Gestión integrada de los procesos y máquinas para la mejora del mantenimiento y flexibilización de la producción

Nº Expediente: IMDECA/2015/82

PROGRAMA: PROYECTOS DE I+D EN COLABORACIÓN

ACTUACIÓN: IMDECA-Proyectos de I+D en colaboración

Fecha de concesión: 23 de octubre de 2015

Entregable 6.2 (E6.2)

Informe de internacionalización y explotación de resultados

Perteneciente al paquete de trabajo: PT6

Participante responsable: AIMPLAS

Mes estimado de entrega: 24

Tabla de Contenidos

1. Glosario de términos

En el presente documento se utilizará algunos conceptos que deben ser definidos con anterioridad a su lectura para aclarar ambigüedades y facilitar el entendimiento.

- **Fabrica del Futuro (FoF):** Fábrica inteligente capaz de adaptar el proceso productivo a las necesidades de producción haciendo uso de las nuevas tecnologías a fin de aumentar la eficiencia, la calidad y reducir el impacto medioambiental.
- **Big data:** Conjunto de tecnologías que permiten el manejo de grandes volúmenes de datos que no pueden ser tratados con las tecnologías convencionales.
- **Machine Learning:** Conjunto de técnicas que permiten crear algoritmos capaces de generalizar comportamientos a partir de información no estructurada.

2. Introducción

2.1. Objetivos del paquete de trabajo 6

El objetivo del paquete de trabajo 6 es la definición de un plan de trabajo que permita implementar una metodología activa de orientación continua de los resultados y productos obtenidos hacia la explotación de producto.
A este plan activo de explotación se realizará un plan de difusión general de proyecto para transmitir de la mejor manera posible los resultados a medios de difusión genéricos, académicos e industriales.
También se orienta los resultados del proyecto a la internacionalización de la línea de trabajo y a nuevos futuros diseños y desarrollos que complementen el proyecto. En este punto es en el que se centran los contenidos del presente Entregable.

2.2. Objetivo del presente documento (E6.2)

El principal objetivo del entregable E6.2 es la compilación, realizada durante la ejecución del proyecto, de los resultados del análisis de las líneas europeas del Horizonte 2020 y otras de I+D+i internacionales en el que la línea del trabajo del proyecto puede enfocarse.

Además como parte de este documento se indican aquellos mercados o sectores potenciales a los que pueden ir dirigidos los resultados y la forma en que dichos resultados podrían articularse como producto para explotar comercialmente.

El documento recoge los resultados de la siguiente Tarea del paquete de trabajo:

- **T.6.2. Análisis de explotación de resultados e internacionalización**

  En esta tarea se realizará, durante la ejecución del proyecto, un análisis de las líneas europeas del Horizonte 2020 y otras de I+D+i internacionales en el que la línea del trabajo del proyecto puede enfocarse.

  En el periodo final de ejecución del proyecto de un análisis de los mercados y sectores a los que pueden ir dirigidos los resultados y productos del proyecto. Se elaborará un plan de negocio de orientación de explotación.

3. Líneas de I+D+i europeas alineadas con el desarrollo del proyecto.

3.1. Convocatorias FoF- 17.

A lo largo de 2016 se realiza una revisión de aquellos tópicos directamente o indirectamente relacionados con el desarrollo realizado en el marco del proyecto OPTIMAN y que tienen su traslación en las líneas marcadas en el ámbito del programa H2020.

De esta prospección se identifican los siguientes tópicos y temáticas:

- FoF-06-2017: New product functionalities through advanced surface manufacturing processes for mass production.
  http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/fof-06-2017.html

  La descripción del Topic es la siguiente:

  - **Specific Challenge**:

  As a response to increasing competition in global markets, many industrial sectors (e.g. automotive, aerospace, tooling or packaging) aim at improving their product performances through surface functionalisation. As the products are increasingly complex in terms of scale (from nano to macro) and shape, processes need to deliver efficiently, ensuring an uncompromised quality together with high versatility and controlled costs. One way to reach this goal is to differentiate between a product body and its surface, where specific properties can be tailored. Furthermore, the required functionalities may be achieved with little or no addition of new raw material. For example, modifications in the surface geometry or even microstructure induced by texturing processes enable to improve the performance of those products by providing them with dedicated functionalities such as tailored friction, antibacterial properties, aesthetic issues or self-cleaning capabilities, among others.
  In this context, substantial research is needed for exploring innovative approaches aimed at producing high added-value functional surfaces by a superficial modification of the substrate. Special attention should be paid to the cost efficiency of the novel surface manufacturing processes and to the development of technologies that are adaptable and up-scalable to real scale conditions and to their implementation into mass production conditions. Finally, environmental aspects of the processes should also be addressed.

  - **Scope**:

  The proposal should address surface-modifying methods which do not alter the chemical composition of the surface or add an extra layer of a different material, for example: micro-machining, texturing, photon-based technologies, laser, mechanical treatments, etc. These methods should be used to create new manufacturing processes that can be applied on mass production lines. Due to the need for cost-effective technologies, these processes should be easy to integrate within the existing

manufacturing plants and cost-effectiveness should be demonstrated. The research activities should be multi-disciplinary and address all of the following issues:

- *Development of cost-efficient, up-scalable and adaptable surface processing techniques that introduce micro- or nano-scale modifications at the surface level of the part providing it with specific properties or capabilities.*
- *Design and implementation of specific methods and systems that enable highly efficient up-scaling of the developed processing techniques from laboratory scale to real scale, with a specific objective to apply the processes for mass production.*
- *Implementation of modelling tools to support selection of the processing parameters that lead to the targeted surface modifications.*
- *Solutions which are economically viable, environmentally friendly and easy to transfer to other fields than the demonstrated fields of application.*
- *In-process inspection and monitoring possibilities to ensure that the final results remain within the quality requirements.*

The projects are expected to cover applied research but also demonstration activities, such as testing a prototype in a simulated operational environment. The ability of the demonstration activities to validate a technology's high level of readiness will be reflected in the evaluation.

- **Activities are expected to focus on Technology Readiness Levels 4 to 6.**

This topic is particularly suitable for SMEs.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

- **Expected Impact**:

The developed innovative product functionalities should lead to a remarkable impact for both producers and users, in the following terms:

- *Cost increase pertaining to those functionalities integrated into products should be below 10% with respect to the cost of conventional products .*
- *The improvement in the product performance should be above 20% in the targeted functionalities such as: surface friction (increase or decrease), wear resistance, surface energy, corrosion and thermal resistance, hardness, self-cleaning properties, conductivity, anti-fouling, catalytic properties, etc. Besides, the improvement can also consist in obtaining tailored optical properties including for aesthetic or functional purposes.*
- *Strengthened global position of European manufacturing industry through the intensive implementation of innovative and unconventional technologies along the European manufacturing value chain.*

- FoF-07-2017: Integration of unconventional technologies for multi-material processing into manufacturing systems.

http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/fof-07-2017.html

La descripción del Topic es la siguiente:

- **Specific Challenge**:

The competitiveness of European manufacturing depends on producing differentiated and high added value products in an efficient and sustainable manner, with reduced production costs, increased product quality and minimised time to market. Multi-material products have the advantage of putting the right material in the right place to satisfy all the expected requirements, which is particularly relevant when high cost or critical materials are involved. The aim of this topic is to integrate unconventional manufacturing technologies within a specific set (water jet, ultrasonic and micro-wave, electron beam welding and/or electro discharge machining, laser and photopolymerisation) into a manufacturing system to make multi-material products composed of high cost or critical materials with a prolonged service life. These innovative manufacturing concepts and technologies can help European industry to face the challenge of improving resource efficiency and sustainability.
The integration of the above-mentioned unconventional manufacturing technologies into the process chain may be complemented with processes such as thermal treatment, in-process inspection and control, stress-relieving, micro-structural improvements, machining and joining. Successful integration will help to achieve a breakthrough in innovative manufacturing approaches for multi-material products. The major challenge lies in reinforcing the integration of these unconventional processes into manufacturing systems for multi-material products and subsequently implementing them throughout the European manufacturing sector, as well as ensuring that the disassembly of the materials is possible to enable re-use and recycling.

- **Scope**:

The proposal should use one or more of the following unconventional manufacturing technologies (water jet, ultrasonic and micro-wave, electron beam welding and/or electro discharge machining, laser and photopolymerisation) to create new manufacturing systems for multi-material products. To tackle this major challenge successfully, research will need to cover all of the following areas:

- innovative process chains for high cost or critical multi-material products based on unconventional technologies, integrated if appropriate with more conventional manufacturing techniques such as machining and joining;
- manufacturing processes capable of generating the features and geometries required for multi-material products as well as integrating additional improvements such as thermal treatment, stress relieving, surface hardening, corrosion resistance or micro-structural improvements;
- new flexible machinery concepts and components to allow the integration of unconventional technologies and processes into industrial manufacturing systems able to handle a range of material combinations and products;

- in-process inspection and control to ensure quality requirements within the innovative process chains.

- **Activities are expected to focus on Technology Readiness Levels 4 to 6.**

This topic addresses cross-KET activities.
This topic is particularly suitable for SMEs.
The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

- **Expected Impact**:

The developed new technologies should lead to a remarkable impact in the following terms:

- *Reduction of at least 10% in the production time through the integration of operations and the reduction of idling time between manufacturing steps.*
- *Reduction of at least 15% in the production cost through process integration and improved manufacturing quality.*
- *Resource efficiency improved by reducing the use of raw materials and energy consumption by at least 10%.*
- *Strengthened global position of European manufacturing industry through the intensive implementation of innovative and unconventional technologies along the European manufacturing value chain.*
- *Low capital investment solutions available for SME uptake.*

- FoF-08-2017: In-line measurement and control for micro-/nano-enabled high-volume manufacturing for enhanced reliability.
http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/fof-08-2017.html

La descripción del Topic es la siguiente:

- **Specific Challenge**:

Rapid developments in micro-/nano-technologies require complex business models that respond to volatile markets in demand for faster product delivery with an unprecedented yield and quality. High-volume manufacturing is not spared from these requirements, and will in fact need to demonstrate a productivity improvement compared to lab-scale process development and low-volume manufacturing in order to remain commercially competitive.
The process scaling needs to include system-level architectures for metrology and control. This includes data acquisition and control at the levels of the process, the physical handling and the component validation. The in-line metrology and inspection for micro-/nano-production play an important role, together with a common reference system and approach across process chain. The evolution of the control system on the factory floor will also need to show various levels of distributed control in order to

cover both batch-to-batch and run-to-run variations with real-time parameter prediction and feedback.
Practical industry solutions for reference metrology at these small dimensions are not readily available. However, whilst efforts are made towards producing reference materials, reliable and fast measurements that allow for control both at the process level and at the higher level of product vehicle or line, are needed. This will enable predictive management of batches, improved quality and speed control, and machine learning enabling fully autonomous control at the level of the process tool.

- **Scope**:

Proposals should include a systems-level strategy for integrating measurement and control throughout the production line for micro-/(nano-)enabled high volume manufacturing. To address this challenge the proposal will need to cover all of the following areas:

- *Measurement techniques that target highly integrated and functional products at the micro- (and nano-)scale.*
- *Measurement and data acquisition which are non-destructive, i.e. no waste material at the measurement steps, and allow for high throughput scenarios in their respective industrial settings.*
- *Traceability in the measurements back to reference samples (e.g. calibrated standard artefacts and products). Direct contributions to related standards may be a part of the proposal.*
- *Approaches to control at the different levels of factory integration, including process variation, product/component reliability, waste optimisation, yield/output improvements and predictive/preventive corrections to the entire line.*

- **Activities are expected to focus on Technology Readiness Levels 5 to 7 and to be centred around TRL6.**

This topic addresses cross-KET activities.
The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

- **Expected Impact**:

The developed new technologies should lead to a significant impact in the following terms:

- *Improvement in existing manufacturing processes through implementation of system-wide control systems, demonstrating better resource efficiency, yield and productivity of a wide variety of components and final products.*
- *Improvement in technical knowledge on the in-line metrology for micro-/(nano-)sized components in a high-volume manufacturing setting.*
- *Accelerated uptake by industry of in-line measurements and related control systems that allow for traceability in terms of physical dimensions, functionality and reliability of micro-/nano-sized components.*

- *Contribution to standardisation in the field of reference materials targeting micro-/(nano-) technology and factory integration.*

- FoF-09-2017: Novel design and predictive maintenance technologies for increased operating life of production systems.
  http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/fof-09-2017.html

  La descripción del Topic es la siguiente:

  - **Specific Challenge**:

  The elevated complexity and costs of production assets combined with the requirements for high-quality manufactured products necessitate novel design and reliability-based maintenance approaches that are able to provide the required levels of availability, maintainability, quality, safety while considering the system as a whole and throughout the production lifecycle.
  Analysis of operational parameters and in-service behaviour, self-learning features and condition prediction mechanisms could contribute to improve smart predictive maintenance systems capable to integrate information from many different sources and of various types, in order to more accurately estimate the process performances and the remaining useful life. That will lead to a more efficient management, reconfiguration and re-use of assets and resources, avoiding false alarms and unforeseen failures which lower operators' confidence in such systems.

  - **Scope**:

  The aim would be to design optimal maintainability solutions into production systems to improve operating life at maximised performance and reduce costs by carrying out maintenance activities at the most optimised time before failure occurs, thus minimising the degree of intervention required and maximising the system availability.
  More trustworthy predictive maintenance and cause-and-effect analysis techniques should be developed to aggregate and interpret data captured from production systems and effectively share the massive amount of information between users. Measurements of a range of parameters at the level of components, machines and production systems should be carried out to provide data for building trend reference models for prediction of equipment condition, to improve physically-based models and to synchronise maintenance with production planning and logistics options. The dependability of the techniques would be demonstrated for a range of components and machines.
  While the focus will be on demonstrating the design approaches and maintenance technologies, R&D activities supporting the integration and scale-up are expected as well.
  Demonstration activities should address all of the following areas:
  - Methodologies and tools for improved maintainability and increased operating life of production systems.

- Methodologies and tools to schedule maintenance activities together with production activities.
- Predictive maintenance solutions, combined with integrated quality-maintenance methods and tools, as well as failure modes, effects, and criticality analysis (FMECA) techniques, that effectively share information among different data sources in a secure way. Exploitation of networks of Smart Objects Technologies is an option.
- Versatility, in order to make solutions transferable to different industrial sectors.
- The project must include two complex demonstrators in real industrial settings to represent a clear added value.

In order to ensure the industrial relevance and impact of the demonstration effort, the active participation of industrial partners, including SMEs, represents an added value to the activities.

- **Activities are expected to focus on Technology Readiness Levels 5 to 7** and to be **centred around TRL6**.

This topic addresses cross-KET activities.
This topic is particularly suitable for SMEs, as well as for international cooperation.
The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

- **Expected Impact**:

The developed new technologies should lead to a significant impact in the following terms:

- 10% increased in-service efficiency through reduced failure rates, downtime due to repair, unplanned plant/production system outages and extension of component life.
- More widespread adoption of predictive maintenance as a result of the demonstration of more accurate, secure and trustworthy techniques at component, machine and system level
- Increased accident mitigation capability.

- FoF-10-2017: New technologies and life cycle management for reconfigurable and reusable customised products.
http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/fof-10-2017.html

La descripción del Topic es la siguiente:

- **Specific Challenge**:

New customised products will be increasingly incorporating, in a seamless fashion, intelligence and smart functionalities through advanced materials and embedded components. The integration of highly differentiated materials and components is a

key requisite for flexible manufacturing of individualised consumer/customised products. On the other hand, enhanced integration of sophisticated ICT-based components and of advanced materials implies a rapid product obsolescence rate, and can thus introduce further pollution risks if reuse of products and/or components is not improved. Therefore, reconfiguration and reuse of products, and related services, need to be developed.

- **Scope**:

To face sustainability and flexibility challenges customised products need to be conceived, designed and manufactured in a modular way, and their single components have to be developed so as to be interoperable with one another during the product/service lifetime, so as to be exchangeable and updateable whenever necessary. This influences both the hard and soft requirements and calls for new production technologies that enable the fast manufacturing, assembly and configuration of complex products, as well as the products updatability and disassembly for re-use and end of life management.
In particular, consumer goods manufacturers should be able easily and effectively to integrate products and components which can be independently designed, produced and used in order to make diverse final personalised products in different production systems.
All involved actors in the product life cycle, from manufacturers of basic products components to retailers and vendors up to the final customers, should be provided with the needed hard and soft tools to reassemble and/or reconfigure the product or its components.
Research activities should address all of the following areas:

- *Methodologies, engineering and tools for the fast reconfiguration and re-use of personalised products and their components*
- *New production techniques allowing for a fast manufacturing, assembly and configuration of complex personalised products*
- *Innovative methods and technologies for personalised products updatability, disassembly for reuse and end of life management of the products as well as their different components*
- *Methodologies and tools for the development of assembly, configuration, disassembly and reconfiguration services along the whole consumer/customised products value chain and along its overall life cycle also including the aftersale stage.*

The proposals are expected to include use-case demonstrations aiming at the rapid deployment of the new modularity, reconfiguration and re-use of personalised consumer/customised products and life cycle management. All relevant value-chain stakeholders are expected to participate, including relevant Social Sciences and Humanities (SSH) practitioners.
The resulting personalised products are expected to satisfy the final consumer needs at an individual level and consequently to facilitate daily life (particularly concerning elderly, disabled or other target groups with special needs) or improve workers and sportsmen safety and health.

- **Activities are expected to focus on Technology Readiness Levels 5 to 7 and to be centred around TRL6.**

This topic addresses cross-KET activities.
This topic is particularly suitable for SMEs.
This topic is particularly suitable for collaboration at international level, especially regarding the involvement of multiple actors in complex value chains on a global scale for consumer/customised goods.
The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

- **Expected Impact**:

The developed new technologies should lead to a significant impact in terms of:

- Reduction of time to market of new personalised products/services by 30% through a modular product/service design and manufacturing approach
- Cost reduction of the manufacturing of personalised products by 25% by decreasing lead times in product-services development and configuration
- Reduction of environmental impact by more than 50% due to modular reusable components and final products
- Savings of overall products/services life cycle costs by 30% as a consequence of the reusability and re-adaptability of the components of the personalised products
- Wide adoption of the technologies developed leading to increasingly flexible manufacturing of customised products

- FoF-12-2017: ICT Innovation for Manufacturing SMEs (I4MS).
http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/fof-12-2017.html

La descripción del Topic es la siguiente:

- **Specific Challenge**:

For Europe's competitiveness in manufacturing, it is crucial that advances in ICT are taken up in engineering and manufacturing "at large" as soon as they have the appropriate maturity level. The topic will support fast adoption, and wide spread technology transfer of advanced ICT-based solutions for manufacturing across the business process chains – from "cradle to grave".

- **Scope**:

As Phase 3 of I4MS (www.i4ms.eu) this topic addresses the adoption of the next generation of ICT advances in the manufacturing domain. Focus is on emerging innovative technologies and processes, which need to be customised, integrated, tested and validated before being released on the market. Special emphasis is on strengthening European SMEs and mid-caps along the value chain by adopting new

concepts linked to innovative business and/or service models, and bringing them into contact with actors that can provide access to finance and access to advanced training to reskill workers.

a. Innovation actions must address all of the following three aspects.

1. Establishing across Europe networks of multidisciplinary competence centres offering "marketplaces" for companies that want to experiment with digital technologies in manufacturing of discrete or continuous goods. Centres should have the capacity to offer access to technology platforms and skills for developing and testing innovative technologies and applications, including access to design and manufacturing, rapid prototyping and equipment assessment initiatives. They should also act as brokers between suppliers and users of the technology products. Competence centres are encouraged to link to existing/emerging regional (smart specialisation) or national innovation hubs. If Horizon 2020 funding is complemented by ESIF or other regional or national funds: Horizon 2020 funding shall be used for carrying out highly innovative experiments that will multiply the impact of local initiatives to a European scale, and will build partnerships between businesses in Europe.
2. Carrying out a critical mass of cross-border experiments bringing together different key actors along the full value chain to customise the technologies according to the requirements of the users. Driven by the requirements of first-time users, **Application Experiments** bring together the actors of the value chain and the experts necessary to enable new users to develop novel products or services and assist them in customising and applying these in their respective environments. Experiment descriptions in proposals should include an outline of the initial exploitation plan and business scenario, which will be developed further in the proposed experiment. To remain flexible on which experiments will be carried out, the action may involve financial support to third parties, in line with the conditions set out in part K of the General Annexes. The consortium will define the selection process of additional users and suppliers running the experiments for which financial support will be granted (typically in the order of EUR 20 000 – 100 000[1] per party). Maximum 50% of the EU funding can be allocated to this purpose[2].
3. Activities to achieve long-term sustainability of the competence centres and the eco-system. This includes the development of a business plan for the competence centres and the marketplace, of which an outline business case and industrial exploitation strategy should be described in the proposal, as outlined in the Introduction to the LEIT part of this Work Programme. In addition, investors should be attracted to support business development of SMEs and mid-cap actors in successful experiments. Training needs of the SMEs and mid-caps should be collected and shared with training providers in the eco-system, with the ultimate aim that sufficient training opportunities will be available for all companies.Such activities would include also dissemination.

   Proposers should cover at least one of the following four areas of technologies for adoption in manufacturing. Proposers are encouraged to support the

building of pan-European ecosystems of emerging platforms and are expected to collaborate on reinforcing the European I4MS ecosystem, and to establish links to related activities, e.g. in the IoT Focus Area, the Joint Undertaking ECSEL, and the SPARC or big data PPPs.

1. **CPS and IoT:** Adoption and piloting of CPS/IoT in smart production environments, with special focus on scalable, modular and re-configurable automation systems across the process chain especially for SMEs.
2. **Robotics**[3]**:** New robot systems that are cost effective at lower Iot sizes, with the benefit of long-term improvements in productivity, the ability to work safely in close physical collaboration with human operators; and that are intuitive to use and adaptive to changes in task configuration. Key for fast adoption is the availability of flexible and easy to apply material feeding solutions. Step changes to at least two of the following abilities are therefore considered necessary: configurability, interaction capability, decisional autonomy in terms of context-awareness, and dependability.
3. **Modelling, simulation and analytics**: HPC Cloud-based modelling, simulation and analytics services with special emphasis on sustained service models; on providing real-time support; and on addressing comprehensively security and privacy issues at all levels.
4. **Digital design for additive Manufacturing**: Supporting the broad uptake of innovative additive manufacturing equipment and processes particularly focusing on the link between design tools and production, changes in business models, process chains and stakeholder relations.

The Commission considers that proposals requesting a contribution from the EU up to EUR 8 million would allow the areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one innovation action is supported for each area of technologies.

b. Coordination and Support actions

To advance the European I4MS innovation ecosystem the network is to be reinforced. The aim is to achieve broad coverage in technological, application, innovation, and geographic terms, and to link up with regional/national innovation initiatives, including access to finance and access to training. Its tasks and services shall include maintaining a single innovation portal for newcomers, including a catalogue of the competences available in the I4MS network; sharing of best practices and experiences from I4MS and relevant regional/national initiatives; dissemination; identifying new innovative ICT technologies that can benefit from this scheme, brokering between users and suppliers; leveraging further investment for SMEs and mid-caps to bring the results of the application experiments to real use in the company, providing support in finding training providers for reskilling the workers in the SMEs and midcaps.

For these support actions, close cooperation with the European Factories of the Future Association (EFFRA[4]), the newly established Knowledge Innovation Community (KIC)

on Added Value Manufacturing and the CSA funded under the Smart Anything Everywhere initiative is required.

- **Expected Impact**:

Proposals should address all of the following impact criteria, providing metrics to measure success when appropriate:

- Exploration of new application areas for advanced ICT in manufacturing at large: Attract a significant number of new users of advanced ICT in the manufacturing sector, in particular SMEs and the mid-caps.
- More innovative and competitive technology suppliers, in particular SMEs, both on the level of ICT and on the level of manufacturing equipment, able to supply manufacturers with new equipment, components, and tools for improved manufacturing and engineering operations.
- More competitive European service providers through provisioning of new types of services; through strengthening the presence on local markets.
- Creation of a self-sustainable ecosystem of competence centers, users and suppliers supported by services available through a marketplace, covering a large number of regions and their smart specialisation.
- A critical mass of pan European experiments that demonstrate innovative, sustainable business models covering the whole value chain leading to quantifiable increases in market shares and/or productivity of European companies and/or industrial capacities in Europe.

Tras revisar los distintos tópicos expuestos se observa su relación con algunos de ellos:

- *FoF-06-2017. Cuando se indica que se persigue "In-process inspection and monitoring possibilities to ensure that the final results remain within the quality requirements".*
- *FoF-07-2017. También se alinean con los objetivos de OPTIMAN dado que pretenden conseguir "in-process inspection and control to ensure quality requirements within the innovative process chains".*
- *FoF-08-2017. También se pretende "Approaches to control at the different levels of factory integration, including process variation, product/component reliability, waste optimisation, yield/output improvements and predictive/preventive corrections to the entire line".*
- *FoF-12-2017. Tareas desarrolladas en OPTIMAN se alinean perfectamente en una de las ramas descritas en este tópico, en concreto la parte de "Modelling, simulation and analytics".*

Estas relaciones de los objetivos del proyecto OPTIMAN al compararlos con los topics más recientes del H2020 dan idea de que los desarrollos realizados en el proyecto pueden suponer inicialmente para los Centros Tecnológicos implicados y posteriormente en su traslado a las empresas, el colaborar con las principales líneas marcadas en el ámbito del programa H2020 a nivel internacional.

3.2. Convocatorias relacionadas con Industria 4.0. Otras convocatorias.

Además de las convocatorias enlazadas con la línea de Factories of the Future, se identifican otras líneas de I+D+i encuadradas en otros programas del marco del H2020. A continuación se muestran las más relacionadas.

- Advanced robot capabilities research and take-up
  http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/ict-25-2016-2017.html

  - The specific challenge

    Develop robots that respond more flexibly, robustly and efficiently to the everyday needs of workers and citizens in professional or domestic environments, and which will also maintain Europe at the forefront of global research and development. The actions will address the whole research value chain, whether generic technology, developing RAS building blocks in the form of key technical capabilities, or market-led prototypes directly involving end users. End users will help drive Innovation Actions as active partners, setting the operating parameters for a given application as well as testing and validating the prototype solutions.

  - Scope:

    Research and Innovation Actions addressing generic advances and technical capabilities:

    a. Open, generic forward-looking research into novel technical advances in robotics – open to all robotics-related research topics and disciplines. Proposals are expected to address technical topics which cut across application domains and which can be developed further with a view to achieving high future impact on markets or societal sectors in Europe.

    b. Technology research and development to achieve step changes in the capabilities of the following high priority RAS technologies: systems development, human-robot interaction, mechatronics, perception, navigation and cognition. Step changes are sought through either a multiplicative improvement in technical capability, for example achieving a difference in order of magnitude in the number of everyday objects a robot can recognise or

handle, or a categorical advance, for example moving from rigid to intuitive human-robot interfaces.

The Commission considers that the open research and the technical capabilities proposals are expected to require EUR 2 to 4 million each; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one action will be supported for each bullet (a or b above). Proposals are expected to identify which bullet is their main centre of gravity.

Innovation Actions driven by end users:

c. Improving the deployment prospects of RAS through end user-driven application developments in domains and application areas with significant market potential. Proposals are expected to address system development beyond TRL 5.[1]

The outputs will not be purely technological; actions will generate economic and operational data that will provide a valuable basis for setting operating parameters and for reducing commercial risks for future investors.

d. Filling technology or regulatory gaps through end user-driven innovation actions, where the gap represents a challenging market entry barrier. Proposals are expected to address a gap in either technical capability or system ability. The targeted gap and the required steps to tackle the gap must be clearly identified in the proposal.

The Commission considers that End-user proposals are expected to require 2 to 4 million each; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one action will be supported for each bullet (c or d above). Proposals are expected to identify which bullet is their main centre of gravity.

- Expected Impact:

The expected impacts for the Research and Innovation Actions are:

- Promote excellent science and technology knowledge in Europe, demonstrated by a high standard of research outputs (including publications, open source software or, as appropriate, patents);
- Develop a new generation of robotic and autonomous systems with clear and measurable progress over the state of the art in terms of step changes in technical capabilities, as evidenced by improvements in performance (including in terms of affordability, reliability and robustness, energy autonomy and user acceptability);
- Greater industrial relevance of research actions and output as demonstrated by deeper involvement of industry and stronger take-up of research results;
- Fostering new links between academia and industry, accelerating and broadening technology transfer;

- Contributing by 2020 to the strategic vision of a more competitive positioning of European robotics providers in the marketplace, in terms of their penetration in new or emerging robotics sectors.

The expected impacts for the Innovation Actions on end-user research are:

- Increasing the market-readiness of robotics applications including in terms of technological validation outside the laboratory and of sound operational and cost-benefit models;
- Lowering of market entry barriers of a business or regulatory nature and increasing industrial and commercial investment in Europe at a rate comparable with other global regions;[2]
- Contributing to the faster growth of competitive small and mid-scale robotics companies in Europe.

- Robotics Competition, coordination and support
http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/ict-28-2017.html

  - Specific Challenge:

The global robotics market will change shape significantly in the next few years. As the deployment of robotics technology increases, it is necessary to ensure that robotics actions are flanked by specific measures to optimise market take-up of European research whilst the window is still open.

There are several challenges including the lack of sustained exchanges about robotics between members of the widespread European stakeholders' community and of coordinated European effort towards global standardisation and regulation. There is also a lack of systematic foresight of developing trends and issues to inform strategy-makers and the robotics community e.g. as relating to a pro-active approach of ethical, legal and socio-economic (ELSE) issues. Understanding and responding to developments in these areas will require engagement with non-robotics experts able to analyse impact within their area of expertise. Robotics-specific strategy can then be developed from this analysis and used to shape the processes of design, development and deployment of market services and applications.

It is also important to disseminate information not only to the robotics community but also externally to those users and organisations impacted by robotics technology. Furthermore it is important to identify and assess socio-economic weaknesses and threats in the European robotics landscape. These will change over time and long term monitoring actions will be critical to the development of a responsive strategy.

Potential issues range from the development of supportive and effective regulatory environments to assessing the public perception of robotics and its socio-economic impact, as well as the underlying imaginaries (e.g. pre-conceptions helping to envisage

the future) of robotics developers. Broader technology impact issues such as data privacy, legal rights, liability, responsible innovation and ethical issues concerning vulnerable sections of society will also need to be addressed.

An intense user-engagement in the developments of robots designed to perform social tasks, and a wide public debate around the issues and concerns that these developments may raise are key conditions to ensure a societal and socio-economic uptake of robotic technology in an informed way and to enhance market and community development.

Competitions on smart robotics can also play an important role in increasing the levels of public understanding, as well as helping to accelerate progress in a stimulating way.

- Scope:

Coordination and Support Actions focusing on one or more of the following topic areas and taking into account ongoing actions:

a. Non-technical barriers to robotics take-up:

Promotion of entrepreneurship skills specific to robotics and the provision of non-technical early stage support for SMEs and spinouts. Analysis of funding mechanisms, including follow-on funding support for take-up of research results and the effectiveness of public funding;

Addressing non-technical market barriers in a pro-active way such as ethical, legal and socio-economic issues affecting take-up, including the impact of robotics on the labour market, ethical concerns about safety, informed consent, clear legal responsibility and insurance structures. The engagement and coordination with non-robotics experts, for example in law, social sciences and economics, will be sought;

The effective promotion of responsible research and innovation (RRI) in robotics and the assessment of societal readiness for robotics products;

Given the fast-moving evolution of RAS research and innovation, develop dynamic strategies to anticipate new skills requirements, reduce skills shortage and provide responses to economic change through training, skills development, and education from pre-school to university level.

b. Standards and Regulation:

Coordination of standards harmonisation and regulation across Europe in all domains to enable the development of supply chains and certification processes;

Dialogue with regulatory bodies and policy makers to support the market entry of robotics and raise awareness of the impact of robotics.

c. Community support and outreach:

New mechanisms to improve information exchange across the diverse sections of the European robotics community (including networking between EC projects), to provide open access resources, for example brokerage for design information, communicating the outcomes of EC-funded research projects and to improve the public level of understanding and societal uptake of robotics through two-way public engagement activities.

d. Competitions:

Organisation of robotic competitions to speed up the advance towards smarter robots, demonstrating progress in the field and raising the awareness of the general public towards intelligent robots.

The Commission considers that Coordination and Support Actions proposals covering all or an appropriate mix of topic areas (a), (b) or (c) above are expected to require up to EUR 3 million; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one action will be selected. Competition proposals addressing topic area (d) are expected to require up to EUR 2 million each; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one action will be selected.

- Expected Impact:

Strengthen collaboration between diverse robotics communities;

Gain a higher level of European involvement in global robotics regulatory policy and standard-making;

Lower non-technical market barriers to robotics market readiness and take-up; increase the uptake by entrepreneurs and end users through e.g. skills acquisition and training;

Clearer understanding by the community and non-technical experts of the impact of robotics technology through two-way engagement, which helps to better inform related strategy and policy decision-making;

Significant and measurable evolution in the public awareness and understanding of robots, especially amongst broad demographic groups, as shown by surveys, greater media coverage and increased take up of robotic products in domestic applications;

Increase public and private investment interest in robotics technology for all stages of company formation and growth, from start-up to mature company, as measured by levels of grant and investment activity by national, regional or private-sector bodies.

o INNOSUP-03-2017 Technology services to accelerate the uptake of advanced manufacturing technologies for clean production by manufacturing SMEs

http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/innosup-03-2017.html

- Specific Challenge:

Foresight studies show that the massive integration of advanced manufacturing will displace in a few years many of the current traditional manufacturing processes. In particular, energy and resource-efficient and low carbon technologies and the circular economy will be key drivers of innovation in SMEs. To remain competitive, manufacturing SMEs will increasingly need to rely on advanced manufacturing technologies for clean production. These technologies enable the development of new production processes, but also improve the manufacturing of existing products by reducing production costs, the reliance on raw materials and the consumption of energy, while diminishing the adverse impacts on the environment by reducing the generation of waste and pollution.

Currently, only one third of manufacturing companies in the EU has used advanced manufacturing technologies so far and plans to use them in the next year[1]. The challenge is to provide technology support to SMEs who lack resources and/or competences to integrate innovative advanced manufacturing technologies for clean production.

SMEs' access to technology services and facilities remains difficult in many regions of the EU (a recent inventory shows that two thirds of the technology infrastructures providing services to SMEs in the field of advanced manufacturing are located in only four Member States[2]). In this context, the High Level Group on Key Enabling Technologies (KETs) recommended in its report of June 2015 to ensure pan-European access of manufacturing companies to "premier-class" technology infrastructures in the field of KETs. As a first step, the Commission has published an inventory of existing technology infrastructures in the EU capable of providing SMEs with technology services and facilities in the field of KETs[3].

- Scope:

In order to ensure cross-border access of manufacturing SMEs to technology services and/or facilities enabling them to integrate innovative advanced manufacturing technologies for clean production into their production process, the action will consist of all the elements listed below:

Establish one-stop shop access for SMEs to technology services and/or facilities from a network of technology infrastructures in the field of advanced manufacturing for clean production.

The technology infrastructures should have the capacity to deliver services such as prototyping, testing, pilot production, engineering, training as well as expertise and advice (in technology but also on the overall innovation process) in order to assist SMEs to integrate innovative advanced manufacturing technologies for clean production into their production processes. The service provided to the SME should be

driven by its business needs and the implementation should be flexible and fast to cope with the pace of innovation and the SME requirements. The consortium will define capacity and quality criteria and the network should be open to all technology infrastructures able to deliver services in compliance with these criteria. Criteria for monitoring the quality and impact of the services provided to the SMEs should also be established.

Proposals should outline how the network will develop a common coherent methodology to support SMEs in integrating innovative advanced manufacturing technologies for clean production into their production process, including how to reach out to SMEs across Europe.

Proposers are encouraged to link to existing or emerging regional and national networks in the field of advanced manufacturing for clean production, in particular in the context of smart specialisation.

Using the established network with one-stop shop access, provide cross-border services to a critical mass of manufacturing SMEs, over a period of maximum 3 years, to enable them to integrate innovative advanced manufacturing technologies for clean production into their production process and make informed decision for further investment. The services should bring together all relevant actors and the experts necessary to enable SMEs to integrate innovative advanced manufacturing technologies into their production process and assist them in customising and applying these solutions in their respective environments.

The action is expected to include financial support to third parties in line with the conditions set out in part K of the General Annexes. The third parties are expected to be SMEs willing to integrate cutting-edge advanced manufacturing technologies into their production process in an innovative way which requires the purchase of a technology service and/or access to specific technology facilities. The consortium will define the criteria for selecting the proposals submitted by the SMEs (such as expected substantial improvement of the environmental performance, innovativeness, expected significant competitive advantage) as well as the criteria for identifying the technology infrastructures capable of providing the necessary services to the SMEs. The consortium will also define the process to select the best offer from the technology infrastructures within the network to provide the required services at the best value for money for each proposal submitted by SMEs. Grants awarded to third parties shall be provided as a lump sum not exceeding EUR 60,000 and should not cover the full cost of the service provided to the SMEs.

Activities and measures to achieve the long-term sustainability of the scheme, including governance and dissemination. This includes the development of a business plan. Collaboration with national and regional authorities in charge of innovation support programmes is encouraged.

Proposals should cover advanced manufacturing technologies for clean production from a circular economy perspective. This can include advanced manufacturing technologies allowing reduced energy, materials and water consumption, reduced

waste generation and emissions, the use and re-use of recovered and recycled materials, biomass and/or other renewable inputs, the making of modular products and easier disassembly and separation, as well as process control technologies.

Proposers are encouraged to link with ongoing activities in relevant Public-Private Partnerships (PPPs) such as the Sustainable Process Industry (SPIRE) and the Factories of the Future (FoF) and their stakeholders.

Proposers are encouraged to liaise with the Enterprise Europe Network, and cluster organisations, in particular for dissemination activities and identification of the. manufacturing SMEs having a big potential and willingness to adopt innovative advanced manufacturing solutions for clean production.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 4.9 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

- Expected Impact:

Attract a significant number of new SMEs users of innovative advanced manufacturing technologies in the manufacturing sector, leading to significant and quantifiable increase in their productivity, environmental performance and/or in market shares due to increased quality and innovativeness of products;

Creation of a self-sustainable ecosystem gathering technology infrastructures, SME users and suppliers of innovative advanced manufacturing technologies, and providing access to technology services and facilities through a marketplace, covering a large number of regions and their smart specialisation;

Deployment of a critical mass of innovative solutions to apply advanced manufacturing technologies into the production processes of SMEs.

o Accelerating the uptake of nanotechnologies advanced materials or advanced manufacturing and processing technologies by SMEs
http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/smeinst-02-2016-2017.html

- Specific Challenge:

Research results should be taken up by industry, harvesting the hitherto untapped potential of nanotechnologies, advanced materials and advanced manufacturing and processing technologies. The goal is to create added value by creatively combining existing research results with other necessary elements[1], to transfer results across sectors where applicable, to accelerate innovation and eventually create profit or other benefits. The research should bring the technology and production to industrial readiness and maturity for commercialisation after the project.

- Scope:

The SME instrument consists of three phases, including a coaching and mentoring service for beneficiaries. Participants can apply to phase 1 or directly to phase 2.

In Phase 1, a feasibility study shall be developed in order to verify the technological/practical as well as economic viability of an innovation idea/concept with considerable novelty to the industry sector in which it is presented (new products, processes, design, services and technologies or new market applications of existing technologies). The activities could, for example, comprise risk assessment, market study, user involvement, Intellectual Property (IP) management, innovation strategy development, partner search, feasibility of concept and the like to establish a solid high-potential innovation project aligned to the enterprise strategy and with a European dimension. Bottlenecks in the ability to increase profitability of the enterprise through innovation shall be detected and analysed during phase 1 and addressed during phase 2 to increase the return in investment in innovation activities. The proposal should contain an initial business plan based on the proposed idea/concept. It should outline the specifications of a more elaborate business plan, which is to be the outcome of the project, and the criteria for success.

Funding will be provided in the form of a lump sum of EUR 50.000. Projects should last around 6 months.

In phase 2, innovation projects will be supported that address the specific challenges identified and that demonstrate high potential in terms of company competitiveness and growth underpinned by a strategic business plan. Activities should focus on innovation activities such as demonstration, testing, prototyping, piloting, scaling-up, miniaturisation, design, market replication and the like aiming to bring an innovation idea (product, process, service etc.) to industrial readiness and maturity for market introduction, but may also include some research. For technological innovation, Technology Readiness Levels of 6 or above (or similar for non-technological innovations) are envisaged; please see part G of the General Annexes.

Proposals shall be based on an elaborate business plan. Particular attention must be paid to IP protection and ownership; applicants will have to present convincing measures to ensure the possibility of commercial exploitation ('freedom to operate').

Proposals shall contain a specification for the outcome of the project and criteria for success. They will include an explanation of how the results of the supported project are to be commercialised and of what kind of impact on the company is expected.

The Commission considers that proposals requesting a contribution from the EU of between EUR 0.5 and 2.5 million would allow phase 2 to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts (higher or lower). Projects should last between 12 and 24 months.

Phase 3 of the SME Instrument aims to increase the economic impact of the funding provided by the SME Instrument phase 1&2 grants and by the business coaching. Phase 3 is not subsequent to phase 1 and/or 2, but provides specific support to SME instrument beneficiaries during and after phase 1 or 2.

All support under phase 3 of the SME instrument will be accessible through a single, dedicated entry point, which will serve as an information portal and a networking space.

This platform will offer access to two main strands of services:

- Access to markets
- Access to finance

In addition, phase 3 will create opportunities for partnering, networking and training, which are set out in the Dedicated Support Actions at the end of this call.

SME instrument beneficiaries are also offered dedicated business innovation coaching and mentoring support. This service is facilitated by the Enterprise Europe Network and delivered by a dedicated coach through consultation and signposting to the beneficiaries. The coaches are recruited from a central database managed by the Commission and have all fulfilled stringent criteria with regards to business experience and competencies.

Throughout the three phases of the instrument, the Network will complement the coaching support by providing access to its innovation and internationalisation service offering. This could include, for example, depending on the need of the SME, support in identifying growth potential, developing a growth plan and maximising it through internationalisation; strengthening the leadership and management skills of individuals in the senior management team and developing in-house coaching capacity; developing a marketing strategy or raising external finance.

- Expected Impact:

Enhancing profitability and growth performance of SMEs by combining and transferring new and existing knowledge into innovative, disruptive and competitive solutions seizing European and global business opportunities.
Market uptake and distribution of innovations tackling the specific challenges in a sustainable way.
Increase of private investment in innovation, notably leverage of private co-investor and/or follow-up investments.
The expected impacts should be clearly described in qualitative and quantitative terms (e.g. on turnover, employment, market seize, IP management, sales, return on investment and profit).

o Mapping a path to future supply chains

http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/nmbp-37-2017.html

- Specific Challenge:

Product production and delivery processes are seeing fundamental changes worldwide. E-commerce and the internet have revolutionized order and delivery – changes are still underway and will doubtless evolve further. Automation and new process techniques (such as additive manufacturing or 3D printing) are revolutionising the concept of the factory. New and inter-dependent value chains in process industries lead to new process pathways, achieving new levels of resource and cost-efficiency. Logistics chains are adapting to cater for these changes, but these are often ad-hoc developments.

Existing project funding contexts, such as the Factories of the Future and national programmes addressing the fourth industrial revolution, are implementing a research and innovation agenda along roadmaps oriented to integrating new technologies into manufacturing processes, increasing environmental friendliness. Similar strategic agendas exist for e-commerce and for process industries (SPIRE – sustainable process industries for resource efficiency).

However, little reflection has been applied to the way that these new forms of production and delivery will work together.

- Scope:

This action should draw up a roadmap for supply-chain integration, addressing in particular distributed and customised manufacturing, along with the associated logistics. New supply-chains will be increasingly global. While including the global view, this reflection should focus on identifying roles and pathways for Europe's industry in particular.

Proposals should consider Social Sciences and Humanities (SSH) aspects, in particular, use established economic modelling tools to develop and assess industrial scenarios to 2030, and possibly beyond; and address the role of consumers and users as active participants in the innovation process.

The Commission considers that proposals requesting a contribution from the EU between EUR 0.6 and 1.2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

No more than one action will be funded.

- Expected Impact:

The project should deliver primarily answers to the following two questions:

What scenarios can we expect for future supply-chains and in which timescales?

These scenarios should cover the major supply and production chains in industry today, for both discrete and process production.

Which technologies need to be developed in addition to those identified in existing roadmaps?

It is not expected that full-scale technology roadmaps for all scenarios will be developed in the scope of this topic, but preliminary strategic research agendas would be an advantage.

- MANUNET call for proposals is to foster the competitiveness of Europe's Manufacturing Industry by co-funding manufacturing research projects performed by enterprises (preferably SMEs) and their strategic partners. https://www.manunet.net/index.php?option=com_content&view=article&id=2&Itemid=114

  - The strategic objective of the MANUNET

  Call for proposals is to foster the competitiveness of Europe's Manufacturing Industry by co-funding manufacturing research projects performed by enterprises (preferably SMEs) and their strategic partners.

  The funding objectives of the call are transnational application oriented and high risk R&D projects related to Manufacturing. The project proposals must clearly demonstrate:

    - Transnational, collaborative R&D with a significant degree of innovation and scientific and technical risk
    - SME strong participation
    - Market orientation
    - Application and practical use of manufacturing technologies
    - Expertise of the project partners in their respective fields of competence
    - Added value through transnational cooperation
    - Scale of impact and market positioning of the applicant

  MANUNET call includes all fields in Manufacturing, structured in the following topics:

    - Knowledge-based engineering, information and communication technologies for manufacturing (industrial robotics, computer-aided engineering and design, automated manufacturing, zero defect manufacturing, product lifetime management, etc.).
    - Manufacturing technologies for environmental and energy applications including resource efficiency and recycling
    - Adaptive manufacturing technologies including processes for removing, joining, adding, forming, consolidating, assembling
    - New materials for manufacturing (alloys, lubricants, coatings, textile fibres, construction, composites, insulation, etc.).
    - New manufacturing methods, components and systems (development of demonstrators, devices, tooling and equipment, logistic systems, etc.).
    - Other technologies, products and services related to the manufacturing field.

  However, the respective regional/national thematic programme focus should also be taken into account.

- EU funded network which has been established to support and increase the coordination of European research programmes and related funding in materials science and engineering.
  https://m-era.net/

  - Offer:

  M-ERA.NET provides a central forum where substantial pan-European research funding programmes can be aligned to support the European RTD community. M-ERA.NET aims to address societal challenges and technological needs with an interdisciplinary approach, providing a flexible umbrella structure to cover emerging topics in materials research and innovation, including materials for low carbon energy technologies and related production technologies. As a core activity, a series of joint calls for transnational RTD projects will be implemented. These calls will offer the European RTD community an opportunity to access coordinated funding across Europe and to gain access to leading knowledge world-wide. Over five years, the M-ERA.NET consortium aims to mobilise substantial national and regional public funding as well as EU funding.

  - Strategic impact:

  M-ERA.NET is a large network and a powerful tool to tackle European and global challenges in materials research. Improving the coordination and cooperation of national and regional programmes will reduce the fragmentation of public funding across Europe and align programme strategies for transnational collaboration, eliminating programme duplication and a wasteful use of resources. M-ERA.NET will enable collaboration between leading academic and industrial research partners from European and non-European countries and regions and will facilitate access to previously inaccessible new markets. The joint calls for transnational RTD cooperation will mobilise a critical mass of public funding to support key players in materials research to intensify pan-European partnerships and to encourage newcomers to transnational RTD cooperation to realise innovative RTD projects.

De las distintas iniciativas y tópicos mencionados en el apartado 3.2 aparecen, como más alineados con los objetivos y tareas desarrolladas en el proyecto OPTIMAN, los siguientes tópicos:

- *INNOSUP-03-2017. INNOSUP-03-2017 "Technology services to accelerate the uptake of advanced manufacturing technologies for clean production by manufacturing SMEs". OPTIMAN encaja en esta idea dado que podría considerarse como un producto/servicio más que se pùede implementar en la industria para optimizar su proceso productivo.*
- *MANUNET call. OPTIMAN se puede englobar perefectamente en el apartado de "Other technologies, products and services related to the manufacturing field".*

4. Cooperación entre Centros para identificar resultados explotables.

4.1. Sectores industriales con potencial de aplicación. Análisis de mercados.

Los resultados de OPTIMAN tendrán una **aplicabilidad directa sobre todo el sector industrial**, muy especialmente en los sectores de la **inyección del plástico** y **el calzado**, ámbitos en los que se centra la ejecución del proyecto y en los que se podrán validar los resultados alcanzados.

En lo referente al sector de inyección del plástico indicar que los resultados del proyecto tendrían una aplicabilidad directa en la **mejora de la calidad de producto obtenido** además de asegurar una **garantía de trazabilidad y optimización de proceso productivo** que otorgaría **mayor fiabilidad a la empresa de inyección valenciana** como empresa proveedora.

El sector de inyección del plástico valenciano **necesita instrumentos que le permitan adaptarse a la producción de piezas y productos más exigentes**, en una necesidad evidente promovida por el mercado actual para el que ya no es suficiente únicamente fabricar piezas y productos a coste reducido.

Esta tendencia, a la que no es ajeno el sector de la inyección en un entorno de globalización generalizado que empuja cada vez más a la "especialización cualificada" en la producción de piezas y componentes, necesita que las empresas puedan **diversificar su producción hacia piezas más técnicas** y hacer esta "transición" en las mejores condiciones posibles y en el más corto plazo.

El impacto de herramientas inteligentes como la planteada en el proyecto permitirá dar el **salto de calidad a gran parte del tejido de PYMEs de inyección de nuestra Comunidad** que están buscando su hueco en la fabricación de pieza técnica de valor añadido.

Por su parte, los resultados del proyecto producirán un impacto directo en las empresas del **sector calzado,** permitiendo un uso más eficiente de la maquinaria implicada en los centros de mecanizado e incidiendo, por tanto, en aquellas empresas que fabrican **componentes de calzado** mecanizables: hormas, plantillas y tacones. Los desarrollos derivados de este proyecto se podrán **implantar de forma inmediata en las cadenas de producción** de las empresas de estos sectores, permitiendo una mejora en la producción mediante un uso energético más eficaz de las máquinas-herramientas, una mejora en la calidad del producto, y una producción más estable, así como una posibilidad real de contar con herramientas que permitan **anticipar fallos en los sistemas de producción** y por tanto actuar de forma preventiva ante las incidencias de fabricación que pudieran aparecer.

El impacto de este proyecto afecta a la **mayor parte del sector del calzado**, interesado en ofrecer un producto competitivo que contenga valor añadido frente a las importaciones de

bajo coste que provienen de Asia. Es precisamente, esta aplicación de nuevas tecnologías en un sector tan tradicional como el del calzado, con una **muy baja penetración de los desarrollos TIC**, lo que permitirá mejorar la competitividad de esta industria y de los productos españoles derivados. Así el proyecto contribuirá al **fortalecimiento del sector calzado**, de gran importancia económica en la Comunitat Valenciana, dando respuesta a los retos que plantea la globalización, **afianzando** su crecimiento económico futuro. La introducción de inteligencia en la configuración y operación de máquinas herramienta, científicamente sustentada en análisis de datos, supondrá la adquisición de alto valor añadido en la producción, así como una disminución de costes directos y costes de operación, lo que implica una **mayor competitividad** de las empresas de calzado españolas y, por tanto**,** una mejora del sector calzado a nivel nacional.

Identificación y cifras de los sectores, subsectores y tipologías de empresa

La aplicación de los resultados de OPTIMAN son **válidos para la totalidad del sector industrial** y, muy especialmente, en los sectores del **plástico y calzado**, que serán los dos ámbitos principales de aplicación en el proyecto.

Más en concreto, referente a estos sectores, podemos identificar a su vez subsectores en los que de manera particular el proyecto tendrá más incidencia:

- **Sector plástico:** subsector de empresa de inyección de plástico.
- **Sector calzado:** subsector de empresas fabricantes de componentes de calzado mecanizables (hormas, plantillas y tacones).

Los sectores del plástico y el calzado se consideran estratégicos dentro de la industria valenciana y suponen un porcentaje importante tanto en número de empresas como de empleados, tal y como se muestra en el siguiente apartado.

Si nos atenemos a cifras de las industrias del plástico y el caucho, las principales magnitudes del sector se pueden observar en la siguiente tabla:

SECTOR PLASTICO
EN LA INDUSTRIA TOTAL DE LA COMUNITAT VALENCIANA Y ESPAÑA

AÑO 2012	Plástico y Caucho CV	Industria CV	% respecto a Industria CV	Plástico y Caucho España	% respecto a PYC España
NÚMERO DE EMPRESAS	746	15960	5%	3.668	20%
PERSONAS OCUPADAS	14.270	222295	6%	88.218	16%
INGRESOS EXPLOTACIÓN (MILES €)	2.236.343	54.788.443	4%	18.177.469	12%
GASTOS EXPLOTACIÓN (MILES €)	2.160.866	52.672.144	4%	17.251.724	13%

Fuente: Instituto Valenciano de Estadística (IVE)

Figura 1. Sector del plástico de Comunitat Valenciana y España. Fuente: IVEX con datos del INE

La industria del plástico y el caucho supone un 5% respecto del total de la industria en la Comunitat Valenciana, con 746 empresas y con unos ingresos de explotación de más de 2.200 millones de euros. El total de empleados del sector en la región es de más de 14.270 personas (el 6% del total en la CV).
En lo concerniente al sector del calzado, y según los últimos datos consolidados de los que se dispone (año 2013, fuente Federación de Industrias del Calzado Español) la Comunitat Valenciana cuenta con 940 empresas que emplean a 14.335 trabajadores y tienen un volumen de facturación total de 2.139 millones de euros. Estas cifras suponen una tendencia alcista respecto al año anterior.
La importancia y el potencial actual que el sector del calzado tiene en la industria valenciana quedan reflejadas en el mismo informe del FICE. Según este informe, el número de empresas en la Comunitat Valenciana pertenecientes al sector calzado supone un 66,5% del total de las empresas del sector a nivel nacional, dato que habla de un verdadero clúster empresarial.

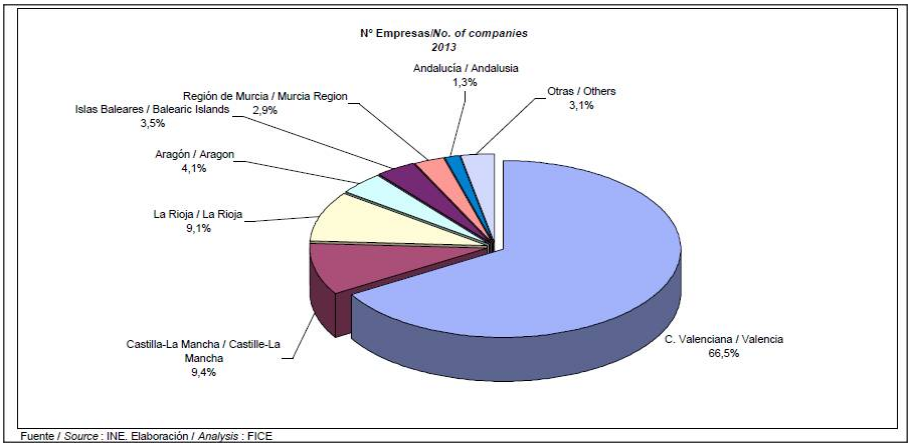

Figura 2. Porcentaje de empresas del calzado por CCAA. Fuente: FICE, Anuario 2013

A modo de resumen, se indican el número total en la Comunitat Valenciana de empresas beneficiarias (entre otros datos) de los resultados del proyecto:

Sector	Número de empresas	Número de empleados	Facturación (M€)
Plástico y Caucho	746	14.270	2.236
Calzado	940	14.335	2.139
Total	**1.686**	**28.605**	**4.375**

En resumen, estamos hablando de más de **1.600 empresas potenciales usuarias** y beneficiarias de los resultados de OPTIMAN **para el aseguramiento de la calidad y la eficiencia en el proceso** productivo. Además, el hecho de escoger como uno de los casos de aplicación de esta herramienta, su implementación en el sector de inyección de plástico, probablemente uno de los más exigentes de todos los procesos productivos asociados a la fabricación de productos plásticos, nos permite ganar en confianza a la hora de configurar esta misma herramienta para

otros procesos de transformación empleados en el sector menos exigentes en su sistemática de producción.

Cuantificación empresas beneficiarias a nivel de Comunitat Valenciana

Según los datos calculados, el total de empresas potenciales beneficiaras del proyecto asciende a 1.686. Dado que el proyecto facilita la optimización de los procesos de producción de las industrias incrementando su eficiencia y competitividad, se considera que la mitad del total de las empresas innovadoras son potenciales beneficiarios del proyecto a medio plazo y que entre las empresas no innovadoras, un 20% podrían asumir dichos resultados y dar el salto a la innovación. Por tanto, el **total de empresas potenciales beneficiarias a nivel nacional resulta de 453 empresas.**

Teniendo en cuenta que el número de empresas potenciales beneficiarias a nivel de Comunitat Valenciana, tal y como se indicó en el apartado anterior, es de 453 frente a 1.686 totales, y que el volumen de facturación total de los sectores identificados en CV es de 4.375 millones de euros, se ha estimado un volumen medio de facturación total de las empresas beneficiarias de 1.060 millones de euros. Si consideramos un impacto medio inducido de los centros tecnológicos del 0,89% para el volumen de negocio según FEDIT, y que la solución propuesta está por encima de media en cuanto a su impacto económico debido a cambios drásticos en términos de eficiencia en la producción de bienes (factor corrector 1'2), **el impacto económico total anual resulta de 11,32 millones de euros anuales**.

Además de los datos mencionados, recabados al inicio del proyecto comentar que, también basándonos en fuentes más actualizadas del INE (ver http://www.ine.es/prensa/np950.pdf) las comunidades autónomas con mayor porcentaje de empresas innovadoras en el periodo 2012-2014 fueron Cataluña (un 32,3% de sus empresas fueron innovadoras), La Rioja (31,8%), y Comunitat Valenciana y País Vasco (ambas con un 31,2%).

Empresas innovadoras en el periodo 2012-2014 por comunidades y ciudades autónomas

	Empresas innovadoras		Empresas con innovaciones tecnológicas (*)		Empresas con innovaciones no tecnológicas (**)	
	Total	%	Total	%	Total	%
TOTAL	**39.893**	**28,6**	**18.511**	**13,3**	**32.626**	**23,4**
Andalucía	5.253	26,0	1.903	9,4	4.489	22,3
Aragón	1.257	30,0	656	15,6	1.011	24,1
Asturias, Principado de	554	22,1	316	12,6	412	16,4
Balears, Illes	714	19,7	267	7,4	590	16,3
Canarias	1.513	26,4	510	8,9	1.329	23,2
Cantabria	341	22,6	188	12,4	246	16,3
Castilla y León	1.376	22,9	688	11,5	1.063	17,7
Castilla-La Mancha	1.184	24,6	498	10,3	1.001	20,8
Cataluña	8.830	32,3	4.307	15,8	7.162	26,2
Comunitat Valenciana	4.439	31,2	1.954	13,8	3.742	26,3
Extremadura	556	24,5	248	10,9	398	17,5
Galicia	1.925	25,8	997	13,4	1.480	19,9
Madrid, Comunidad de	7.188	30,7	3.255	13,9	6.065	25,9
Murcia, Región de	1.149	26,0	485	11,0	946	21,5
Navarra, Comunidad Foral de	673	27,8	436	18,0	500	20,7
País Vasco	2.531	31,2	1.530	18,9	1.898	23,4
Rioja, La	362	31,8	236	20,7	265	23,2
Ceuta	22	15,6	18	12,4	16	11,0
Melilla	25	19,3	19	14,9	12	9,5

Nota: Porcentajes calculados sobre la población de empresas de 10 o más asalariados de cada comunidad o ciudad autónoma.

(*) Empresas que han introducido innovaciones de producto y/o de proceso.

(**) Empresas que han introducido innovaciones organizativas y/o de comercialización.

Figura 3. Datos extraídos de http://www.ine.es/prensa/np950.pdf

Esto da idea del potencial de aplicación que tenemos a nivel regional, alineándonos con la política innovadora de la mayoría de nuestras empresas industriales, interesadas en la innovación orientada a producto y proceso.

Además., como se puede observar en la siguiente Tabla, los sectores de calzado y plásticos son lo que presentan una mayor intensidad innovadora de los sectores teóricamente más "tradicionales", sólo por detrás de las industrias de un perfil más innovador y con mayor presencia de grandes empresas como puede ser el sector farmacéutico, el automovilístico o las empresas tecnológicas (comunicaciones o sector eléctrico-electrónico).

15.1.7. Gastos e intensidad en innovación por ramas de actividad. Millones de €

	2011		2012		2013		2014	
	Gastos	Intensidad	Gastos	Intensidad	Gastos	Intensidad	Gastos	Intensidad
TOTAL	14.755,81	0,91	13.410,35	0,84	13.233,29	0,91	12.959,84	0,89
1. Agricultura, ganadería, silvicultura y pesca	96,06	0,60	118,05	0,79	90,46	0,49	87,40	0,52
2. Industrias extractivas y del petróleo	160,48	0,26	151,30	0,22	151,22	0,20	147,52	0,18
3. Alimentación, bebidas y tabaco	655,36	0,67	562,01	0,58	558,75	0,61	578,19	0,61
4. Textil, confección, cuero y calzado	145,35	1,07	125,20	1,00	134,38	1,06	175,57	1,32
5. Madera, papel y artes gráficas	172,93	0,73	113,55	0,51	101,37	0,49	125,20	0,60
6. Química	349,50	1,00	345,52	0,99	366,12	1,08	360,52	1,04
7. Farmacia	1.115,52	5,10	1.127,62	5,47	1.043,00	4,96	1.124,42	5,48
8. Caucho y plásticos	225,41	1,21	200,06	1,14	183,89	1,07	175,69	1,04
9. Productos minerales no metálicos diversos	122,59	0,67	108,34	0,68	144,49	1,01	102,49	0,70
10. Metalurgia	192,47	0,61	138,71	0,48	155,92	0,56	117,96	0,41
11. Manufacturas metálicas	273,42	0,95	248,05	0,98	257,81	1,14	258,66	1,11
12. Productos informáticos, electrónicos y ópticos	258,85	6,23	217,30	6,26	221,82	6,66	226,35	6,27
13. Material y equipo eléctrico	314,05	1,78	312,96	2,05	262,91	1,99	271,94	1,99
14. Otra maquinaria y equipo	403,43	2,06	328,31	1,79	304,58	1,72	326,74	1,79
15. Vehículos de motor	1.473,41	2,75	1.545,22	3,13	1.779,30	3,38	1.263,79	2,18
16. Otro material de transporte	960,21	8,16	839,64	7,53	831,17	7,46	666,46	6,10
17. Muebles	52,14	1,03	34,68	0,80	30,83	0,83	27,11	0,70
18. Otras actividades de fabricación	74,56	2,17	66,40	1,68	67,02	2,28	60,49	1,83
19. Reparación e instalación de maquinaria y equipo	22,26	0,48	19,07	0,43	22,25	0,43	21,64	0,51
20. Energía y agua	237,64	0,40	258,34	0,37	242,61	0,36	221,72	0,37
21. Saneamiento, gestión de residuos y descontaminación	65,47	0,63	50,22	0,44	44,08	0,43	36,24	0,35
22. Construcción	288,75	0,25	193,16	0,20	161,14	0,26	167,56	0,26
23. Comercio	581,96	0,14	508,60	0,12	438,61	0,12	362,90	0,10
24. Transportes y almacenamiento	682,47	0,84	380,86	0,50	325,04	0,44	276,35	0,38
25. Hostelería	23,28	0,08	27,82	0,07	14,98	0,04	15,55	0,05
26. Información y comunicaciones	2.370,85	3,04	2.059,23	2,51	1.752,25	2,28	1.968,61	2,60
27. Actividades financieras y de seguros	792,50	0,40	738,91	0,36	966,30	0,55	1.128,71	0,71
28. Actividades inmobiliarias	17,75	0,28	17,59	0,32	4,63	0,06	7,74	0,12
29. Actividades profesionales, científicas y técnicas	2.367,71	5,81	2.294,24	5,73	2.318,58	5,48	2.388,61	4,98
30. Actividades administrativas y servicios auxiliares	63,64	0,14	81,77	0,19	82,49	0,20	71,74	0,18
31. Actividades sanitarias y de servicios sociales	133,80	0,43	150,36	0,34	135,96	0,46	146,80	0,46
32. Actividades artísticas, recreativas y de entretenimiento	16,40	0,29	14,12	0,28	11,44	0,18	16,49	0,27
33. Otros servicios	45,59	1,59	33,14	1,36	27,90	1,18	32,70	1,31

NOTA.- Intensidad es el gasto en innovación en porcentaje de la cifra de negocios.
Fuente de información: Encuesta sobre Innovación en las Empresas. INE.

Figura 4. Intensidad innovadora por sector (fuente: http://www.ine.es/prodyser/pubweb/anuario16/anu16_15tecno.pdf).

Todo ello contribuye a reforzar la idea de que esta herramienta desarrollada en el proyecto OPTIMAN, aunque se encuentra en un TRL no inmediato a su traslación a mercado, si está bien posicionado para poder captar el interés de la mayor parte de las empresas interesadas en la innovación en proceso, tal y como nos muestran los distintos estudios estadísticos mencionados.

4.2. Definición de los resultados de OPTIMAN como producto comercializable.

La innovación tecnológica del presente proyecto a la industria de **inyección del plástico** se va a plasmar en:

- Un sistema de sensorización del comportamiento de máquina (enfocado al mantenimiento predictivo y preventivo del equipamiento).
- Un sistema de recogida de datos de parámetros de funcionamiento de la inyectora durante la producción de piezas.
- Un sistema de recogida de datos de consumo y alineación de los mismos con los datos de producción.

Todos estos subsistemas se enmarcarían en una herramienta capaz de informar acerca de tendencias en el proceso productivo, detectar señales de alarma asociados al funcionamiento de la máquina y también proporcionar outputs útiles para optimizar consumos energéticos.

Respecto al **sector del calzado** (producción de componentes), la innovación tecnológica que presenta el proyecto se puede resumir en:

- Un sistema para asegurar la calidad de la producción al tiempo que se aumenta la eficiencia energética, mediante la aplicación de inteligencia en el proceso de configuración de la máquina
- Un sistema que permita la implementación de mantenimiento predictivo de las herramientas, para anticipar problemas de producción, mejorar el mantenimiento, y anticipar el consumo de materia prima.

Estas soluciones tecnológicas descritas implican por una parte la integración de elementos sensores en los centros de mecanizado, así como de dispositivos de captura y transferencia de datos en la nube, y un posterior tratamiento de los mismos (mediante técnicas de análisis de Big Data), para terminar con un modelado matemático de sistemas predictivos, sistemas de alerta y modelos de configuración inteligente de la maquinaria.

Si articulamos el modelo de explotación de los resultados de OPTIMAN, la vía más clara de comercialización pasa por el híbrido producto/servicio dado que va a suponer:

- Una necesaria labora de asesoría para definir, conocer e identificar en detalle todos los principales aspectos que delimitan la realización del proceso productivo en el que se quiera implantar este sistema de control y monitorización in line.
- Un producto final resultante, un software, que recoja toda la información acerca de las variables del proceso. Serán aquellas variables que afectan a aspectos críticos como la productividad del mismo, la calidad de los productos obtenidos y la eficiencia energética conseguida optimizando los parámetros de proceso y mediante un

continuo monitoreo del comportamiento de los equipos industriales implicados que evite mal funcionamiento de los mismos o un funcionamiento ineficiente.

4.3. Rol de los Centros en el futuro Plan de Negocio.

Aunque el TRL alcanzado con las tareas ejecutadas en los 2 años del proyecto OPTIMAN únicamente nos permiten alcanzar un TRL 5-6 si podríamos definir un modelo aproximado de negocio siguiendo el método CANVAS.

Este modelo de Negocio se definiría a partir de:

- Segmentos de clientes: Los mencionados en el apartado 4.1 inicialmente (es decir, sector calzado y plásticos) aunque extrapolable a otros sectores de manufactura industrial.
- Propuesta de valor: El sistema en sí, es decir el software de control y monitoreo del proceso de fabricación asociado también a la asistencia técnica cualificada que prestarían los Centros tecnológicos implicados.
- Canal: La comunicación directa con los clientes, la interlocución con los mismos, la recogida de datos e información sobre el proceso productivo a controlar exige un contacto continuo de manera que el producto final será la versión optimizada del sistema que se irá desarrollando en colaboración con el cliente a lo largo de la prestación y ejecución del servicio.
  Además, está la posibilidad de utilizar canales de promoción vía web o empleando como amplificadores las asociaciones empresariales y los distribuidores de equipos industriales.
- Relación con los clientes: Existe una mayor seguridad y confianza en la relación con los clientes, al menos en la etapa inicial de comercialización del producto dado que se va a efectuar en sectores industriales en las que los centros tecnológicos implicados, AIMPLAS e INESCOP, constituyen centros de prestigio y referencia para sus empresas manufactureras.
- Flujo de ingresos: Los ingresos vendrían asociados tanto a la fase de asistencia y asesoramiento en la mejora del proceso productivo como al mismo desarrollo de la herramienta para el control. Nos encontraríamos entonces con dos propuestas de valor diferenciadas, un servicio y un producto ciberfísico que se deberían cuantificar dependiendo de la complejidad de cada proceso productivo o de los equipos empleados.
- Recursos clave: Los aportados por los 3 Centros Tecnológicos implicados, tanto a nivel de equipamientos y tecnologías disponibles como de know-how específico.
- Actividades clave: Las actividades que se necesita desarrollar para poder generar negocio con OPTIMAN pasan por acciones como:
  - difusión entre los clientes potenciales,
  - convencer de la necesidad de implantar un sistema como OPTIMAN en sus empresas (mediante jornadas, seminarios y workshops),
  - una correcta coordinación en la preparación y ejecución de las tareas asociadas a la implantación del sistema OPTIMAN.

  - Un adecuado mantenimiento del sistema a lo largo del tiempo, para hacerlo adaptable a cambios en los requerimientos de productividad o calidad de los productos manufacturados o a variaciones en los equipos de producción.
- Alianzas: El núcleo será inicialmente el formado por los 3 centros involucrados, ITI, AIMPLAS e INESCOP pero deberá ser ampliado necesariamente a otros actores industriales como son los proveedores de software o de equipos industriales de referencia. En el medio plazo se deberá contemplar la posibilidad de crear otros núcleos de implantación (replicando los conocimientos y estructura del núcleo original) para favorecer la extensión de este modelo de negocio a otras áreas geográficas u entornos productivos técnicamente más alejados de la expertise y localización geográfica que representan actualmente ITI, AIMPLAS e INESCOP.
- Costos: En este punto de ejecución del proyecto no es posible realizar una evaluación de los costes unitarios que puede suponer una implantación báscia de OPTIMAN.

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