of HPC for manufacturing in its publications. Outside PlanetHPC, EPCC has started the initiative Supercomputing Scotland (see http://www.supercomputingscotland.org) which is encouraging uptake of HPC by business including manufacturing.	Mar 29, 2012 1:27 AM
4	We already have European research projects in this field in full coherence with this roadmap.	Mar 15, 2012 3:05 AM
5	We are carrying out research in this area and are linked to some customers and their applications in these activites	Mar 11, 2012 1:05 PM

Page 2, Q10. Please outline the main drivers for research and development in the domain of ICT for Manufacturing in your organization		
1	Automation and control, Mechanical engineering, Robotics and computer vision and Tools for sustainable management	Apr 27, 2012 12:55 AM
2	ICT is indispensable for Manufacturing. There is, however, a need for better tools for strategic planning, management and control of Information Systems where the utilisation of ICT is only a part of a larger system.	Apr 20, 2012 1:57 AM
3	- Factory Simulation - Scheduling system - Manufacturing performance optimisation	Apr 19, 2012 12:46 AM
4	Identifying the gaps in the portfolio of knowledge technology software and developing prototype solutions for enterprise level deployment.	Apr 11, 2012 4:40 AM
5	To identify and develop prototype tools in order to fill identified gaps in the Knowledge Technology portfolio and their application to ICT in Manufacturing.	Apr 11, 2012 3:03 AM
6	Indusrtial demands Improve productivity	Apr 5, 2012 6:18 PM
7	Standardization of communication among machines.	Apr 3, 2012 3:47 AM
8	Data mining, Sensing and Robotics	Apr 2, 2012 11:31 PM
9	The main drivers for research and development in the domain of ICT for Manufacturing are the simulation in process at real time with data loggers that capturate information in real time to manage the performance of the productive process at the domain of production and energy	Apr 2, 2012 12:41 PM
10	Reduction of cost Improvement of Lead times to reduce inventories and customer demand Increase of profitability	Apr 2, 2012 8:29 AM
11	sensor, software, mecanotronics systems, electronic control systems,	Apr 2, 2012 4:02 AM
12	Product/process knowledge management Collaborative working environments Lean design/lean manufacturing Lifec cycle management Sustainability	Apr 2, 2012 12:59 AM
13	Progrming, planing, control and optimization in Manufacturing Processes	Mar 30, 2012 8:45 AM
14	Product process knowledge management Energy efficient in manufacturing Lean product process manufacturing Collaborative working environents Sustainability inmanufacturing	Mar 30, 2012 4:39 AM
15	Monitoring of machine and process performance. Managing of manufacturiung related data and its influence on productivity, maintenance, accuracy and safety	Mar 30, 2012 4:22 AM
16	Research and development of new ICT technologies for control, monitoring and optimization of manufacturing processes. Artificial Intelligence based techniques, optimisation algorithms and advanced signal analysis and processing for process modelling and control design. Application of thus strategies to high performance mechanical machining operations, from macro to nano scale.	Mar 29, 2012 2:46 PM
17	Use of HPC facilities and software for design of products and optimisation of manufacturing processes.	Mar 29, 2012 1:27 AM

Page 2, Q10. Please outline the main drivers for research and development in the domain of ICT for Manufacturing in your organization		
18	transparency of processes cost savings international manufacturing cooperation	Mar 16, 2012 7:09 AM
19	We provide ICT solutions and platforms for quality control (laboratory, at the line and inline) in various sectors - windmil, automotive, railways, aeronautics	Mar 16, 2012 1:42 AM
20	Advanced human machine interfaces in terms of physical, sensorial and cognitive interaction, and learning processes. Tools to capture user information (anthropometric data, physical capacities, emotions, preferences, etc.) by means of ICT, specific register hardware, social networks, etc. Knowledge based tools for personalisation of products and services and to process user information in order to provide criteria and design rules for user-centred products and services.	Mar 15, 2012 8:28 AM
21	Cost reduction / lead time reduction / green processing	Mar 15, 2012 3:05 AM
22	Research Topics on the European Level, Customer Specifications of needed research	Mar 13, 2012 2:57 AM
23	- Business intelligence for manufacturing - Plant connectivitiy - Integration of ERP and Logistics in the Manufacturing	Mar 12, 2012 7:59 AM
24	system safety cost effectiveness system compatibility system adaptivity machine man interface	Mar 11, 2012 1:05 PM
25	- manufacturing equipment integration - product and process data tracking - OEE-Analysis (overall equipment efficiency) - condition monitoring and predicitive maintenance	Mar 10, 2012 7:13 AM
26	reduce losses and cycle times, increase yield rates, optimize material and information flux	Mar 6, 2012 9:30 AM
27	- faster communication - easy to handle and user-friendly - to use standard IT technologies, or refine them for using in manufacturing - networked with the standard IT-world, but secure and separated in manufacturing clusters	Mar 5, 2012 8:05 AM
28	Smart Factories, Intelligent Systems, Virtual Realitiy	Mar 5, 2012 3:03 AM
29	competitiveness for future applications in manufacturing. ICT will play an important role, but has to be minimized in complexity to make sure it really is used in industry.	Mar 5, 2012 1:52 AM
30	various	Mar 4, 2012 9:31 AM
31	hightech equipment, its control and programming	Mar 4, 2012 7:33 AM
32	Adaptive and Autonomous Control Systems for energy efficiency, energy tracking and integration of renewable energy systems	Mar 2, 2012 2:48 PM
33	Productivity Competitiveness	Mar 2, 2012 12:57 PM
34	Process Description, Data Warehoese, Modelling	Mar 2, 2012 12:52 AM
35	Service oriented Architectures; Internet of Things, Cloud Computing, Future Internet, Event driven architactures	Feb 19, 2012 8:57 AM

Page 3, Q11. Demographics and consumption

Urbanisation with the development of megalopoles and a growing middle class in developing countries are fuelling demand for niche industrial products. Purchase decisions are being made based on brand perception of safety, quality and personalised/customisable produ...

1	There is still some gap in terms of ICT knowledge and expertise between aged and young workforce. A great effort for the ease of use of ICTs for aged workers is still needed.	Apr 27, 2012 1:10 AM
2	ICt tools are important, but a lot of examples has shown inadequate for knowledge transfer. Tacit knowledge is impossible to transfere with ICT and is typically very important for an competitive advantage.	Apr 20, 2012 2:37 AM
3	We work with KM and LeanKLC to address the issue to of capturing tacit knowledge and to transfer the knowledge to the new generation	Apr 5, 2012 6:26 PM
4	Actually I think a two-way transfer is needed here. Within five years, no-one entering the workforce will have experience of life before internet and mobile communications. These people can benefit from the experience of the older generation of workers, but can also transfer some of the cultural apsects of having grown up immersed in a world of global commuications to the older generation.	Mar 29, 2012 1:46 AM
5	The ageing population as workers enclose specific characteristics as a result of the declining functional capacities that should be considered in the design and/ or assignment of the workplace. On the other hand, the retirement of the ageing workers implies the lost of a great experience, knowledge and vision of the workplace of high value for the company and that should be shared and transferred to younger generations. The needs and habits of the ageing consumers change with increasing age. Ageing population agree that companies are not considering their needs and preferences in the design of products and services. Attributable to the emancipation of children and retirement, the ageing population disposes of more leisure time and economic resources, paying therefore more attention and being able to spend more on practical, functional, accessible and usable products and services adapted to their needs.	Mar 15, 2012 8:30 AM
6	Human Robot Cooperation, Human Machine Cooperation is a topic which is very important, new ICT tools for safe cooperation of Human and Robots	Mar 13, 2012 3:02 AM
7	- Change of worker skills and consumption preferences will play a role	Mar 12, 2012 8:09 AM
8	The problem is serious and acknowledged. The question you link to it misses in the context of manufacturing an important point: it is not only the ICT tool that is needed. This tool has to be connected - when we address manufacturing - to mechatronic devices. This dimension I don't see addressed in your question. We don't want the knowledge of the old guy transferred to the then smart yxoung guy, we need machinery that is running and is adapted to thjis situation. This is where we see the real high impact.	Mar 11, 2012 1:33 PM
9	not transfer of knowledge is important but better integration of aged workers. Transfer of knowlegde is only possible if aged workers are willing to give their knowledge which is difficult because they fear the replacement or the loss of their jobs.	Mar 10, 2012 7:27 AM
10	Bosch has traditionally a high liability to their workers	Mar 6, 2012 9:39 AM
11	Additional and very important is to find properly skilled workforce. To find ways of easy and fast learning of new tools and a fast user-support.	Mar 5, 2012 8:05 AM

Page 3, Q11. Demographics and consumption

Urbanisation with the development of megalopoles and a growing middle class in developing countries are fuelling demand for niche industrial products. Purchase decisions are being made based on brand perception of safety, quality and personalised/customisable produ...

12	yet it is a pity to loose knowledge, but manufacturing does evolve rapidly with new machines, new processes etc. Take welding, today we do it with lasers, not with classical welders or take coating, today we do that with Fast Atomic Layer Deposition, not with painters any more.	Mar 4, 2012 7:41 AM
13	In theory this is correct however the pace of technology development in ICT is outstripping the ability of the experienced workforce to stay up-to-date and the younger workforce are not clearly convinced that they have anything to learn for the older generation.	Mar 2, 2012 2:54 PM

Page 3, Q12. Global competition and Innovation

Globalisation has led to the emergence of smaller dynamic enterprises able to put innovation into practice more rapidly than their bigger – and slow-moving – counterparts. The urge to be innovative is taking the global market by storm, putting pressure on lar...

1	Innovate or die is the mantra for european companies. There is a need for innovations in all levels such as technology, products, processes, supply chains and business models.	Apr 20, 2012 2:37 AM
2	Innovation will really have a strong impact on competitiveness as far as the results become into real products that can be introduced in the market	Mar 30, 2012 4:25 AM
3	Innovation focused on persons. Person-oriented products and services.	Mar 15, 2012 8:30 AM
4	This needs also to fasten the research process This could be done by a.) Administrativ actions (faster evaluation, faster negotioations) but more efficient by b.) Research programms covering the development chain from research to the product (very market near), Common calls betweenn FP7, EUREKA with different steps of MRL	Mar 13, 2012 3:02 AM
5	- The competition with low wage countries will be more critical, so that the improvement of efficiency and productivitiy of European enterprises will play a crucial role	Mar 12, 2012 8:09 AM
6	Let us have close look on what we mean by globlization and innovation. It will be design of the "smart value chain" that can cope with this situation. Specifically this means humans coming up with a better way of cooperation, requesting tools that fit this purpose and using them intelligently. This will not be the faster computer of a bank that reacts even faster to stock market moves than its competitor.Production is already today coming back to Europe because our theories of just in time, outsourcing and getting value by right purchasing strategies are operating at their limit.	Mar 11, 2012 1:33 PM
7	speed to success is the key to prosperous growth and securing jobs in europe	Mar 6, 2012 9:39 AM
8	only knowlegde, that is high content of research & technology knowledge and much innovation, intensie companies will survice, whether large of small doesn't matter.	Mar 4, 2012 7:41 AM
9	fail fast, fail cheap. No long research programs --> immediate field test via pilots	Mar 2, 2012 1:01 PM

Page 3, Q13. All-round sustainability

Sustainability has become a key topic on the agenda of politicians and corporate executives. It is necessary to transition from a wasteful to a frugal economy. This requires awareness and transformation of industrial processes towards low carbon footprints and energy e...

1	Sustainability is a special challenge for SMEs that usually cannot afford the sometimes high investments to become more sustainable. The sustainability targets shoud be adequatelly scaled according the size of organizations. Public awareness of the benefits of being "sustainable" must be strongly raised.	Apr 27, 2012 1:10 AM
2	Sustainability is the only way to survive in the long run. Demands form customers, legislation and other stakeholders will grow and the conpanies that are prepared for this wil win.	Apr 20, 2012 2:37 AM
3	the fact is the sustainability issue is addressed more by academic. The industry although they have interest but the action is less than expected, especially during this time of Financial crisis	Apr 5, 2012 6:26 PM
4	It is desirable and should be a key factor, but only if rules apply to all countries (the countires like China are not doing well in suistainability).	Apr 2, 2012 11:36 PM
5	From my point of view, the sustainability is not always a primary goal of the enterprises (they have to stay competitive) and should be more driven and supported by government organizations	Mar 12, 2012 8:09 AM
6	Japanese companies have recognized this long time ago and they have undertaken huge efforts to counteract by means of organization, by means of underlying IT, by means of striving for sustainable processes. In Europe ecological sustainability is recognized, economic sustainability in some areas is becoming profitable, social sustainability has not really reached the agenda. Âll threei "versions" together are the form of agenda we need.	Mar 11, 2012 1:33 PM
7	sustainability only works with a good business model. Otherwise productivity stays more important than sustainabiltiy and energy efficiency.	Mar 10, 2012 7:27 AM
8	ICT put's rich possibilities for development of intelligent controls for e.g. power and media consumption, thus leading to a greener manufacturing	Mar 6, 2012 9:39 AM
9	This must be open new markets to the european industry and should give us an advance.	Mar 5, 2012 8:05 AM
10	if you do not have sustainability in your companies DNA by 2020, your company will not exist by 2030.	Mar 4, 2012 7:41 AM

Page 3, Q14. Dynamic collaboration

Efficient and secure collaboration between many different stakeholders will become crucial for day-to-day operations of European manufacturers. Large companies as well as SMEs stand to gain from collaborative manufacturing, service management and customer engagement via s...

1	This depends on your business. If your products are complex and expenisive, (such as a machine tool) yes. If it is more a comodity -product but a complex manufacturing such as manufacturing of a hard drive less.	Apr 20, 2012 2:37 AM
2	This is an inevitable trend given the technology capability to support it exists. However business will in my opinion still value some of the more conventional business practices. It is not yet clear to me how reputations will be established and trusted in a highly dynamic environment.	Mar 29, 2012 1:46 AM
3	The mindset of enterprises may still not be open to collaborative manufacturing due to fear to loose their know-how. For this reason the legislative and ICT security measures have to be provided to address these fears.	Mar 12, 2012 8:09 AM
4	Administration and management of collaboration will become crucial. Different business interests may interfere the collaboration	Mar 10, 2012 7:27 AM
5	Clear trend, but critical in aspects of security and acceptance, more a matter of social mindset, then technical possibilities.	Mar 6, 2012 9:39 AM
6	Remote Services as also used today will be more and more important. So you will have quick support no matter where are the supporter and customer is.	Mar 5, 2012 8:05 AM
7	Here it is not the service management, but the creation of eco-systems of suppliers being able to create a new value chain rapidly. This has nothing to do with social media or web tools. it all has to do with regional and supportive economic policies to strenghten networks of companies.	Mar 4, 2012 7:41 AM

Page 3, Q15. Enterprise mobility

The exponential proliferation of mobile devices presents an attractive proposition to 'on-the-go' and 'always-on' users. While mobile technologies have permeated the consumer market, enterprise applications are still relatively limited.

To leverage the potential of next...

1	The impact of mobility is also very high, but in the industrial environment the mobility is seen only as backoffice tools.The real challenge is to bring the mobility to the low levels of manufacturing (Down to the sensor and actuator).	Apr 27, 2012 1:10 AM
2	I strong foothold in a local community with good relations to stakeholders will still be vital for competitiveness.	Apr 20, 2012 2:37 AM
3	We have to be careful for respecting the personal life. It could develop telecommunting.	Apr 19, 2012 12:56 AM
4	Mobile technology is already taking over from the desktop.	Mar 29, 2012 1:46 AM
5	Having the information everywhere on their fingerpoint will drive the mobile applications.	Mar 12, 2012 8:09 AM
6	Manufacturing is a rather long term stable process. To expect that technology in the form described will prevent manufacturing to be in abetter off psotion in Europe as compared to its global competitors is a mistake. The levery of adaptive equipment, of new busines processes that are demanding other forms of ICT nad of reevlauting the human contribution in these processes are much higher.	Mar 11, 2012 1:33 PM
7	Short life-cycle of consumer devices and rapid change of interfaces and hardware is a challange for enterprise application and manufacturing equipment as their life-cycle is longer	Mar 10, 2012 7:27 AM
8	Clear trend, offering more and more possibilities.	Mar 6, 2012 9:39 AM
9	Aps for everything. So the management/executive board can control and steere from everywhere.	Mar 5, 2012 8:05 AM

Page 3, Q16. Real-world connectivity

Sensors, automation controllers and embedded systems are already commonplace in personal life as well as in industrial applications. However, so far few companies have been deploying more than their own ‘Intranet of Things’ focused on local, isolated and closed-loop sce...

1	The challenge here is to cope with the current restrictions of Internet communications inside environments that in many cases are demanding real time communications, that up to now, are only safely achieved with local an controlled networks. The "Internet of Manufacturing Things" should be the final target.	Apr 27, 2012 1:10 AM
2	This is important but must be doen in a clever way. There is a danger of overflow of data and to neglect the important pieces. Moreover it should help, and no restrict process innovations. See Q17.	Apr 20, 2012 2:37 AM
3	In our factory, 90% of our tools are already connected to our intranet.	Apr 19, 2012 12:56 AM
4	I see possible inhibitors as being security, and trust of the systems during a period of transition.	Mar 29, 2012 1:46 AM
5	Bosch started in 2012 our "internet of things" driven by management	Mar 16, 2012 7:23 AM
6	To monitor the way products and services are used by persons; to apply this feedback information to the design and manufacturing of products and services.	Mar 15, 2012 8:30 AM
7	The connectivity between different systems in an enterprise as well as between different enterprises is still a big issue and requires a lot of efforts for configuration. The Internet of Thing should address this to realize its vision.	Mar 12, 2012 8:09 AM
8	The global scale is imprtant for big enterprises if they can control their own processes safely. All others will need a safeguarding of their respective interests first. On (local) factory level sensors, controlles and embedded systems are common place but their potential could be xploited much better and to the big advantage of the enterprise.	Mar 11, 2012 1:33 PM
9	data security is very important as well as administration and management of security mechanisms.	Mar 10, 2012 7:27 AM
10	Extremely high impact, run for best business models should accompany the formulation of technical development needs / research priorities.	Mar 6, 2012 9:39 AM
11	The need for intelligent interaction with widescale sensors systems is obvious however the 'internet of things' is not necessarily to best way to develop intelligent industrial systems.	Mar 2, 2012 2:54 PM

Page 3, Q17. Manufacturing intelligence

Collaboration and connectivity will give rise to copious amounts of context and data which will have to be analysed on-the-fly and rendered on mobile devices of decision makers at both management and plant levels.

Manufacturing enterprises will have a competitive...

1	As mentioned in Q16, the intelligence lies in the way data are processed, analysed, visualized and how to implement several layers of control loops to manage and control the processes. The control lops should be both autmatic, semi-automatic, and decision supported but besd on human interpretations in a goo fmix.	Apr 20, 2012 2:37 AM
2	Ok for tactical decisions. Strategic decisions doesn't require real time analysis.	Apr 19, 2012 12:56 AM
3	Undoubtedly enterprises that can extract data from their data will be at an advantage. However the capability f tools to manage data lags behind the rate at which data is being generated, and developing such tools is not a core skill of manufacturers. Therefore there will be a reliance on those who can both understand the business and provide the tools before high impact can be felt.	Mar 29, 2012 1:46 AM
4	The complexity of the manufacturing systems is growing further, so that the appropriate tools for real-time and historical analysis should be realized to support the decision makers. This should involve new and easy-to-use analysis and optimization algorithms, visualization techniques and added-value-oriented approaches.	Mar 12, 2012 8:09 AM
5	definitily but first you have to make the Internet and the mechanisms safe. You may recall the computers that played with each other during the financial crisis taking decsions on their own very much to the disadvantage of the market. A clear description of what is behind the short description would be very helpful.	Mar 11, 2012 1:33 PM
6	Understanding what are you doing, knowing the influence of design changes before start of production calls for deep understanding, physical models and simulation	Mar 6, 2012 9:39 AM
7	see question 15.	Mar 5, 2012 8:05 AM
8	this is an marketing isssue, not a manufacturing issue. Banks and telephony companies have even much more to benefit, so why not copy their solutions.	Mar 4, 2012 7:41 AM

Page 4, Q18. Towards agile manufacturing systems & processes

Real-world ressources such as connected objects, devices and advanced robots would leverage advances in the Internet of Things domain to communicate, collaborate and organise themselves autonomously. Furthermore, manufacturing processes would...

1	Nowadays the industrial processes are providing large quantities of data that in many cases are stored, poorly analyzed and sometimes forgot. The need for the extraction of meaning and knowledge from this data is crucial.	Apr 27, 2012 1:16 AM
2	Some decisions need to be explain not only execute.	Apr 19, 2012 1:03 AM
3	The reality is that research in this area address more futuristic applications rather than address the current industrial challenges. This need to be address during the planning of Future ICT for Manufacturing	Apr 5, 2012 6:32 PM
4	It is not relevant the use of smart phones in this context	Apr 2, 2012 11:38 PM
5	The degree to which this can be automated is the key issue. Capturing the human knowledge into a form which can be used for autonomous organisation is one of the hard parts.	Mar 29, 2012 2:02 AM
6	Agree with the the vision "Real-world ressources such as connected objects, devices and advanced robots would leverage advances in the Internet of Things domain to communicate, collaborate and organise themselves autonomously. Furthermore, manufacturing processes would react in real-time to changes within an enterprise ecosystem – such as availability of equipment, assembly lines and dynamic configuration of process parameters." and it´s benefits. Disagree, that "...would be capable of applying advanced computing operations to process large volumes of real-time manufacturing data, perform analyses and forecasting on productivity, throughput and downtime. Lastly, these real-time changes and decisions would be executed by plant managers on their smart phones which will process enterprise and manufacturing data to facilitate efficient management-by-exception." could fulfill this vision. There is also no benefit be doing this per smart phone.	Mar 16, 2012 7:49 AM
7	This is clearly an improtant goal if the steps leading towards it are broken down to - for hardware this means - for costs of software this means - at this stage computing power is available or not .. prbably not what has to be developped is - an enterprise opting for such a solutions will have to develop its organization to ..	Mar 11, 2012 1:42 PM
8	the complexity of IT tools is currently too high and a smaller screen doen't make it better. Allthough new concepts, such as iOS etc, help to drive into the right direction. But back-end systems (servers) have to go through a big change as well.	Mar 5, 2012 1:57 AM

Page 4, Q19. New seamless factory lifecycle management

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 ma...

1	Predictive information is the highest value here. Ability to forecast outcomes of multiple scenarios would be useful in this context.	Mar 29, 2012 2:02 AM
2	Requires cross-plattform communication with standards for machine status and interpretation of content	Mar 16, 2012 7:49 AM
3	You need to spell this out. Research directed to this will not be an IT method.	Mar 11, 2012 1:42 PM
4	Aps for everything.	Mar 5, 2012 8:08 AM

Page 4, Q20. 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 novel knowledge-delivery mechanisms.

Future enterprises will not only be...

1	The interaction between ICT and the overall Information System and the strategy around this.	Apr 20, 2012 5:06 AM
2	Also will be experiences at the same time, because the knowledge could be learn but the experience must be done by oneself with effort.	Apr 2, 2012 4:17 AM
3	ICT will enable faster of transfer of skills. However it is my opinion that the best and most highly motivated will develop their skills whatever the environment. Use of knowledge bases within oganisations will be significant, although it introduces security and confidentiality issues.	Mar 29, 2012 2:02 AM
4	I think that with respect to aging working forces, we should not simply assist but empower workers with technology so that on one hand they can perform for longer periods key tasks without risk to their health and safety and within the framework of their cognitive capabilties.	Mar 16, 2012 2:13 AM
5	Adaptation of workplaces' demands to physical, sensorial and cognitive capacities of workers, especially for older workers and disabled people. Products and services adapted to needs and requirements of elderly people and of disabled people. Promotion of workers' participation in safety and health at work decisions.	Mar 15, 2012 8:31 AM
6	agree: user-friendly, intuitive interfaces are important disagree: knowledge-transformation from elderly to young workers. Elderly workers won't collaborate because they fear the loss of their jobs	Mar 10, 2012 7:37 AM
7	Very important because of short lifetime (often changed equipment), because of next and never generations of technology. Methods to support an easy and fast learning, also for older work-staff.	Mar 5, 2012 8:08 AM
8	System based knowledge capture and virtual learning tools to train new workers may obviate the need for human centric knowledge systems	Mar 2, 2012 3:00 PM
9	It is not only old persons and ICT-learning, it is also general leadership skills and leadership behavior challenge.	Mar 2, 2012 1:04 PM

Page 4, Q21. Fostering collaborative supply network

Manufacturing 2.0 enterprises will define a new collaboration paradigm between stakeholders in the manufacturing supply chain, including but not limited to original equipment manufacturers (OEM), suppliers and subcontractors. Manufacturing processes will ...

1	The "product as a service" is the key topic.	Apr 27, 2012 1:16 AM
2	New opportunities for new players will raise, and then the market won't be only for OEMs. Europe has a large community aware of such advantage.	Apr 3, 2012 3:58 AM
3	The product as service model is well established already in my opinion. I don't see this as a new paradigm, but certainly as one which will become a dominant business model.	Mar 29, 2012 2:02 AM
4	To pass on knowledge and design criteria obtained in enterprises from end-users analysis (based on quality, perception, usability, etc.) to collaborative suppliers.	Mar 15, 2012 8:31 AM
5	what is the time scale you are considering?	Mar 11, 2012 1:42 PM
6	different business models and interests could interfere. But there are great opportunities for new business models. The agile and changeable enterprises will win.	Mar 10, 2012 7:37 AM

Page 4, Q22. Aiming at customer centric design and manufacturing

Another level where Manufacturing 2.0 enterprises would excel is in customer engagement. Manufacturing 2.0 enterprises would extract customer feedback from social media and incorporate it into engineering and manufacturing processes.

Manu...

1	In reality I think the customer centric aspect of this will only go as far as ensuring that the customers do not defect to other products/brands. There will have to be a serious incentive, verifiable by analysing customer behaviour, for truly individualised manufacturing to be viable.	Mar 29, 2012 2:02 AM
2	Fully agree for products for private customers Somewhat disagree for products of automotive OEM	Mar 16, 2012 7:49 AM
3	interesting concept, certainly an area for research	Mar 11, 2012 1:42 PM
4	the application of knowledge capture from social media and the internet is far from precise and the speed of change in the 'mood music' is not currently possible in manufacturing systems. The speed of development and redevelopment of manufacturing process needs to made faster with better control systems and then increased learning and inputs from a variety of sources (including social data) can be handled.	Mar 2, 2012 3:00 PM

Page 5, Q23. Takeaway #1: All is connected

ICT solutions must bridge the gap between the physical world (shop floor) and the enterprise world (business systems)

1	ICT alone can't provide an holistic understanding of factory organisation and operation. It needs qualitative studies based on sociological methods.	Apr 19, 2012 1:10 AM
2	Several current Tech claim to do that but the reality is they do not!	Apr 5, 2012 6:34 PM
3	yes, but don't see tasks ICT as a stand-alone. Projects need to adress both ICT and Hardware aspects to be successfully implemented in production.	Mar 6, 2012 9:45 AM

Page 5, Q24. Takeaway#2: From massive data to lean information

ICT solutions must facilitate storage and processing of copious production data

1	I will change the statement like: ICT solutions must facilitate storage and knowledge extraction of copious production data ICTs are ready for storage, but the meaning and knowledge extraction is a topic to be developed.	Apr 27, 2012 1:27 AM
2	Including data for user characterization (e.g. anthropometric data).	Mar 15, 2012 8:33 AM
3	This you can buy from IBM today, data safety is the issue	Mar 11, 2012 1:49 PM

Page 5, Q25. Takeaway#3: Cloud's the word

ICT solutions must implement secure, high performance and open services platforms for large, medium, and small enterprises.

1	Large enterprises can afford their own "Clouds" it is the SMEs who need support regarding this topic.	Apr 27, 2012 1:27 AM
2	When talking about "open service platforms", mixing large enterprises with SMEs ones has been pointed as one strong rock to overcome. Even the statement may be right, serious restrictions due to large enterprises gobernment must be treated.	Apr 3, 2012 4:02 AM
3	This trend is taking already taking off.	Mar 29, 2012 2:05 AM
4	Cloud worlds is important but even safety and secure points are maybe a barrier. Cloud should not be the overall solution	Mar 13, 2012 3:16 AM
5	but this will not necessarily be the cloud	Mar 11, 2012 1:49 PM
6	private clouds/intra-factory clouds are important, network availability and security are crucial	Mar 10, 2012 7:41 AM
7	Despite of the connections, it is important to have a high security for my production and knowhow. My knowhow is my advantage.	Mar 5, 2012 8:12 AM

Page 5, Q26. Takeaway#4: To know, understand, and forecast

ICT solutions must make sense out of the stored and streamed production data through modelling, simulation and analytics.

1	In spite I agree I think the Takeaway #2 and #4 point in the same direction. In fact #2 is too general and #4 is more "manufacturing-oriented". If I have to choose between #2 and #4 I will definitively choose #4.	Apr 27, 2012 1:27 AM
2	.. if ICT really reflects the thinking and expectation of production. A big car manufacturer would have like to optimize its design process, whioch wouold have been economicall adavnatageous. He could not because he was tied to an American ICT tool. This is thje dimension taht has to be taken into consideration.	Mar 11, 2012 1:49 PM
3	effort for modeling and simulation may not be to high	Mar 10, 2012 7:41 AM

Page 5, Q27. Takeaway#5: Everywhere and everyone on-demand

ICT solutions must integrate the human element – workers and customers – to a greater degree in their day-to-day functioning.

1	Too general	Apr 27, 2012 1:27 AM
2	Robots and Machines should fully cooperate with workers by new, advanced software and ICT	Mar 13, 2012 3:16 AM
3	possible with new generations of people (workers), who are used to IT.	Mar 5, 2012 1:58 AM

Page 5, Q28. Takeaway#6: Cross-boundary applications for the global enterprises

Agile and lightweight applications are the key for innovation in European enterprises

1	Too general. Not too much manufacturing oriented.	Apr 27, 2012 1:27 AM
2	Lightweight sometimes cannot be applied depend on the enterprises	Apr 2, 2012 4:21 AM
3	key to innovation will be the respective strategy	Mar 11, 2012 1:49 PM
4	to general, focus and goals are not clear! Buzzwords?	Mar 6, 2012 9:45 AM

Page 6, Q29. The ActionPlanT Roadmap presents a coherence between the ICT development needs and future manufacturing challenges

1	For me the ActionPlanT Raodmap describes ICT challenges correctly, sometime too many buzz words, but I can support this. For me it misses out on two important areas. If you want to be innovative you have to check all constituents of your equation. In this case it means state of IT hardware development, clear concept of the depencies (hardware US, Asia), power comsuption of the "all connected devices", etc. This will lead to other priorioties for research. The other important area where in my perception it avoids the discussion is the underatanding of the world of the manufacturing enterprises. Take the cloud discussion. IBM offers theses services today, the week before the Cebit Dell published a study on clouds for SMEs (less than 100 employees). The real research topics are beyond.	Mar 11, 2012 1:57 PM
2	The roadmap has to be seen in conjunction with hardware, thus go on with joint ICT and NMP research priorities!	Mar 6, 2012 9:46 AM
3	Almost everything is there, but leadership and incentive issues area lacking. Europe will not be competitive ONLY via ICT but only IF ICT is fully used ALONG other necessary topics. More stress should be put on 3D-printing.	Mar 2, 2012 1:08 PM

Page 9, Q33. RP1.2 – Professional Service Robots and Multimodal Human-Machine-Robot Collaboration

Immersive collaboration between human workers and robots leads to a more efficient, safer and flexible manufacturing environment. Cognition-based intelligent features within machinery and robots will radicall...

1	The social aspect of humans working with robots is a possible inhibitor which may slow the uptake of such technology.	Mar 29, 2012 2:20 AM

Page 9, Q34. RP1.3 – Adaptive Process Automation and Control

Intelligent plug-and-play systems will feature sensing and actuator structures integrated with adaptive control systems and with active compensation features for fully optimizing the performance of the manufacturing systems in terms of autonomy,...

1	I'm not sure that 'full' optimisation is ever possible.	Mar 29, 2012 2:20 AM

Page 9, Q36. RP1.5 – Monitoring, Perception & Awareness on Manufacturing
Within a view of high value adding manufacturing processes, it becomes essential to monitor the actual state of components and machines in a continuous manner, as means for assuring diagnosis and context-awareness capabilities in th...

1	Some of the technology for aheiving this has been developed for environements that are subject to stringent health and saftey regulation. It can probably re-used where market forces are the incentive.	Mar 29, 2012 2:20 AM

Page 12, Q39. RP2.1 – Integrated factory models for evolvable Manufacturing Systems

Factories are becoming more complex, expensive, distributed and faster evolving than in the past. The integration and interoperability of current IT applications makes the possibility of a holistic representation, monitoring...

1	This RP2.1 doesn't seem too much focused and the topics mentioned are covering virtually everything of the rest. I would put the focus on the modelling.	Apr 27, 2012 1:45 AM

Page 12, Q40. RP2.2 – Intelligent maintenance systems for increased reliability of production systems

Complex and expensive production assets in conjunction with market requests for high quality products require novel maintenance approaches which are able to ensure required capacity and production quality....

1	The estimation of RUL is the real challenge in this RP. It is a must if someone is willing to implement a "real predictive maintenance system"	Apr 27, 2012 1:45 AM

Page 12, Q42. RP2.4 – ICT supported energy consumption optimisation in Manufacturing 2.0 enterprises

Reduced energy consumption in future Manufacturing 2.0 enterprises is an environmentally challenging issue which also makes business sense to the enterprise by resulting in cost savings. Energy savings area...

1	The seamsly integration of Renewable Energy Sources will play a very important role.	Apr 27, 2012 1:45 AM

Page 12, Q43. RP2.5 – Multi-level simulation for enhanced factory modelling

Distributed simulation systems offer good local optimization outcomes but lack interoperability and holistic modelling options, especially for complex manufacturing systems. Integrated multi-level simulation systems will facilitate ...

1	This RP is strongly linked with "RP2.1 – Integrated factory models for evolvable Manufacturing Systems". They should be decoupled to avoid repetition.	Apr 27, 2012 1:45 AM

Page 15, Q50. RP3.3 – Advanced Information Models for knowledge creation and learning Increasing amount of data in manufacturing environments is not kept in appropriate forms for capitalization and further expl

1	Not clear. The text is incomplete.	Apr 27, 2012 5:04 AM

Page 20, Q66. RP5.4 – Crowd sourcing for highly personalized human-centric innovative product

The 2.0 paradigm has proved the ability to activate and motivate people to participate in social networks. Future manufacturing will depend on rapid conversion of the customer individual requirements (personalizat...

1	I hope we do not lost the real conatct and look into the eyes of the customer in important decisions	Apr 2, 2012 4:27 AM