WORK PROGRAMME 2013

COOPERATION

Annex 5

RECOVERY PACKAGE

PUBLIC-PRIVATE PARTNERSHIP INITIATIVES[49]*:*

- FACTORIES OF THE FUTURE (FoF)

- ENERGY-EFFICIENT BUILDINGS (EeB)

- GREEN CARS (GC)

Annex 5 brings together for easy reference all the WP 2013 topics of the three PPPs from the different participating Themes: NMP, ICT, Transport, Environment and Energy.

[49] The Public Private Partnership Initiative on the Future Internet, launched in 2010, is outside of the context of the Recovery Package. It is described under Theme 3

Recovery Package: Public-Private Partnerships (PPPs) and Risk Sharing Finance Facility

The European Economic Recovery Plan adopted by the European Commission on 26 November 2008 and endorsed by the European Council on 11-12 December 2008 proposes actions to develop technologies for the manufacturing, construction and automotive sectors, which have recently seen demand plummet as a result of the crisis and which face significant challenges in the transition to the green economy. The Commission proposed to increase research financing through the RSFF instrument and to launch three Public-Private Partnerships (PPPs) which provide the required support to the three sectors:

- *in the manufacturing sector: a 'Factories of the Future ' initiative to help EU manufacturers across sectors, in particular SMEs, to adapt to global competitive pressures by increasing the technological base of EU manufacturing through the development and integration of the enabling technologies of the future, such as engineering technologies for adaptable machines and industrial processes, ICT, and advanced materials (EUR 1.2 billion);*
- *in the construction sector: an 'Energy-efficient Buildings' initiative to promote green technologies and the development of energy-efficient systems and materials in new and renovated buildings with a view to reducing radically their energy consumption and CO_2 emissions (EUR 1 billion);*
- *in the automotive sector: a 'Green Cars' initiative, involving research on a broad range of technologies and smart energy infrastructures essential to achieve a breakthrough in the use of renewable and non-polluting energy sources, safety and traffic fluidity (EUR 1 billion).*

These initiatives are part of a comprehensive, integrated package to be implemented in cooperation between all the responsible services within the Commission, complemented by actions on the demand-side, such as public procurement, technical standards, and regulatory measures. This includes a further EUR 4 billion for non-research activities under the Green Cars Initiative.

The three PPPs are intended to prevent the crisis from deflecting attention from the EU's longer-term interests and the need to invest in its future. Research and Innovation are considered as strategic and "smart" investments to prepare the ground for the future of the EU economy which has to become a knowledge-based and low carbon economy, as stated in the Europe 2020 strategy. This is crucial for the EU to come out from the crisis stronger, more sustainable and more competitive.

The Commission, working in close collaboration with industrial representatives, has developed multi-annual roadmaps and longer-term research strategies for the three sectors. The initiatives will continue to be implemented, through a series of Cross-thematic Calls and through dedicated topics, under the 2013 work programmes of the relevant FP7 Themes. Responsibility for these Cross-thematic Calls and dedicated topics is as follows:

- *The 'Factories of the Future' initiative involves financial support from the NMP[50] and ICT[51] Themes;*
- *The 'Energy-efficient Buildings' initiative involves financial support from the NMP and Environment Themes[52];*

[50] Nanosciences, Nanotechnologies, Materials & New Production Technologies
[51] Information and Communication Technologies

- *The 'Green Cars' initiative involves financial support from the ICT and NMP Themes (in two separate calls), as well as the Energy and Transport Themes (topics being part of broader calls in their respective work programmes).*

In addressing the industrial needs and objectives of each PPP, the Themes will work closely together to ensure a coherent, complementary and holistic approach. To ensure high visibility and to promote cooperation and exchange of information between the research projects funded under the different Themes, it is intended to gather the researchers and the industrial stakeholders together in annual cross-thematic workshops and seminars for each PPP. This would be part of the implementation of the projects.

The Call Fiches for the topics in the Green Car PPP implemented by NMP and ICT Themes are included in Annex 5, whereas the Call Fiches for the topics implemented by Energy and transport Themes can be found within the corresponding work programme chapter of each of the two Themes. The topics in the FoF and EeB PPPs are organised in two calls implemented in a coordinated way with a common deadline and the Call Fiches are included in Annex 5 and in the corresponding work programme chapter of some of the participating Theme. Each Theme will remain responsible for its own budget and for the implementation of the related topics.

The corresponding research topics for each PPP under the work programme 2013 are given in the following three sections V.1 to V.3.

The RSFF is one of the instruments that can provide support to projects emerging under the PPPs through loan funding. RSFF loans have already been provided to a number of automotive companies which invest in cleaner engines and technologies. Furthermore, for the Green Car PPP, the EIB provides funding either by the RSFF or the (European Clean Transport Facility (ECTF).

In addition to the PPPs launched under the recovery package, a Public Private Partnership Initiative on the Future of the Internet is launched under Theme 3 "ICT – Information and Communications Technologies" of the Cooperation Programme. This FI-PPP focuses on the development of innovative open network and service platforms with generic common enablers serving a multiplicity of demand-driven use cases in "smart applications".

[52] In addition, the coordinated Call on Smart Cities and Communities between the Energy and ICT Themes will contribute to the objectives of the 'Energy-efficient Buildings' initiative

V.1 "Factories of the Future" Public-Private Partnership (FoF) - Cross-thematic coordination between NMP and ICT

Manufacturing is still the driving force of the European Economy. Manufacturing activity in Europe represents approximately **21% of the EU GDP** and provides about **20% of all jobs** (more than 30 million) in **25 different industrial sectors**, largely dominated **by SMEs**. With each job on the factory floor generating approximately two other jobs in services, about 60 million people are additionally engaged in the related service areas. Therefore, manufacturing is of high importance to Europe, with a huge potential to generate wealth, jobs and a better quality of life. The long-term shift from a cost-based competitive advantage to one based on high added value requires that European manufacturing increases its technological base, building on the EU's excellent R&D in this domain, and develops a number of **enabling trans-sectoral production technologies**.

The *Factories of the Future PPP Initiative* aims at helping EU manufacturing enterprises, in particular SMEs, to adapt to global competitive pressures by developing the necessary enabling technologies to support EU manufacturing across a broad range of sectors. It will help European industry to meet the increasing global consumer demand for greener, more customised and higher quality products through the necessary transition to a demand-driven industry with lower waste generation and energy consumption.

The activities will concentrate on increasing the technological base of EU manufacturing through the development and integration of the enabling technologies of the future, such as engineering technologies for adaptable machines and industrial processes, ICT for manufacturing, and the novel industrial handling of advanced materials. The initiative will concentrate on industry-led R&D projects and will include demonstration activities, such as large-scale production-line demonstrators for validation and market applications. The partnership will work together to identify the R&D needs of manufacturing industry and in particular SMEs. In order to further ensure the PPP character of the initiative, a large part of the activities in the projects is expected be performed by industrial organisations themselves. This initiative, being by nature **cross-sectoral** and including efforts to address the **needs of SMEs**, aims to transform Europe into a dynamic and competitive knowledge-based economy by delivering:

- A new European model of production systems for the factories of the future (e.g. transformable factories, networking factories of excellence, learning factories) depending on different drivers such as high performance, high customisation, environmental friendliness, high efficiency of resources, human potential and knowledge creation.
- ICT-based production systems and high quality manufacturing technologies capable of optimising their performance with a high degree of autonomy and adaptability for a balanced combination of high throughput and high accuracy production.
- Sustainable manufacturing tools, methodologies and processes that have the capability of cost-efficiently shaping, handling and assembling products composed of complex and novel materials.

The indicative budget for 'Factories of the Future (FoF)' is EUR 230 million in 2013, of which EUR 160 million is from the NMP Theme and EUR 70 million from the ICT Theme.

V.1.1 "Factories of the Future (FoF)" - Topics covered by the NMP Theme

FoF.NMP.2013-1 Improved use of renewable resources at factory level

Technical content/scope: A more efficient use, at factory level, of material and energy resources, while at the same time ensuring high productivity rates, has become a key issue for a sustainable manufacturing sector. In this regard, a more extensive integration of technologies related to renewable energy and material resources and an optimal re-use of air, water and scrap (or other waste) along the lifecycle of factories may become a valuable complement to current strategies for resources efficiency. The resources consumed in the production processes, including air and water, should be minimised and the energy efficiency should be optimised in a continuous and iterative manner.

This novel approach would allow European manufacturing companies to take a qualitative leap towards environmentally neutral factories where the production processes and systems will move towards reduced ecological footprints (e.g. near-to-zero carbon approaches), whilst ensuring competitiveness.

This strategy demands new concepts and solutions at factory level, both for existing and new production plants. Research activities should be multi-disciplinary and address all of the following areas:

- Methodologies and tools for eco-efficient design or re-adaptation of production facilities based on co-evolving product-process-production systems including the integration of technologies for energy scavenging and recovery.
- Seamless integration of renewable energy harvesting in production systems for high productivity and maximum energy efficiency in the factories.
- Simulation and optimisation tools for assessing both environmental and economic costs linked with the use of renewable materials and energy resources, as well as technologies for energy recovery with reliable predictive analytics to guide decision-making.

Standardisation, regulation and pre-normative research aspects should be considered. Proof of concept in terms of at least one demonstrator should be delivered before the end of the project, excluding commercially usable prototypes (2006/C323/01), but convincingly demonstrating scalability towards industrial needs.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact.

The proposals should cover both research and demonstration activities. Prototypes and pilot implementations in real industrial settings represent a clear added-value. Whilst there is no lower or upper limit on the requested EU contribution, the target is that proposals allocate around 50% of the total eligible costs of the project (excluding management costs) to demonstration activities and this objective will be taken into account in the evaluation under the criteria S/T Excellence and Impact.

Projects are expected to use appropriate Life Cycle Assessment techniques in order to estimate the impact of energy efficiency and improved use of renewable materials and energy resources on the price of final products. Projects are also expected to generate knowledge to support European policy development and promote standardisation (at national or international level).

Funding scheme: DEMO-targeted collaborative projects.

Expected impact:

- In economic terms, reduction of 20% in the total lifecycle costs of factories with respect to conventional factories of similar productivity rates, due to an increase in energy efficiency and improved use of renewable resources.
- In environmental terms, a major step towards zero-carbon footprint manufacturing systems and processes, with drastic reduction of total lifecycle environmental impacts.
- Strengthened global position of European manufacturing industry through the introduction of the new technologies related to an improved use of renewable resources and contributions to international standardisation.
- Strong support for eco-labelling policies and standardisation.

FoF.NMP.2013-2 Innovative re-use of modular equipment based on integrated factory design

Technical content/scope: Current markets and customer demands impose quick changes in terms of product models, with smaller lot sizes and increased variety. Moreover, with increased customisation, multiple similar products are produced in small lots in a shared production line as a result of just-in-time production. Therefore, for the economic sustainability of the production systems, an innovative re-use of modular equipment based on integrated factory design methodologies needs to be addressed. This requires a cost-efficient and modular approach for production systems, with a higher standardisation level regarding production equipment and components, allowing a highly flexible and reconfigurable production in the long term.

Research activities should address at least the first two of the following areas:

- Proactive modularisation and re-use strategies for the development of the future machinery and production systems and their integration in old, new or renewed factory facilities.
- Innovative factory lay-out design techniques able to integrate new approaches to leverage all potential synergies between the concurrent design of plant and processes, taking into account best practices for de-manufacturing, dismantling, recycling and value-chain extension.
- Flexible, low-cost assembly/disassembly solutions to aim at a high market penetration with those solutions by the machine component suppliers and systems integrators, by developing low weight and mobile solutions (e.g. flexible grippers), as well as systems (e.g. automation, vision and control) for their seamless integration in factories.

Standardisation, regulation and pre-normative research aspects should be considered. Proof of concept in terms of at least one demonstrator should be delivered before the end of the project, excluding commercially usable prototypes (2006/C323/01), but convincingly demonstrating scalability towards industrial needs.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact.

The proposals should cover both research and demonstration activities. Prototypes and pilot implementations in real industrial settings represent a clear added-value. Whilst there is no lower or upper limit on the requested EU contribution, the target is that proposals allocate around 50% of the total eligible costs of the project (excluding management costs) to demonstration activities and this objective will be taken into account in the evaluation under the criteria S/T Excellence and Impact.

Projects are expected to use appropriate Life Cycle Assessment techniques and to generate knowledge to support European policy development and promote standardisation (at national or international level).

Funding scheme: DEMO-targeted collaborative projects.

Expected impact:

- Cost reduction of around 30% due to re-use of existing modular equipment when setting-up production systems for new product variants.
- Set-up and ramp-up time reduction of around 30% for new or retrofitted plant designs.
- At the end-of-life stage, a step contribution towards a 100% reuse of production system components in new life cycles.
- Strengthened global position of European manufacturing industry through the introduction of the new technologies related to an innovative re-use of equipment based on integrated factory design and contributions to international standardisation.

FoF.NMP.2013-3 Workplaces of the future: the new people-centred production site

Technical content/scope: The workplaces of the future will give much more importance to the human dimension. Putting people at the centre of future factories will provide a stimulating environment for the employees, and make the most from their knowledge, skills and cultural background, in particular through life-long learning and training. Those new workplaces should effectively be integrated into the social (e.g. urban/rural) environment in order to sustainably respond to the needs of the citizens (e.g. quality of air, level of lighting and noise, traffic congestions, etc.) and, at the same time, provide extended services to the workers in terms of safety, accessibility, inclusiveness, efficiency and work satisfaction.

This approach would lead European manufacturing industry to make a qualitative leap towards new people-centred and knowledge-based production workplaces which take into account the constraints of the work force, for example those of aged workers. The workplaces of the future should, therefore, be based on methodologies for enhancing flexible, safe and smart production where adequate levels of automation are applied, while maintaining a level of employment with highly satisfied and skilled workers and, at the same time, ensuring competitiveness.

This strategy demands new concepts and solutions at factory level, both for existing and new production plants. Research activities should be multi-disciplinary and address several of the following areas:

- New approaches to integrate the European factories of the future in their social (urban/rural) environment including urban transport, parking, shopping and entertainment centres, support to families, etc.
- New methods and technologies for an optimised use of workers' knowledge and cognitive capabilities (e.g. for data acquisition, transmission, handling and post-processing), for the stimulation of team interactions and to enhance work related satisfaction, in order to achieve a more human centred and safe workspace, e.g. through the use of knowledge management and decision making systems which are better designed to access, capture and share know-how.
- New methods and technologies for enhanced cooperation of the human operators and the production systems (e.g. Human Factors Engineering), in a safe, flexible and dynamic way, to carry out tasks interactively. New models for human/system integration taking into account the skills, capabilities, and knowledge of the human operator early in the production system design process. New methods and

technologies for efficient human/human interaction and team collaboration, to enhance joint decision-making and team-based efficiency.

- New approaches related to safety and ergonomics of the working areas by the optimisation and personalisation of working environment parameters (e.g. indoor/outdoor lighting, temperature, and humidity) and the integration of advanced safety systems, taking into account worker's age, experience and physical condition, and workers interactions.
- Methodologies and tools for people-centred production to guarantee an efficient transition from current to future worker task/role definitions and multi-skilled involvement of individual workers with expanded responsibility in broader sets of operations (e.g. maintenance, logistics, and quality control).

Screening of existing national/international standards (e.g. safety regulations) and of the needs for new standards is required. Other standardisation, regulation and pre-normative research aspects should also be considered.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact. The projects are expected to cover demonstration activities, including pilot implementations in industrial settings, and this will be likewise reflected in the evaluation.

This topic is particularly suitable for collaboration at international level, particularly under the IMS scheme[53]. Project partnerships that include independent organisations from at least three IMS regions[54] are therefore encouraged.

Funding scheme: Small or medium-sized collaborative projects.

Expected impact:

- In economic terms, an increase of above 20% in the productivity rate due to an enhanced use of human resources, reduction of costs related to accidents and occupational diseases, reduction of absenteeism in the workplace and by increasing the pool of potential workers through widening the skill profile.
- In environmental terms, a more friendly integration of the factory in the social environment, with drastic reduction of total environmental impacts.
- In social terms, a reduction in the number and severity of work accidents and diseases, an improvement in the working conditions in factories and in the attractiveness of the working environments for the right-skilled people due to knowledge-based ergonomic approaches to manufacturing.

FoF.NMP.2013-4 Innovative methodologies addressing social sustainability in manufacturing

Technical content/scope: In order to ensure the social well-being of people in the factories of the future, there is a need to redefine the human role in manufacturing.

New forms of interaction between process, machinery and human beings need to be addressed in such a way that future factories can be operated profitably, and at the same time provide a stimulating environment for the employees, and make the most from their skills and

[53] IMS (Intelligent Manufacturing Systems) is an industry-led, global, collaborative research and development programme, started in 1995 as the world's only multilateral collaborative R&D framework: *www.ims.org*

[54] The current member regions of IMS are the European Union, the United States of America, Korea, Mexico and the EFTA states of Norway and Switzerland.

knowledge through life-long learning. On the basis of these new interactions, manufacturing jobs need to be re-defined and re-engineered and new roles for people in the factory need to be introduced. Cross-discipline studies are needed in order to explore profitable business approaches where the social element in sustainability can be a key factor to ensure midterm economic success while maintaining a high level of employment, even in a period of crisis.

Those business approaches may require an adaptation of organisational structures and management strategies to take into account social sustainability requirements.

Developments in this area are expected to lead to:

- Work satisfaction of employees within the factories of the future.
- New profitable business approaches benefitting from the relevance given to the importance of social sustainability.
- Sustainable use of human capital (e.g. staff knowledge) in the factories of the future.

Within this context, this Support Action should deliver an assessment of relevant past and current activities in Europe (and worldwide) towards the achievement of social sustainability in manufacturing, a set of recommendations on how social sustainability can be measured and enhanced, a definition of what is necessary to support this in terms of research, i.e. a future research roadmap on relevant S&T themes, a definition of the conditions in a factory and /or in society that are favourable for this purpose, and a relevant pilot case.

Additional eligibility criterion: The requested EU contribution must not exceed EUR 500 000 per project, and the project duration must not exceed 18 months.

Funding scheme: Coordination and Support Actions (Support actions). No more than one support action will be funded.

Expected impact:

- Improved understanding of the current situation and future perspectives for social sustainability in European manufacturing.
- Improved synergy among stakeholders around Europe, and community building for future take-up actions.
- Facilitation of a structured approach to promote social sustainability for the European factories of the future.
- Improved production and consumption strategies in line with the societal challenges foreseen by the Europe 2020 strategy.

FoF.NMP.2013-5 Innovative design of personalised product-services and of their production processes based on collaborative environments

Technical content/scope: New product-services go nowadays beyond the physical and service oriented concept, since they are designed in order to be always connected, self-learning, adapting and intelligent. In order to generate economic growth, manufacturers should focus on delivering *solutions* for customer needs rather than simply *products* (or product-services) for their customers. Therefore, new business opportunities will be generated when providing increased added-value to users by integrating personalised innovative functions into traditional and high-tech products.

This business challenge can be addressed by embedding more and more knowledge in highly-personalised innovative product-services (i.e. the so called Meta Products). These novel products are expected to be self-innovative and become smarter while ensuring simplicity for users. They will be upgradable through software applications or hardware module

enhancement, which extend their lifespan, and reduce the environmental impact. In addition, they will provide improved value-added services for a wide range of users, but with personalisation aspects so as to consider individual demands. Meta Products will therefore require the use of new, interoperable, self-organising and collaborative design methodologies and systems. Product development should take place through a collaboration within the product ecosystem, involving multiple companies and actors, in order to offer the high-value personalised product-services to users.

On the other side, new product design and development is fully linked to the concurrent design of the related manufacturing processes, equipment and facilities, including plant lay-out. This need has a strong influence on several aspects related to the life-cycle of both the product and its manufacturing processes (e.g. costs, production, disposal, environmental footprint). Meta Products will be capable of providing advanced service solutions along the whole customer value chain (from the product acquisition to the product dismissal), integrating personalised design, sustainable production, efficient distribution, after sale services, as well as foreseen recycling and re-manufacturing. Cost-effective design solutions with high potential in terms of eco-design content (i.e. minimal footprint impact along the product life-cycle) leading into a new technological cycle (i.e. cradle to cradle concept), should aim at the simultaneous life-cycle optimisation of product-services and related processes.

Research activities should focus on several of the following areas:

- Methodologies and systems for cross-sectoral collaborative design (e.g. 3D drawings, simulation models) enabling the seamless connection and use by all the stakeholders (e.g. product designers, service providers, users) involved in the Meta Product life cycle.
- Collaborative design tools to support the development of Meta Products based on Service Oriented Architecture (SOA). They should be able to connect the design of the product hardware with the development of the software related to the embedded services, based on open source software applications.
- Novel approaches for embedding knowledge into product-services (e.g. use of smart materials, tracking systems, sensing and interacting technologies) in order to add more personalised innovative functions into traditional and high-tech products.
- Embedded tools for product adaptability to enable Meta Products to store usage behaviour and utilise the data to re-organise the embedded services. Feedback mechanisms should be integrated within the tools and should provide the data to the networked companies involved in the design, manufacturing and service-related operation of the Meta Products.
- User-oriented simulation systems (e.g. virtual reality, reverse engineering) for product-service modelling and production-related decision-making approaches (e.g. requirements identification by means of the demand market and user-perceived quality analysis), covering the needs all along the life-cycle.

Standardisation, regulation and pre-normative research aspects should be considered. Proof of concept in terms of at least one demonstrator should be delivered before the end of the project, excluding commercially usable prototypes (2006/C323/01), but convincingly demonstrating scalability towards industrial needs.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact. The projects are expected to cover demonstration activities, including pilot implementations in industrial settings, and this will be likewise reflected in the evaluation.

Projects are expected to use appropriate Life Cycle Assessment techniques and generate knowledge to support European policy development and promote the standardisation (at national or international level).

Funding Scheme: Large-scale integrated collaborative projects.

Expected impact:

- Increased ability to rapidly follow the market dynamics by means of fast production and delivery of personalised final products
- Cost reduction of around 30% by decreasing lead times in product/process development.
- Set-up and ramp-up time reduction for new processes and plant designs (30%).
- Reduction of around 40% in the environmental footprint and the resources consumption during the production and use phases of the Meta Products, together with an increased use of more environment-friendly materials.

FoF.NMP.2013-6 Mini-factories for customised products using local flexible production

Technical content/scope: Product customisation on functional and aesthetic aspects is a common trend to different market segments (e.g. fashion and interior furnishing, sport and leisure, metal working, bio-medical and safety-related products). Advanced production equipment and innovative systems are needed to enable ultra-fast and cost-effective manufacturing of fully customised products on the spot and exactly at the required time. Innovative production solutions should be developed to bring manufacturing operations closer in time and space to the final customer, eventually exploring the possibilities of moving from batch to continuous flow manufacturing. In addition, new factory concepts need to be developed, such as on-site factories or factories-in-a-container, which provide instant manufacturing and customisation services locally, for example in retail environments or utilisation sites.

Those mini-factories, addressing adaptation to customer needs at or near the point of sales or use, will be characterised by fast ramp-up, small environmental footprint and reusability, and will be easy to handle and to set-up. Those production systems should also include new technologies for supply chain management, product distribution and direct end-user interaction.

Research activities should focus on some of the following areas:

- Scale reduction and increased flexibility of production systems in order to satisfy the special requirements of the local flexible mini-production units, which have to show a competitive advantage compared to the traditional larger factories in terms of space, complexity and operator skills.
- Adaptive control and auto-configurable automation systems for local flexible production with high customisation capabilities, where manufacturing operations and sequences need to accommodate to the highly unpredictable customer demands.
- New and integrated product/process engineering solutions, including CAD-CAM systems, able to automatically adapt product features to specific customer demands and accordingly configure processes and machines for local production.

Standardisation, regulation and pre-normative research aspects should be considered. Proof of concept in terms of at least one demonstrator should be delivered before the end of the project, excluding commercially usable prototypes (2006/C323/01), but convincingly demonstrating scalability towards industrial needs.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact.

The proposals should cover both research and demonstration activities. Prototypes and pilot implementations in real industrial settings represent a clear added-value. Whilst there is no lower or upper limit on the requested EU contribution, the target is that proposals allocate around 50% of the total eligible costs of the project (excluding management costs) to demonstration activities and this objective will be taken into account in the evaluation under the criteria S/T Excellence and Impact.

Funding scheme: DEMO-targeted collaborative projects.

Expected impact:

- Increased ability to rapidly follow the market dynamics by means of fast production and delivery of customised final products.
- Reduction of the time to market by 50%.
- Cost reduction (around 30%) by decreasing lead times in product and process development.
- Reduced environmental impact per produced unit compared to traditional larger factories.
- Set-up and ramp-up time reduction (around 30%) for new processes and plant designs of the mini-factories.

FoF.NMP.2013-7 New hybrid production systems in advanced factory environments based on new human-robot interactive cooperation

Technical content/scope: The future factory environments for manufacturing, and in particular assembly/disassembly operations and auxiliary processing such as lifting and moving of heavy goods, will radically improve by integrating new forms of interaction between process, machinery and workers in such a way that future factories can be operated profitably and make the most from employees' knowledge and skills. Hybrid production systems, where robots physically interact with humans, need to ensure an intuitive and safe cooperation among them and an enhanced awareness of the work conditions and the constraints imposed by the factory environment.

A new generation of production systems (e.g. machinery as well as industrial and service robots) will maintain the competitive advantage of the European manufacturing sectors. Future machinery and robots will be based on intelligent features, increasing flexibility in a totally safe environment, enhancing the use of this advanced equipment in a cooperative way with their human operators (machine/robot-human and machine/robot-robot interactions), as well as on self-learning functionalities that allow them to be aware of the current and future tasks.

Research activities should focus on at least three of the following areas:

- Technologies for a reliable and safe machine/robot-human and machine/robot-robot interactive cooperation in applications where the equipment will carry out the tasks which provide power, repeatability and extended work-space while the human operators will provide accuracy, flexibility and problem solving capacity.
- Methodologies for the improved planning of the shared tasks, based on analysis and simulation of real-time collaboration at the production site and by the user-friendly programming of complex tasks, using information from factory sensor networks, and taking into account the constraints from factory environments in predefined automatic

or semi-automatic assembly/disassembly operations, e.g. using advanced real-time augmented reality in complex operations.

- Novel methods of programming for fast-teaching and guided-learning in order to adapt robot work tasks dynamically during operation to the changeable production requirements (e.g. in hybrid assembly of serial products such as automotive, white goods, airplanes, where frequent changes of production require regular updates of the assembly tasks as well as adjustment of workplaces, fixtures and tools).

- Technologies on mobile robots for improved intra-factory logistics, based on enhanced safe navigation in non-structured environments. Dynamic planning methodologies, coordination control and path reconfiguration strategies, taking into account wireless communication, in a safe interaction with operators have to be addressed.

The human-robot safety features, enabling production operation in workspaces shared with humans without separating safety fences or in direct human-robot operations, should lead to advances in the certification of the related production systems working in industrial environments and in the characterisation of risks and safety systems.

Screening of existing national/international standards (e.g. safety regulations) and of the needs for new standards is required. Other standardisation, regulation and pre-normative research aspects should also be considered.

Proof of concept in terms of at least one demonstrator should be delivered before the end of the project, excluding commercially usable prototypes (2006/C323/01), but convincingly demonstrating scalability towards industrial needs.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact. The projects are expected to cover demonstration activities, including pilot implementations in industrial settings, and this will be likewise reflected in the evaluation.

Funding Scheme: Large-scale integrated collaborative projects.

Expected impact:

- Increasing use of robot installations in manufacturing. Today, only some 15% of robot automation potential is being exploited. Further improvement in robot exploitation will contribute to higher employment as more manufacturing capacity will remain in Europe.
- Increasing adaptability of advanced factories by combining the flexibility inherent to humans with the enhanced potential of cooperative production systems, maintaining reduced investment costs and allowing a wide use of those systems in new production areas and sectors, particularly SMEs.
- Promotion of equal opportunities on the shop-floor in terms of gender, age and skills, due to less physically demanding jobs in manufacturing and improved working environment and including accessibility for programming and use.

FoF.NMP.2013-8 Innovative strategies for renovation and repair in manufacturing systems

Technical content/scope: Extending the life and performance of manufacturing equipment as well as designing for re-use/upgrade or ease of renovation (including functional/technological upgrade) and repair requires innovative methodologies which may include Life Cycle

Assessment (LCA) and smart devices based on ICT or advanced materials. Design and manufacturing of plants and equipment which integrates renovation, refit and repair strategies (including upgrade for the enhancement or lifetime extension of equipment) as well as increased ability to track equipment use should be simultaneously addressed to optimise the life cycle of production systems.

Research activities should focus on several of the following areas:

- Renovation and repair approaches for manufacturing plants and equipment including the design phase and life-cycle evaluation.
- Use of existing smart devices and systems based on ICT or advanced materials in the renovation and upgrade of existing structures.
- Repair, upgrade, re-manufacturing and re-assembly processes (including replacing modules by less energy-consuming ones) in the in-situ renovation of infrastructures.
- Systems providing (self) monitoring and diagnostic tools to manage plant and equipment usage and addressing maintenance/renovation/repair or substitution needs.
- Mathematical methods and algorithms for failure mode detection and component degradation assessment.
- New engineering methodologies and supporting tools for machinery recovery and re-use approaches for substituted components.

Standardisation, regulation and pre-normative research aspects should be considered. Proof of concept in terms of at least one demonstrator should be delivered before the end of the project, excluding commercially usable prototypes (2006/C323/01), but convincingly demonstrating scalability towards industrial needs.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact. The projects are expected to cover demonstration activities, including pilot implementations in industrial settings, and this will be likewise reflected in the evaluation.

Projects are expected to use appropriate Life Cycle Assessment techniques and to generate knowledge to support European policy development and promote the standardisation (at national or international level).

Funding Scheme: Large-scale integrated collaborative projects.

Expected impact:

- In terms of economic sustainability, reduction of around 20% of renovation and repair costs, through a better condition-based monitoring and condition-based substitution and repair.
- In terms of environmental sustainability, recovery of at least 80% of the substituted materials for its re-use.
- In terms of social sustainability, eventual elimination of hazardous materials and renovation of outdated plants and structures.

FoF.NMP.2013-9 Advanced concepts for technology-based business approaches addressing product-services and their manufacturing in globalised markets

Technical content/scope: In order to remain on the leading edge and to extend their shares in future global markets, European companies need to offer new user-oriented higher value-added solutions, with appropriate global service infrastructures. Moreover, the decreasing

lifecycle times of products and the increasing number of variants require the design and operation of assembly plants and production networks that are fully flexible, i.e. capable of switching production from one model to another to meet the fluctuating and diverse demand.

Therefore, advanced holistic concepts for technology-based business approaches are needed, in order to help European global enterprises to dynamically operate at multiple locations around the world in a volatile economic environment, taking into account local resources such as commodities, energy, labour, etc. Such global business approaches should include emerging technologies and innovative manufacturing systems and methods, in order to enable European companies to offer their customers a broader variety of affordable products and an extended range of services.

These innovative concepts should provide a fast and efficient response to market variations and should be easily adaptable to the requirements of other industrial sectors. They should support the transition of a European manufacturing enterprise from a traditional product-based approach to a global-minded approach, in which a complex network of actors (mainly SMEs) is able to provide a customised product-service solution to each final customer in the global market. Such a global approach should define standardised formats and interfaces, models and procedures for planning and running fast, integrated, flexible and scalable manufacturing related activities for product-services, using a global supply chain.

Research activities should focus on all of the following areas:

- Technological concepts to address economic and risk assessment in order to support decision-making in the early design of the manufacturing systems, in particular for the integration of new complex technologies in the factory.
- Interactive, model-based decision-making processes for business management, able to assess the impact on performance of alternative configurations of the network of actors involved in the global supply chain for product-services and related production systems.
- Methodologies and tools to manage the co-evolution of products-services and the related production systems in the framework of innovative business approaches.

Screening of existing national/international standards (e.g. safety regulations) and of the needs for new standards is required. Other standardisation, regulation and pre-normative research aspects should also be considered.

Projects are expected to use appropriate Life Cycle Assessment techniques and to generate knowledge to support European policy development and promote the standardisation (at national or international level).

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact. The projects are expected to cover demonstration activities, including pilot implementations in industrial settings, and this will be likewise reflected in the evaluation.

This topic is particularly suitable for collaboration at international level, particularly under the IMS scheme.[55] Project partnerships that include independent organisations from at least three IMS regions[56] are therefore encouraged.

Funding scheme: Small or medium-sized collaborative projects

[55] IMS (Intelligent Manufacturing Systems) is an industry-led, global, collaborative research and development programme, started in 1995 as the world's only multilateral collaborative R&D framework: *www.ims.org*

[56] The current member regions of IMS are the European Union, the United States of America, Korea, Mexico and the EFTA states of Norway and Switzerland.

Expected impact:

- Cost savings of around 30% in production due to improved scheduling and to more robust manufacturing methods.
- Higher reactivity to customer needs around 40% as result of real time adaptable business approaches which include proper legislation monitoring.
- Increased robustness of the supply network around 30%.
- Product-services and their manufacturing processes which are more environment-friendly at global scale.

FoF.NMP.2013-10 Manufacturing processes for products made of composites or engineered metallic materials

Technical content/scope: Products made of composites or engineered metallic materials are becoming more popular in many industrial sectors due to the increased capabilities of design techniques which are able to simulate material properties with a high level of accuracy and, therefore, to optimise the exploitation of their improved properties. Increasingly challenging demands continue arising from market and society in terms of better functional properties, weight reduction, cost decrease, compact design, and minimal carbon foot-print. Composites and engineered metallic materials are now used in many products, either as standalone components or embedded reinforcements in order to locally provide their specific performance in terms of enhanced mechanical properties. An extensive use of such materials leads to significant product improvements that cannot be achieved with the traditional metals or polymers.

However, the processes for manufacturing such products require a better understanding and further optimisation in order to ensure the required quality for the specific applications and a high productivity rate for cost-efficient manufacturing. Production technologies for composites and engineered metallic materials include casting, forming, removal and additive processes related to 3D metals, sandwich materials, multi-materials, new metallic alloys, thermoplastics or composite laminates.

Research activities should focus on several of the following areas:

– Innovative methodologies and technologies for manufacturing which are capable of producing and post-processing new engineered metals and composites taking into account the needs for specific applications.

– Systems and devices to monitor and optimise the process parameters for these new materials to be produced and post-processed at industrial scale.

– New technologies for joining and assembly of multi-materials components (e.g. metal/composite, polymer/composite, and engineered metallic/composite) based on enhanced understanding of the material-interface behaviour at micro/nano scale.

– Characterisation and testing techniques to evaluate the performance (e.g. quality, throughput rate, robustness) of the manufacturing processes for products made of new materials.

– Development of product repair technologies and methodologies to assess the repair feasibility of the manufactured product and to ensure repeatable, safe and certified repair procedures.

– Recycling technologies and routes that guarantee a minimal environmental foot-print of the products made of the new materials at the end of their life.

Screening of existing national/international standards (e.g. safety regulations) and of the needs for new standards is required. Other standardisation, regulation and pre-normative research aspects should also be considered.

Proof of concept in terms of at least one demonstrator should be delivered before the end of the project, excluding commercially usable prototypes (2006/C323/01), but convincingly demonstrating scalability towards industrial needs.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact. The projects are expected to cover demonstration activities, including pilot implementations in industrial settings, and this will be likewise reflected in the evaluation.

Funding scheme: Small or medium-sized collaborative projects.

Expected impact:

- Higher utilisation of advanced materials in products with improved performance without a cost increase.
- Decrease in raw materials and energy consumption by at least 20% during the processing, manufacturing and/or dismantling phases.
- Reduction of waste and emissions (e.g. fumes, chemicals, dust, hazardous materials) by at least 30% during the processing, manufacturing and/or dismantling phases.

FoF.NMP.2013-11 Manufacturing of highly miniaturised components

Technical content/scope: Product miniaturisation requires a good understanding of the intended application, the scale-related property variation, the manufacturing methods and the material behaviour. Miniaturisation has been an increasing trend in the last 15 years because of the drive for minimisation of energy and materials use in manufacturing processes, the increased need for redundancy, the requirements of faster and more energy-efficient devices, and the enhanced functionalities (such as selectivity and sensitivity).

Micro-fabrication techniques are widely exploited by the semiconductor industry, which has invented many micro- and nano-scale manufacturing methods. These methods could be regarded, in general, as potential techniques for the miniaturisation of components in many other industry sectors. However, they are mostly addressing a particular class of materials and 2D surfaces with specific features, and are highly sophisticated and expensive (high cost of ownership).

Alternative manufacturing technologies are currently needed to overcome the challenges of volume production of miniaturised components or sub-components made of a wide range of materials (e.g. metallic alloys, composites, ceramic and polymers). These techniques should be cost-efficient and flexible in terms of both the shapes of the features and the materials being used. In order to reach this objective in a competitive way, the upgrading of appropriate high-throughput and cost-efficient processes like conventional forming, moulding, imprinting and surface deposition processes, or new integrated process chains, will be needed. New materials pose new challenges for cost-efficient manufacturing in order to shape, handle and assemble complex structures that can involve macro-micro-nano scale features and may require the analysis of the micro-structural behaviour of materials and its interaction with the production process.

Research activities should focus on at least three of the following areas:

– Processing techniques for miniaturised components made of a wide range of materials with different properties (e.g. thermo-responsive, piezoelectric, or phase-change materials), in order to achieve a flexible and high-throughput production.

– Integration of multiple material combinations and smart materials for the sensing and actuation technologies.

– Merging the top-down and bottom-up approach in order to go into parallel and/or continuous manufacturing.

– Novel on-line monitoring and quality inspection systems in manufacturing of highly miniaturised components, in order to ensure efficiency, reliability and high product quality.

Projects are expected to address issues like energy savings, cost and waste reduction, and recycling that should be studied through Life-Cycle Assessment.

Projects should show substantial improvements in the manufacturing of components at the micro and nano-scale in terms of cost/performance balance (e.g. lower costs per integrated function), accuracy and reproducibility by providing the appropriate cost-efficient and reliable manufacturing technology.

Screening of existing national/international standards (e.g. safety regulations) and of the needs for new standards is required. Other standardisation, regulation and pre-normative research aspects should also be considered.

Proof of concept in terms of at least one demonstrator should be delivered before the end of the project, excluding commercially usable prototypes (2006/C323/01), but convincingly demonstrating scalability towards industrial needs.

In order to ensure an efficient implementation and maximum impact of SME-related activities, the leading role of SMEs with R&D capacities will be evaluated under the criteria Implementation and Impact: the coordinator does not need to be an SME but the participating SMEs should have the decision making power in the project management; and the output should be for the benefit of the participating SMEs and the targeted SME dominated industrial communities.

Funding Scheme: SME-targeted collaborative projects.

Expected impact:

- Improved high-throughput and/or highly flexible and cost-efficient processes for micro/nano-manufacturing of components for application areas such as tools, electrodes, solar cells, consumer products, and communication and medical devices.

- Scaling up of micro-production processes from lab-scale to an industrial scale for multifunctional applications such as in medicine, energy, transport and electronics.

- Further progress on micro/nano-manufacturing towards intelligent, scalable and adaptable systems, enabling the cost-efficient, competitive and market-demand-targeted production, ranging from small/medium volumes to high throughput and thus facilitating the access to target markets characterised by small or growing volumes.

V.1.2 "Factories of the Future (FoF)" - Topics covered by the ICT Theme

– **Objective FoF-ICT-2013.7.1 Application experiments for robotics and simulation**

All projects under this objective shall carry out a critical mass of vertical application experiments related to robotics or simulation, complemented by horizontal support services: Driven by the requirements of first-time users, individual experiments shall bring together all actors of the value chain necessary to equip new users with novel products or services and assist them in customising and applying these in their respective environments, e.g. first time users, application experts, technology suppliers, system integrators, and service providers. Special emphasis is on SMEs, both on the supply and the demand side. Proposers are referred to the general description of take-up actions in the introduction to this Challenge.

Target outcomes:

a) **Robot solutions for new manufacturing applications**

Experiments shall showcase the take-up, integration and evaluation of methods, components, and tools reflecting the paradigm shift in industrial robotics, away from immobile, large-sized, pre-programmed robots to more flexible, energy efficient and adaptable service robots (e.g. lightweight, mobile systems). Experiments should target key functionalities such as mobility, reconfigurability, dexterity, safety and human-robot interaction, and focus on downstream activities like systems integration, testing and validation under realistic manufacturing conditions. In areas such as manufacturing, service, maintenance and repair, or monitoring and control, application scenarios must be well motivated in technical terms and exploitation potential. Experiments shall be innovative, e.g. in terms of integrating new materials, advanced sensors and control technologies in robotic systems.

b) **Simulation services for engineering and manufacturing**

Experiments shall showcase the customisation and adoption of HPC-cloud-powered simulation services by users, particularly SMEs. Innovation shall be addressed at three levels: (1) Users get a "one-stop-shop" access to simulation technologies novel for them, including expertise and tools for visualisation, analytics, customisation and integration; and dynamic, easy and affordable access to computing resources; (2) as business owners, independent software vendors and simulation service providers, supported by competence centres, port their applications to a cloud of HPC resources and run experiments with those cloud-based service and business models in controlled environments; (3) HPC resource and service providers join forces in providing, across experiments, a prototype of a sustainable European commercial cloud of HPC resources in manufacturing and engineering including the necessary orchestration and access services. An operational prototype of the targeted cloud infrastructure is expected to become operational at an early stage. HPC-cloud providers shall build on existing infrastructures as far as appropriate.

c) **Constituency building and road-mapping**:

Building constituencies and developing broad research and innovation agendas in areas such as (i) analytics, simulation, and forecasting technologies deployed in manufacturing and engineering; (ii) architectures and services integrating agile and flexible manufacturing processes into distributed, interoperable, "green", and context aware enterprises of the future.

Expected impact:

- Strengthen European SMEs in manufacturing to adopt advanced robotics and simulation technologies towards improving their global competitiveness in terms of innovative, high quality products and services at affordable manufacturing costs and prices.
- Strengthen European technology and service providers by further opening to them the SME market in the manufacturing sector and by giving them the opportunity to experiment with new business models.
- Furthering the adoption of cloud infrastructures in Europe in a large niche market segment important for Europe's economy.

Funding schemes:

a), b): IP – it is expected that minimum one IP is supported for each target outcome.

c) CSA

Objective FoF-ICT-2013.7.2: Equipment assessment for sensor and laser based applications

All projects under this objective shall carry out a critical mass of equipment assessment experiments related to laser or sensor-based tools: Suppliers of innovative high-tech equipment install and assess their prototypes or products in production-like environments and validate them in established or dedicated manufacturing lines. The primary aim is to strengthen the ICT equipment supplier base, predominantly SMEs, through a close cooperation with globally acting manufacturers, by improving the manufacturing processes in relation to quality, speed, environmental and resource efficiency. Equipment assessments require the following steps: (i) definition of state-of-the-art requirements for a specific application scenario; (ii) establishment of productivity metrics and (iii) assessment of experiences and results. Special emphasis is on SMEs on the supply side. Proposers are referred to the general description of take-up actions in the introduction to this Challenge.

Target Outcomes

a) Intelligent equipment solutions in custom manufacturing and/or re-manufacturing: Equipment assessment of sensor-/actuator-driven equipment targeting smart production flexibly through an effective monitoring and control of small volume, small lot size customisation requirements and/or end-of-life manufacturing operations – such as dismantling, recycling, material reuse. The assessment framework shall address improvements related to precision, speed, cost, flexibility and efficiency of (re-) manufacturing operations.

b) **Innovative laser applications in manufacturing: Equipment assessment** of all equipment relevant to laser manufacturing such as the laser itself, power supplies, handling tools, beam guiding/manipulation and quality, sensors to monitor the equipment and manufacturing process, periphery in general (materials, housing, safety issues etc). The assessment framework shall address improvements related to quality, speed, flexibility and resource efficiency of laser-based manufacturing and processing.

c) Establish a network of **innovation multipliers** in the manufacturing sectors across all take-up projects of this Challenge taking an interdisciplinary approach to achieve broader technological, applications, innovation, and regional coverage thereby maximising impact and addressing better the needs of SMEs.

d) Support a rapid **build-up of new manufacturing skills**: training methodologies and ICT-based tools to attract the interest of young talents in manufacturing and engineering.

Expected Impact

- Penetrate new application areas (e.g. high customisation, end-of-life product engineering and manufacturing), close to the market and opening new markets
- Strengthen supply-side SMEs by enabling them to supply manufacturers with new equipment and components for improved manufacturing operations.
- Leveraging innovation capacity and competitiveness of European producers of laser manufacturing equipment and their suppliers, in particular SMEs, and of the users of such equipment.

Funding schemes:

a), b): IPs – it is expected that minimum one IP is supported for each target outcome.

c), d) CSA