I4MS

Enhancing the digital transformation of the European manufacturing sector

The I4MS initiative
ICT Innovation for Manufacturing SMEs

April 2016

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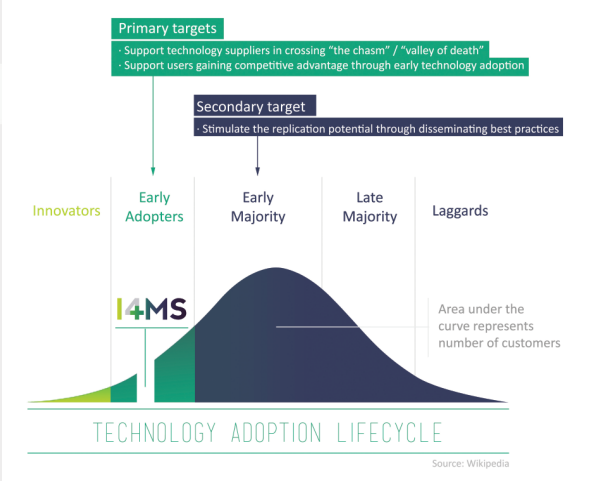
Website: http://ec.europa.eu/digital-agenda/en/smart-manufacturing

The I4MS initiative in a nutshell

Commissioner Oettinger has announced a **European strategy for digitising European industry with a communication on "Digital Industrial Leadership"** in April 2016[1]. It aims at supporting the digitisation of all our industries and complements the efforts of other EU programmes, national and regional initiatives with the objective of strengthening the digital sector (Public Private Partnerships, Joint Undertakings, Focus Areas, ...) and capitalising on the opportunities offered by digital innovations in industry.
The proposed ambitious EU-wide strategy for digital and digitised industry embraces the digital transformation of industry providing a unique opportunity for reshoring production to Europe and the growth of new digital and digitised industries in all sectors of the economy. It is based on four pillars.

One important action of the strategy to Digitise European industry is to reinforce and network Digital Innovation Hubs (DIH) independent under what regional, national, or European scheme they are funded and to establish new hubs wherever required also using structural funds. European networks have a key role in providing the glue between national and regional initiatives across the EU. The DIH should provide industry with "universal" access to digital competences and with all other necessary resources (such as finance and business know-how) thereby building regional ecosystems that help turning excellent technical solutions into new innovative products and services. The ultimate goal is to accelerate the digital transformation of European industry in order to strengthen Europe's competitiveness. Whilst big European players are in a stronger position to face the global competition, small and medium sized companies (SME) and mid-caps have difficulties to use leading-edge ICT to modernise their production processes and to bring innovations to the market. In order to build the bridge over the valley of death SMEs and mid-caps need easy access to sources of finance and to facilities to explore the potential of highly sophisticated ICT technologies before engaging with investments in digital innovations.



[1] https://ec.europa.eu/digital-single-market/en/digitising-european-industry#Article

The I4MS initiative in a nutshell

The **I4MS initiative** (ICT Innovation for Manufacturing SMEs) of the European Commission is one of the European networks and has started its Phase 1 in July 2013 and continued with Phase 2 in autumn 2015 (total funding nearly 110 Mn EUR) with the aim to support SMEs and mid-caps in the manufacturing sector along three dimensions:

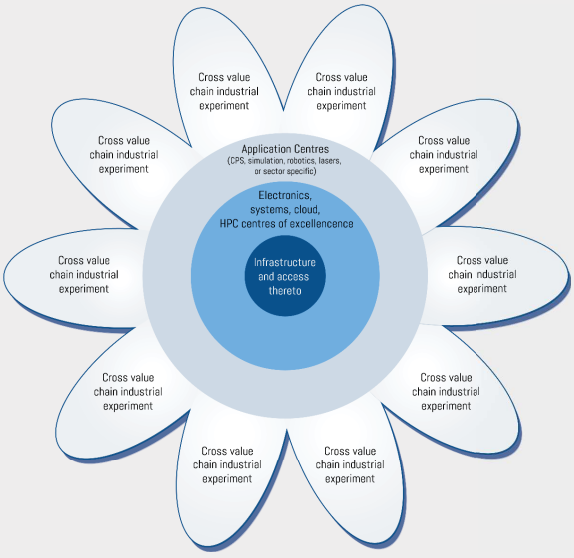
- Provide access to competences that can help in assessing, planning and mastering the digital transformation.
- Provide access to innovation networks of a broad spectrum of competences and best practice examples.
- Provide financial support to SMEs and mid-caps on the demand and the supply side to master the digital transformation.

The basic idea is to enable and foster the collaboration of manufacturing SMEs and mid-caps across their value chains through the help of European competence centres/innovation hubs (such as HPC centres, top universities, application oriented research organisations) in predominantly cross-border experiments to create a **win-win situation** for all actors.

In those focused experiments of short duration brokerage and transfer of know-how and technology are provided by the innovation hubs to the SMEs and mid-caps. I4MS therewith resolves the competence gap of SMEs at the same time providing them with the financial means to adopt leading edge technology such that they are capable to bring innovative and highly competitive new products and services to the market.

Innovative suppliers profit from I4MS as the experiments enable them to mature their existing technologies and to broaden the field of their application ultimately opening them new markets and services.

The competence centres benefit from the initiative, as they extend their largely research oriented activities with industrial projects thereby gaining a new sustainable business model.



The initiative focuses on four technology areas that have been identified to be key for the digital transformation of the manufacturing sector at large:

HPC cloud-based simulation services

Designing high tech products such as aircraft wings or turbines involve simulations that require knowledge of modelling and simulation technologies in combination with high power computing (HPC) resources. To have and maintain an HPC data centre with a mainframe computer is not affordable for SMEs. Europe has a good coverage of HPC centres which have the computing power required for complex simulations. However, access to those HPC facilities needs specialised knowledge and software. Experiments funded by the initiative bring HPC centres, independent specialised software vendors (ISV), simulation experts and manufacturing SMEs together to establish an affordable pay-per-use cloud-based HPC simulation service for the SMEs. This ultimately enables SMEs to design high tech products and ultimately boosts their business.

Advanced laser based equipment assessment

Laser technology has scientifically strongly advanced in the last years. However, this new knowledge has only rarely been applied industrially facilitating more sophisticated and cost efficient production processes. The I4MS experiments transfer knowledge of research institutions into new laser based products of SMEs and assess their applicability in the production contexts of potential end-user customers. The twofold effect is that SMEs now can offer leading edge laser equipment products for industrial manufacturing that are already verified by end-users. This ultimately extends their customer base and enables increased revenues.

Industrial robotics systems for SMEs

Well-established industrial robotics platforms are targeted towards large industrial manufacturers (e.g. automotive) only and are complex and costly in set-up and maintenance. To bring the benefits of robotics also to SME and mid cap manufacturers the I4MS experiments motivate leading suppliers of industrial robotics platforms and system integrators to develop in collaboration with SME endusers a light-weight and modular robotics solution. To ensure that it is suitable to SME and midcap manufacturers the solution is validated in an industrial environment.

Smart Cyber Physical Systems for high precision and efficient production

The introduction of Cyber-Physical-Systems in the shop floor will dramatically improve the efficiency and quality control of production processes thus reducing costs and producing better products. The I4MS experiments develop in close collaboration between SME technology providers and sensor system OEMs on the one hand and SME manufacturers on the other hand a Cyber Physical Production System (CPPS) cloud-based platforms federation to extend shop floor control functionalities.

In I4MS Phase 1 of the initiative, **7 EU-funded innovation projects** have been started mostly already having an initial number of experiments at the outset. These have been enhanced during the projects' lifespan by additional experiments that were selected out of proposals submitted upon open calls. Those innovation projects are about to be concluded by the end of 2016 and have already delivered numerous successes (see a small but representative selection of success stories from page 12 onwards). The innovation projects were complemented by a **Support Action** that hosted the initiative's web presence, organised initiative wide events and assisted the innovation actions in disseminating and coordinating their activities as an innovation multiplier.

In Phase 2, six projects have started in autumn 2015.

Four Innovation Actions (IAs) have been launched covering three technology areas:

- near-autonomous robotics systems
- HPC cloud-based advanced modelling, simulation and data analytics services for European engineering and manufacturing SMEs (with focus on big data, real-time response, security and privacy issues)
- Cyber Physical Systems and Internet of Things in manufacturing processes (with focus on process maintenance and surveillance)

The first three IAs continue to address technology areas of the first phase. However, this is more than just continuing Phase 1 activities, as new technology and market demands will be covered for those two domains. The fourth IA on the integration of Cyber Physical Systems and Internet of Things in manufacturing processes extends the initiative to a new and most relevant technical field that is gaining enormously in importance for manufacturing.

In order to multiply the effects of the 4 Innovation Actions and to reinforce the I4MS ecosystem two Coordination and Support Actions have been started. Apart from continuing the successful support and coordination efforts of Phase 1 their predominant task is to be the catalyser of pro-actively enhancing the role of centres of scientific excellence to also become industry-oriented digital innovation hubs, networking local manufacturing enterprises, national and regional initiatives, the regional funding authorities and European funds to them in order to ultimately extend the I4MS ecosystem to new regions. 3 such new digital innovation hubs have already been selected in regions in Greece, Poland and Spain in a piloting first open call. Finally, the CSAs will establish a dynamic repository of information on initiatives at all levels across the EU that will be made publically accessible. It provides SMEs and mid-caps with relevant and difficult to retrieve input facilitating their integration in the I4MS ecosystem. The CSAs will also monitor activities such as the World Manufacturing Forum 2016. Finally, they will collaborate with institutions on international level so as to identify opportunities potentially arising from similar initiatives elsewhere or to spot legal, skills and other issues that would require to be tackled at an international scale.

Projects - Phase 1

Cloud services and simulation

FORTISSIMO

Simulation services on High Performance Computing cloud infrastructure to increase the competitiveness of European SMEs in the manufacturing domain.

CLOUDFLOW

Computational Services distributed on the cloud and accessible on-demand for the optimization of the SMEs´ engineering design workflows.

CLOUDSME

Cloud Simulation Platform designed for developing simulations as a Service (SaaS) in the cloud in order to enhance the productivity of manufacturing and engineering SMEs.

Laser technologies

APPOLO

Customisation and validation of emerging innovative laser technologies and processes in end-user application areas such as photovoltaics, automotive, printing and decoration.

LASHARE

Laser-based Equipment Assessments to support small and medium sized companies to develop demand driven innovative solutions for improved manufacturing performance that serve current production needs.

Robotics and intelligent fixtures

EUROC

Attract new end users toward customisable robot solutions for the development of new products and services so to enable future manufacturing in areas such as production, logistics and maintenance. These activities are complemented by EU actions having a similar structure such as ECHORD and ECHORD++.

INTEFIX

Intelligent fixture systems developed for increasing the performance of machining processes through the ability to monitor, control and adapt manufacturing lines.

Cloud services and simulation

FORTISSIMO 2

Follow on to the Fortissimo project, it will enable European SMEs to be more competitive globally through the use of simulation services running on a High Performance Computing cloud infrastructure.

Cyber physical systems

BEINCPPS

Improving the adoption of Cyber Physical Prodcution Systems all over Europe by means of the creation, nurturing and flourishing of CPS-driven regional innovation ecosystems, made of competence centers, manufacturing enterprises and IT SMEs starting from five selceted Smart Specialization Strategy Vanguard regions (Lombardia in Italy, Euskadi in Spain, Baden Wuertemberg in Germany, Norte in Portugal, Rhone Alpes in France).

Robotics

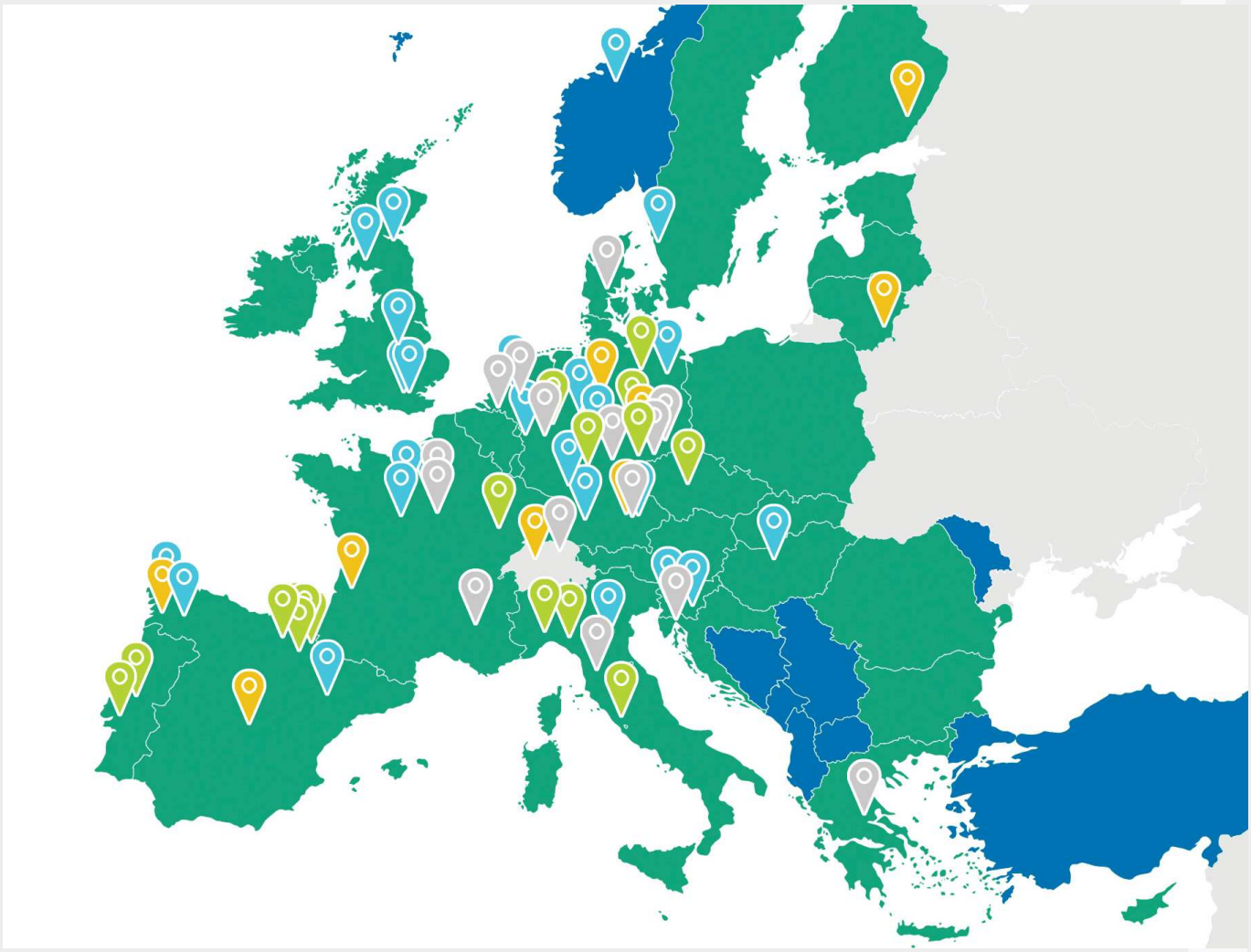
HORSE

Fostering technology deployment towards SMEs by developing a methodological and technical framework for easy adaptation of robotic solutions and by setting up infrastructures and environments that will act as clustering points for application experiments in the manufacturing sector.

RECONCELL

Enabling few-of-a-kind production for manufacturing SMEs by deploying a widely autonomous robotic workcell that allows very short, self-adaptable and affordable changeovers under the conditions demanded and based on end-user needs.

I4MS



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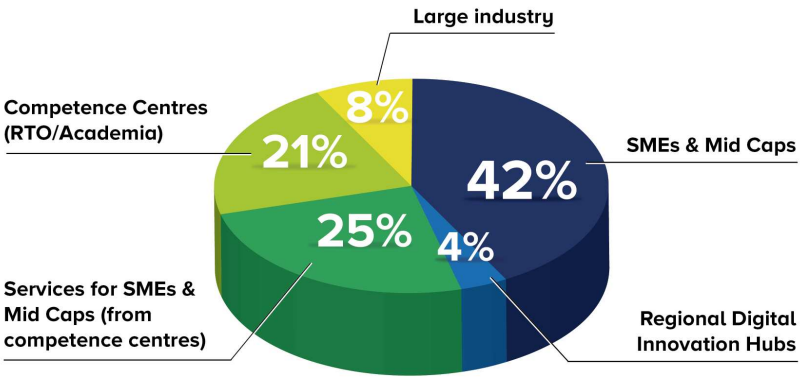
Financial support to SMEs and Mid-Caps

Distribution of the nearly 110 million EUR funding in % (Phase 1 and Phase 2)



Highly attractive to industry

In Phase 1 and Phase 2, out of 480 current contractors **340 are from industry**.

75% of the industrial partners are **SMEs and mid-caps** out of which around 65% had never participated in EU research and innovation programmes before.

As 50% of the industrial participants are end-users, the direct application of the experiments' results is guaranteed.

As opposed to financially oriented SME instruments I4MS provides **SMEs** with **easy access** to:

- competences and skills
- pan-European competence and business networks
- financial support

Collaboration across Europe for a stronger European industry

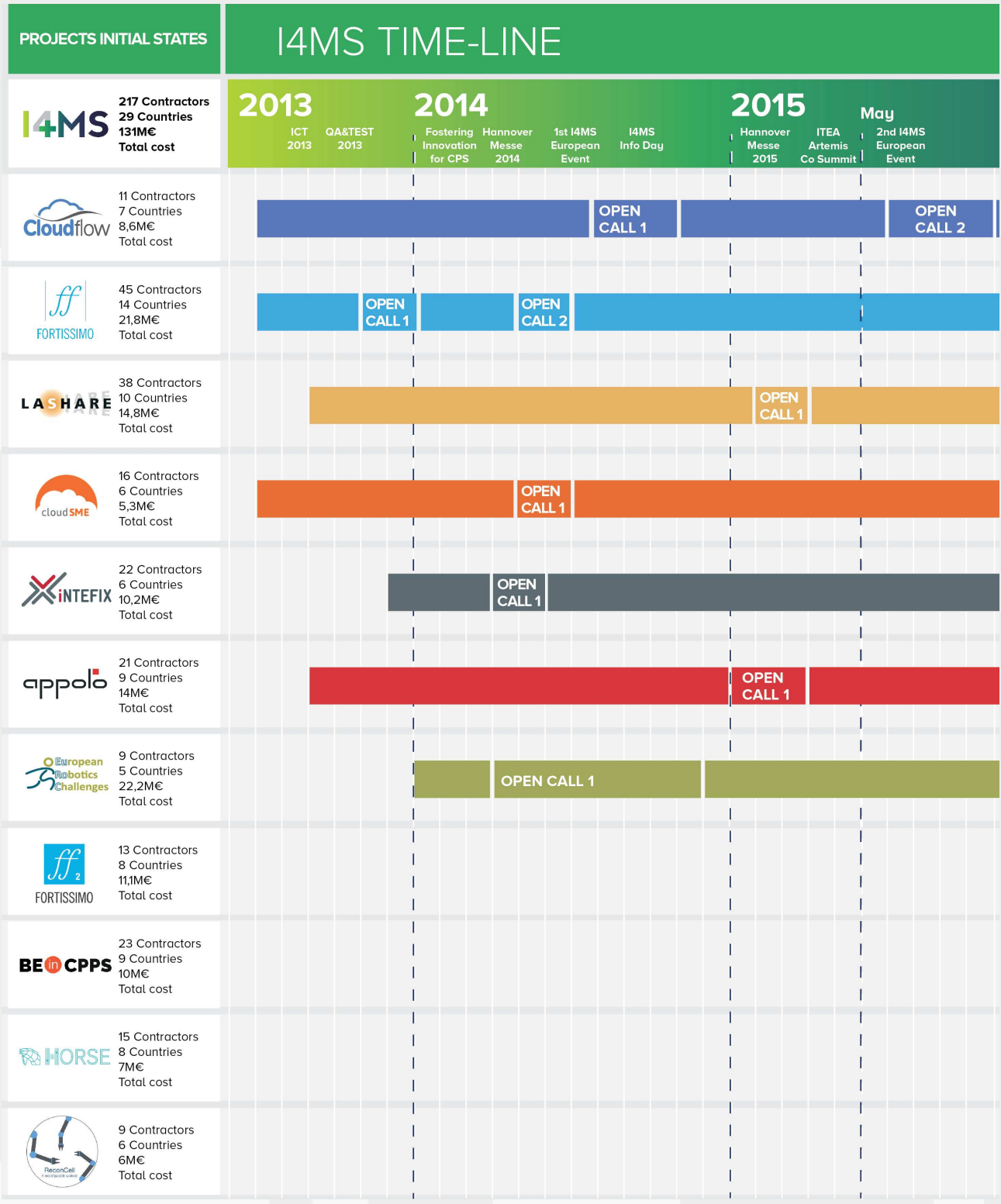
More than 70% of the experiments have a relevant European dimension and are executed in collaboration of partners from different EU member states combining existing regional strengths and know-how. Even more of them facilitate collaboration and interaction across different regions.

29 member states and associated countries are involved (Phase 1 and Phase 2).

195 experiments have already been started in Phase 1. They have either been completed achieving the intended technological and economic impact or are in their final state of implementation.

25 experiments have been launched at the outset of Phase 2 and **60 additional experiments** are planned to be selected through open calls establishing new user-supplier collaborations.

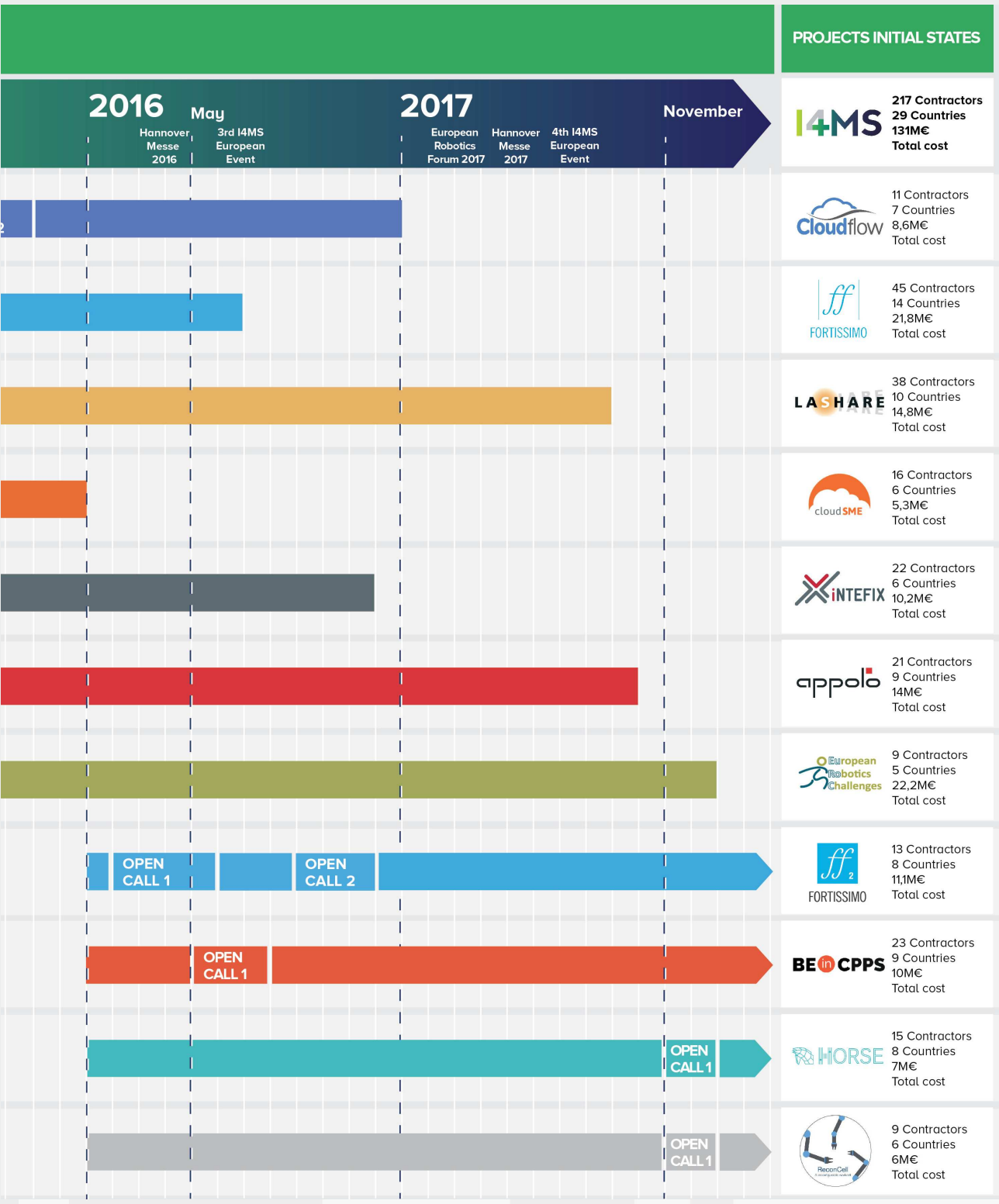
Facts and Figures



Open Calls to promptly respond to emerging market challenges

More than 20 million EUR funding distributed in 9 Open calls already allocated to SMEs & Mid-Caps. Additional 8.5 million EUR is expected to be distributed in 8 Open calls of Phase 2, out of which 1.5 million EUR will be dedicated to enhance the role of RTOs and Centres of scientific excellence to also become regional Digital Innovation Hubs.

Light, **SME friendly application scheme:** 10 page proposals.



Enlargement of manufacturing to other industrial sectors

The I4MS experiments extend recent advances of ICT beyond the traditional European manufacturing sectors (e.g. automotive, aerospace and machine tooling) to other **industrial sectors such as in food, textile, printing and health care**, in which efficient use of advanced ICT would enable SMEs to play a stronger role.

SME improves the design of aircraft

Problem and solution

In order to develop a new aircraft one needs to understand, how air flows over its aerodynamic surfaces. There are two ways of gaining this required knowledge:

1. wind tunnel tests or

2. computer aided simulation of the air-flow using Computational Fluid Dynamics (CFD).

For an SME the use of wind tunnel tests during the design phase of a new aircraft is by far too expensive. The only option an SME has is to simulate the flow of air deploying complex aerodynamic models. But such simulations require computing power that is not accessible for SMEs. So far the Slovenia based SME PIPISTREL had made some limited simulations using in-house computing resources, but these did not give the required fidelity and did not run sufficiently quickly. For simulations with sufficient accuracy large models are to be run, which would take 0 to 30 days on in-house resources with obvious prohibitive effects on time to market and design cost. As PIPISTREL needs to simulate the air-flow only occasionally during the design process, the option to have sufficient powerful computing capacity in-house is neither cost efficient nor affordable. A possible solution to this problem is the use of HPC systems. However, the access to HPC systems requires very specialised skills that are not available in an SME.

How did I4MS help

During the experiment in the I4MS project FORTISSIMO the HPC competence centre ARCTUR and the technology service provider XLAB provided PIPISTREL with the HPC resources and the know-how to run simulations of sufficiently high fidelity “online” on a Cloud-based HPC system. A typical large model would run now in approximately 2 to 3 days at affordable cost, thus providing a cost efficient and timely solution with the desired quality of results. I4MS was of paramount importance, as it removed the existing knowledge barriers for PIPISTREL to access HPC resources by bringing them together with the required HPC resource and the service provider that translates the SME’s simulation models into executable code that can be run on an HPC machine.

Impact

The use of Cloud-based HPC offers PIPISTREL the required level of simulation results 10 times cheaper than having a suitably powerful in-house system that is only occasionally used. The indicative annual costs of using Cloud-based HPC simulations are approximately €30k compared with an in-house solution cost of €300,000. Such a saving is a game changer for an SME. The FORTISSIMO experiment also facilitated important benefits for the HPC technology providers. The SME XLAB gained strategic new knowledge and extended its service offer ultimately acquiring new customers and enhancing business.

The experiment also helped the HPC centre ARCTUR to implement first steps towards becoming a commercial HPC provider rather than serving the scientific domain only.

End-user: Pipistrel (SME, SI)
Cloud and HPC technology Providers: XLAB(SME, SI), Arctur(SME, SI)

Changing the way we design and manufacture technologies of the future

Problem and solution

High average power, high repetition rate and ultra-short pulsed lasers are being adopted as the new workhorse in the processing of materials such as metals, glass, silicon, ceramics and thin films. EKSPLA, a laser manufacturing SME, has invested heavily in developing picosecond lasers that provide the qualities needed for industrial laser technologies and are synchronized with external devices, e.g. polygon scanners.

Next ScanTechnology (NST) has developed and introduced a polygon scanner solution that is much faster than all others. The NST patent pending technology unlocks the potential of the newest MHz pico- and femtosecond pulsed lasers as e.g. being produced by EKSPLA. The laser-based proposition of NST offers to industry reduction of manufacturing cost versus classical manufacturing approaches such as chemical processes (e.g. etching).

How did I4MS help

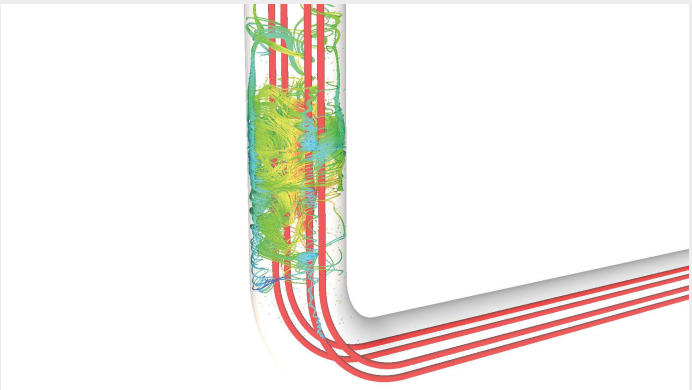
The laser equipment assessment experiments in the I4MS project APPOLO enabled EKSPLA to validate their recently developed picosecond lasers for new technology areas such as thin-film photovoltaics or flexible electronics for FIAT. NST could investigate in their APPOLO experiment the applicability of their new polygon scanner for patterning of touch screen displays in consumer electronics. This technology has also proven its potential for fast growing markets like medical devices, automotive and aerospace, as laser material processing enables manufacturers to add micro features facilitating product capabilities that have not been thought of before.

Impact

EKSPLA expects that the experiment's result will increase their turnover by more than 50% and will create more than 20 qualified specialist jobs in the next 3 years. NST hopes to sell 100's of additional scanners boosting revenues by 5+ million EUR within the next 3 years. Achieving this would support the creation of 5-10 new jobs for experienced engineers.

Technology providers: EKSPLA (SME, LT), NST (SME, BE)

Cheaper cable production through 3-D design



Problem and solution

In designing cables of all sorts and high-voltage cables in particular the company PRYSMIAN was using 2-D models running on a few high-end workstations in the past. However, in order to stay competitive, simulations need to be scaled-up enormously. More accurate information on parameters such as losses inside an energy cable or the transfer of heat from the cable to the surrounding environment are essential to optimise the cable design such that security margins can be minimised allowing for thinner cables and thus material cost savings. These requirements can only be satisfied by 3-D simulations, which exceed the capabilities of the computing power available in-house even for a large enterprise.

How did I4MS help

In the FORTISSIMO experiment the HPC provider CINECA transferred the know-how to PRYSMIAN that enables them to use Cloud-based HPC 3-D simulations that satisfy the need for new and finer simulations in significantly shorter time, together with an insight into how improved simulations could be exploited in a future business model. Furthermore, CINECA provided open-source software to PRYSMIAN that could be used in these simulations thereby eliminating the need for expensive software licences.

Impact

The business benefits stemming from the use of a Cloud-based HPC system arise from several sources. The design cost savings per cable design are in the range of 100k€, which is significant taking the high amount of cable designs per year into account. However, the main competitive advantage for PRYSMIAN is shorter time to market. Finally, increased profit margins per meter of cable by using less material add to the considerable commercial benefits that the use of Cloud-based HPC brings about to PRYSMIAN.

The HPC service provider CINECA has extended their service offer to multi-physics simulations that opens for them new markets together with having a strong reference case with PRYSMIAN. Furthermore, the experiment paved the way for CINECA to a more commercially oriented business model away from being a provider for mostly scientific purposes.

End-user: Prysmian (Large Industry, IT)
HPC expert and HPC service provider: Cineca (IT)

Cloud simulation for more green energy

Problem and solution

Checking and assessing the hydrodynamic performance, e.g. the prediction of the increase in energy efficiency of a newly designed or repaired turbine blade, involves many Computational Fluid Dynamics (CFD) simulations. The full characterisation of a complex hydraulic turbine may require several hundreds of such simulations, where each simulation takes several hours to several days, depending on the available computing resources. Such a complete calculation is time and cost prohibitive for an SME using traditional desktop machines. Thus, so far the turbine characteristics are only partially and thus sub-optimally simulated by the SME STELLBA that is active in hydropower plant maintenance, repair and overhaul. However, accurate simulations are nowadays a must to stay competitive. The option to have sufficient powerful computing capacity in-house is neither cost efficient nor affordable. The use of HPC resources from existing HPC providers would be solution, but requires specialised know-how that is not available in STELLBA.

How did I4MS help

In the experiment of the I4MS project CLOUDFLOW this competence gap within STELLBA was bridged using 'cloudified' CFD software of NUMECA and Product Lifecycle Management (PLM) software by JOTNE. Running those software solutions in an integrated fashion on the HPC infrastructure of ARCTUR it became possible to calculate the full turbine characteristics by performing 10 times more calculations in a third of the time currently being used for just a sub-set of the problem, resulting in an overall performance benefit of a factor of more than 30.

Impact

Every turbine STELLBA engineers and manufactures is different and tailored to the needs of a given specific power plant. Reducing the development costs at the same time raising the product quality and reducing the development times (time-to-market) boosts their competitive position enormously.

Furthermore, by increasing the accuracy of the CFD, STELLBA can reduce the security margin for their efficiency guarantees. E.g. an increase of efficiency of a 40 MW turbine by only 2% provides the turbine owner with an electricity output gain from his water plant worth 200.000€ per year. It is expected that savings in the design cost will increase the profit margins of STELLBA considerably, whilst increased product quality and faster time to market will strongly increase their customer base.

For NUMECA, the accessibility of the cloud-based CFD solution from basically anywhere and the possible savings in engineering exemplified in this experiment will largely increase the number of SMEs using CFD in the short and medium term, resulting in new customers for NUMECA. Due to this business increase 1-2 new jobs will be created within short.

Also this experiment paves the way for the HPC centre ARCTUR to extend their existing business model being a predominantly scientific HPC service provider to providing sustainable services to industry.

End user: Stellba Hydro GmbH (SME, DE),
Technology providers: NUMECA (SME, BE), Jotne AS (SME, NO)
Cloud technology/platform providers: Arctur (SME, SI)

Cloud enabled beer production and delivery

Problem and solution

A microbrewery or craft brewery produces beer on a much smaller scale than corporate breweries. In order to succeed in such a fiercely competitive marketplace it is important that all beer is produced to a consistent high quality so that discerning consumers can truly appreciate the unique aroma and flavour of the brand. The 15,000 craft brewers in Europe represent a significant SME manufacturing sector. One of their key quality objectives is to ensure that their products are consumed in an optimum time window when beer is neither too young nor too old. All beers have unique characteristics and this window varies from beer to beer. The first in-first out principle for delivery does not optimise quality at the time of consumption. To optimize quality casks need to be intelligently allocated to clients individually so that the casks are opened and consumed at the beer's ideal age for consumption. Such a quality optimisation could be achieved by a powerful process simulation software. However, software development skills are not available in small breweries. Furthermore, craft breweries are often located in remote areas in order to be near to the production of the beer ingredients. Therefore, such a simulation software needs to be made accessible in the cloud so as to make it executable from basically everywhere.

How did I4MS help

As part of the I4MS initiative, the CloudSME project has created a process simulation solution that serves practically all needs of craft brewers bringing all needed skills together in one experiment. Based on the requirements of the Hobsons Brewery (craft brewer), Saker Solutions (SME) together with the Simul8 Corporation (SME) developed a low-cost, cloud-based process simulation solution that allows for optimised beer production and delivery at an affordable price.

Impact

This solution is estimated to lead to over €10,000 per year savings from reduced waste, energy consumption and more efficient cask utilisation and transportation costs for Hobsons. It is also expected that a craft brewer producing more reliable products will also improve sales leading to an expanded business and increased employment opportunities in rural areas. At a 10% take-up of the new cloud based service by all concerned microbreweries this could lead to around €17 million savings and over 200 new jobs in rural areas across the sector.

Provided this take-up the two technology providers estimate their yearly economic impact to be in the range of €750 K of profit increase creating 6 new jobs.

End-user: Hobsons Brewery (SME, UK)
Technology Providers: Saker Solutions (SME, UK), and Simul8 Corporation (SME, UK)

Corrosion of tubes addressed by a laser-based inside cladding system

Problem and solution

Wear and corrosion of hollow tubes is estimated to cause annual cost of 2.1 trillion USD worldwide. In order to increase the lifetime and to decrease the maintenance cost of e.g. oil drilling tools, the tubes need to be coated inside, which is in particular difficult for tubes with small diameters and considerable depth. Most recent advances in laser technology facilitate a solution that achieves a homogeneous and cost effective inside cladding also for diametersbelow 100mm and with a depth of more than 1.5 meters.

How did I4MS help

The INCLAD laser equipment assessment within the I4MS project LASHARE teamed up the Fraunhofer Institute for Laser Technology (FhG-ILT) that is at the forefront of technology in this domain with the laser equipment supplier SME IXUN and the end-user Oerlikon Metco. In the experiment most recent laser technology was transferred from FhG-ILT to IXUN. Furthermore, the experiment made IXUN aware of the real needs and requirements of potential customers such as Oerlikon. Therefore, the experiment furnished IXUN with technology and customer demand know-how which now enables them to offer a robust and highly competitive solution that meets the various challenges to be mastered to satisfy the current needs of the manufacturing industry.

Impact

For the SME IXUN the experiment has already had enormous economic impact. The gained knowledge has considerably increased the competitiveness of their products and services. The strongly raising demand for inside cladding optics has already turned into doubled sales and the creation of six new high tech jobs within IXUN since the inauguration of the experiment. It is expected that further improvements of the system that are ongoing will boost their business even more.

The end-user Oerlikon Metco has now access to a solution that fully meets their customers' needs. Also for this mid-cap sized division of the international technology corporation OC Oerlikon Management AG, increased sales can be envisaged in the short term thanks to the superiority of their technology and service offer.

Technology provider: Fraunhofer Institute for Laser Technology (DE)
Supplier: IXUN (SME, DE)
End user: Oerlikon Metco (mid-cap, CH)

Optimised Sports-Car Aerodynamics

Problem and solution

The Swedish SME KOENIGSEGG, a leading designer and manufacturer of high-performance sports cars, has endeavoured to develop the world's first megacar named One:1 (1 horse power per kilo weight) with a ground-breaking vehicle's maximum speed of 440km/h. To safely control such a top speed and power equally ground-breaking aerodynamic capabilities were to be achieved. Despite the vast experience the company has with the design of high-performance sports cars, the aerodynamics of the One:1 posed unprecedented challenges that could not be mastered with the means available to an SME.

Using the Computational Fluid Dynamics (CFD) simulation software of the SME ICON on the Cloud-based-HPC system of CINECA has enabled KOENIGSEGG to reduce or even, in some circumstances, avoid wind tunnel testing. In less than eight months, hundreds of simulations to test various configurations have been carried out representing 100% of the aerodynamic development of the model One:1. During that time various driving setups for different conditions were developed. The results were an impressive 250% increase in down-force with only a 15% increase in drag at 250km/h and with a 50% higher down-force at 440km/h. That's an improvement that would have been unachievable without the use of CFD.

How did I4MS help

KOENIGSEGG had only limited computer resources available in-house and insufficient experience in HPC-based CFD. The FORTISSIMO experiment allowed them to team up with ICON that piloted the new cloud models, CINECA providing advanced HPC facilities and expert advisors from the National Technical University of Athens, Greece. Doing so, the necessary aerodynamic capabilities using for the first time CFD simulation software on a Cloud-based-HPC system could be achieved at affordable cost (pay-per-use rather than purchasing and maintaining an in-house HPC system) and in shortest time. ICON has been able to test software and deliver services on much larger industrial simulation cases than before and can now deliver simulation projects of comparable size and scale to those performed inside OEMs themselves since they no longer need to acquire vast IT resources in-house.

Impact

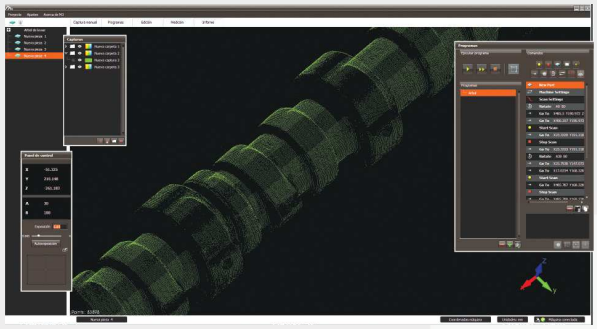
For KOENIGSEGG the benefits obtainable by the use of HPC-Cloud-based simulation can be quantified as saving about €90K per year only on the development process. A saving of 10% in operational costs, a 30% saving in design costs, a 60% saving in prototyping costs, a reduction of 50% in wind tunnel and physical testing, and a 30% shortening of the time to market has been experienced. All these effects are estimated to increase the company revenue by about €4M over the next 5 years.

ICON has been able to create a new service. Secondly, ICON has already acquired one new customer, being a global oil & gas company. ICON now estimates up to 15% annual revenue growth per year to be due to cloud over the next 5 years. ICON has also started recruiting and re-training its staff to have web technology skills.

CINECA expanded their penetration in the sector of HPC services for the automotive industry. For instance, in the months following the experiment they engaged in two business projects with major Italian industries active in the field of sports and competition cars.

End-user: Koenigsegg (SME, SE)
ISV: ICON TECHNOLOGY & PROCESS CONSULTING LIMITED (SME, UK)
HPC expert and HPC centre: National Technical University of Athens (HE), CINECA (IT)

Improving Camshaft Manufacturing through HPC-based Simulation



Problem and solution

In the manufacture of camshaft and other high-fidelity components and artefacts requires nowadays the combination of scanning, measurement and analysis in order to enable the early identification, during the manufacturing process, of deviation from design parameters and of the necessary corrective measures to be taken to ensure the required product quality. The intelligent, fast and intensive analysis of the quality of the manufacturing process using 3D digital specifications of the parts to be manufactured, however, generates huge amounts of data in terms of processing, analytics and storage. In particular, the typical size of the files involved in this FORTISSIMO experiment is around 300 MBytes, representing 15 million points. This means that a single SME such as end-user EPC produces several TBytes of information in short periods of time. A service-provider such as Unimetrik dealing with several customers simultaneously may have to analyse and process between 30 and 50 times this volume of data.

In the experiment a novel HPC-cloud-based service was developed. DATAPIXEL achieved the optimization of the processing algorithms enabling quicker access to the information contained in the pointclouds. UNIMETRIK enabled the effective processing of huge data files on the CESGA HPC resources via the cloud. The developed new service enables a reduction in the time taken to extract dimensional deviations by a factor of 5 and provides for new reporting capabilities at affordable cost and without the necessity of the involved SMEs to purchase and to operate an HPC system.

How did I4MS help

The I4MS initiative, and in particular the Fortissimo Project, has enabled the right mix of domain expert (Unimetrik), independent SW vendor of metrology software (Datapixel) and end-user (EPC) to have access to cloud-based, HPC resources and to pioneer an effective Cloud-based data-processing service for SMEs in a real world industrial manufacturing process. They were able to evaluate the benefits of this pay-per-use technology for the generation of high-quality dimensional information in the manufacture of camshafts and, by extension, for wider advanced manufacturing processes. Furthermore, participation in this experiment has disseminated partner skills and achievements at the European level. This has improved the reputation of the companies involved for the commercialisation of products and for further participation in collaborative projects.

Impact

As an outcome of the experiment Unimetrik will increase its service provision by 30% and its portfolio of international customers by 20% within the manufacturing sector, based on its current scanning capabilities, particularly where there is a need for high-resolution measurement and analysis. An increase in turnover of 450,000 € over the next five years and the creation of two new posts within the company are foreseen. The ISV involved in this experiment, Datapixel, expects an increase of 25% in new licences, representing an additional turnover of 750,000 € over the coming five-year period, due to the commercialization of the optimised point-cloud data structuring and processing software offered as a result of this experiment. The end-user, EPC, expects to improve the quality of its manufacturing process and eliminate the delivery of defective parts, corresponding to a 1.5 M€ saving over a five-year period. Finally, CESGA has acquired new industrial customers that use their existing HPC resources.

End-user: EPC (SME, ES)
Technology provider: UNIMETRIK (SME, ES)
ISV: DATAPIXEL (SME,ES)
HPC centre: CESGA (ES)

Innovative shoes using cloud-based insole design

Problem and solution

The production of tailored insoles for footwear usually requires a personal design, which means the later product can be cost intensive. If they could otherwise be offered at a much more competitive price, there would be many more potential customers. Mass customisation - this describes the way Podoactiva, a biotechnology company specialised in podiatry and biomechanics and the IT provider INGECON designed their customer service. By migrating their 3D insole scan & design method to the CloudSME Appcenter in the CloudSME project, the two companies managed to achieve both addressing a considerably increased group of customers worldwide and reducing costs. The cloud platform provides access to High Performance Computing capabilities which on the one hand reduce the computing time needed for the design and on the other hand enable simultaneous remote user access which increases the insoles manufacturing capability.

How did I4MS help

As part of the I4MS initiative, the CloudSME project supported this experiment developing the fully automated “3D Scan Insole Designer” which is a set of tools allowing to fully automate and facilitate the design process while enabling a row of benefits for customers, such as ubiquity from software licenses, no need of skills regarding CAD software, immediate validation and a perfectly fitting product (customised shoes for workers with peculiar feet or with pathological problems). The aim of this experiment was to establish a portal through which scans can be uploaded to the cloud-based software service (SaaS) and then execute remotely the CAD plug-ins getting the result back.

Impact

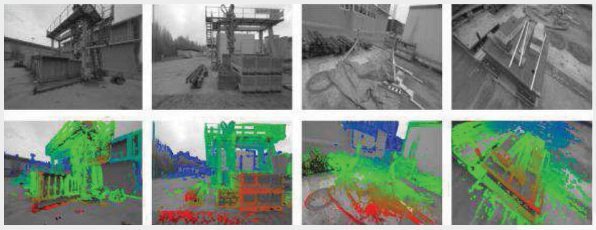
Customers not only receive a highly customised product, but they also benefit from reduced waiting time, as the immediate validation in the podiatrist office of the scanned images before sending them to Podoactiva will avoid rejections and later delays in the design as well as the need for the patient to go back to the podiatrist office to repeat the scanning process.

In a second step the workflow was complemented with an intermediary service offered by Base Protection, a manufacturer of safety shoes. Base Protection aims to not only provide a new line of innovative shoes with a high level of customisation, but also the perfectly fitting pair of a tailored insole and a BasePro shoe. Both can be sent to the manufacturer, subsequently.

Using the cloud based ICT platform will generate a multiple positive impact in terms of growth. After the first 3 years of project implementation Base Protection estimates to increase its turnover from €250k to €750k, gain an additional 3% market share, double its direct employment and reduce its time to market by 40%. Furthermore, the results acquired in the project will be exploited by industrialising the products and services in collaboration with the existing partners moving outside the safety shoes market into leisure, sport and fashion shoes market.

End-user: Base Protection (SME, IT), Podoactiva (SME, ES)
Technology provider: INGECON (SME, ES)

More efficient bridge inspection by using autonomous micro aerial vehicles (MAVs)



Problem and solution

Systematic inspection and maintenance of the huge amount of structures in Europe such as industrial plants, wind power plants, or traffic infrastructure (e.g. bridges) is highly important for sustaining the productivity of European industry. Nowadays, such inspections are often made visually. Experienced inspection teams climb through the structures with the help of climbing equipment and access vehicles (manlift, bucket truck, etc...). This procedure is highly dangerous for the inspection teams and is very time consuming and costly. It is often difficult for the team to perform a full and systematic inspection, which may cause overlooked deficiencies. Finally, the inspection team typically has no accurate position information to exactly locate deficiencies, such that comparisons across multiple inspections are difficult to achieve. The recent approach in inspection and maintenance of large buildings and structures is using micro aerial vehicles (MAVs) that rely on GPS for autonomous navigation and require highly skilled and well trained pilots to maneuver the MAV close to structures.

The TUM Flyers project develops novel vision-based localization, 3D reconstruction and navigation technologies for increasing the level of autonomy of MAV inspection systems and the quality of systematic inspections. The characterizing elements of the system are vision-based localization in real time, a semi-autonomous assistive MAV flight mode, autonomous MAV waypoint navigation, image analyses methods, robustness, generality and customizability.

How did I4MS help

In the I4MS project EuRoC the TUM Flyers Challenger Team was able to use the excellent facilities of the Challenge Host Eidgenoessische Technische Hochschule Zurich, offering a dedicated arena of 8mx10mx4m with movable, reconfigurable scaffolding to create narrow passages, movable obstacles, fans and lights to create varied test conditions. Technology Developer Ascending Technologies GMBH offered the special version of its EuRoC-UAV, a completely new design based on experiences gathered with the hex-rotor helicopter “AsTec Firefly”, while Alstom Inspection Robotics AG put its expertise as System Integrator for the TUM Flyers team.

Impact

The Schällibaum AG (SLB) is a family-owned SME with 80 employees and provides Civil Engineering, Geomatics and Architectural Services. As an end-user of the developed technology, SLB leads the way to MAV inspection services, expands the range of offered services, and strengthens its position on the market as inspection service provider. Compared to conventional inspections, systematic mobile inspection with MAV technology would significantly reduce inspection time by more than 50% (a traditional visual inspection takes about 4-5 days whereas a MAV inspection needs 2 days using the same number of staff), increase repeatability and cut down costs by 30-50% (from €14k to €7-9k). In addition, the number of potential objects which require such services is growing continuously: on the one hand the specific market for bridge inspections is larger than currently exploited (there are around 15.000 bridges that require inspection every year for both Germany and Switzerland) and on the other hand the same inspection techniques can be used also for other objects.

End-user: Schaellibaum AG Ingenieure und Architekten (SME, CH)
Technology provider: Computer Vision Group of Technische Universitaet Muenchen (TUM) (DE)

Turning of low pressure turbine casing

Problem and solution

Aircraft components and in particular their engines have very strict quality requirements and tight tolerances. Therefore, their production needs to be extremely accurate. The production of a low pressure turbine as part of an aircraft engine poses challenges to the classical fixture process in terms of vibrations and active modification of the clamping conditions during finish turning.

A demonstrator system has been developed mainly in collaboration of technology provider CEDRAT Technologies with end-user ITP to modify and enhance the current fixture. It integrates active vibration dampers to reduce the vibrations during machining and actuators to produce an actively controlled deformation of the work-piece therefore improving the clamping conditions. The system includes sensing capabilities to detect the state of the work-piece and modifies the behaviour of the work-piece as required to ensure quality. To achieve this, a dedicated high force, controllable actuator has been developed by CEDRAT Technologies and validated in an industrial context including its drive electronics.

How did I4MS help

The experiments about intelligent fixtures in the I4MS project INTEFIX allowed CEDRAT TECHNOLOGIES to accelerate the development of their new magnetic actuator and associated drive electronics, also allowing the validation of the system in an industrial application proposed by ITB. The I4MS initiative has also helped to disseminate the results of the project through the organization of events that permitted to increase the visibility of CEDRAT TECHNOLOGIES and the new products that result from the project work.

Impact

CEDRAT TECHNOLOGIES will add two new products to their portfolio thanks to the project. For the 5 years following the product launch in September 2016, the company estimates to increase its turnover by over 15% thanks to a considerable increase of new and old customers that are interested in buying sophisticated solutions from CEDRAT TECHNOLOGIES. The new products are estimated to increase the revenue of the company by 1M€ by 2021 and it is envisaged that 4 new jobs will be created increasing the size of the company by 7%.

The developed solution provides to ITP a solution to improve the clamping of this kind of turbine case, avoiding the vibration tendency of the work-piece due to an adaption of the fixture to the machining process requirements. The economic impact for ITP is related to the reduction of reworks and scraps in finished parts. In this way the reworks will result in annual savings of 872 labour hours and 27k€ of incurred costs. The improvements of the new fixtures also affects the productivity of the whole process with an estimated improvement of 20%, allowing to produce 1.2 components per day compared to the current 1 component per day. In this way the turnover associated to this component could be also increased by 20% (1.2 M€).

End-user: Industria de Turbopropulsores, S.A (ITB), (LE, ES)
Technology provider: CEDRAT TECHNOLOGIES SA (SME, FR)

Cooling Airflow-Optimization for Compressors

Problem and solution

To mitigate the noise of loud air-cooled machines there are usually sound-reducing enclosures around them. This implies the challenge to have a sufficient cooling air flow. So far the typical way of finding the best trade-off between efficient cooling, noise reduction and low power consumption of the cooling ventilator was carrying out trial and error experiments. Even after a high number of such experiments the result remains suboptimal. CFD (computational fluid dynamics) is well-known to help in understanding and optimising airflow. However, using CFD was hampered for SMEs by the costs for the software and - more importantly - the costs for training to use it which approximately correspond to three months after the acquisition of a CFD program.

Using the CFD numerical simulation SW of CAPVIDIA that was extended to run on an HPC system in the cloud BOGE was able to improve noise/acoustic emission and cooling airflow by predicting them more accurately evaluating necessary design variants without building several expensive and time-consuming prototype test samples. This enabled impressive improvements of the compressor. The noise of the compressor was reduced by 15 %. Furthermore, a 30% reduction of electrical fan power consumption has been measured. Finally, the development time for one variant of the enclosure-fan combination could be reduced from today's 3 to 5 person months to 1 to 2 person months.

How did I4MS help

The I4MS project CloudFlow enabled an affordable access to HPC resources and CFD simulation software as well as to people helping to use the CFD programs via a European collaboration. Such a collaboration on a pay-per-use base facilitated SMEs to design highly sophisticated products without investing in expensive resources such as HPC hardware, CFD software and manpower to maintain the HW and to train staff in using the SW.

Impact

Predicting noise emission and power consumption of a compressor more accurately in the development phase thereby has considerable economic advantages for BOGE in terms of development cost and time-to -market. Furthermore, existing BOGE clients will save electricity cost that amounts to about 350.000€ per year reducing ultimately the CO2 footprint. The important product improvements offer potential to increase the BOGE market. Taking the development cost reduction and the competitive advantage through better products and a faster time-to market into account, it is conservatively estimated that BOGE can increase their revenues by about 2 M€ over the next 5 years.

Having demonstrated the successful application of its FlowVision CFD analysis software, CAPVIDIA expects a twofold economic impact of the project results. Using the software on cloud HPC resources on a pay-per-use base makes CFD and therefore this software attractive and affordable for many more companies. This will increase the sales of FlowVision licences considerably. Moreover, the combination of the CFD specific knowledge of CAPVIDIA with HPC resources in a package provides the company with a new business model selling all-inclusive CFD simulation services where customers get a turn-key simulation result for a fixed price in a given short time. CAPVIDIA expects to increase revenues by 5 M€ over the next 5 years thanks to the project results.

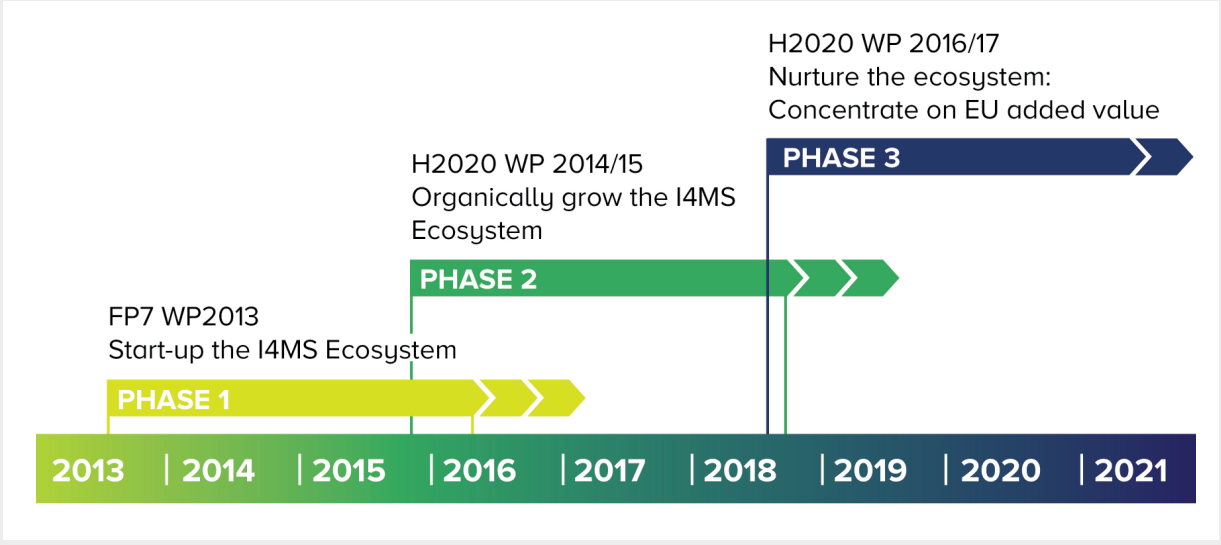
The successful collaboration with CAPVIDIA and a reference end-user company provides the HPC centre ARCTUR with additional customers from industry.

End-user: BOGE (SME, DE)
ISV and HPC centre: CAPVIDIA (SME, BE), ARCTUR (SME, SI)

What's next

The I4MS Phase 2 projects will launch 7 more open calls for experiments and innovation hubs, out of which at least 3 will be announced in 2016. Further calls for experiments will be launched in 2017 so as to conclude Phase 2 in 2018 such that 85 application experiments will be endeavoured and led by SMEs and mid-caps which are mostly newcomers to European Research and Innovation programs. Typical experiments bring together cross-value chain collaborations between commercial suppliers, innovative end-users and one or more competence centres, at least one of the actors being an SME or mid-cap.

About 80% of the European funding will be spent to support SMEs and mid-caps. This amount includes direct financial support of about 8.8 Mn EUR for open calls in order to have additional experiments and of about 9 Mn EUR for services provided by the competence centres, such as access to infrastructure or transfer of leading edge solutions and technologies to SMEs so as to facilitate the offer of new and more competitive products and services. Also the presence of large industrial players will ultimately help SMEs and mid-caps, as establishing a customer relationship with such big players as reference will boost their business.



Enhancing the I4MS ecosystem towards less developed regions

An important and new part of I4MS is to reach out to new and in particular less developed European regions. The goal is to encourage centres of excellence to also adopt their role as digital innovation hubs providing any manufacturing company in Europe with access to the most sophisticated digital technologies and competences thereby helping them in mastering their transition to the digital economy. These new digital innovation hubs would typically be research centres, innovation oriented university laboratories, innovation clusters, science parks etc.

All 6 projects of I4MS Phase 2 have the necessary experience and are well placed to motivate such competence centres in the less developed regions in Europe to become regional digital innovation hubs. They have furthermore the network in their respective fields to organically develop and grow the European digital innovation ecosystem for manufacturing companies. Using their network they bring new competence centres together with the relevant regional manufacturing SMEs.

All in all, 1.5 Mn EUR have been set aside by the projects with the objective to coach about 30 new digital innovation hubs to support match making between the smart specialisation and digital

transformation needs of their region and the competences being available in I4MS. This includes as well an analysis of potential regional funding sources like for example the European Structural and Investment Fund (ESIF) with the goal to support the establishment of local ecosystems and linking them on a European scale.

The first piloting call for expression of interest has already been implemented for three hubs. Taking experiences from the pilot into account the most promising 27 applications of potential innovation hubs from the target regions will be selected in 2016 and linked to their mentor organisation from the I4MS Phase 2 projects which has the most applicable competence to coach them in technical, innovation, administrative and financial terms.

Up to 50k EUR per mentorship will be made available to bootstrap an extended I4MS ecosystem embracing the innovation hub, manufacturing SMEs and regional funding bodies and programmes with individually fit for purpose actions.

I4MS Phase 3

Following the very successful implementation of Phase 1 and the already witnessed growth of the I4MS network and ecosystem, the European Commission will further invest H2020 resources in strengthening European SME and mid-caps along the value chain by adopting innovative business models and bringing them into contact with actors that can provide access to finance and access to advanced training to reskill workers. The I4MS Phase 3 will be called in the Work Programme 2017 under the call FOF-12-2017 with deadline for submission of proposals in early 2017. The focus will be on motivating and enabling SMEs and mid-caps to collaborate at European level to carry out highly innovative experiments that will multiply the impact of local initiatives to a European scale.

Reinforce EU's competitiveness in digital technologies

Many national and regional initiatives such as Industrie 4.0 in Germany, Smart Industry in the Netherland, Catapults in UK and Industrie du Futur in France have been launched in order to exploit and reinforce the opportunities offered by digital innovations in industry. They show the commitment across Europe to seize the digital opportunities ahead.

The European Commission will complement those initiatives by creating a dynamic framework for coordination and experience sharing between public and private initiatives at EU, national and regional level. More coordination in the Digital Single Market (DSM) landscape will help to channel public and private investment capital into digital technologies thereby attracting the requested critical mass to foster European competitiveness at large.

Enlarge the target technology areas

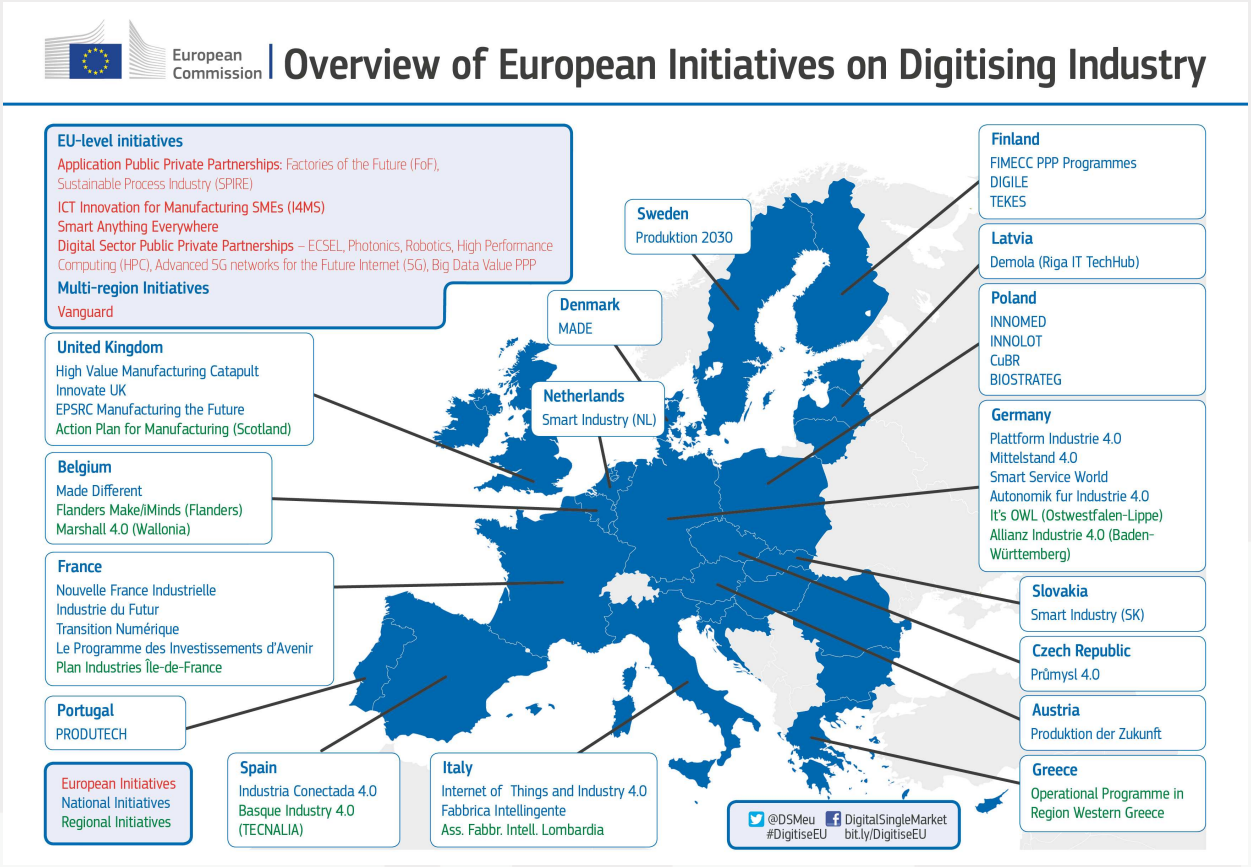
In I4MS Phase 3, projects are expected to continue to grow the existing I4MS networks in the current technology areas by enlarging the ecosystem of emerging platforms in cooperation with other European networks such as the IoT Focus area, the Joint Undertaking ECSEL, and the SPARC or Big Data PPPs.

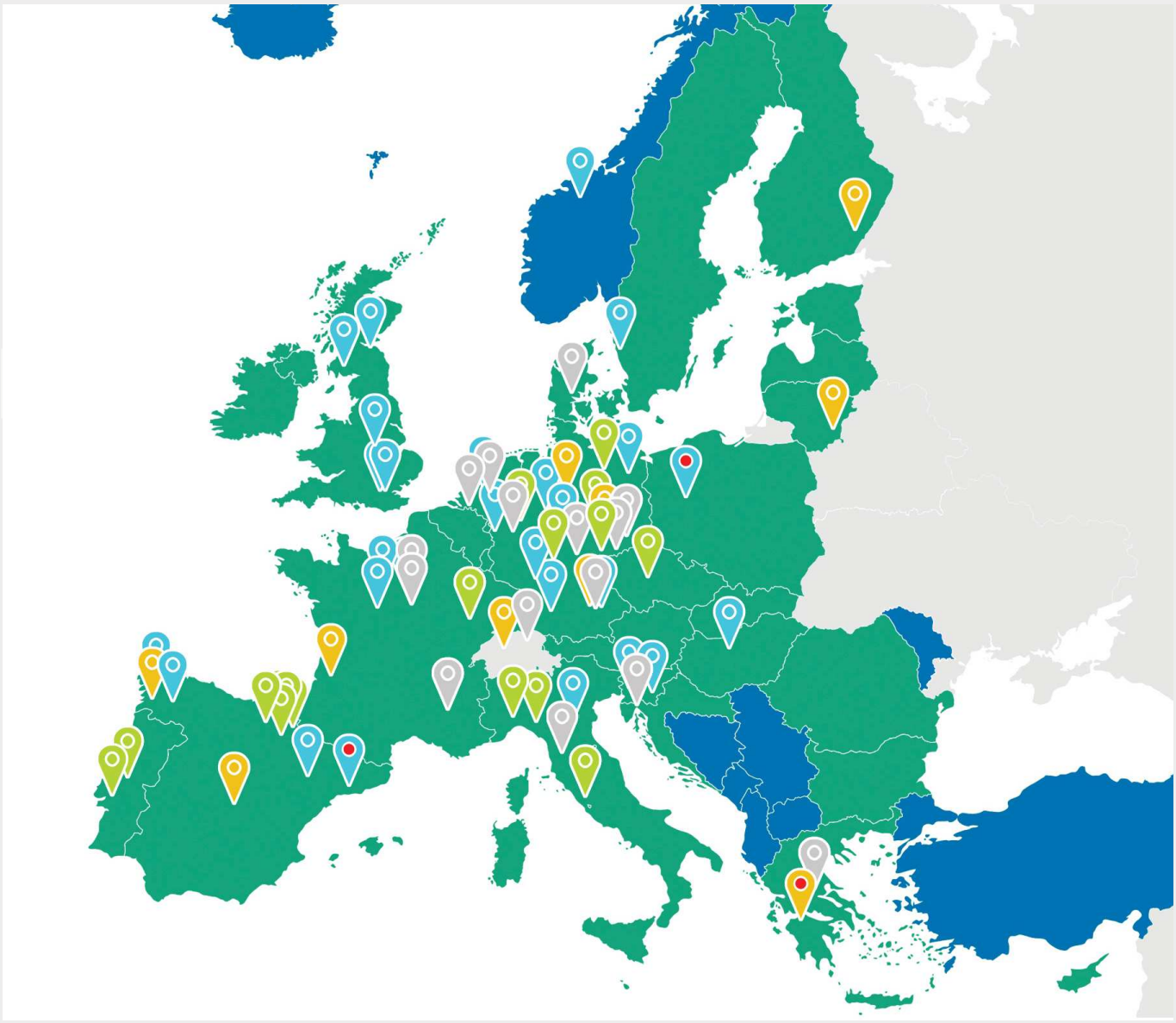
A new technology area will be added to the existing ones due to its increasing relevance for the manufacturing sector, namely the adoption of digital design tools for additive manufacturing. Innovative equipment and processes targeting design and production phases will be able to drastically reduce modifications and re-design thereby ultimately increasing the capability of SMEs

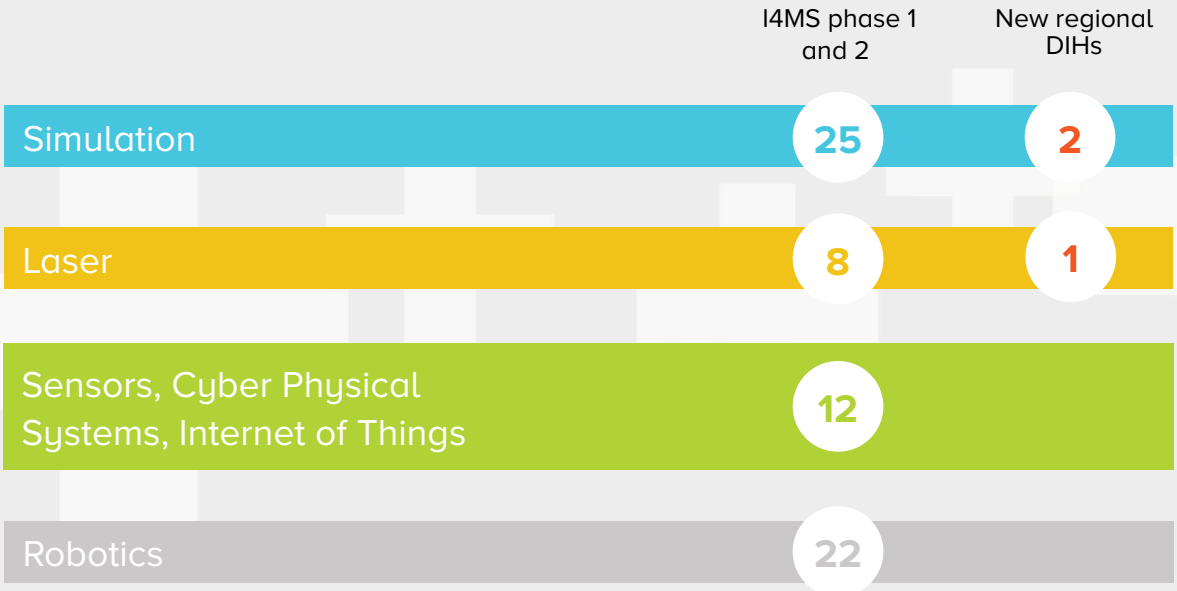
and mid-caps of designing new and innovative products in shorter time-to-market. These tools will also reshape the supply chain allowing companies to manufacture via internet through access to a global network of 3D printers and production systems. In this context new business models addressing these changes can be explored. Experiments will allow SMEs and mid-caps to integrate this technology in order to produce small lots of highly sophisticated products at reasonable price thus improving their competitiveness in the global market.

Nurturing the I4MS ecosystem

To enhance the European I4MS innovation ecosystem, a Coordination and Support Action (CSA) will be called for reinforcing the network of innovation multipliers in order to leverage investment in research and innovation by consistently acting as a broker between end-users, technology suppliers and system integrators and mapping and matching competences in and between regions in close cooperation with the European Factories of the Future Research Association (EFFRA).






I4MS phase 1 and 2
New regional DIHs
Simulation
25
2
Laser
8
1
Sensors, Cyber Physical Systems, Internet of Things
12
Robotics
22

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