Impact of the Factories of the Future Public-Private Partnership

Final Report on the Workshop held on March 11-12, 2013, Brussels

Contents

Executive Summary

FoF projects address a wide range of technologies and issues relevant to enhancing the competitiveness of European manufacturing and many potential impacts are evident in these projects. The challenge though is how to turn impacts into tangible business benefits in the marketplace, which requires a focus on business and market issues.

There is evidence now of more focus on matters relating to exploitation which is to be expected in projects as they move towards completion. In a few cases where projects are reaching maturity, there is some evidence that business and market related issues are being given much more attention, with efforts made to calculate potential returns on investment, which is the type of information that is needed in order to attract interest from investors.

Projects are beginning to realise that a much stronger business and market focus is needed within the PPP projects, and they have identified activities in this area that could form the basis for clustering activities.

Many other activities have also been identified that could be undertaken as part of a clustering initiative. The case for clustering is beyond doubt a beneficial one, and there are many potential benefits. It is also the case that clustering is something that spans the whole project lifespan, and beyond.

Some clustering activities are relatively easy, such as joint dissemination, or collective contributions to standardisation. Some activities however, are more challenging, such as addressing business and market related issues, and also sharing results, which raises confidentiality and IPR related issues. Yet in terms of that which will have most impact for projects and the PPP as a whole, it is the *hard-to-do* clustering activities that are likely to be most effective.

As in previous workshops, there was again a call for demonstration and pilot activities, where several results could be demonstrated together, or could be integrated to provide more integrated solutions. Yet the complexities of such collective demonstrations and pilots were not discussed. Clustering would provide a good forum for exploring and developing in more depth, the concept of collective demonstrations and pilots.

Collectively, there is a view that the FoF PPP fulfils a valuable role in delivering research projects that are strongly industry driven. Academic and research institutions find the initiative of value as it places research students in contact with real industrial problems. More can however be done in the future to develop the FoF PPP, also as a training vehicle for young researchers.

More dissemination of information to a wider group of stakeholders, with the investment community being a key target groups in this respect, is needed in the future.

As the FoF PPP has grown in size, it has become more difficult for people both within and outside the PPP to understand what is being done, how projects relate to each other, what results can be expected, and who owns the IP for these results. There is also a lack of classification of results in terms of Technology Readiness Level, which would help people to better understand how close to market the results are. These problems will only get worse as more projects are added to the portfolio. Now is the time to start to deal with this matter.

Specific recommendations are focused on actions that the various stakeholders, including the European Commission, the *Ad-hoc Industrial Advisory Group,* the European Factories of the Future Research Association (EFFRA), and the funded projects and their participants could take.

The main recommendations are:

- Clustering is clearly necessary and beneficial. Projects should begin to consider and organise clustering activities immediately.
- Clustering that addressed business and market related issues should become the main component of clustering activities.
- Cluster-oriented dissemination activities should be organised, both on a small scale by projects, and for large events by EFFRA or the European Commission.
- EFFRA should make available a public domain version of its (confidential) database as soon as possible.
- Consideration needs to be given to providing support for clustering activities through a Coordination Action, especially in relation to handling sensitive IPR issues. Such an action could also address how to make available to a wider group of stakeholders, information that is important to understanding what results will be available and who to contact with regard to the licensing of results.

Introduction

Factories of the Future (FoF) is a Public-Private Partnerships (PPP); one of three that were launched in 2009 as part of the European Economic Recovery Plan. This Recovery Plan comes to an end in 2013 and the European Commission will be undertaking, during the course of 2013, an assessment of all three PPPs.

An interim evaluation of the effectiveness of the PPPs was organised in the early part of 2011[1]. Prior to this assessment the European Commission organised a workshop for the FoF PPP project participants, to consider matters relating to impacts, in terms of both the funded projects and the PPP itself, with the resulting workshop report[2] providing input to the PPP interim evaluation exercise. Following on from this first workshop, which was held in November 2010, the European Commission held a second impact assessment workshop in March 2012[3]. The focus of this second workshop was on further considering impacts of individual FoF PPP projects, but also exploring in more depth discussions started at the first workshop into ways in which the impacts of the FoF PPP, overall, could be improved and developed.

With a final evaluation of the PPPs to be undertaken in 2013, the European Commission organised in March 2013, a third impact assessment workshop, with this report being the result, which is designed to provide an input to this final evaluation.

In addition to once again considering impacts relating to specific projects, it was possible on the occasion of this third workshop to look in more detail at a number of the more mature projects (those from the first Call, drawing close to completion) to consider some very clear outcomes and exploitation intentions. The workshop also provided a networking opportunity for FoF project participants to help them to better understand other projects and to promote the message that all the FoF activities are part of a family of related Research and Technology Development and Innovation projects within the common framework that is the FoF PPP. Specific workshop objectives were to:

- Explore and identify the impact of the projects funded by the FoF PPP and to communicate this information to all stakeholders;
- Provide a platform for stakeholders to consider the matter of synergies among projects, especially in relation to the matter of clustering, as a means of creating activities that add value both to individual projects and to the PPP as an initiative; and
- Consider the lessons to be learned from the four years of operation as a PPP, with a view to improving and shaping, post-2013 (into Horizon 2020), the FoF PPP as a future mechanism for industry-driven manufacturing technology related research, development and innovation.

[1] Interim Assessment of the Research PPPs in the Economic Recovery Plan
http://ec.europa.eu/research/industrial_technologies/pdf/research-ppps-interim-assessment_en.pdf
[2] Impact of the Factories of the Future Public-Private Partnership – 2010 Workshop Report
http://www.effra.eu/attachments/article/125/FoF_PPP_Workshop_Final%20Report.pdf
[3] Impact of the Factories of the Future Public-Private Partnership – 2012 Workshop Report
http://ec.europa.eu/research/industrial_technologies/pdf/fof-ppp-workshop-march-2012_en.pdf

The purpose of this report is to present the main views and insights that emerged from the third impact workshop discussions and to identify conclusions and recommendations.

Workshop Methodology

With regard to workshop methodology, members of the FoF PPP *Ad-hoc Industrial Advisory Group*, along with project co-ordinators, were invited to attend the workshop. A number of European Commission officials also participated. A list of registered workshop participants is given in Appendix 1.

The agenda for the workshop is included in Appendix 2. The workshop started on the Monday afternoon, with project presentations organised into three high-level themes (run in three parallel sessions). The three themes addressed were: ICT for Manufacturing; High-Performance Manufacturing; and Sustainable Manufacturing. Each of these themes was sub-divided into topics that were based on FP7 FoF Work Programme topics from 2009, 2010 and 2011, which provided the basis for organising the presentations from the many diverse projects that form part of the FoF PPP.

For these sessions, each project was asked to prepare a few slides to a pre-defined template. They were asked to briefly outline the project, but most importantly, specify the expected impacts in the context of the project outcomes (results) but also in relation to the Work Programme topic and the Multi-annual Roadmap, with exploitation and dissemination actions also mentioned. In addition, projects, either individually or collectively within topics, were asked to provide answers to the following questions relating to clustering:

- What technical cross-cutting issues among projects should be taken into account to increase the overall impact?
- What non-technical cross-cutting issues among projects should be taken into account to increase the overall impact?
- How can cluster activities add value to projects?
- How can cluster activities help exploitation of results after a project ends?

The second day of the workshop was chaired by José-Lorenzo Vallés, Head of Unit for New Forms of Production, Directorate General for Research and Innovation. The day began with welcome remarks, and contextual comments and observations, from Herbert von Bose, Director for Industrial Technologies, DG Research and Innovation. This was followed by a presentation of industry viewpoints concerning the impact of the FoF PPP, after which session rapporteurs presented feedback from the parallel activities held on the previous afternoon.

Four projects then presented some more detailed information about their expected impacts, and in two cases some early steps being considered to bring these impacts to fruition were presented. Then followed a Panel Discussion on how synergies and cluster activities can increase the impact of the FoF initiative. A further panel discussion on the lessons to be drawn from the four years of operation of the FoF PPP was then held. The questions used to stimulate both panel discussions are given in Appendix 3. The workshop rapporteur then provided some preliminary observations and conclusions, and this was followed by several closing statements.

A networking cocktail was also held on the evening of the first day, to facilitate further building of contacts among the project representatives.

Expected Impacts of the FoF Projects

In total 91 out of 98 projects were presented in three parallel sessions held on the Monday afternoon. This is a large number of projects hence presentations had to be kept very short and focussed.

These projects represent research and technology development and innovation related activities that cover the full spectrum of manufacturing, from the processing of raw materials to delivery of manufactured products to customers, across many sectors, covering both large volume and small scale production, dealing with such matters as supply chain configurations, virtual factories, material processing and handling, programming and planning, customer driven design, energy efficiency, emissions reductions, new processing technologies, new materials, upgrading of existing machines and technologies, and so forth, including many projects involving elements of, or wholly focused on, various uses for Information and Communication Technologies (ICT).

ICT for Manufacturing Projects

In the domain of ICT there are projects that focus on what are called platforms, which can be considered as the hardware, system architectures and software necessary to undertake a range of related tasks. Typically these platform projects are focused on specific interests such as: manufacturing information and knowledge management; supply chain configuration; creation of virtual factories assembled from multiple independent factories; and collaborative engineering. But there are also ICT projects addressing simulation, game-based training, support for end-of-life material recovery and re-manufacturing, advanced robotics, energy efficiency monitoring, laser welding, etc.

Highlights of impacts identified by these projects include reduced costs, accelerated product and process engineering, greater flexibility, improved quality, better equipment availability, reduced use of consumables, lower energy consumption, etc. ICT is also in many of these projects more than just a technology, but also an enabling technology in that it has the potential to bring about changes in method, procedures, or to open up new possibilities. Some of the targeted impacts in this respect include developing specific software targeted at SMEs to take account of their specific constraints (for example, limited time and expertise). Another enabling impact is greater flexibility, both in terms of capabilities of specific machines and processes, but also in the capability to redeploy these in new configurations (factory layouts), to meet changing demands. In some of the ICT projects it is also possible to see consideration being given to add-ons and upgrades to existing machines and systems, which will help to improve the performance of existing equipment and to extend its useful life.

High Performance Manufacturing Projects

There are also a diverse range of projects that were presented under the theme of High Performance Manufacturing. Projects here are focused on: production of high precision plastic parts; development of photonic device production capabilities; development of precision glass moulding processes; enhancing tool-making technologies for high-

precision micro-forming; development of new manufacturing routes for micro- and nano-scale feature manufacturing; zero defect manufacturing; control of milling processes for thin-walled work-pieces; production of graphene; etc. There are also projects investigating additive manufacturing and robotics for maintenance tasks applied to large scale structures. Consideration is also being given in some projects to modular reconfigurable production systems and the development of capabilities to customise products and to put in place the necessary manufacturing capabilities needed for customisation.

Impacts for this theme were presented in term of improved dynamics for cutting processes, higher precision, and improved reliability during changing process conditions. But also evident were impacts in terms of lowering commissioning and ramp-up times, and avoiding investments in new production machinery through enhancing re-usability of manufacturing technologies and systems, and extending the life of machinery through add-ons and upgrades. Some developments are evidently also enabling, in the sense that once the processes and associated technologies are developed they will enable those who purchase them to engage in their own innovation (additive manufacturing is one example of this).

Sustainable Manufacturing Projects

Under the theme Sustainable Manufacturing, projects, also diverse in character and focus, are dealing with matters that have relevance to creating a more environmentally responsible approach to manufacturing. Here there are projects that are also addressing customisation issues, with one example being customised clothing that allows the customer to choose more environmentally benign materials. There are also other projects dealing with customisation with an eco-dimension, delivering environmental assessment tools while also providing web-based access to support the customisation process. Work is also being undertaken on the development of the supporting manufacturing and supply chain infrastructure necessary for a shift away from large volume standardised products, to small scale production of customised products. Other projects are working on topics such as: environmental footprint reduction for metal formed products; resource efficient manufacturing systems; waste energy recovery; eco-efficient firing processes; use of predictive maintenance to achieve optimal energy use; condition and energy consumption monitoring; harmonisation of product, process and factory lifecycle management; etc.

For projects with a sustainability focus, impacts tend to be presented in terms of reductions in costs, energy consumption, emissions, and material wastage, but also in terms of increased availability of processes and machines and improved plant efficiencies. Also evident are impacts such as better understanding of customer needs, reduced time to market, reductions in delivery times, reduced transportation costs, and more time and cost effective customisation. Improved decision-making as a result of more in-depth understanding of environmental impacts is also mentioned. Potentially, the capability to produce customised products cost-effectively on a small scale could result in a shift away from large expensive centralised production facilities (with their associated significant transportation-driven carbon emissions) to more local production closer to the point of sale.

Success Stories

Four success stories were presented at the workshop to illustrate the achievements emerging from some of the more mature projects and their potential impacts.

eCustom: A Web-based Collaborative System for Mass Customisation

www.ecustom-project.eu
Coordinator: Lab. for Manufacturing Systems & Automation (LMS), University of Patras

eCustom addresses the development of a set of tools and methods for supporting Mass Customization, with demonstrations of the project results through pilot applications in three sectors: automotive; healthcare; and machine tools. The project's focus is on engaging customers in the customisation process, with a strong orientation towards an eco-friendly approach.

eCustom's main exploitable results are software modules that comprise:

- A web-based user-friendly tool for the integration of the customer in the design phase of new products;
- An advanced Virtual and Augmented Reality visualization feature usable via a web-browser, being based on free and open source software;
- A web-based platform for supporting the decision making procedure for the production of individualized products in a fast, cost-efficient and environmentally friendly way;
- A module to provide an assessment of the environmental footprint of supply chain configurations, using simulation-based metrics.

Early results from pilots indicate a clear environmental benefit in the form of reductions in energy costs (in the range 5% to 10%); as well as other benefits, which include: reduced transportation costs by up to 20%; 15% shorter design time for personalized products; decrease in time-to-market of up to 15%; reduced delivery time by approximately 15%-20%.

IMAGINE: Innovative End-to-End Management of Dynamic Manufacturing Networks

www.imagine-futurefactory.eu
Coordinator: Intrasoft International

IMAGINE is an ICT project that is focused on interoperability in contemporary manufacturing, specifically addressing the area of networked manufacturing where partners, such as suppliers, logistics operators and customers collaborate to achieve a shared manufacturing goal. The aim in such a context is to achieve network level management of processes and to provide visibility to all involved. Under development is a framework with supporting software that enables network manufacturing lifecycle management, covering network configuration, design, and monitoring and governance. Key relevant dimensions addressed include planning, sourcing, manufacturing, and delivery.

It is expected that the work undertaken by IMAGINE will lead to a wide range of business benefits for a number of stakeholders, including large enterprises and SMEs. These business benefits include: capability to better respond to global competition;

improved efficiency, adaptability and collaboration; sharing of risks and resources; and collaborative entrepreneurial innovation, to mention just a few.

An innovative feature of the IMAGINE project is its engagement with stakeholders through Specific Interest Groups that allow for collaboration at different stages of the project, and which give stakeholders a forum to share views.

Femtoprint: A Femtosecond Laser Printer for Micro- and Nano-scale systems

www.femtoprint.eu
Coordinator: Eindhoven University of Technology

Femtoprint has been implementing a new method for manufacturing microsystems and devices by bypassing the need for large scale infrastructures for producing microsystems. To this end the project has successfully developed and demosntrated a table-top printer for producing microsystems with nanoscale features. This has potential applications in the production of: optical and opto-mechanical devices, as well as lab-on-a-chip devices used for opto-fluidics; and the marking of optical memories.

A key advantage of the printer is that it has the potential to boost innovations in microsystems by providing affordable rapid-prototyping tools to SMEs. Femtoprint has also demonstrated, using the printer, a number of important technical achievements:

- First demonstration of exotic polarization state converters;
- First demonstration of an optically transparent glass actuator;
- Evidence of 5D optical memories;
- Demonstration of chaotic to self-organized bubble patterns.

The Femtoprint project, in addition to producing the prototype table-top printer, has made two patent applications, and is in the process of addressing the set-up of a spin-off company to further develop and to market the printer.

HARCO: Hierarchical and Adaptive Smart Components for Precision Production Systems Application

www.harcoproject.eu.com
Coordinator: Ce.S.I. Centro Studi Industriali

The key achievement of the HARCO project is the development of a set of smart modules for machine tool applications and robots that can be combined to produce a desired set of applications needed to enhance dynamic and thermal stability in situations requiring high speed precision actions. The results are relevant to both new and existing (via retro-fitting) machine tools. Three product modules have been developed:

- Micro-positioning table: This is a linear two-axis module for ultra-high precision motion control. The module is an add-one device which provides two auxiliary micrometric axis (x-y) to the machine;
- Structural Monitoring Module: This enables the detection (through smart sensors) and correction (using Artificial Intelligence algorithms) of errors caused by structural deformation either from thermal or finite stiffness effects, by monitoring the structure on-line using embedded sensors;

- Smart Rods: A set of active struts to drive mobile platforms of PKM robots offering a promising alternative for delivering high damping and high stiffness with low weight. The active fibres can be actuated to damp overshoot and oscillation and reduce settling time of the robot.

The key innovative features of these products are:

- HARCO module integration will lead to the design of lighter machines with embedded mechatronic stiffness and damping;
- The modules are intelligent, providing active and adaptive components that can be integrated in self-adaptive manufacturing equipment in a flexible and reconfigurable manner;
- The modules provide "inherent" intelligence to the structural elements and components of the machine tool or robot.

HARCO has demonstrated a good return on investment potential for the micro-positioning table, which provides the commercial case for post-project investment to bring the product to market.

Overall Observations on Impacts

A number of projects mentioned their participation, or hinted at their intention to participate in, European Commission-supported Exploitation Strategy Seminars which involve project partners and an appointed consultant working together to identify: exploitable project results; which project partners will invest time and effort in each result; intentions of each partner with regard to the dissemination and use of all results; and conflicts of interest and weaknesses in the exploitation plan. A number of projects also mentioned that they had applied for patents, or were intending to do so. One project also mentioned that it already had two products in the market. Another (the Femtoprint project described above in the success stories) also reported the possibility of creating a spin-off company to market the results of the project. The HARCO project (also described above in the success stories) has considered the matter of demonstrating a case for further investment, by undertaking a profitability analysis in terms of Net Present Value and Internal Rate of Return, which are essential parameters for attracting the post-project investment that will be needed to take results to market.

The presentations overall suggest a lot of understanding among projects about potential impacts, which are quite varied. Worthy of note however, is that what was less evident in the presentations, is the matter of business and markets, return on investment, and profit margins. This missing dimension, and the need for it, is something evident from the comments that arose from the considerations given by projects to the questions relating to clustering, and more is said about this in the next section.

Another observation worth making at this point, is that the outputs emerging from these projects represent a wide range of results, some patentable, but also many that are very unlikely to fall within the scope of patent protection (especially those related to ICT), or which are so conceptual in nature that they are likely to be regarded as being obvious to a person skilled in a given area, or concepts which are already known. The results also represent a wide variety of exploitation routes, timescales and investment needs. These factors point to there being a lot of complexity, and there being no one best approach as to how to handle post-project exploitation or provide support via clustering activities.

This should be taken note of when considering clustering, but also when people start discussing the recurring theme of collective demonstrations.

Maximising and Improving the Impacts of FoF Projects and the PPP through Clustering Activities

Discussions about the central matter of how to use clustering to improve the impacts of the PPP, both in terms of impacts from individual projects, and for the PPP as a whole, demonstrate a wide range of opinions and options. Clustering is something that can be tackled in many different ways. Clustering could be attempted in a top-down manner with projects allocated to clusters, or done in a bottom-up way with projects deciding for themselves how to cluster, or some combination of the two. Clustering can also be done along the lines of themes, technologies, applications, markets, exploitation challenges, and so forth. Clustering of course does not necessarily mean islands of activities, for across clusters some common horizontal activities could be conceived.

Technical and Non-technical Cross Cutting Issues

The workshop identified a massive range of issues which could be addressed as part of clustering.

Under the area of what were termed *cross-cutting technical* issues, many suggestions were made, some several times by different projects. The list of main issues includes:

- Addressing matters of common approaches to data integration and visualisation, cross company product data exchange, interoperability, standardised connectivity, and middleware to enable different solutions and outputs from similar projects to work together;
- Common approaches to standardisation activities, and submissions to standardisation bodies, and the development of standardised metrics and testing procedures;
- Consideration of trust and security issues underlying inter-company collaboration;
- User interface design;
- Sharing information on technical issues and challenges;
- Consideration of maintenance issues;
- Better understanding of user needs in areas of common interest, and understanding also needs relevant to other sectors;
- Linking results and components together to form more complete systems or end-to-end infrastructures;
- Finding common solutions to common problems;
- Developing common Key Performance Indicators and business case methodologies;
- Working together to validate and demonstrate results of more complete systems;
- Development of common vocabularies and terminology.

There were also suggestions relating to some more specific technologies, like for example the development of a shared database of laser processing data for various materials and lasers.

The most common *non-technical* issue raised was shared dissemination activities. But other matters raised include:

- Developing common knowledge and understandings concerning health and safety issues for specific technologies;
- Exploring approaches to culture change issues, and identifying change management methodologies;
- Identifying user training needs for specific technologies and systems;
- Interlinking related project web sites;
- Identifying and communicating information about relevant background IPR;
- Undertaking international surveys on specific matters;
- Better understanding of human roles in Factories of the Future;
- Developing best-practice definitions and joint guidelines;
- Sharing know-how concerning setting up of spin-off companies;
- Creating technology awareness across relevant stakeholders.

The Added Value to Projects of Clustering Activities and Potential Benefits in Terms of Exploitation

Many benefits of clustering were identified at the workshop. In terms of the added value that clustering brings to projects, several important benefits were mentioned:

- Bringing different perspectives and different knowledge together to create a wider and more comprehensive understanding of issues, and creating a broader decision base for choosing the right technologies;
- Increasing awareness of project results among projects and also user communities, especially increased awareness of what is being done in similar projects;
- Discovery and exploitation of complementarities among projects, and fostering knowledge sharing;
- Avoidance of duplication of effort and re-inventing what already exists;
- Insights into areas that are not part of a particular project;
- Using clustering as a means of providing additional learning for personnel working in projects;
- Assessing and comparing the technological readiness of project results leading to better understandings of how close project results actually are to being transformed into market-ready products;
- Identifying the potential and opportunities for further innovation.

The most interesting and insightful comments were however made concerning how clustering could aid exploitation. There was of course a repeat of what was said at

previous workshops about the possibility to undertake combined pilots demonstrating many different results in one place, which was felt would aid exploitation. But, new insights emerged, in particular:

- The cataloguing of results to create a match between these results and identified business and market needs;
- Creating a forum to discuss exploitation issues;
- Providing the basis for developing business and technology relationships after project completion;
- Exchange of information about dissemination and exploitation strategies and experiences, and development and sharing of relevant business models;
- Discussions with a broader community of potential early adopters/users, and development of a capability to reach a broader base of interested customers;
- Greater awareness of what is already available in the market and how this might reshape project developments;
- Improved perspectives on exploitation of whole systems and the associated collective exploitation, and providing opportunities for cross-licensing of project results;
- Better understandings of markets, competition, and existing IPR ownership;
- Establishment of user groups for creating reference applications.

All the latter points are in fact mostly what was not so evident among project presentations; that is to say, business and market-related issues that in the end will make the difference and which could be crucial in shaping projects during their course of execution to increase likelihood of business success.

Important Issues Relating to Clustering

Although the case for clustering is a strong one, some matters of concern, some points of emphasis, and some points of disagreement arose during the workshop.

One key concern is protection of Intellectual Property. For projects that might produce patentable results, which are mostly those involved in the invention of new processes and pieces of hardware etc., this is a real concern. But how many projects will in the end produce patentable results? Many will not, especially those involving ICT, where in fact openness and willingness to share results are often key issues for wider adoption and take-up. So, while IPR may be a concern, and one that will need to be addressed, it is not a general reason to avoid engaging in clustering, unless it can be demonstrated otherwise.

Another issue was timing, meaning when is the best time to engage in clustering? One view was as early as possible, but another view was clustering should mostly be done when projects were over and there are results to exploit. The latter view, however, may be difficult to realise given the end of the funding period of the projects. It was suggested that some issues, especially those that relate to business, market, and exploitation, belong to the post-project phase. This however is more a matter of traditional linear stage-wise thinking, still sometimes found in industry, especially in large corporations. It is not an approach however that sits well with a dynamic fast-

changing economy with many agile competitors who do not think along traditional lines.

Training was also seen as an important clustering activity, as this is often overlooked by projects. Training is one of those activities that should be addressed early on in a project, and can also become a dissemination activity creating greater industrial awareness. Training is also a clustering activity that needs to be continued after a project is completed. Training therefore, evidently needs to be on the clustering agenda.

Another concern expressed about clustering was that projects might do it only because they are being told they need to. So evidently there has to be an incentive for projects to engage in clustering. Many of the benefits previously listed should provide that incentive. Another issue of concern was that clusters could just become inward looking. One way to overcome this might be to open up clusters to relevant projects from other world regions (e.g. under an initiative such as IMS). Another way would be to focus on business and market related issues which require an outward looking mind-set. This will also help to give a focus towards thinking about how to communicate with investors. Another way to avoid inward looking thinking would be to ensure that clusters are not just constituted from people with the same perspective, but that they are designed to bring a wide range of different perspectives into play, which is, in any case, one of the perceived benefits of clustering.

It was said during the discussions that clustering should be based on identified areas where projects are not so strong. What the workshop showed was that at the moment, it is in the area of business and market related matters, where there is less evidence of strengths, and where projects could achieve significant benefits by focusing on such matters. This business and market focus should provide a good incentive for projects to engage in clustering, if sensitive issues can be properly handled.

Another point that was made is the need to provide good-practice guidance to projects concerning how to cluster and how to maximise benefits. The above mentioned issues, for example, how to handle IPR issues, point towards some of the matters that need to be addressed in any good-practice guidance document.

Cleary clustering requires a contribution from the public and the private side. Some funding to deliver support (e.g. via a Coordination Action) will definitely be of help given the need to address the issues discussed above. But the private side can also make an important contribution by bringing key stakeholders such as investors to meet with those engaged in clustering activities.

During the workshop an example of a bottom-up approach to clustering was presented. This clustering arose as a result of the second impact workshop, which inspired the four projects working in the area of Zero Defect Manufacturing to form a cluster called 4ZDM[4]. This shows the potential to enhance the focus of specific projects with their specific user company foci, by creating more sector focused thinking, which can then drive activities within the projects. In this case, the cluster aims to use this focus to address dissemination, but also to undertake some shared work of benefit to all four projects, specifically to analyse what work is being done in the USA and Japan. The cluster provides a basis for the development of a common vision, as well as collectively addressing pre-competitive issues such as standardisation and development of common architectures. There is also an intention to explore more sensitive issues such as sharing technological approaches, which, interestingly, was suggested at the second workshop

[4] These projects are Ifacom, Megafit, Midemma and Muprod.

to be a barrier to clustering! Also on the agenda is consideration of exploring commercial opportunities beyond the end of the projects.

While it is easy to conceive reasons not to address certain matters in a cluster, this clustering example shows: that is possible to address difficult and sensitive issues; that there are benefits from doing so; and that impediments are not insurmountable. Evidently projects can, given the right motivation, take on clustering, and the example demonstrates that business and market issues are a good motivator for projects to engage in clustering.

Lessons to be Drawn from the Four Years of Operation of the FoF PPP

Over four years the FoF PPP has grown to encompass 98 projects, with more to be added as a result of the Call for Proposals launched in July 2012. The workshop participants acknowledged that the FoF PPP has been a good initiative to generate a large family of very industry-related projects. The participants also support the continuation of the FoF PPP in Horizon 2020. Specific features of the FoF PPP recognised as important and valuable for success, and which need to be retained, are:

- A partnership between the public and private sides which provides the basis for developing a research programme focussed on industry related topics, which are defined through the Mult-annual Roadmap;
- The creation of a broad spectrum of research projects, addressing higher levels of Technology Readiness than basic research projects;
- For SMEs, who need solutions designed to fit their constraints (time, money, expertise) the FoF PPP is potentially very valuable, as it enables consideration to be given to projects that address these constraints;
- Projects provide a rich opportunity for sharing information with, and learning from, other partners, as well as through interactions with other projects;
- The FoF PPP provides potential for dissemination synergies with other related and similar projects;
- Academia and Research Institutions participate in FoF PPP projects, and for them there is an added value of being able to provide students with research projects driven by a clear industry need, and also to provide contacts for these students with industry personnel and facilities.

Inevitably though, as the FoF PPP is a new vehicle for organising manufacturing technology related research, the four years of operation have been a learning period for all stakeholders. Consequently there are a number of areas that were identified where improvements are possible:

- Going forward, greater emphasis needs to be given to the research training potential of FoF PPP projects, to maximise the benefits for young researchers that come from working with industry;
- Development of manufacturing oriented Living Labs may have a role to play in enhancing industry-academia interactions, providing for academia, platforms for both research and educational activities;

- As the workshop discussions illustrate, there is still a need to implement formal inter-project collaboration activities in the form of clustering, that can help improve the business and market focus of projects, as well as to deliver on the potential for dissemination synergies.
- Given the size of the PPP and its diversity in terms of projects and topics addressed, the PPP is complex and difficult to comprehend, especially for those outside (bur also to some extent to those inside) trying to understand what is going on and what results might be available, for example, for licensing. This issue needs to be tackled and this would contribute towards achieving higher industrial impact and leverage.
- EFFRA has created a database of FoF projects, but this database is confidential and only accessible to EFFRA members. There is a proposal from EFFRA to develop a public domain version, which is welcome, but this might not be entirely what is needed. Any public domain database needs to be based on satisfying external needs, which the workshop indicated, goes beyond just summaries of projects. It was suggested that one improvement would be, not only to document the expected available results, but also to position these in terms of Technology Readiness Level, so that people can better understand how close to market these results are.
- One further way that higher industrial impact and leverage might be achieved in the future, while at the same time addressing broader dissemination, is by considering events directed at a broader range of stakeholders, both inside and outside the PPP, with a focus on participating in more large scale industrial exhibitions and also considering events that are directed towards the investment community.

Conclusions and Recommendations

Conclusions

Conclusions from the workshop can be grouped under the headings of:

- Impacts
- Clustering, Benefits and Challenges
- Improving the Operation of the FoF PPP

Impacts

- FoF projects address a wide range of technologies and issues relevant to enhancing the competitiveness of European manufacturing, and many potential impacts are evident in these projects.
- The challenge though is how to turn impacts into tangible business benefits in the marketplace, which requires more focus on business and market issues.
- There is evidence now of more consideration being given to matters relating to exploitation which is to be expected in projects as they move towards completion.

- In a few cases where projects are reaching maturity, there is some evidence that business and market related issues are being given much more attention, with efforts made to calculate potential returns on investment, which is the type of information that is needed in order to attract interest from investors.
- Some projects are reporting patent applications or an intention to make such applications. However, for many projects, owing to the nature of the work addressed, patent protection will not be feasible. The issue for these projects is really how to create synergies with existing Intellectual Property, either that which belongs to project partners (background IP), or that available in other projects (foreground and background) or that which lies outside the FoF PPP projects, or all three. This again points towards a need for a greater focus on business and market issues. And ideally this should be done during the course of a project, to enable such matters to shape developments, and to reduce the time taken to bring project results to market.
- Projects are beginning to realise that a much stronger business and market focus is needed within the PPP, and they have identified activities in this area that could form the basis for clustering.

Clustering, Benefits and Challenges

- Many activities have been identified that could be undertaken as part of a clustering initiative. The case for clustering is beyond doubt a beneficial one, and there are many potential benefits. It is also the case that clustering is something that spans the whole project lifespan, and beyond.
- One of the great benefits of clustering is bringing different perspectives and expertise together, which points towards clustering that is based on diversity, rather than similarity. However, some balance between the two does need to be achieved.
- Some clustering activities are relatively easy to do, such as joint dissemination, or collective contributions to standardisation. Some activities however are more challenging, such as addressing business and market related issues, and also sharing results, which raises confidentiality and IPR related issues. Yet in terms of that which will have most impact for projects and the PPP as a whole, the *hard-to-do* clustering is likely to be most effective.
- Projects have identified that clustering which addresses business and market related matters can be of great importance with regard to helping to take results to market.
- Self evidently, difficulties such as coping with IPR issues and guidance on how best to undertake challenging clustering activities will be needed, but none of the problems that people raise to undertaking this type of clustering are insurmountable.
- As in previous workshops, there was again a call for demonstration and pilot activities, where several results could be demonstrated together, or projects could cooperate to provide more integrated solutions.
- Yet the complexities of such collective demonstrations are not yet discussed. These complexities may be more than people realise. The challenges arise from the sheer size of the FoF PPP and the vast array of work being undertaken, which also represents a high degree of complexity in terms of types of Intellectual Property, exploitation routes, exploitation timescales and challenges, as well as investment

needs. Furthermore, as yet there is also no classification of these results in terms of Technology Readiness Level.

- There is as yet also no understanding evident with regard to what type of results and technologies are best suited to a collective demonstration and piloting approach. A stronger case that this would be a valuable exercise, and under what circumstances, would be helpful to taking forward this concept. Evidently a lot of work needs to be undertaken to firmly establish what is likely to work and to be beneficial, before any decisions are taken to commit significant resources to this. This could be an area where clustering could be used to establish what projects really want from collective demonstration and piloting, and what they would be willing to contribute, and under what terms and conditions.

Improving the Operation of the FoF PPP

- Collectively, there is a view that the FoF PPP fulfils a valuable role in delivering research projects that are strongly industry driven. This is seen as beneficial for all stakeholders. Academic and research institutions find the initiative of value especially in enabling them to undertake problem driven research and to put their research students in contact with real industrial problems and issues.
- Nevertheless, there is a feeling that more could be done to develop the FoF PPP as a training vehicle for young researchers, which would be beneficial for such people in terms of developing their career prospects and producing a generation of researchers attuned to the needs of industry driven research.
- More needs to be done in the future with regard to disseminating information to a wider group of stakeholders, with the investment community being a key target group in this respect.
- As the FoF PPP has grown in size, it has become more difficult for people both within and outside the PPP to understand what is being done, how projects relate to each other, what results can be expected, and who owns the IP for these results. There is also a lack of classification of results in terms of Technology Readiness Level, which would help people to understand better how close to market the results are. These problems will only get worse as more projects are added to the portfolio. Now is the time to begin to deal with this matter.
- EFFRA has produced a database but it is confidential and only accessible to EFFRA members. EFFRA propose to produce a public domain version, which is to be welcomed, but this does not necessarily provide a resolution to the above mentioned problems. Evidently more needs to be done to assist those who are not involved in EFFRA to access a greater amount of useful information. This will be of benefit to both individual projects, and to external stakeholders who may wish, for example, to obtain licences to use project results. In some cases, especially with regard to ICT related results, lack of openness could be potentially damaging to wider take-up and use of project results.

Recommendations

Several actors are involved with the FoF PPP: the European Commission; the *Ad-hoc Industrial Advisory Group,* individual projects and their participants; the European Factories of the Future Research Association (EFFRA). All of these have a role to play in moving the PPP forwards.

Several recommendations arise from the workshop:

- Clustering is clearly necessary and beneficial. However, there is no need for projects to wait for the European Commission to initiate clustering activities. This is something that projects can do immediately (Action for the individual projects).
- Clustering that addressed business and market related issues should become the main component of clustering activities (Action for the individual projects and the European Commission).
- Clustering should be used to explore in more detail and better define the concept of collective demonstration and piloting activities, seeking to understand strengths and weaknesses and under what circumstances such an approach yields the highest possible impacts and benefits (Action for the European Commission, the *Ad-hoc Industrial Advisory Group*, individual projects and their participants and EFFRA).
- There is an opportunity and a benefit to be gained from more cluster-oriented dissemination activities, which is something that can be tackled, both bottom-up by projects within clusters according to interests and needs, and at a higher level of coordination (possibly across clusters) for larger scale events, with the support of EFFRA or the European Commission (Action for the individual projects, EFFRA, the European Commission).
- Clustering themes need to be further reflected upon by all stakeholders, with the aim of identifying clusters that will help to deliver some structure to the FoF PPP, which will help to clarify better the type of research work that is being undertaken within the PPP. This type of clustering should not replace bottom-up clustering initiatives started by specific projects (Action for the European Commission, the *Ad-hoc Industrial Advisory Group*, individual projects and their participants and EFFRA).
- Attention should be paid to developing the researcher training dimension of the FoF PPP, possibly by adding this as a specific feature to future Calls, or perhaps by creating a link with the Marie Currie Programme, specifically the European Industrial Doctorates that are part of the Initial Training Networks in Marie Currie (Action for the European Commission).
- Dissemination through events directed at a broader range of stakeholders, both inside and outside the PPP, with a focus on participating in more large scale industrial exhibitions and also considering events that are directed towards the investment community, should be addressed and delivered on an annual basis (Action for the individual projects, EFFRA, the European Commission).
- EFFRA should make available a public domain version of its database as soon as possible (Action for EFFRA).
- There is a need for a Coordination Action that can not only help with clustering, but also demonstrate to projects exactly what results are already known and in the public domain, and provide advice about how to handle IPR issues. Such an action could also address how to make available to a wider group of stakeholders, information that is important to understanding what results will be available and who to contact with regard to IPR ownership issues (Action for the European Commission).

- In the shorter term, Project Technical Assistants (PTAs) could be used to provide advice and assistance to individual projects concerning their worries about clustering (Action for the European Commission).

Appendix 1 – List of Registered Workshop Participants

First name	Last name	Project	Organisation name
Amanda	Allison	AMCOR	Group TWI Ltd
Aitor	Alzaga	POWER-OM, MAINBOT	Fundacion Tekniker
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Thomas	Bauernhansl		Fraunhofer IPA
Eduardo	Beltrán	AIAG	MONDRAGON Corporation
Miguel Ángel	Bengochea	DAPHNE	KERABEN GRUPO, S.A.
Michael	Bernas	AIAG	FESTO
Eberhard	Bessey	Manufuture	Daimler
Gash	Bhullar	ADVENTURE	Control 2K Limited / TANet Limited
Paola Lucas	Borjabad	MEGAROB	Aitiip
Thomas	Brand	Bridle	DILAS Diodenlaser GmbH
Peter	Brown	AMCOR	Group TWI Ltd
Rikardo	Bueno Zabalo	PLANTCockpit	Tecnalia
José Carlos	Caldeira		PRODUTECH/INESC Porto
Paolo	Calefati	ENEPLAN	PRIMA POWER
Stuart	Campbell	ADVENTURE	TIE Kinetix
Giuseppe	Caprara	Fashion-able	Universidad Politécnica de Valencia - IBV
Michel	Carton	AIAG	CETIM
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Chris	Decubber		EFFRA
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Markus	Dickerhof	SMARTLAM	Karlsruhe Institute of Technology (KIT),
José Antonio	Dieste Marcial	MEGAROB	Aitiip
Antonio	Diterlizzi	MYWEAR	BASE Protection
Djea	Djeapragache	SUPREME	CETIM
Jochen	Eichert	DREAM	Fraunhofer Institute for Industrial

			Engineering IAO
Aitor	Elorriaga Elorza	ExtremeFactories	InnoPole
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Jens	Friedrich	AIMACS	Universität Stuttgart
Kay	Fuerstenberg	PAN-Robots	SICK AG
Apostolos	Fysikopoulos	ENEPLAN	LMS University of Patras
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Maurizio	Gattiglio		PRIMA POWER
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Nathaniel	Groothoff	Femtoprint	Eindhoven University of Technology
Luis	Guaita Delgado	DAPHNE	KERABEN GRUPO, S.A.
Joan	Guasch	FLEXICAST	ASCAMM
Gökalp	Gümüşdere		CECIMO
Jan Willem	Gunnink	COMET	Delcam plc
Sergio	Gusmeroli	MSEE	TXT e-Solutions SpA
Christoph	Hanisch	AIAG	FESTO
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Ludwig	Prinsen	PREMANUS	Sirris
Jun	Qian	Hi-Micro	KU Leuven
Ewald	Quak	TERRIFIC	SINTEF
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Antonis	Ramfos	IMAGINE	Intrasoft International
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Svetan	Ratchev	PRIME	University of Nottingham
Ursula	Rauschecker	FAB2ASM	Fraunhofer IPA
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Mariola	Rodríguez	CableBOT	Tecnalia
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Joachim	Seidelmann	ManuCloud	Fraunhofer IPA
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Sophie	Sieg-Zieba	SUPREME	CETIM
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Egbert-Jan	Sol	AIAG	TNO
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Johannes	Volkmann	Apps4aME	Fraunhofer IPA
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John	Cleuren		European Commission
German	Esteban		European Commission
Cristina	Fernandez Ramos		European Commission
Francesca	Flamigni		European Commission
Erastos	Filos		European Commission

Andrea	Gentili		European Commission
Christoph	Helmrath		European Commission
Max	Lemke		European Commission
Sebastien	Mortier		European Commission
Neophytos	Neophytou		European Commission
Jan	Ramboer		European Commission
Rolf	Riemenschneider		European Commission
Barry	Robertson		European Commission
Roberta	Salonna		European Commission
Danuta	Seredynska		European Commission
José-Lorenzo	Vallés		European Commission
Herbert	von Bose		European Commission
Cristina	Fernandez Ramos		European Commission
German	Esteban Muniz		European Commission

Appendix 2 – Workshop Agenda

Agenda
Workshop
Impact of the Factories of the Future PPP

Date and Place: 11-12 March 2013, Brussels, Belgium
Rapporteur for the event: Paul Kidd, Cheshire Henbury

11 March, Monday
Venue: Centre Borschette, rue Froissart 36, Brussels

13:30-14:00 Registration

14:00-14:30 Getting together in preparation of the parallel sessions

Parallel sessions – Rooms AB-3A, AB-3B, AB-3D

14:30-18:00 Presentations on the Impact of FoF PPP Projects (by topic)
Objective: Assessing the achievement of the expected impacts and of potential benefits of clustering

(Coffee break 16:00-16:30)

Session 1: Sustainable Manufacturing – 30 Projects in 8 Topics
Chair: Andrea Gentili, EC, DG RTD
Facilitators: Damián Bornás-Cayuela - Sébastien Mortier, EC, DG RTD
Rapporteur: Johan Stahre, Chalmers University

Topics:

FoF.NMP.2010-2 Supply chain approaches for small series industrial production – 6 projects

FoF.NMP.2011-1 The eco-factory – 3 projects

FoF.NMP.2011-2 Cooperative machines and open architecture control systems – 3 projects

FoF.NMP.2011-3 Robots for automation of post-production – 4 projects

FoF.NMP.2012-1 Adaptive production systems and measurement and control equipment in manufacturing processes – 2 projects

FoF.NMP.2012-2 Methodologies and tools for maintenance of production equipment – 3 projects

FoF.NMP.2012-6 Knowledge-based tools and approaches – 4 projects

FoF.NMP.2012-7 Innovative technologies for casting, material removing and forming processes – 5 projects

Session 2: ICT for Manufacturing – 38 Projects in 5 Topics
Chair: Rolf Riemenschneider, EC, DG CNECT
Rapporteur: Prof Marco Taisch, Politecnico di Milano

Topics:

FoF.ICT.2010.10-1 Smart Factories: ICT for agile and environmentally friendly manufacturing – 8 projects

FoF.ICT.2012.7.1 Smart Factories: Energy-aware, agile manufacturing and customisation – 10 projects

FoF.ICT.2011.7.3 Virtual Factories and Enterprises – 10 projects

FoF.ICT.2011.7.4 Digital Factories: Manufacturing design and product lifecycle management – 8 projects

FoF.ICT.2011.7.2 Manufacturing solutions for new ICT products – 2 projects

Session 3: High-Performance Manufacturing – 30 Projects in 8 Topics
Chair: John Cleuren, EC, DG RTD
Facilitators: Neophytos Neophytou - Jan Ramboer, EC, DG RTD
Rapporteur: Amanda Allison, TWI

Topics:

FoF.NMP.2010-1 Plug and produce components for adaptive control – 6 projects

FoF.NMP.2010-3 Intelligent, scalable, manufacturing platforms and equipment for components with micro- and nano-scale functional features – 5 projects

FoF.NMP.2011-4 High-tech solutions for customised healthy, green and safe consumer products – 2 projects

FoF.NMP.2011-5 Towards zero-defect manufacturing – 4 projects

FoF.NMP.2011-6 Manufacturing chains for nano-phased components and coatings – 2 projects

FoF.NMP.2012-3 Intelligent production machines and 'plug-and-produce' devices for the adaptive system integration – 3 projects

FoF.NMP.2012-4 High-performance manufacturing technologies – 4 projects

FoF.NMP.2012-5 High precision production technologies for 3D micro parts – 4 projects

18:00 Networking Cocktail with welcome address by the Directors

12 March 2012, Tuesday
Venue: Centre Borschette, rue Froissart 36, Brussels

Plenary session – Room AB-0A

Chair: José-Lorenzo Vallés, Head of Unit, DG RTD

9:00-9:10 Welcome and Objectives of the Workshop

9:10-9:25 Factories of the Future and Horizon 2020
Herbert von Bose, Director, DG RTD, Industrial Technologies

9:25-9:40 Impact of the FoF PPP – Viewpoints of Industry
Rikardo Bueno, FoF Ad-Hoc Industrial Advisory Group

9:40-10:30 Feedback on the parallel sessions

10:30-11:00 Coffee break

11:00-11:45 Success Stories
- HARCO, Gian Mauro Maneia, CESI
- E-CUSTOM, Dimitris Mourtzis, University of Patras
- IMAGINE, Antonis Ramfos, Intrasoft
- FEMTOPRINT, Nathaniel Groothoff, TUE

11:45-12:45 Panel/Roundtable discussion: How can synergies and cluster activities increase the impact of the FoF initiative?
- Prof José Caldeira, INESC
- Kai Peters, VDMA
- Juan Antonio Arrieta IK4-IDECO
- Jan Willem Gunnink, Delcam

12:45-14:00 Lunch Break

14:00-14:10 EFFRA Project Database, Chris Decubber (EFFRA)

14:10-15:10 Panel/Roundtable discussion: What lessons can be drawn from the four years of implementation of the FoF initiative?
- Eberhard Bessey, DAIMLER

- Sven Herrmann, Bosch
- Egbert-Jan Sol, TNO
- Jean-Bernard Hentz, AIRBUS

15:10-15:40 Rapporteur's Summary & Conclusions

15:40-15:50 Statement from the Private side of the FoF PPP
Massimo Mattucci, EFFRA

15:50-16:00 Statement from the Public side of the FoF PPP
EC Representatives

16:00 End

Session 1: Sustainable Manufacturing
30 projects

Topics:

FoF.NMP.2010-2 Supply chain approaches for small series industrial production – 6 projects
PHOCAM, E-CUSTOM, S-MC-S, MICRODRESS, MANUCLOUD, CORENET

FoF.NMP.2011-1 The eco-factory: cleaner and more resource-efficient production in manufacturing – 3 projects
REFORM, EMC2-FACTORY, ENEPLAN

FoF.NMP.2011-2 Cooperative machines and open architecture control systems – 3 projects
HOL-I-WOOD, AUTORECON, PRACE

FoF.NMP.2011-3 Robots for automation of post-production and other auxiliary processes – 4 projects
THERMOBOT, MIROR, MAINBOT, CABLEBOT

FoF.NMP.2012-1 Adaptive production systems and measurement and control equipment for optimal energy consumption and near-to-zero emissions in manufacturing processes – 2 projects
DAPHNE, FACTORY-ECOMATION

FoF.NMP.2012-2 Methodologies and tools for the sustainable, predictive maintenance of production equipment – 3 projects
IMAIN, SUPREME, POWER-OM

FoF.NMP.2012-6 Knowledge-based tools and approaches for process planning and integrated process simulation at factory level – 4 projects
CAPP-4-SMES, APPS 4 AME, DREAM, DES-MOLD

FoF.NMP.2012-7 Innovative technologies for casting, material removing and forming processes – 5 projects

AMCOR, PLAST4FUTURE, FLEXICAST, EFEVE, DIPLAT

Session 2: ICT for Manufacturing
38 projects

Topics:

FoF.ICT.2010.10-1 Smart Factories: ICT for agile and environmentally friendly manufacturing – 8 projects
PLANTCOCKPIT, QCOALA, FOFDATION, KAP, CUSTOMPACKER, TAPAS, ROBOFOOT, ACTIONPLANT

FoF.ICT.2011.7.3 Virtual Factories and Enterprises – 10 projects
MSEE, COMVANTAGE, VENIS, EPES, IMAGINE, EXTREMEFACTORIES, ADVENTURE, GLONET, PREMANUS, BIVEE

FoF.ICT.2011.7.4 Digital Factories: Manufacturing design and product lifecycle management – 8 projects
KNOW-4-CAR, LINKEDDESIGN, TERRIFIC, FFD, RLW NAVIGATOR, AMEPLM, VISTRA, SIMPOSIUM

FoF.ICT.2012.7.1 Smart Factories: Energy-aware, agile manufacturing and customisation – 10 projects
ARUM, MUSIC, PAN-ROBOTS, SENSE&REACT, X-ACT, HALO, UV-MARKING, BRIDLE, HEPHESTOS, VALERI

FoF.ICT.2011.7.2 Manufacturing solutions for new ICT products – 2 projects
TREASORES, FLEX-O-FAB

Session 3: High-Performance Manufacturing
30 projects

Topics:

FoF.NMP.2010-1 Plug and produce components for adaptive control – 6 projects
COMET, POPJIM, HARCO, DYNXPERTS, LOCOBOT, AIMACS

FoF.NMP.2010-3 Intelligent, scalable, manufacturing platforms and equipment for components with micro- and nano-scale functional features – 5 projects
FAB2ASM, MANUCYTE, FEM2PRINT, WAFERLEVELOPTCS, IMPRESS

FoF.NMP.2011-4 High-tech solutions in the production processes for customised healthy, green and safe consumer products – 2 projects
FASHIONABLE, MYWEAR

FoF.NMP.2011-5 Towards zero-defect manufacturing – 4 projects
MEGAFIT, MUPROD, IFACOM, MIDEMMA

FoF.NMP.2011-6 Manufacturing chains for nano-phased components and coatings – 2 projects

GRAFOL, NANO-MASTER

FoF.NMP.2012-3 Intelligent production machines and 'plug-and-produce' devices for the adaptive system integration of automation equipment, robots and other intelligent machines, peripheral devices, smart sensors and industrial IT systems – 3 projects

SKILL-PRO, I-RAMP, PRIME

FoF.NMP.2012-4 High-performance manufacturing technologies in terms of efficiency (volumes, speed, process capabilities etc), robustness and accuracy – 4 projects

AMAZE, MEGAROB, DYNMILL, HYPROLINE

FoF.NMP.2012-5 High precision production technologies for high quality 3D micro parts – 4 projects

HI-MICRO, 3D-HIPMAS, HIPR, SMARTLAM

Appendix 3 – Discussion Panel Questions

Questions for the discussion panels

Panel discussion 1
How can synergies and cluster activities increase the impact of the PPP initiative?
1) What activities bringing added value in terms of impact should be promoted at cluster level?
2) To which extent should cluster activities be supported by the public side and by the Associations?
3) Which cluster activities are still worth continuing after the end of the projects?
4) Can clustering bring problems with IPR and exploitation?
5) How can the PPP approach bring activities and synergies to help reach a greater overall impact than for just FP7 projects?
6) What is the impact of the PPP on achieving higher innovation?

Panel discussion 2
What lessons can be drawn from the four years of implementation of the PPP initiative?
1) Has the PPP approach been advantageous for industry and in particular SMEs?
2) Is a PPP approach also interesting for academia and research centres?
3) Is there a justification to continue with this PPP in Horizon 2020 with similar goals?
4) How could the PPP ensure the highest industrial impact and leverage?
5) How can we achieve broader dissemination & stakeholder participation?
6) What could be the future role of the Associations in the PPPs?