

Impact of the Factories of the Future Public Private Partnership

**Final Report on the Workshop held on
November 25, 2010, Brussels**

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Executive Summary

The Factories of the Future (FoF) Public Private Partnership (PPP) has established the basis for an approach to undertaking research and development in manufacturing-related technologies, problems, and challenges, differentiated from standard FP7 projects through the industrially driven nature of the projects. The challenge for the coming years is how to build on this differentiation, as well as helping projects to strengthen impacts. Looking longer term, it is also necessary to consider how to move forward beyond 2013. The workshop demonstrated that there is now a committed community ready and eager to consider these matters. The main conclusions that emerged from the workshop are as follows:

- The FoF PPP is perceived as being very valuable and important to helping EU manufacturing industry respond to both current and future competitive challenges.
- Enhancements to the operation of the FoF PPP are possible, which will help to both improve effectiveness and differentiation (from standard FP7 projects). These enhancements can come from differentiation that adds value through consideration of issues not normally addressed in research projects (e.g. business strategy etc. – see below), which will ultimately increase the potential for the creation of impact.
- Building on what has been learnt from previous manufacturing technologies research, especially with regard to the importance of topics such as business and manufacturing strategy, culture, organisational design, etc., which can be subsumed under the term, *Technology Management*¹, is one clear way forwards, leading to both greater differentiations compared with FP7 projects and improvement in the potential for impact.
- One important enhancement is the development of cooperation among the funded projects in terms of activities such as collective dissemination, clustering around important dimensions such as common issues, or markets, etc.
- Community building measures, such as an annual conference, could be supported, which will help also to provide an entry point for new participants, and an opportunity for participants to influence the future shape of the PPP.
- Socio-economic impact studies need to be undertaken at some appropriate point to systematically establish the impact (both achieved and potential) of projects.
- Scope exists for collaboration with other PPPs, and this should be explored in more depth.
- Improvements to the roadmap are needed, especially with regard to moving forward beyond 2013. This is not just a matter of adding new topics, but of providing the justification for the inclusion of topics, and the exclusion of others.
- Benchmarking needs to be undertaken to establish those technologies and sectors where the greatest impact can be achieved, along with the development of criteria for including topics within the roadmap, and the definition of an appropriate methodology for the transparent development of a research strategy.

¹ *Technology Management* is defined as the disciplines and practices, e.g. business and manufacturing strategy, organisational design, job design, implementation methods, etc. that are essential to commercially successful development, deployment and operation of new technologies. Experience gained from over 25 years of manufacturing technologies research points to *Technology Management* as being the key to achieving competitive advantage, given otherwise equal access to markets, capital and technologies.

- There are several open issues that need to be addressed, such as the roles of the various bodies such as the *Ad-hoc Industrial Advisory Group*, *Manufuture*, and the European Factories of the Future Research Association, and how to create synergies with *Manufuture* (and avoid duplication), and whether a more sector based approach should be adopted.
- The case for continuing with the PPP is based on the argument that the effects of the economic crisis will be felt beyond 2013, and that the need to respond to the EU 2020 Agenda will require an action with the features offered by the PPP.
- The way forward is to build on what is emerging, and to focus on *Designed in Europe*, *Made in Europe* and *Recycled in Europe*, but these concepts are in need of more precise definition, especially with regard to the production of convincing business scenarios.

Specific recommendations resulting from these conclusions 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 could take. Included in these recommendations are: the inclusion of a *Technology Management* element in the PPP; bottom-up and top-down clustering of projects; assessment of clustering activities as part of project reviews; the organisation of an annual event starting in 2011; undertaking a socio-economic study focused on identifying the impacts of the funded projects; further development of the roadmap, within a more rigorous framework that leads to the identification of topics and sectors where the greatest commercial, employment, and environmental impacts can be expected, etc.; review of relationships with *Manufuture*; and development of more insights into the concepts of *Designed in Europe*, *Made in Europe* and *Recycled in Europe* through the production of convincing business scenarios.

Introduction

Factories of the Future (FoF) is one of the three Public Private Partnerships (PPP) included in the European Commission's Economic Recovery Plan launched in November 2008 in response to the global economic crisis. This particular PPP aims at helping EU manufacturing enterprises, in particular SMEs, to adapt to global competitive pressures by improving the technological base of manufacturing across a broad range of sectors. The FoF PPP consists of a research programme of 1.2 billion Euro to support the manufacturing industry in the development of new and sustainable technologies. The programme is co-financed jointly by the private sector and the European Commission under the Seventh Framework Programme (FP7). The FoF PPP is cross-thematic, encompassing the Information and Communications Technologies (ICT) Theme and the Nanosciences, Nanotechnologies, Materials and New Production Technologies (NMP) Theme.

Twenty five projects have been launched as a result of the first wave of funding under the FoF PPP, with the expectation that this number will rise to over 100 projects by the end of 2013. The content of Calls for Proposals for the FoF PPP is determined by a Multi-annual Strategic Roadmap², which was finalised and published in January 2010. This roadmap provides the strategic planning for the initiative, and this planning was undertaken in parallel with the first calls for proposals (using existing FP7 instruments). This evolutionary approach was adopted to facilitate a rapid start-up of the FoF PPP.

Given that the PPP has a fixed life, extending over the period 2009 to 2013, the FoF PPP (along with other PPPs) is already approaching its mid-term point, and the European Commission is looking to begin to assess the effectiveness of the PPPs. To this end the European Commission has established an Expert Group to undertake, in early 2011, a combined interim evaluation of three PPPs: Factories of the Future; Energy-efficient Buildings; and Green Cars.

Consequently, given the above, the European Commission considered it timely to organise a workshop with the FoF PPP's stakeholders to consider:

- issues relating to the impact of the FoF PPP, and how this impact can be enhanced;
- opportunities for improving the differentiation that has already been established between the FoF projects and traditional FP7 projects in terms of focus and added value; and
- how to move forward, including updating the Multi-annual Strategic Roadmap and possible continuation of the initiative beyond 2013.

The workshop was held in Brussels on November 25th, 2010. Specific workshop objectives were to:

- promote networking and exchange of information among the research projects funded under the FoF PPP;
- provide a forum for discussion on the added value and impact of the FoF PPP from the perspective of the stakeholders; and
- provide inputs and information from the stakeholders to the Expert Group created to assess the PPPs, and to the policymakers involved in the preparation of FP8.

² Factories of the Future PPP Strategic Multi-annual Roadmap (http://www.manufuture.org/manufacturing/wp-content/uploads/FoF_PPP_Roadmap_Final_Version.pdf)

The purpose of this report is to present the main views and insights that emerged from the workshop discussions and to identify conclusions and recommendations that arise from what was said both during the individual project presentations and the panel discussion sessions. The focus of this report is on highlighting the high level and strategic issues.

The document is structured to provide, first, a brief description of the methodology adopted for the workshop. An overview is then presented of the many topics and issues addressed by the workshop, followed by analysis and discussion, leading to some important conclusions and recommendations.

Methodology

With regard to workshop methodology, members of the FoF PPP *Ad-hoc Industrial Advisory Group*, along with project co-ordinators (who were asked to bring one other project representative) were invited to attend the workshop. Participation in the meeting was by invitation only. A number of European Commission officials also participated. A list of workshop participants is given in Appendix 1.

Prior to the meeting the project co-coordinators were asked to prepare a five minute presentation of their project, based on a pre-defined structure (see Appendix 2). At the start of the meeting the participants were also given a set of questions which formed the structure for each of the afternoon panel discussions (see Appendix 3 for the list of questions).

The workshop started with a number of opening presentations from European Commission Officials to set the context and to define the objectives for the workshop. These opening comments were followed by project presentations. These project presentations were grouped under the following headings:

- Smart Factories;
- Virtual Factories for Networked Production;
- Adaptive Production Equipment;
- High-Precision Manufacturing.

The project presentation sequence is listed in Appendix 4.

The afternoon was then devoted to two panel discussions, each of which involved a number of short opening statements (from pre-selected individuals – see agenda) to stimulate discussion. Several closing statements were made at the end of the workshop, followed by the rapporteur's observations about key matters raised during the presentations and discussions, and possible conclusions arising from the workshop. At the end of the workshop, participants were given an opportunity to make written inputs, and those received by the specified deadline are provided in Appendix 5. The agenda for the workshop is included in Appendix 6.

A networking dinner was also held on the eve of the workshop, to facilitate building contacts among the project representatives and the *Ad-hoc Industrial Advisory Group*.

Topics Discussed at the Workshop

A wide range of issues and challenges were exposed and discussed. The content of these discussions are structured for the purpose of this report around the following themes:

- Added Value and Overall Impact of the FoF PPP

- New Inputs for a Roadmap Beyond 2013

Added Value and Overall Impact of the FoF PPP

Consideration was given to a number of issues that highlight the added value of the PPP for the industrial participants, and also ways in which this existing added value can be enhanced, both for the projects and for the PPP itself.

Overwhelmingly the project participants appreciated the rapid time from proposal acceptance to completion of contractual matters, and suggested that this could still be improved by making the process even more streamlined, but there were no suggestions how this could be achieved. The possibility to pursue more industrially relevant projects based upon clearly defined industrial needs is seen as an advantage of the PPP, as is the existence of a cross thematic roadmap that provides more certainty concerning which topics will be supported over the coming years, thus enabling better forward planning by the industrial participants. The roadmap also enables the development of complementary initiatives at national level, potentially facilitating the leverage of greater financial resources. There may however be a case for modifying the proposal evaluation criteria, to take more account of the benefits of projects which are more mature, closer to market, and therefore potentially capable of delivering an impact in a shorter timescale.

For the public side, the stakeholders believe that the FoF PPP contributes towards preserving and creating jobs. The PPP also provides a framework for public-private collaboration, as the PPP is providing a catalyst for industry to become more organised and to speak with a unified voice to the European Commission. This provides the European Commission with a clear path to communicate better with manufacturing industries concerning their problems, challenges and needs. Collectively, this two way dialogue provides a basis to address the concerns of both parties. Feedback from running projects also provides the European Commission with information on open issues and challenges arising from research activities.

From the industrial side there is a clear appreciation that the PPP delivers an opportunity to undertake research and development activities during difficult economic times, when private sector funding for research and development is limited. The projects also provide an opportunity to train young researchers, engineers and technicians, which is something that would be extremely difficult to do during a recession.

The project presentations suggested to the workshop participants, significant opportunities for cross fertilisation among projects, which is a matter that the projects and the *Ad-hoc Industrial Advisory Group* need to give further consideration to. Also of relevance is the opportunity that the PPP offers to industry to address challenges, develop solutions, and then to turn these into business opportunities. The FoF has also created a community which provides a basis for the development of new proposals, but the PPP should ensure its processes are transparent and open and should encourage broad stakeholder participation. Further opportunities for community building, such as an annual event, would be welcomed by the FoF participants, and would provide one means to integrate newcomers into the community and to achieve wider participation.

Dissemination emerged as an important concern that needs to be addressed by the stakeholders. From the morning session it became apparent that the projects would benefit from a more coordinated approach to dissemination. But dissemination is also needed at regional and local levels (in local languages), and this implies the involvement of regional agencies. Demonstration of integrated solutions, focused on particular sectors, was also proposed, which may also provide the basis for clustering of projects. But clustering should

not be too restrictive, and pilot applications may be one basis for clustering of projects. Associated with these clusters could be advisory boards, which could also be implemented at project level (which is more traditional in FP7 projects). Demonstrations may also provide the basis for addressing longstanding problems such as interoperability and could be used to link with other initiatives such as SME specific actions and programmes, as well as government supported business assistance initiatives. Clearly, proposals for clustering need to be carefully considered, with complementarity, synergy and integration being important considerations.

One issue briefly mentioned, is the matter of the capital cost of new technologies developed in the projects. To achieve impact, the returns for users must be worth the investment, yet this was not a factor that stood out as being a significant element shaping the work undertaken in the projects. Consequently, this is something that needs to be considered by the projects, by the FoF PPP *Ad-hoc Industrial Advisory Group*, and by the European Commission.

Collectively the above issues provide indicators towards the development of the PPP in such a way as to achieve significant differentiation from standard FP7 projects and point towards the added value that can be derived from the PPP. The issues mentioned above also highlight the need to develop the PPP in such a way that the projects are driven to deliver innovation in business and markets, as this innovation is the key to preserving and creating jobs. Here *Technology Management*³ will play an important role, and it will be necessary for projects and the *Ad-hoc Industrial Advisory Group* to address this matter to consider what can be done to collectively manage the technologies emerging from the FoF PPP, to improve the chances that the projects will lead to innovation, e.g. by identifying specific barriers that projects could collectively address through clustering.

New Inputs for a Roadmap Beyond 2013

Looking beyond 2013, discussions centred on considering the need to continue with the PPP after 2013, if the roadmap needs updating, and how a higher impact can be achieved beyond 2013.

It is evident that the need for the PPP (with features such as a dedicated funding envelope, multi-annual roadmap, and focus on addressing industry defined topics), will continue beyond 2013, as the effects of the economic crisis will still be felt, and there will be an ongoing need to respond to the EU2020 Agenda. Europe's manufacturing sector has been in decline for a number of years, and the FoF PPP provides a clear framework for a public-private collaboration to address this decline. Not to use this collaboration in the longer term, beyond 2013, would be a missed opportunity. Most likely the need for the FoF PPP will increase in the future. This is because China (and other developing nations) will move beyond sub-contract manufacturing and low cost manufacturing, into higher added value areas, also exploiting their own research and development results as they do so. Moreover this will be happening while European manufacturing will be facing increased requirements to diminish resource consumption, lower its energy use, and reduce its emission of greenhouse gases. All these elements are part of an environment of continuing change, and continuing with the PPP beyond 2013 will be fundamental to providing a sound response to all these competitive challenges.

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With regard to the updating of the roadmap, many suggestions were made concerning topics to be added. These include Future Internet, Internet of Things, Business Intelligence, interoperability of ICT systems and devices, mirco-manufacturing, social networking technologies, point-of-need manufacturing, product-process integration, multi-culture factories, human-machine cooperation, bio and nano manufacturing technologies, highly distributed production networks, remanufacturing and recycling, product take-back and disassembly, robotics, resource efficient technologies, low CO2 emission technologies, etc.

Specific justifications for the inclusion of these topics in a post 2013 roadmap do however need to be developed, otherwise the roadmap will lack credibility. Greater involvement of the manufacturing research community, including industry, universities and research centres, is also needed in the further development of the roadmap. The aim should be to move away from a listing of research topics, towards a research strategy, with a roadmap providing the steps leading towards outcomes defined in terms of such features as capabilities, competitive characteristics, etc, with the topics listed being more integrated into a route to achieving these desired outcomes, and with consideration of the balance between NMP and ICT related topics.

Of note was an emphasis placed on the introduction of non-technical research topics, in particular, the perceived need to address the development of new business models (both business-to-business and business-to-consumer), which is a further pointer towards the importance of *Technology Management* in the FoF PPP. Commonalities with other PPPs were also highlighted, in particular the Energy Efficient Buildings PPP, given that manufacturing facilities also need to become more energy efficient, and that manufacturing plants are often located in or near cities and towns. The energy efficiency of manufacturing facilities should therefore be considered within neighbourhood level approaches to energy reduction, and one way to address this is through collaboration among the relevant PPPs.

In the future, the FoF PPP could also address more, the matter of longer term testing and validation of technologies in shopfloor environments. It was suggested that this could be a part of an Innovation Partnership, but the workshop did not elaborate upon the details of how this could be achieved, and whether these demonstrations were to be funded at European or at national level.

With regard to barriers, further consideration must be given to the needs of SMEs. One part of this could be best practice catch-up, the other part could be awareness raising, taking into account the constraints that SMEs operate within (i.e. shortages of time, money and skills).

Consideration was given to the problem of how to increase innovation. One suggestion was to undertake an assessment of proposals in a global context, asking if each proposal was the best globally or just the best in Europe. Ideally selected proposals should be the best in a global context. It was also proposed that evaluations should give greater weight to proposals that have the potential for significant industrial impact. One way in which more impact might be achieved is by focusing more on the concept *Made in Europe*, and how this can be translated into competitive advantage for those who manufacture in Europe, and to the disadvantage to those who do not.

Analysis and Discussion

Although the FoF is still in its early phases, it is evident that the initiative has already created a strong community with a clear passion and commitment to revitalising and strengthening

Europe's manufacturing industries. This provides an excellent platform for further developments.

The workshop highlighted that a good start has been achieved, with the PPP now in a position to move forwards in terms of addressing the enhancement of the PPP and its further development. These enhancements and developments become evident from what was actually discussed and stated, the written submissions, as well as from that which was not given sufficient attention, especially during the project presentations. The following analysis and discussion is therefore focused on identifying from the workshop content, issues that need to be addressed to achieve enhancements and further development:

The European Commission has a long history of supporting manufacturing related research, dating back to the early 1980s, in both the domains of ICT and Industrial Technologies, encompassing also short, medium and longer term research topics, and sometimes also very industry driven projects. Some of the comments made during the workshops suggested that this fact is not fully appreciated by all stakeholders. Key to the development of the PPP may well be, therefore, building on and integrating existing knowledge and experience in the context of improving the competitiveness of all types of *factories*, and recognising the importance of both innovative technologies and innovative business models and organisations (*Technology Management*). Projects should have the appropriate sized consortia, so that the effectiveness and impact of the PPP can be enhanced.

During the project presentations it became evident that some projects are focused on specific technologies, or problems, or sectors, while others are more generic, with potential applications in several sectors. This raises some interesting challenges. For the more focused projects the challenge will be to consider and identify other problems or sectors where the results might be applicable. For the more generic projects the challenge will be to identify the sectors where the results will be most applicable, or where the biggest impact can be achieved. These are matters that are best addressed during the course of projects, rather than being treated as afterthoughts in the post-project period.

It was also evident that some projects are addressing related topics (e.g. mass customisation) and could benefit from co-operation in terms coordination of dissemination to avoid duplication of effort and also to communicate a common message, as well as defining and identifying common barriers to exploitation. Coordinated and common dissemination may also be important as the resulting discussions among related projects could also lead to a better appreciation of the topics being addressed, and the strengths and weaknesses of concepts such as mass customisation, and greater awareness of market factors that need to be in place for the approach to be successful, which are all important matters with regard to dissemination campaigns, e.g. in deciding which sectors and types of companies and products to target. Common dissemination also sends a message that the PPP is more than just a collection of loosely related projects. Coordination among related projects could also lead to more impacts in terms of contributions to standards, which is an area that needs to be fully explored by the projects. In addition, the matter of the market focus of the more generic projects could be enhanced by cooperation with the more focused projects, and this could help to foster greater consideration of Intellectual Property issues, which the project presentations indicated is a matter requiring enhancement within some projects.

Although clustering has been used for Framework Programme projects, there is an opportunity in the FoF PPP for a cluster approach centred on market, exploitation, and dissemination issues, rather than technology or sector themes. This is one way in which the projects could add more value to the PPP and vice versa, and this would serve to increase cross fertilisation among projects, and may well lead to additional exploitation opportunities.

Additional community building is also needed, beyond the idea of clustering, providing the means for participants to become more familiar with other projects and the skills and competencies of other stakeholders. To this end an annual conference may provide a useful networking platform, also allowing those not yet involved to begin to build partnerships for future calls. Such an annual event will help to increase participation, provide opportunities for stakeholders to shape the PPP, and also contribute towards the openness of the PPP.

The PPP is still in a formative stage, so specific impacts in terms of jobs preserved etc. are not yet visible. At some point during the life of the PPP however, it seems essential that a systematic socio-economic impact study be undertaken to provide a sound understanding of the impacts that have been delivered or which can be reasonably expected in the short term. This could also feed valuable information into the process of revising the roadmap (see below).

Discussions demonstrated that there is also evidently room for further development and expansion of the roadmap, and many suggestions emerged. Among the topics identified was mention of the need to address business models, which may be an important topic in the development of sustainability. Business models however, are primarily matters of value propositions, ways of doing business and generating revenues, etc. These are not technology development matters, although technologies enabling specific business models could also be considered. Nevertheless, the rationale for adding to the roadmap, all the topics mentioned during the workshop, needs to be more carefully justified, as the time available in the workshop for such consideration was very limited.

Also mentioned during the workshop is the need for demonstration projects, where costs and benefits can be explored in detail and which could also provide a practical means of delivering convincing proof-of-concept. In addition, a need to increase awareness among SMEs was mentioned, for which these demonstrators would be a valuable aid. To address these matters an extension of the scope of the PPP would most likely be needed (as well as additional funding).

One of the important consequences of the above discussions is that they imply developing a non-technical theme within the roadmap. This could be broadly positioned as a *Technology Management* dimension, which not only adds more value to the PPP, but also contributes to better differentiation from standard FP7 projects. A *Technology Management* approach could also contribute to strengthening the impacts of individual projects. This *Technology Management* dimension is one matter that the Expert Advisory Group may wish to consider in the interim assessment of the PPPs.

The workshop discussions on the roadmap also highlighted a number of interesting and challenging issues, which should be addressed as soon as possible, with regard to the future shape of the PPP:

1. The present version of the roadmap can be seen a good first attempt to bring some structure to the PPP and to identify priorities. This first version of the roadmap however raises some questions, e.g. why specific topics are included, and others are not, why so much jargon and so many buzzwords are used, which sectors are the most important targets, and so on? Therefore the challenge that now has to be addressed is how to build on this roadmap, to make it less of a *list*, and more strategic in the sense that it provides both the rationale for focusing on particular sectors, technologies, topics, etc. The essence of research strategy is that it should provide the basis for the allocation of limited research funds, which implies making decisions *not* to fund some areas or to support certain sectors. For the sake of credibility the reasons for such strategic decisions have to be made more explicit in future versions of the roadmap, and criteria are needed to help with this

process. Also for the sake of clarity and understanding, future versions of the roadmap should be formulated in terms of more meaningful and simpler language.

2. The above is challenging because the issues are not just ones of comparing sectors on the basis of whether they are *low, medium or high tech* and deciding only to support those that are *high tech* sectors. It is possible for sectors to make use of *medium to high tech* manufacturing technologies and processes to produce simple (*low tech*) products, but such products add considerable value to the raw material inputs, can be easily be redesigned to meet changing consumer tastes, and provide access to highly profitable markets (mass or niche). Given that the aims of the PPP are the preservation and creation of jobs, these are factors of relevance to the shaping of the roadmap, and efforts need to be made to identify where the biggest impacts can be achieved with regard to these objectives (see below). Matters such as the nature of impacts should also be considered, since what constitutes commercial success for an SME, may not be the same as that for a larger company. For example, not all companies need to be pursuing global exports, as serving local customers better and more profitably is also a valid outcome. Ambitions therefore need to be matched to the size of the company and what is right for certain types of businesses.
3. Related to the above is the matter of benchmarking, and understanding better, not just what has been done already, but also how projects stand in a global context. This is not just important for selection of projects in the evaluation process, but also for the purpose of developing the roadmap. It will be important to better understand where PPP investments should be made, so that they can be focused for example, on areas where growth in employment is most likely, with reference to global developments, changing customer needs, etc.
4. Several other issues also arise from consideration of the roadmap and the future of the PPP. These include the relationship of the FoF PPP to the European Technology Platform, *Manufuture*, especially with regard to the *Manufuture* Strategic Research Agenda and the FoF Strategic Multi-annual Roadmap. Additionally, there is the matter of considering the role of the FoF PPP *Ad-hoc Industrial Advisory Group* in relation to other stakeholder groups such as *Manufuture*, so that overlap is avoided and synergies achieved.

Finally, the challenge within the timescale of the present PPP is how to preserve manufacturing jobs in Europe. Beyond 2013, the challenge will be how to build on this and to create new manufacturing jobs (which is one reason why the roadmap needs to be reviewed to ensure the best chance of high impact on job creation). Continuation of the FoF PPP beyond the year 2013 is therefore clearly an economic necessity. Europe's manufacturing problems are not just founded in the economic crisis, and will not come to an end when the recovery plan expires. An ongoing loss of manufacturing employment to the developing nations, especially China, has been evident for many years. Left unchecked this loss of prosperity from Europe is set to continue and will be compounded by increased competition when China begins to translate its own R&D investments into new products and services. Many opportunities exist to deal with this, but this will require continuation of the PPP. The FoF PPP is providing the basis for a strategic response to these competitive challenges, based on *Made in Europe*. The present emphasis on *Made in Europe* should perhaps be extended to encompass *Designed in Europe*, *Made in Europe* and *Recycled in Europe*, which could provide the basis for development of the partnership beyond 2013. These concepts however need to be defined in a way that provides convincing business cases.

Conclusions and Recommendations

Conclusions

From the analysis and discussion in the previous section, several clear conclusions can be drawn:

- The FoF PPP is perceived as being very valuable and important to helping EU manufacturing industry respond to both current and future competitive challenges.
- Enhancements to the operation of the FoF PPP are possible, which will help to both improve effectiveness and differentiation (from standard FP7 projects). These enhancements can come from differentiation that adds value through consideration of issues not normally addressed in research projects (e.g. business strategy etc. – see below), which will ultimately increase the potential for the creation of impact.
- Building on what has been learnt from previous manufacturing technologies research, especially with regard to the importance of topics such as business and manufacturing strategy, culture, organisational design, etc., which can be subsumed under the term, *Technology Management*, is one clear way forwards, leading to both greater differentiations compared with FP7 projects and improvement in the potential for impact.
- One important enhancement is the development of cooperation among the funded projects in terms of activities such as collective dissemination, clustering around important dimensions such as common issues, or markets, etc.
- Community building measures, such as an annual conference, could be supported, which will help also to provide an entry point for new participants, and an opportunity for participants to influence the future shape of the PPP.
- Socio-economic impact studies need to be undertaken at some appropriate point to systematically establish the impact (both achieved and potential) of projects.
- Scope exists for collaboration with other PPPs, and this should be explored in more depth.
- Improvements to the roadmap are needed, especially with regard to moving forward beyond 2013. This is not just a matter of adding new topics, but of providing the justification for the inclusion of topics, and the exclusion of others.
- Benchmarking needs to be undertaken to establish those technologies and sectors where the greatest impact can be achieved, along with the development of criteria for including topics within the roadmap, and the definition of an appropriate methodology for the transparent development of a research strategy.
- There are several open issues that need to be addressed, such as the roles of the various bodies such as the *Ad-hoc Industrial Advisory Group*, *Manufuture*, and the European Factories of the Future Research Association, and how to create synergies with *Manufuture* (and avoid duplication), and whether a more sector based approach should be adopted.
- The case for continuing with the PPP is based on the argument that the effects of the economic crisis will be felt beyond 2013, and that the need to respond to the EU 2020 Agenda will require an action with the features offered by the PPP.
- The way forward is to build on what is emerging, and to focus on *Designed in Europe*, *Made in Europe* and *Recycled in Europe*, but these concepts are in need of more precise definition, especially with regard to the production of convincing business scenarios.

Recommendations

From the above, arise several specific recommendations. With respect to the very short term, specifically over the year 2011:

- Recommendation 1: The individual projects should begin a bottom-up process of discussing among themselves the possibilities for innovative clustering centred on such matters as common dissemination, opportunities for exploiting synergies, deployment barriers, etc.
- Recommendation 2: Complementary to this bottom-up approach, the *Ad-hoc Industrial Advisory Group* should provide a top-down strategic view of clustering by developing its views on what might form the most useful basis for clustering. It should then, in collaboration with the projects, come to an agreement on an initial wave of clustering, which will of course need to be revised and extended as new projects are funded
- Recommendation 3: The European Commission should consider requesting projects to report on these clustering matters during project reviews, asking reviewers to verify the appropriateness and usefulness of specific actions taken by the projects.
- Recommendation 4: In addition, issues of capital costs and target pricing relating to the results emerging from funded projects should be more clearly addressed by these projects. This will aid in clarifying exploitation strategies and encourage more market driven projects. Consequently, the European Commission should also request projects to prepare information on market pricing for consideration at project reviews.
- Recommendation 5: The European Commission and the European Factories of the Future Research Association (EFFRA) should begin the process of organising an annual event, the first of which should be planned for 2011.

Looking beyond the year 2011, over the period 2011 to the end of 2013:

- Recommendation 6: The *Ad-hoc Industrial Advisory Group* should reflect upon the importance of concepts such as *Designed in Europe*, *Made in Europe* and *Recycled in Europe*, and, based on the industrial experience and commercial know-how of the group, provide the European Commission with insights, via convincing business scenarios, into how these concepts could be realised.
- Recommendation 7: The European Commission should give consideration to funding an independent socio-economic study focused on identifying the impacts of the funded projects.
- Recommendation 8: The European Commission should also address the process for the further development of the roadmap, by defining the terms and conditions, methodology, elements to be addressed, criteria, etc., so that future versions of the roadmap identifies topics and sectors where the greatest commercial, employment, and environmental impacts can be expected. To aid in this, they should consider, as part of the recommended socio-economic study, requesting the development of benchmarking data that will help to provide focus for the further development of the roadmap.
- Recommendation 9: The European Commission should also consider if there is a need to better define the role of the *Ad-hoc Industrial Advisory Group*, in relation to other stakeholder groups such as *Manufuture*, and also how the FoF PPP Multi-annual Roadmap fits with the *Manufuture* Strategic Research Agenda.

In many of the above recommendations, the European Factories of the Future Research Association (EFFRA) could act as a facilitator and coordinator. The exact role of EFFRA should be determined through consultation among the key parties, namely the European Commission, the *Ad-hoc Industrial Advisory Group*, and EFFRA.

Appendix 1 – List of Workshop Participants

Participants:

Organisation	Name	Project
TU Munich	Eric BOURGUIGNON	CUSTOMPACKER
KUKA Roboter GmbH	Rainer BISCHOFF	TAPAS
Fundacion Tekniker	Iñaki MAURTUA	ROBOFOOT
Fundacion Tekniker	ORMAECHEA	ROBOFOOT
Fraunhofer IPK	Javier GARCIA	ROBOFOOT
EPFL	Sonja PAIKOVSKA	ACTIONPLANT
TWI	GOCEVA	ACTIONPLANT
Tecnalia	Dimitris KIRITSIS	QCOALA
Airbus Operations SAS	Roger WISE	PLANTCOCKPIT
Project Fofdation	Jon AGIRE	FOFDATION
SUPSI	Jean-Bernard HENTZ	FOFDATION
TU WIEN	Van Khai NGUYEN	S-MC-S
DMG Electronics GmbH	Andrea BETTONI	PHOCAM
TXT E-SOLUTIONS SPA	Jürgen STAMPFL	AIMACS
CNR-ITIA	Peter PRUSCHEK	CORENET
VTT	Nicola MAGALETTI	CORENET
Unicatum GmbH	Rosanna FORNASIERO	MICRO-DRESS
FRAUNHOFER-GESELLSCHAFT	Stephen FOX	MICRO-DRESS
FRAUNHOFER-GESELLSCHAFT	Christian LOTT	MANUCLOUD
FRAUNHOFER-GESELLSCHAFT	Joachim SEIDELMANN	MANUCLOUD
IDEKO S. COOP	Matthias MEIJER	Manucyte
UNIVERSITY OF PATRAS	Ursula RAUSCHECKER	DYNXPPTS
UNIVERSITY OF PATRAS	Joseba PEREZ	e-CUSTOM
TEKNILLINEN	BILBATUA	e-CUSTOM
KORKEAKOULU	George	FAB2ASM
Université de Franche-Comté	CHRYSOLOURIS	FAB2ASM
TU EINDHOVEN	Dimitris MOURTZIS	FEMTOPRINT
TU EINDHOVEN	Quan ZHOU	FEMTOPRINT
CE.S.I.	Michael GAUTHIER	HARCO
CE.S.I.	Yves BELLOUARD	HARCO
POLE EUROPEEN DE LA PLASTURGIE	Gerard VERSCHUREN	IMPRESS
CEA	Angelo MERLO	IMPRESS
PROFACTOR	Gian Mauro MANEIA	LOCOBOT
COMAU	Maël MOGUEDET	IMPRESS
AGORIA	M. Bertrand FILLION	IMPRESS
Tampere University of Technology	Christian WÖGERER	LOCOBOT
TNO	Massimo MATTUCCI	
VDMA	Jos PINTE	
VDMA	Reijo TUOKKO	
	Egbert-Jan SOL	
	Dietmar GOERICKE	
	Helmut REMPP	

INESC Porto
FATRONIK
EFFRA
FESTO
TNO
EFFRA
SAP
Rurobots

José Carlos CALDEIRA
Rikardo BUENO
Chris DECUBBER
Johannes HOOS
Annamalai ARUN JUNAI
Frank KNECHT
Uwe KUBACH
Geoff PEGMAN

Organisation

Centro Recherche Fiat
CETIM
CNR-ITIA
CETIM
SAP
EFFRA
DAIMLER
CECIMO
Tecnalia

Name

Edoardo RABINO
Daniel RICHET
Tullio TOLIO
Michel CARTON
Klaus-Dieter PLATTE
Emma LINKLATER
Eberhard BESSEY
Pazin ZELJKO
Iñaki SAN SEBASTIAN

European Commission
European Commission

Herbert VON BOSE
Thierry VAN DER PYL
Augusto DE

European Commission
European Commission
European Commission
European Commission
European Commission
European Commission

ALBUQUERQUE
Lorenzo VALLES
Andrea GENTILI
John CLEUREN
François BUGGENHOUT
Erastos FILOS
Rolf

European Commission
European Commission
European Commission
European Commission
European Commission
European Commission
European Commission
European Commission
European Commission
European Commission

RIEMENSCHNEIDER
Christoph HELMRATH
Kai PETERS
Barry ROBERTSON
Anne MALLABAND
Jan RAMBOER
Roberta SALONNA
Neophytos NEOPHYTOU
Raymond STERLING
Matthijs SOEDE

Cheshire Henbury

Paul T KIDD

Rapporteur

Appendix 2 – Structure for the Project Presentations

Project presentations were structured as follows:

- Project acronym, title and details of the co-ordinator
- Objectives
 - S&T goals of the project
 - Impact Expected
 - Link with the multi-annual roadmap
- Consortium
 - Industry/Industry sectors/ SMEs
 - Research organisations/ universities
- Innovation Issues
 - Exploitation
 - Dissemination
 - Standardisation
- PPP Added Value
 - How does the PPP add value to your project?
 - How can you provide an added value to the PPP?

Appendix 3 – Discussion Panel Questions

Discussion Panel: Added value and overall impact of the PPP

1. As compared to FP7 business as usual, do you see clear advantages in the PPP approach for the private side? ... And for the public side?
2. What specific differences from usual FP7 ways have you found useful?
3. Do you consider that the PPP approach contributes to higher leveraging of private funds for research in this area?
4. What could suggest that the present implementation (roadmap, projects, etc.) will help achieve the stated goals of the PPP?
5. How you consider that the PPP approach may help to reach a greater overall impact than just FP7 projects?
6. What is the impact of the PPP on achieving innovation?
7. What should be the interaction between different projects in this PPP?
8. How can we achieve broader dissemination & stakeholder participation?

Discussion Panel: Roadmap beyond 2013

1. What would justify a continuation of this PPP beyond 2013?
2. What urgent research & innovation needs are not covered by the present roadmap or cannot be completely met by 2013?
3. What strategic research areas should be considered beyond 2013 to fulfil the long-term goals?
4. How could the PPP achieve a proper cross-over between the objectives of the Recovery Plan and those of the EU2020 strategy?
5. Which criteria should be used to help identify the most suitable research areas in a roadmap for beyond 2013?
6. How could the PPP ensure the highest industrial impact beyond 2013?
7. What barriers need to be overcome to promote market uptake of technologies in this area?
8. How could the PPP contribute to a possible Innovation Partnership?

Appendix 4 – Project Presentation Sequence

	Acronym	Full title project
Smart Factories		
1	FoFdaton	The Foundation for the smart Factory of the Future
2	Custompacker	Highly Customizable and Flexible Packaging Station for mid- to upper sized Electronic Consumer Goods using Industrial Robots
3	ROBOFOOT	Smart robotics for high added value footwear industry
4	PLANTCockpit	Production Logistics and Sustainability Cockpit
5	ActionplanT	The European ICT Forum for Factories of the Future
6	KAP	Knowledge, Awareness and Prediction of Man, Machine, Material and Method in Manufacturing
7	TAPAS	Robotics-enabled logistics and assistive services for the transformable factory of the future
8	QCOALA	Quality Control of Aluminium Laser-welded Assemblies
Virtual Factories for Networked Production		
9	S-MC-S	Sustainable Mass Customization - Mass Customization for Sustainability
10	ManuCloud	Distributed Cloud product specification and supply chain manufacturing execution infrastructure
11	e-CUSTOM	A Web-based Collaboration System for Mass Customization
12	CoreNet	Customer-oriented and eco-friendly networks for healthy fashionable goods
13	MICRO-DRESS	Customised Wearable Functionality and Eco-Materials – Extending the limits of Apparel Mass customisation
14	PHOCAM	Photopolymer based customized additive manufacturing technologies
Adaptive Production Equipment		
15	LOCOBOT	Toolkit for building low cost robot co-workers in assembly lines
16	AIMACS	Advanced Intelligent Machine Adaptive Control System
17	HARCO	Hierarchical and Adaptive smaRt COmponents for precision production systems application
18	DYNXPERTS	Plug and Produce Components for Optimum Dynamic Performance Manufacturing Systems
19*	PoPJIM	<i>Plug and Produce Joint Interface Modules</i>
20*	COMET	<i>Plug-and-produce COmponents and METHods for adaptive control of industrial robots enabling cost effective, high precision manufacturing in factories of the future</i>
High-Precision Manufacturing		
21	Manucyte	Self-learning modular manufacturing platform for flexible, patient-specific cell production
22	FAB2ASM	Efficient and Precise 3D Integration of Heterogeneous Microsystems from Fabrication to Assembly
23	FEMTOPRINT	FEMTOSECOND LASER PRINTER FOR GLASS MICROSYSTEMS WITH NANOSCALE FEATURES
24	IMPRESS	Flexible Compression Injection Moulding Platform for Multi-Scale Surface Structures
25*	WaferOptics	<i>WaferOptics - Specific Technological Developments to Create an Intelligent and Scalable Production Platform for Glass Optics Manufacturing</i>

* These projects were unable to participate in the workshop owing to other previous commitments.

Appendix 5 – Written Inputs Received after the Workshop

Written Input 1:

Roadmap beyond 2013

3) What strategic research areas should be considered beyond 2013 to fulfil the long-term goals?

A strategic area concerns is the implementation of nanotechnology's proof-of-concept in real commercial products. Nanotechnology researchers are currently developing new physical principles (e.g. for sensing), but the packaging which is a critical step in manufacturing is currently not considered. The advent of nanotechnology products must be directly linked to the development of innovative nanopackaging, which implies manufacturing technologies related research.

Written Input 2:

Added value and overall impact of the PPP

1) As compared to FP7 business as usual, do you see clear advantages in the PPP approach for the private side? ... And for the public side?

The clear advantage is the focus on industrial driven topics and a short time till the projects are starting. Good industrial needed topics in a short time bring a return on investment earlier and this is also has advantages for the public side. Nevertheless we also need the FP7 topics for a longer horizon.

2) What specific differences from usual FP7 ways have you found useful?

The focus on production and the fact that proposals may be more applied than in usual FP7project (especially for ICT).

3) Do you consider that the PPP approach contributes to higher leveraging of private funds for research in this area?

Definitely yes.

5) How you consider that the PPP approach may help to reach a greater overall impact than just FP7 projects?

By addressing applied and urgently needed industrial research - yes

7) What should be the interaction between different projects in this PPP?

Common actions, common conferences and exploitation activities.

8) How can we achieve broader dissemination & stakeholder participation?

Covering also the costs for such activities in the overheads and not only for the specific topics so that professional staff of the project partner could organize such events and the Key Researchers have time for their core work.

Roadmap beyond 2013

1) What would justify a continuation of this PPP beyond 2013?

It is needed by the industry!

2) What urgent research & innovation needs are not covered by the present roadmap or cannot be completely met by 2013?

CO2 relevant process and manufacturing technologies, resource efficient technologies.

3) What strategic research areas should be considered beyond 2013 to fulfil the long-term goals?

Process technologies, more process industry should be involved

Additional remark:

It is necessary to speed up the process from the call to the start of the projects. The PPP is a first step but the process could be faster and it is necessary to implement follow up measures in Eurostars and Eureka.

Written Input 3:

Added value and overall impact of the PPP

- (1) clear advantages of the PPP approach:
 - sustainable (financial) support for FoF topics according to a roadmap
 - projects are embedded in a framework which could provide formal ways of reporting open issues and challenges originating from RTD work of the individual projects
 - research / academia is acknowledging that industry is in the driving seat
 - topics of industrial relevance are included in the roadmap and are prioritised
- (2) useful specific differences from usual FP7
 - none
- (3) contributing to higher leveraging of private funds
 - the PPP is already leading to higher industrial participation, but some things could still be improved:
 - § streamlining proposal writing: a 2-stage process is deemed to be a much better way to get even more companies (also SMEs) in the driving seat of a project.
 - § An applicant for funding should be able to express the key ideas and the workplan of the project in 20 pages maximum; when successfully reviewed a full proposal is submitted
 - § contract negotiations could be further accelerated, but the last round was already quite good
 - it seems that more funds are available on a national level throughout Europe; this is not the case in Germany, though
- (4) is present implementation helping achieving the overall goals?
 - yes, but decision about topics and amount of funding available should not be based on the input of those few big players alone which can afford participating in all meetings and can be a member in all relevant organizations (ManuFuture, ManuFuture high Level Group, AIAG, EFFRA, ...)
- (5) reach a greater overall impact
 - PPP could provide a framework for collaboration among different FoF projects
 - funding should be made available to promote the exchange of results between projects, e.g.:
 - § extend the testing and validation of research results in the real world of one project to other projects

- § allow more system integrators in the final year of the project to try out the research results by setting up more pilot installations
- § clusters of similar projects could share pilot plant facilities
- the PPP topics are of high industrial relevance which ensures a high overall impact
 - § a counter example where I would not expect high impact is the planned FET flagship initiative because this is putting a lot of money into basic research topics with uncertain / unclear / not useful output, but at the same time taking money from other (more industrially relevant) research areas
- (6) impact on innovation
 - starting from a clear position of strength and technology leadership leads to faster innovation
 - testing and validating available research results on the shop floor will help to mature technologies and lead to innovation
- (7) interaction between FoF projects
 - annual conference presenting and discussion project results, e.g., in relation to the annual info day
 - enable an exchange of results where it makes sense, e.g., additional pilot installations to distribute the results and to provide additional field testing and validation facilities;
 - § additional calls for further demonstrations
 - § a few person months and additional consumables can make a real difference in optimizing the results and accelerating technology transfers
 - § here, IPR issues have to be addressed in amendments to the existing Consortium Agreements
 - instead of applying for a follow up project enable an extension of existing FoF projects for interaction between FoF participants or additional demonstrations
- (8) broader dissemination and stakeholder participation
 - see (7)
 - use EFFRA for marketing of the results

Roadmap beyond 2013

- (1) justification for continuation of PPP beyond 2013
 - how to get to innovative production technologies?
 - innovation requires continuous testing and validation of research results in the real world
 - § there is a lot of excellent research done in Europe...
 - § but many research results hardly make it into products because
 - research results are not known by the companies or
 - the real problems are not known by the researchers or
 - research results are not yet ready (not mature enough) for integration into products and functional demonstrators
 - § projects focusing on taking research results “as is”, trying to embed them into functional models (prototypes), and test and validate these prototypes in the real world is an essential step toward more and faster innovation

- we should not try to increase the pace of research, but the pace of innovation
- this can only happen if research is performed use case driven, where the use case come from industry (end user)
 - § this will also lead to detailed feedback to the EC regarding the original outcome of the research projects which led to the results which are now being tested and validated (post assessment of research projects)
- robotics is the art (science?) of integration ⇒ this probably applies to other manufacturing equipment as well
 - § technologies supporting the integration of single technologies into one system are very important
 - § integrating research results and bringing them to the market fast will secure our high standard of living for the time to come because we can only be better with our products, but not cheaper than our Asian competitors
- productivity and quality of products and manufacturing equipment have to steadily increase, cost to decrease
- transformable solutions are needed: robot systems that can be quickly instructed to perform a variety of manufacturing tasks
- (2) urgent research & innovation needs not covered / not completely met by 2013
 - mobile manipulation, grasping, perception
 - base the RTD work on real use cases
 - testing and validation of excellent research results should be facilitated
 - “Beyond SAP”: SMEs and crafts do not use SAP; they need solutions which work without SAP (and similar systems), which only large companies can afford to invest in
- (3) strategic research areas beyond 2013
 - mobile manipulation, grasping, perception
- (7) barriers to overcome to promote market uptake of technologies
 - pilot installations are needed close to customers, i.e., not one demonstrator at the end of project, but a number of demonstrators (built by early adopters) across Europe
 - § these will create awareness across the whole manufacturing sector
 - technologies developed need to prove in real production settings
- (8) contributions to a possible innovation partnership
 - we have been an innovation partnership

Appendix 6 – Workshop Agenda

Workshop

Impact of the Factories of the Future PPP

Wednesday 24 November 2010

Location: La Brasserie Van Maerlant
Rue Van Maerlant, 2; 1040 Brussels

19:00-19:15 **Welcome address**
Herbert von Bose, Director DG RTD Industrial Technologies

19:15-21:30 **Networking dinner**

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Thursday 25 November 2010

Location: European Commission
Berlaymont Building (Robert SCHUMAN Room)
Rue de la Loi, 200; 1040 Brussels

8:30-9:00 **Registration**

Chair: Andrea Gentili, DG RTD

9:00-9:15 **Welcome and objectives of the workshop**
José-Lorenzo Vallés, Head of Unit, DG RTD

9:15-9:30 **Impact expected of the FoF PPP**
Rikardo Bueno, co-chairman FoF Ad-Hoc Industrial Advisory Group

9:30-9:45 **Political context and assessment of the PPPs**
Anne Mallaband, DG RTD

9:45-13:00 **Short presentations of the projects**
Representatives of the projects participating
(with coffee break at 11:00-11:15)

13:00-14:00 **Lunch Break**

14:00-15:00 **Panel discussion on the added value and overall impact of the FoF PPP**
Jos Pinte, Agoria
Iñaki San Sebastian, Tecnalia
Massimo Mattucci, Comau

15:00-16:00 **Panel discussion on new inputs for a roadmap beyond 2013**
Uwe Kubach, SAP
Reijo Tuokko, Tampere University of Technology
Edoardo Rabino, Fiat Research Centre

16:00-16:30 **Rapporteur's Summary & Conclusions**
Paul T Kidd