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FP7-2012-NMP-ICT-FoF, Grant No.:314055

HI-MICRO

High Precision Micro Production Technologies

Collaborative project - Small or medium-scale focused research project
1.10.2012 – 30.9.2015

PROJECT FINAL REPORT

Grant Agreement number: **314055**

Project acronym: **Hi-Micro**

Project title: **High Precision Micro Production Technologies**

Funding Scheme: **FP7-2012-NMP-ICT-FoF**

Period covered: from **01.10.2012** to **30.09.2015**

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4.1 Final publishable summary report

4.1.1 Hi-Micro project executive summary

The **Hi-Micro** project has successfully developed an innovative approach for the design, manufacturing and quality control of tool inserts to achieve significant breakthrough in mass production of precision 3D micro-parts, through breakthroughs in developing of both enabling manufacturing technologies, e.g. additive manufacturing (AM), micro electrical discharge machining (micro-EDM), micro electro-chemical machining (micro-ECM) and micro-milling, and unique metrology and quality control methods such as computer-tomography (CT) metrology and digital holography. Together with industrial technology providers, the **Hi-Micro** project has laid down the step stones to bolster the performance of industrial equipment for mass production of precision 3D micro-parts, through modular design of tool insert units with improved thermal management capability, development of on-machine handling system and in-line quality control device. Activities will run over the entire value chain of mass production of precision 3D micro-parts, from product and tool insert design, manufacturing of tool inserts, micro injection moulding processes, to the production equipment and quality control in the whole production chain.

In order to tackle the identified challenges and critical problems in European manufacturing industry, the **Hi-Micro** project has provided radical innovations and major breakthroughs as follows:

- Development of design and tolerance guidelines for advanced micro manufacturing of components (nominal size <1mm)
- Reliable capability of manufacturing tool inserts with complex internal features for formal thermal management in micro-injection moulding (µIM) and micro powder injection moulding (µPIM)
- Processing technologies and equipment for manufacturing of 3D micro-parts with increased precision and accuracy to ensure smaller tolerances for the products, and
- Metrology methods for complex internal structure and high-speed inline quality control with improved measurement efficiency and without loss of resolution or accuracy.

The **Hi-Micro** project has successfully helped industrial stakeholders demonstrated their enhanced capacity in realizing next generation of products, including

- **Ceramic knocker components** for high-end watch through micro powder injection moulding
- **Biochip** for lab-on-chip application of disease detection
- Novel surgical device for ophthalmic surgery
- **Multi-fold flow device** for next generation of printing heads, and
- **A micro-injection moulding platform** with integrated on-machine high-speed QA system.

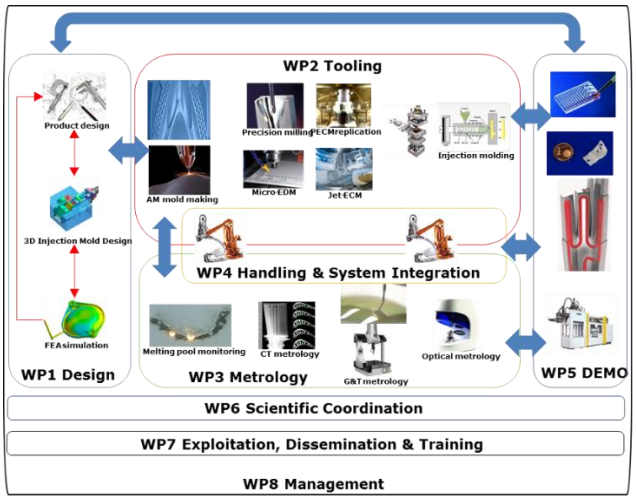


Figure 1: Hi-Micro project PERT chart and management structure

As depicted in Figure 1 as the **Hi-Micro** project approach and strategy according to the organization of WPs, this project is implemented in eight work packages (WP), with WPs 1 to 4 and WP6 dealing with the technical developments and scientific coordination, WP5 containing the demonstration activities, WP7 for dissemination and exploitation of the foregrounds, and WP8 dedicated to project management and coordination activities.

4.1.2 Project context and objectives

Project context

The **Hi-Micro** project has realized an innovative value chain, covering the design, manufacturing and quality control of new, complex micro parts by micro injection moulding, in order to achieve significant breakthrough in reliability and efficiency of versatile, highest quality mass production. This includes not only further developing enabling manufacturing technologies such as Additive Manufacturing (AM), micro electrical discharge machining (micro-EDM), micro electro-chemical machining (micro-ECM) and micro-milling, but also unique metrology and quality control methods such as computer-tomography (CT) and digital holography. Furthermore, **Hi-Micro** has significantly advanced the simulation and process stability of both µIM and µPIM process and developed handling methods to allow for integration of multi-material inserts into sophisticated, cutting edge next-next generation European products in biomedical, micro optical, MEMS and other high economic potential markets.

Together with industrial technology providers, the **Hi-Micro** project has further bolstered the performance of industrial equipment for mass production of precision 3D micro-parts, through modular design of tool insert units with improved thermal management capability, development of on-machine handling system and in-line quality control device. Activities have run over the entire value chain of mass production of precision 3D micro-parts, from product and tool insert design, simulation, manufacturing of tool inserts, micro injection moulding processes, to the production equipment and quality control in the whole production chain.

The implemented scheme of process chain and partner involvement is depicted in *Figure 2*. The **Hi-Micro** innovative process chain has be studied for all demonstrators. In particular: The product and

tool design and engineering have be carried out through cooperation of **SOPHION, XAAR, POX, FORMATEC**, **KULEUVEN** and **DTU**; **KULEUVEN** and **LAYERWISE** have produced the tool inserts by high precision additive manufacturing; **UNIBREMEN, KULEUVEN** and **TUCHEMNITZ** will provide the necessary process chain design and cavity micro machining; **DESMA** and **DTU** have provided the micro manufacturing platform concept including moulding, assembly and handling; **X-TEK** has carried out the computer tomography metrology for the quality control of both tool inserts and components and **UNIBREMEN,** together with **DESMA** has implemented the in-line high speed optical metrology equipment on an industrial micro-injection moulding system.

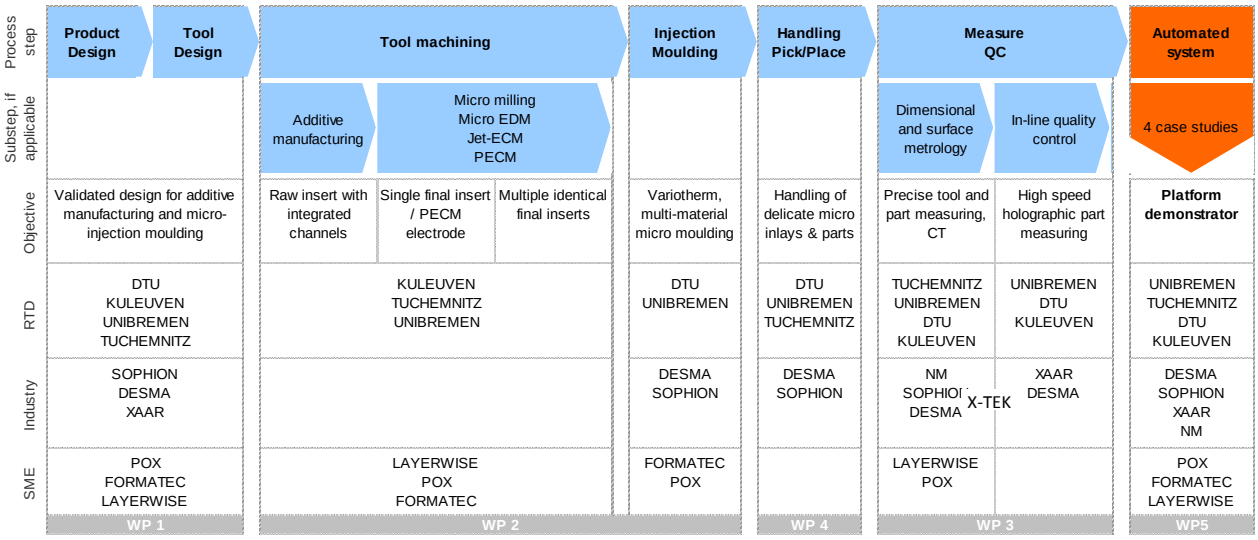


Figure 2: **Hi-Micro** process chain and partner involvement

Project objectives

In order to tackle the identified challenges and critical problems, the **Hi-Micro** project has planned to provide radical innovations and major breakthroughs to achieve **specific objectives** as follows:

- *Reliable capability of manufacturing monolithic tool inserts made by Additive Manufacturing (AM) with integrated complex internal features (<150µm) for thermal management and process control,*

O1 - Novel process chain for 3D micro-parts production, integrating different process technologies (AM, micro-EDM, micro-ECM, ultra-precision milling/turning, CT metrology, digital holography, µIM, µPIM, etc.), whereby reducing energy consumption and waste by 50%.

O2 - Tool inserts for µIM and µPIM with locally embedded thermal sensors and actuators produced using an optimized SLM process, including complex channels of feature size less than 150µm.

O3 - Modularized tool insert units applicable for µIM and µPIM of 4 part demonstrators and compatible with industrial production platform.

- *Development of design and tolerance guidelines for advanced micro manufacturing of components (nominal size <1mm),*

O4 - ISO adaptable tolerance framework for micro parts and sub-micro topography to both drive micro part design and validate/standardize micro manufacture processes capability, whereby reducing 50% waste and scrap in production.

O5 - Design principle and guidelines for additive manufacturing-oriented component design, i.e. design methodology dramatically different from traditional methods for components machined by e.g. milling etc.

O6 - Design rules for PECM-tool electrode design (including flushing) to achieve defined micro structures of highest shape accuracy of 1-2µm.

- *Precision processing technologies and equipment for manufacturing of 3D micro-parts with increased precision and accuracy to ensure smaller tolerances for the products, and*

O7 - Micro Jet-ECM unit capable of precision machining metallic parts produced by Additive Manufacturing. Extensive knowledge on the ECM behavior, applicable process parameters and achievable surface properties enable to improve target diameter to 10µm and increasing process accuracy by factor 5.

O8 - PECM process chain for fast and cost-efficient machining higher numbers of identical mould inserts, substituting time- and tool consuming processes (e.g. cutting and EDM) to increase efficiency by factor 20.

O9 - Micro-EDM tool electrode in-feed mechanism in combination with process monitoring for on-machine tool wear compensation, to achieve 1 µm machining accuracy with 40% increase of machine utilization.

O10 - Precision µIM and µPIM with localized conformal thermal management for large volume 100% defect-free production of 3D micro products for life science, medical, consumable and telecommunication industry, with reproducible/repeatable part tolerance <1% for all process parameters as measured on the micro polymer processing equipment.

- *Metrology methods for complex internal structure and high-speed inline quality control with improved measurement efficiency and without loss of resolution or accuracy.*

O11 - Improved CT hardware with improved reconstruction algorithm capable of reducing the severity of beam hardening and cone beam artefacts.

O12 - Calibration objects for scaling and segmentation of CT measurements of micro-parts (100µm)

O13 - Accurate/high-speed quality control equipment using digital holography for complex 3D micro parts, micro-features and sub-micro surface topography. Capable of (A): fast in-line inspection with high accuracy and precision dimensional measuring capability (repeatability: 0.5-1 µm, uncertainty: 1.0-2.5 µm), including functional test, and total inspection time in the order of the micro injection moulding cycle time (1-10 s, i.e. 10-20 times faster than 3D micro optical currently available systems); (B): Definitive, fast and accurate surface measurements of micro and nano-features vertical resolution: 0.01 µm and surface roughness measurements repeatability: 0.02 µm.

- *Integration of production process with quality control system.*

O14 - **Industrial production platform** (1 or 2K) integrated with in-line high-speed quality control system and handling system to reduce manufacturing platform footprint by 30% (i.e. combination of multistep production, testing, assembly). In-line high speed quality control process (cf. O13) capable of **non-statistic inspecting** 100% of the produced micro-parts and envisioned production system's cycle time lies under 10 s.

*Achieving these objectives is expected to bring about **immediate positive impacts** to **Hi-Micro** beneficiaries and to the European manufacturing industry through knowledge diffusion and exploitation. With the successful development of **Hi-Micro** process chain, enabling processing technologies and unique metrology systems, expected impacts are:*

Contribution to the development of Advanced Manufacturing Systems defined in **EU2020 strategy** to promote the competitiveness of European SMEs and INDs.

- Drastic **reduction of production step, assembly time and quality control cycled** through monolithic design of tool inserts, whereby reducing energy consumption and scrap by 50%.
- Enabling consortium technology providers (**DESMA**, **X-TEK**, **LAYERWISE**) to improve their **technology competence and competitiveness**, and **generate new jobs**, for instance **LAYERWISE** expects 100% yearly growth and expands his business to micro mechatronics and high precision machine components, chemical industry, medical tools and instruments, medical implants.
- Enabling consortium end-users (**SOPHION**, **POX**, **XAAR**, **FORMATEC**) to realise innovation in their new generation of products in a cost-efficient way in different sectors (life-science, medical, consumable and telecommunication etc.).

Compared to the current status (*Figure 3*), the expected impacts of **Hi-Micro** project are summarized in Figure 3.

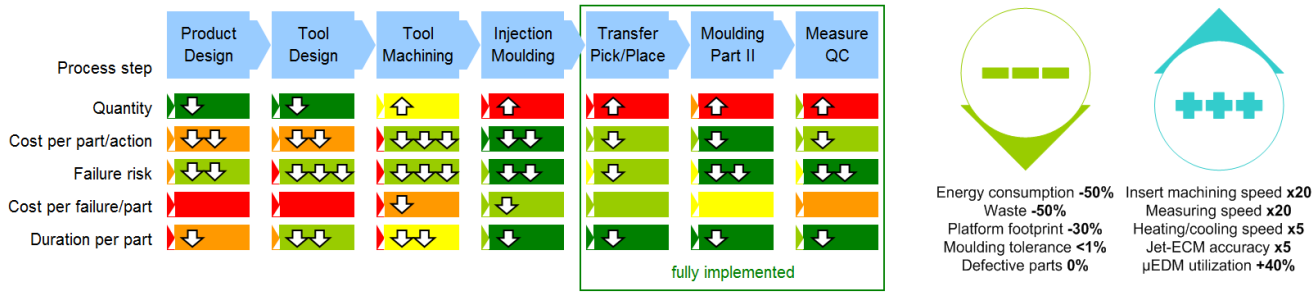


Figure 3: Hi-Micro impact expectation

4.1.3 Main S&T results/foregrounds

The **Hi-Micro** project has been be implemented following eight work packages (WP): WPs 1 to 4 and WP6 dealing with the technical developments and scientific coordination, WP5 containing the demonstration activities, WP7 the dissemination and exploitation of the foregrounds, and WP8 the project management and coordination activities.

The technical developments have been split between the work packages grouped into four important aspects in the process chain of precision manufacturing of 3D micro-parts through micro injection moulding: manufacturing-oriented product design (WP1), high precision manufacturing technologies for tool inserts (WP2), precision metrology for complex features (WP3), and product handling and quality control integration in manufacture system (WP4). These activities and S&T results/foregrounds are further summarized as the following:

- WP1: **Manufacturing-Oriented Product Design** The overall goal of WP1 is to develop general design guidelines to produce mould inserts with Additive Manufacturing (AM), taking into account both the possibilities and the limitations of AM processes. In the same time, a validated tolerance framework and design rules for micro product development in micro-injection moulding (µIM) and micro powder injection moulding (µPIM) will also be developed. The RTD focus and some of the achieved results are illustrated in Figure 4.

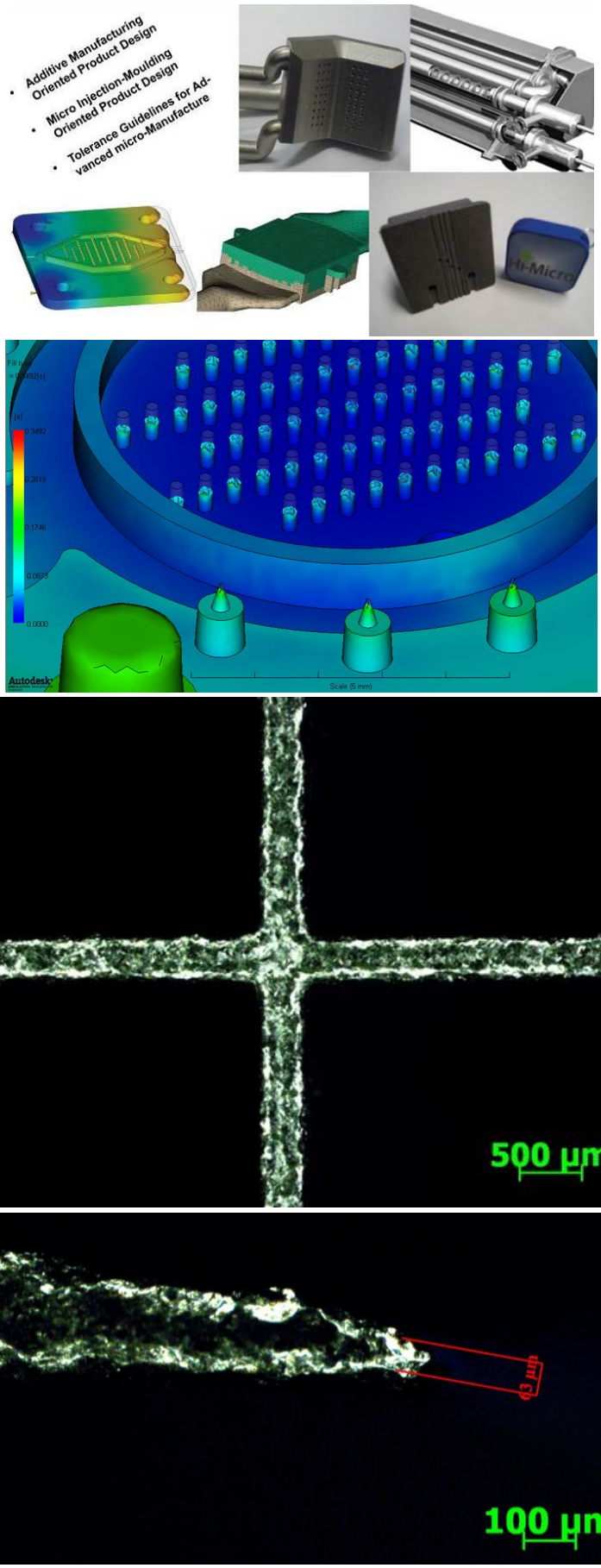


Figure 4: Achievements in manufacturing-oriented product design

In this workpackage, the following deliverables and milestones have been obtained:

- D1.1 Product/Tool/Process simulation report for proof-of-technology (PoT) components (M12)
- D1.2 General guidelines for producing moulds with AM (M24)
- D1.3 Standardized micro moulding simulation procedure and tolerance guidelines (M24)
- MS3 Definition of WP1 RTD requirements (M6) All technological requirements in RTD WP1 are defined and reported.
- MS6 Micro moulding simulation standard procedure is available (M9) The micro moulding simulation standard procedure for concurrent engineering of micro product including a closed loop product/tool/process design is validated, error less than 0.5%..
- MS7 General guidelines to produce moulds with Additive Manufacturing (AM) are available (M9) A set of general guidelines for producing moulds with AM, taking into account both the possibilities and the limitations of AM processes is available, design efficiency improvement 50%.

- WP2: **High Precision Manufacturing Technologies** has focused on the development of enabling precision processing technologies, including additive manufacturing for mould inserts with complex internal features, micro-milling, micro-EDM, jet-ECM and PECM for detailed inserts features and the µIM and µPIM processing technologies.

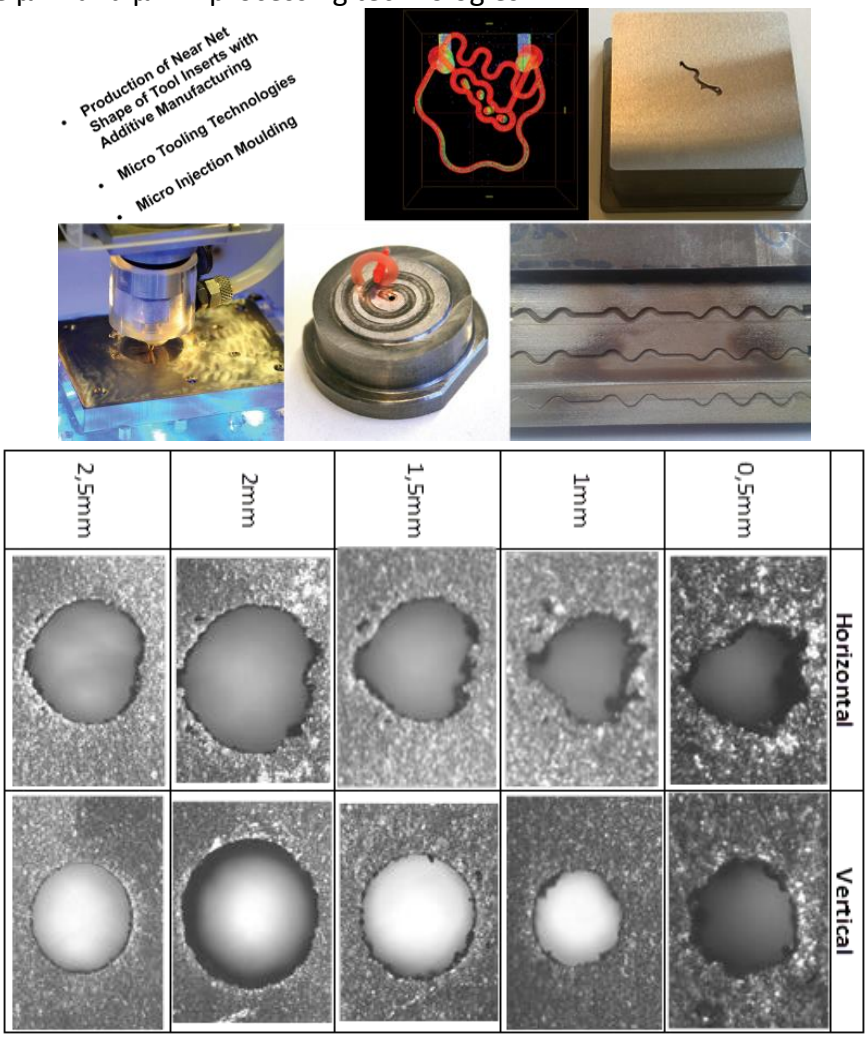
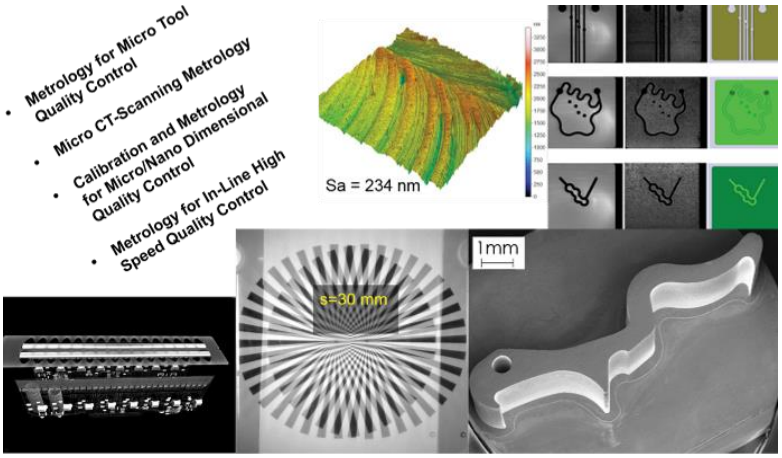


Figure 5: Achievements in high precision manufacturing technologies

In this workpackage, the following deliverables and milestones have been obtained:

- D2.1 AM technology for PoT mould inserts with non-conformal cooling for preliminary tests (M10)
- D2.2 AM technology for PoT mould inserts with conformal cooling for preliminary tests (M15)
- D2.3 Precision micro-machining processes for machining cavities on PoT micro injection mould inserts (M24)
- D2.4 Active micro-wire tool electrode in-feed technique for the real-time compensation (M24)
- D2.5 Adapted micro injection moulding process with AM produced PoT mould insert and local thermal management (M30)
- **MS4** Definition of WP2 RTD requirements (M6) All technological requirements in RTD WP2 are defined and reported.
- **MS8** Process parameters for production of the different chosen mould materials (e.g. IMPAX) available (M9) PoT (proof of technology) components (Ø10mm) with 100-150 µm internal channels produced by AM and quality controlled by CT metrology
- **MS9** Monitoring of micro-manufacturing processes is working (M18) Design monitoring devices of precision machining, micro-EDM, laser processing and replication is completed.

- WP3: **Precision Metrology for Complex Features** will ensure the quality of both tool inserts and 3D micro-parts produced by micro-injection moulding. This WP will deal with both hardware improvement and optimization of reconstruction algorithm in CT scanning metrology for complex internal features and multi-material components. A high-speed in-line quality control system based on digital holography metrology will be developed. In addition to the development of metrology methods, calibration of dimensional metrology will also be carried out in this workpackage.



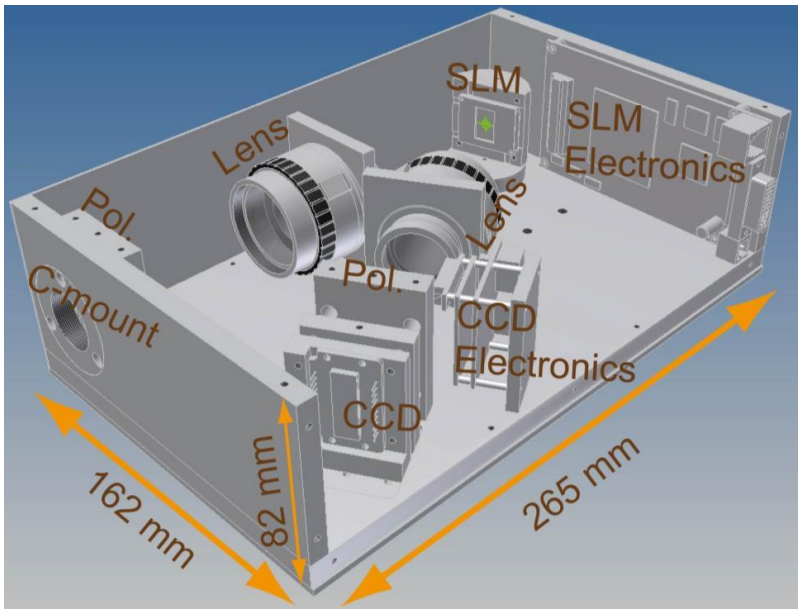


Figure 6: Achievements in precision metrology for complex features

In this workpackage, the following deliverables and milestones have been obtained:

- D3.1 Calibration objects and procedures for scaling and segmentation of CT measurements of micro-parts (M24)
- D3.2 In-line high speed quality control technology based on digital holography (M24)
- D3.3 Metrology of PoT micro tool inserts and quality control (M24)
- D3.4 Micro CT scanning metrology for PoT micro-parts (M30)
- D3.5 Calibration and Metrology for Micro/Nano Dimensional Quality Control (M33)
- MS5 Definition of WP3 RTD requirements (M6) All technological requirements in RTD WP3 are defined and reported.
- MS10 Artefacts for CT metrology of mould inserts are available (M18) Artefacts will be produced, calibrated and traced to length standard (ISO 14253-1).
- MS11 Adapted digital holography device for the in-line high speed quality control (M18) Device experimentally validated, repeatability: 1 µm, uncertainty: 2 µm

- WP4: **Product Handling and Quality Control Integration on a Manufacturing System** is directly linked to the demonstrator production and hardware development of a precision high-volume production platform for 3D micro-parts in **Hi-Micro** project. Handling of micro-parts in the process has been investigated and the high-speed quality control system developed in WP3 has been integrated into a DESMA system.

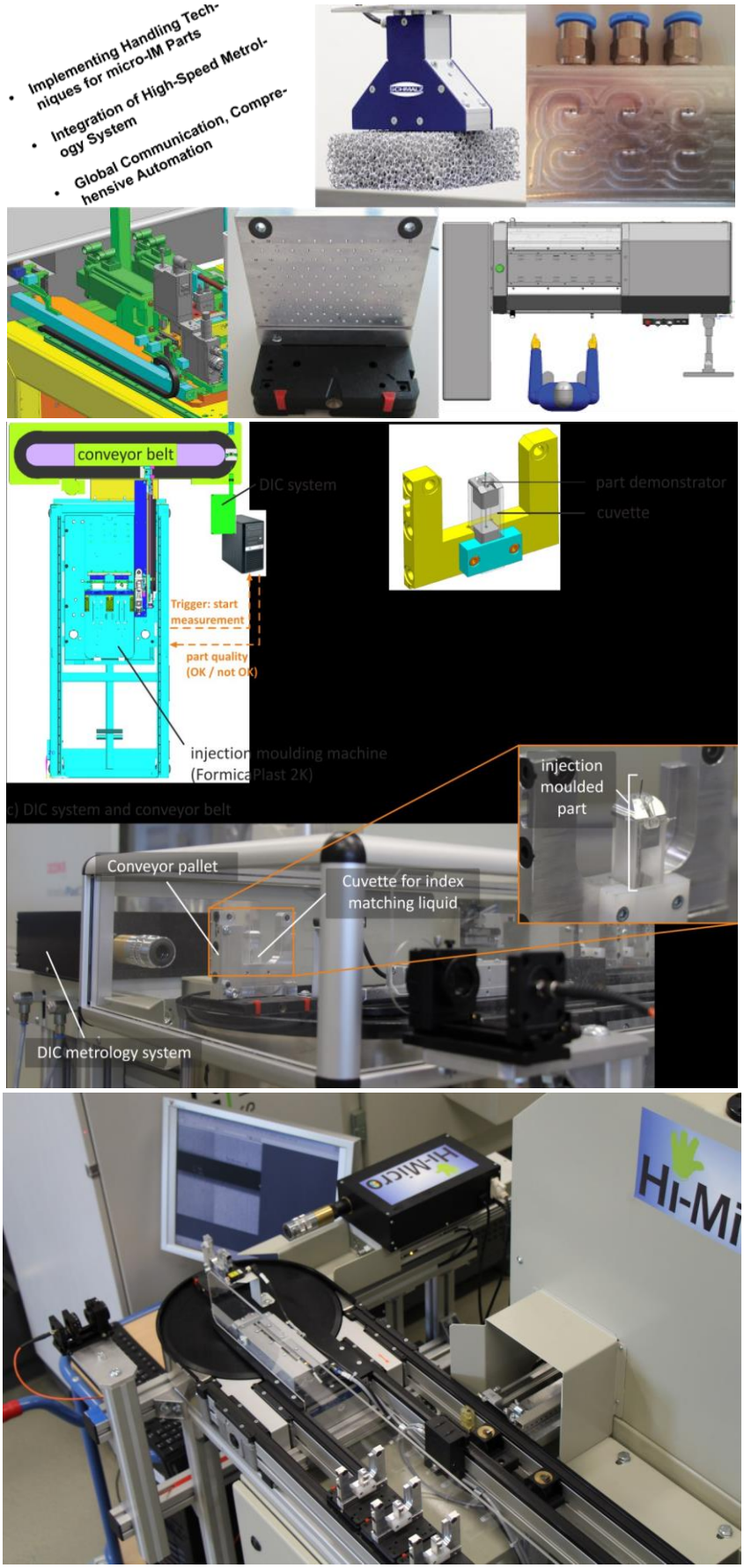


Figure 7: Achievements in product handling and quality control integration

In this workpackage, the following deliverables and milestones have been obtained:

- D4.1 Handling technology for the development of the Hi-Micro production system (M26)
- D4.2 Technologies for fully integrating PoT high speed metrology system (M36)
- D4.3 System integration technologies for Hi-Micro production platform with in-line quality control (M36)
- MS12 Handling concepts for all micro part demonstrators are available (M18) Technical reports approved by **Hi-Micro** consortium.

- WP5: project **Demonstration** has concentrated on the development of the requirements of the case studies 1 to 4, the production of the case study parts (involving the moulds as well as the micro injection moulded parts) and on the set up of the fully operational **Hi-micro** production system to demonstrate the development of advanced technologies within the **Hi-Micro** project. In the last part of the project, the technical developments, especially the precision high-volume production platform for 3D micro-parts will be demonstrated in an industrial environment within WP5.

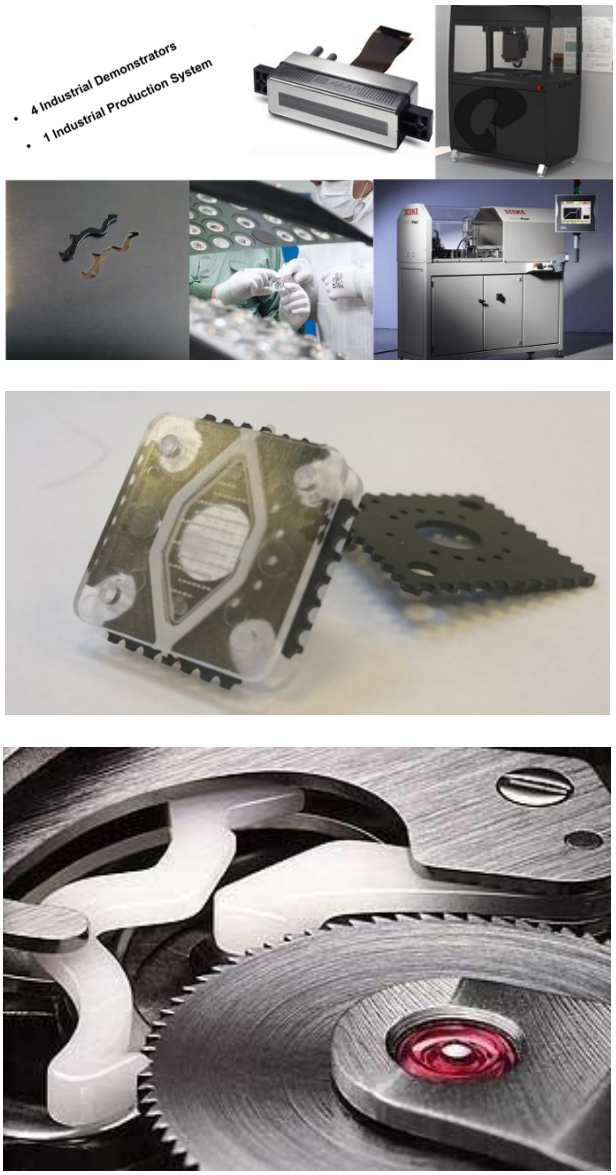


Figure 8: Achievements in project demonstration of industrial components

4.1.4 The potential impact

The impact of the research and development will be industrially assessed in specific 4 case studies, with overall applications in the medical/life science, healthcare, consumable and telecommunication sectors. In addition to producing the 4 demonstrators, the industry relevance of the **Hi-Micro** project will be further assessed through the realization of a high precision high volume manufacturing platform implemented in an industrial environment, capable of producing 3D micro-parts of high precision and improved surface quality with reduced resource and high cost efficiency.

4.1.5 Project website

The official website of the Hi-Micro project is: http://www.hi-micro.eu/

The **Hi-Micro** project consists of two parts, one being open to general public and another section only accessible to project partners. A screen capture of the website is shown in Figure 9.

Figure 9: Hi-Micro Project Website

4.1.6 Project contacts

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4.2 Use and dissemination of foreground

A plan for use and dissemination of foreground (including socio-economic impact and target groups for the results of the research) shall be established at the end of the project. It should, where appropriate, be an update of the initial plan in Annex I for use and dissemination of foreground and be consistent with the report on societal implications on the use and dissemination of foreground (section 4.3 – H).

The plan should consist of:

- Section A

  This section should describe the dissemination measures, including any scientific publications relating to foreground. **Its content will be made available in the public domain** thus demonstrating the added-value and positive impact of the project on the European Union.

- Section B

  This section should specify the exploitable foreground and provide the plans for exploitation. All these data can be public or confidential; the report must clearly mark non-publishable (confidential) parts that will be treated as such by the Commission. Information under Section B that is not marked as confidential **will be made available in the public domain** thus demonstrating the added-value and positive impact of the project on the European Union.

Section A (public)

This section includes two templates

- Template A1: List of all scientific (peer reviewed) publications relating to the foreground of the project.
- Template A2: List of all dissemination activities (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters).

These tables are cumulative, which means that they should always show all publications and activities from the beginning until after the end of the project. Updates are possible at any time.

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[1] (if available)	Is/Will open access[2] provided to this publication?
1	*Economic transformation in Hungary and Poland'*		*European Economy*	*No 43, March 1990*	*Office for Official Publications of the European Communities*	*Luxembourg*	*1990*	*pp. 151 - 167*		yes/no
2										
3										

[1] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).

[2] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

TEMPLATE **A2: LIST OF DISSEMINATION ACTIVITIES**								
NO.	Type of activities[3]	Main leader	Title	Date/Period	Place	Type of audience[4]	Size of audience	Countries addressed
1	*Conference*		*European Conference on Nanotechnologies*	*26 February 2010*				
2								
3								

[3] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

[4] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

Section B (Confidential[5] or public: confidential information to be marked clearly)
Part B1

The applications for patents, trademarks, registered designs, etc. shall be listed according to the template B1 provided hereafter.

The list should, specify at least one unique identifier e.g. European Patent application reference. For patent applications, only if applicable, contributions to standards should be specified. This table is cumulative, which means that it should always show all applications from the beginning until after the end of the project.

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.					
Type of IP Rights[6]:	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)

[5] Note to be confused with the "EU CONFIDENTIAL" classification for some security research projects.

[6] A drop down list allows choosing the type of IP rights: Patents, Trademarks, Registered designs, Utility models, Others.

Part B2

Please complete the table hereafter:

Type of Exploitable Foreground[7]	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application[8]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
	Ex: New superconductive Nb-Ti alloy			*MRI equipment*	*1. Medical* *2. Industrial inspection*	*2008* *2010*	*A materials patent is planned for 2006*	*Beneficiary X (owner) Beneficiary Y, Beneficiary Z, Poss. licensing to equipment manuf. ABC*

In addition to the table, please provide a text to explain the exploitable foreground, in particular:

- Its purpose
- How the foreground might be exploited, when and by whom
- IPR exploitable measures taken or intended
- Further research necessary, if any
- Potential/expected impact (quantify where possible)

[19] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

[8] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

4.3 Report on societal implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	
Title of Project:	
Name and Title of Coordinator:	

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***0Yes 0No***
2. Please indicate whether your project involved any of the following issues (tick box) :	***YES***
RESEARCH ON HUMANS	
• Did the project involve children?	
• Did the project involve patients?	
• Did the project involve persons not able to give consent?	
• Did the project involve adult healthy volunteers?	
• Did the project involve Human genetic material?	
• Did the project involve Human biological samples?	
• Did the project involve Human data collection?	
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	
• Did the project involve Human Foetal Tissue / Cells?	
• Did the project involve Human Embryonic Stem Cells (hESCs)?	
• Did the project on human Embryonic Stem Cells involve cells in culture?	
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
• Did the project involve tracking the location or observation of people?	
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	
• Were those animals transgenic small laboratory animals?	

• Were those animals transgenic farm animals?	
• Were those animals cloned farm animals?	
• Were those animals non-human primates?	
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	
DUAL USE	
• Research having direct military use	0 Yes 0 No
• Research having the potential for terrorist abuse	

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator		
Work package leaders		
Experienced researchers (i.e. PhD holders)		
PhD Students		
Other		

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	
Of which, indicate the number of men:	

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?	○ ○	Yes No

6. Which of the following actions did you carry out and how effective were they?

	Not at all effective				**Very effective**
❑ Design and implement an equal opportunity policy	○	○	○	○	○
❑ Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑ Organise conferences and workshops on gender	○	○	○	○	○
❑ Actions to improve work-life balance	○	○	○	○	○

○ Other:

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

○ No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

○ Yes- please specify

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

○ Yes- please specify

○ No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

○ Main discipline[9]:

○ Associated discipline[9]: ○ Associated discipline[9]:

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*	○ ○	Yes No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

○ No

○ Yes- in determining what research should be performed

○ Yes - in implementing the research

○ Yes, in communicating /disseminating / using the results of the project

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ ○	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- ○ No
- ○ Yes- in framing the research agenda
- ○ Yes - in implementing the research agenda
- ○ Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- ○ Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- ○ Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- ○ No

13b If Yes, in which fields?

Agriculture		Energy		Human rights	
Audiovisual and Media		Enlargement		Information Society	
Budget		Enterprise		Institutional affairs	
Competition		Environment		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		Regional Policy	
Development Economic and Monetary Affairs		Food Safety		Research and Innovation	
		Foreign and Security Policy		Space	
Education, Training, Youth		Fraud		Taxation	
Employment and Social Affairs		Humanitarian aid		Transport	

[9] Insert number from list below (Frascati Manual).

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- ○ European level
- ○ International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	
To how many of these is open access[10] provided?	
How many of these are published in open access journals?	
How many of these are published in open repositories?	
To how many of these is open access not provided?	
Please check all applicable reasons for not providing open access:	
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[11]: ……	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	
	Registered design	
	Other	
17. How many spin-off companies were created / are planned as a direct result of the project?		
Indicate the approximate number of additional jobs in these companies:		

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑ Increase in employment, or	❑ In small & medium-sized enterprises
❑ Safeguard employment, or	❑ In large companies
❑ Decrease in employment,	❑ None of the above / not relevant to the project
❑ Difficult to estimate / not possible to quantify	

[10] Open Access is defined as free of charge access for anyone via Internet.
[11] For instance: classification for security project.

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*
Difficult to estimate / not possible to quantify	❑

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes ○ No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes ○ No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

❑	Press Release	❑	Coverage in specialist press
❑	Media briefing	❑	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
❑	Brochures /posters / flyers	❑	Website for the general public / internet
❑	DVD /Film /Multimedia	❑	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

❑	Language of the coordinator	❑	English
❑	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]

2. FINAL REPORT ON THE DISTRIBUTION OF THE EUROPEAN UNION FINANCIAL CONTRIBUTION

This report shall be submitted to the Commission within 30 days after receipt of the final payment of the European Union financial contribution.

Report on the distribution of the European Union financial contribution between beneficiaries

Name of beneficiary	Final amount of EU contribution per beneficiary in Euros
1.	
2.	
n	
Total	