



I4MS

Digital Innovation Hubs

Accelerators for the broad digital transformation of the
European Industry

Digital Innovation for the European manufacturing sector
The European ICT Innovation for Manufacturing SMEs (I4MS) initiative

September 2017

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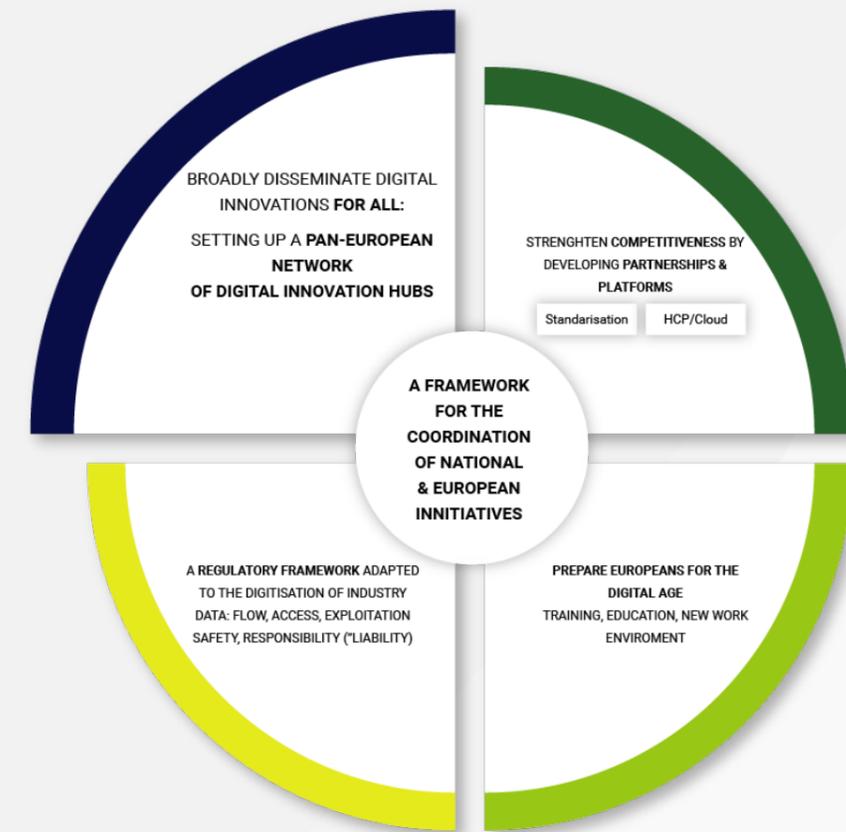
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DIGITAL INNOVATION HUBS (DIH) - THE I4MS CONTRIBUTION

In April 2016 the European Commission presented the Digitising European Industry Strategy (DEI)¹. The overall objective of this initiative is to ensure that any industry in Europe - big or small, wherever situated and in whichever sector - can fully benefit from digital innovations to upgrade its products, improve its processes and adapt its business models to the digital age. This requires not only a dynamic digital sector in Europe but also the full integration of digital innovations across all sectors of the economy. The DEI strategy is based on an ambitious collective effort involving public and private stakeholders across Europe at regional, national and EU level. It consists of five pillars:



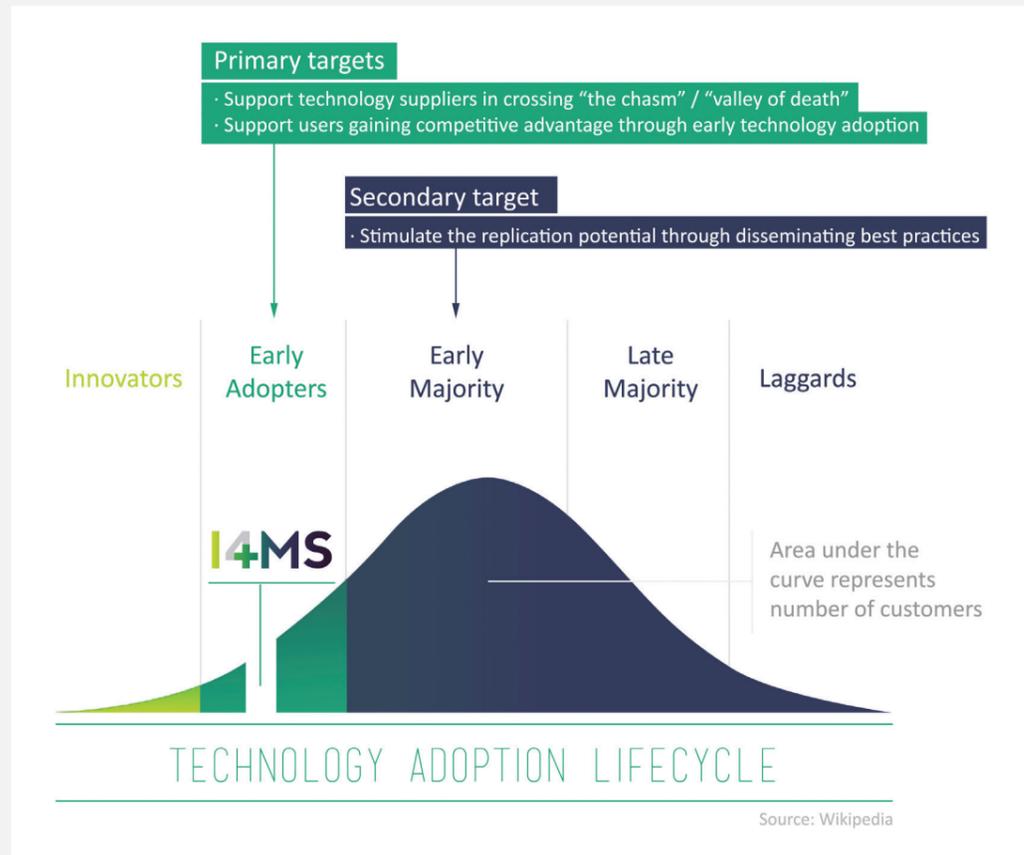
Digital Innovation Hubs (DIHs) are one of the key elements of the DEI strategy. They are support facilities that help companies – notably SMEs, start-ups and mid-caps – to become more competitive through the adoption of latest digital technologies. The DIHs act as a one-stop-shop in working distance, providing their customers with:

- access to digital technologies and competences,
- infrastructure to test digital innovations,
- training to develop digital skills,
- financing advice,
- market intelligence and
- networking opportunities.

<https://ec.europa.eu/digital-single-market/en/news/communication-digitising-european-industry-reaping-full-benefits-digital-single-market>

DIGITAL INNOVATION HUBS (DIH) - THE I4MS CONTRIBUTION

Member States and regions play the key role of establishing the DIHs infrastructure with different sources of funding at national and regional level, but also through the management of European funds such as EFSI. The European Commission, from its side, plays the role of supporting networking and EU-wide collaboration across the network of DIHs.



I4MS: fostering leadership in manufacturing through Digital Innovation Hubs

The European Commission started to invest in the establishment of DIHs already in 2013 with the ICT Innovation for Manufacturing SMEs (I4MS) initiative as one of the key activities. Nearly €110 million have been invested for this initiative since 2013 with a supplementary investment round of €34 million in 2017. The goal of I4MS is to enable and foster the collaboration of manufacturing SMEs, start-ups and mid-caps across their value chains through the help of European DIHs, where companies can run small scale experiments to test digital innovations. This creates 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 DIH to the SMEs, start-ups and mid-caps improving their products and services, processes, business models and digital skills. As a result, I4MS resolves the competence gap of SMEs. Furthermore it pro-

DIGITAL INNOVATION HUBS (DIH) - THE I4MS CONTRIBUTION

vides them with the financial means and network to adopt leading edge technology that allows them to bring innovative and highly competitive new products and services to the market.

Innovative suppliers, for their part, profit from I4MS because the experiments enable them to mature their existing technologies and broaden the field of their application, ultimately opening them new markets and services. The DIHs also benefit from the initiative, as they extend their largely research oriented activities with industrial projects, gaining a new sustainable business model.

The ultimate goal of the experiments is on the one hand to help foster competitiveness of in particular SMEs and mid-caps, and on the other hand to establish fully functional ecosystems of DIHs that can also provide services beyond technical advice such as business consulting and training.

Another important aspect of I4MS is helping the innovative suppliers and the manufacturing companies to change their predominantly product-oriented into service-oriented business models, which is imperative in digital economy nowadays.

Phase 1: Creating a well-functioning ecosystem

The I4MS initiative is structured in different phases that pursue complementary objectives. The first phase started in 2013 with 7 Innovation Actions and one Coordination and Support Action (CSA). Coming to its successful completion at the end of 2017, this phase was dedicated to the creation of well-functioning ecosystems around regional DIHs in four technology areas:

- HPC cloud-based simulation services
- Advanced laser-based equipment assessment
- Industrial robotics systems and
- Intelligent fixtures

The 195 experiments that were conducted in phase 1 have involved 39 DIHs, 210 SMEs and mid-caps. They have created enormous economic and societal impact. They also showcase that having regional DIHs and an initiative targeted at manufacturing SMEs, start-ups and mid-caps delivers the intended results (see some concrete examples in the set of success stories from page 12 onwards). The leverage effect achieved by public money has also been considerable, ranging up to a factor of 30 or more on experiment level.

Phase 2: Growing the ecosystem and its European dimension

The second phase of I4MS started in autumn 2015 with 4 new Innovation Actions and 2 CSAs. The objective is to organically grow the existing ecosystems, extend their European dimension and motivate the creation of new DIHs through a dedicated mentoring programme.

Accessing EU funding has also become easier for companies under the new I4MS phase because the administrative procedures have been simplified. By using the new “Financial Support to Third Parties” scheme of H2020 (the so-called “cascade funding”), companies can sign a light contract with one of the projects’ beneficiaries rather than entering into a direct and more complex contract with the European Commission.

DIGITAL INNOVATION HUBS (DIH) - THE I4MS CONTRIBUTION

Addressing technological evolutions

A new set of 60 experiments has been launched and 12 are still to come, involving 25 new DIHs and 120 SMEs. They all have a cross-border dimension to foster collaboration on European level. In addition, this new phase also reflects the evolution of technology since the start of the initiative. The focus on intelligent fixtures has now turned into the advent of Cyber Physical Systems (CPS) and Internet of Things in manufacturing processes. This is a new and highly relevant technical field that is gaining enormous importance for manufacturing. Furthermore, HPC cloud-based simulation services, which were also one of the technology areas in I4MS phase 1, have been extended to data analytics. Finally, the focus in Robotics has been put on robotic systems particularly affordable and useful for SMEs.

The role of the CSAs in extending the European collaboration

In terms of coordination, the two new Coordination and Support Actions (CSAs) launched in the phase 2 of I4MS are responsible for multiplying the effects of the 4 Innovation Actions and reinforcing the I4MS ecosystem. They continue the successful support and coordination efforts of phase 1 and in particular they pro-actively enhance the role of industry-oriented DIHs. For this purpose, it is essential to network all relevant stakeholders - local manufacturing enterprises, national and regional initiatives, as well as the regional funding authorities and European funds - in order to extend the I4MS ecosystem especially to new regions.

I4MS Coordination and Support Actions also provide access to a dynamic repository of information on initiatives that could help SMEs, start-ups and mid-caps with their digital transformation. The information includes initiatives at all levels across the EU, with relevant and difficult to retrieve information that can facilitate companies to find the support they need. Finally, CSAs collaborate with institutions on an international level in order to identify synergies or common challenges that need to be addressed on an international scale.

Mentoring programme for new DIHs across Europe: filling the white spots

One of the goals of the Digitising European Industry Strategy (DEI) is to have a DIH in every region by 2020 so that every company can find support to benefit from digital transformation. However, many regions are not yet advanced in the development of a DIH. In order to address this challenge, I4MS has sponsored and coached 29 new DIHs in many of these regions through a dedicated mentoring programme.

A funding of €1.45M (average €50K by participant) was made available for this purpose. Participants received the support from the existing network of hubs on how to set up and operate their services. In particular, they were helped to identify the specific needs and challenges of industry in their regions (in line with the Smart Specialisation Strategies) and to develop the necessary competences and services to address them.

The coaching programme had a strong participation from countries such as Spain (6 participants) or Italy (5 participants). 9 hubs also came from Eastern European countries across 5 different Member States and 2 Associated Countries.

The programme has fully achieved its purpose, as the participating hubs have now become an active part of

DIGITAL INNOVATION HUBS (DIH) - THE I4MS CONTRIBUTION

the DIH ecosystem. As a proof, 18 of the coached hubs have participated in the latest I4MS call, where 8 hubs had successful applications and other 10 were part of submitted proposals.

Some particularly successful examples can be found in the Irish and British hubs that participated in the programme. Not only they are up and running but they have also prepared (in collaboration with SMEs of their ecosystem) 12.5% of the proposals in the second call of the I4MS project BEinCPPS. The Italian candidates have become an integral part of the "Piano nazionale Industria 4.0" and the associated national network of DIHs.

Building on these successes, a new project "Smart Factories in new EU Member States" will now specifically reinforce the efforts to build a network of Digital Innovation Hubs (DIHs) in Central and Eastern European (EU13) regions to provide them with a similar programme so that they can advance in the development of DIHs. 30 organisations will be selected still in 2017 to study the feasibility of becoming a Digital Innovation Hub that serves the needs of their region.

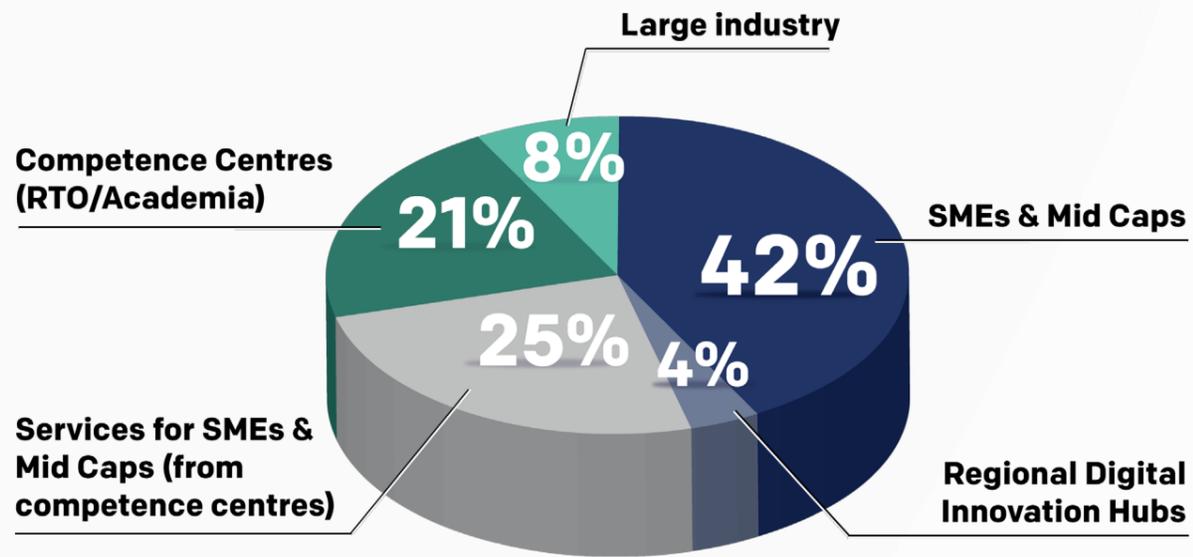
Widening the network of Digital Innovation Hubs is a key priority in the Digitising European Industry Strategy. As part of the Digital Innovation Hub actions of the Focus Area on Digitising and Transforming Industry and Services in the new Horizon 2020 work programme for 2018-19, a further €8 million is dedicated to widening the existing European network of hubs of I4MS. It is intended to help in achieving broad coverage in technological, application and innovation terms in regions that are so far underrepresented in the network. This will be the opportunity for the coached hubs to become an integral part of the EU ecosystem of DIHs.

First conclusions

Even if phase 2 of the I4MS initiative is still ongoing, the objectives have already been achieved to a very large extent. The high interest of industry in the initiative witnessed in phase 1 has further increased and the four open calls launched in 2016 and 2017 have received an ever higher number of proposals. Many of the 29 coached DIHs are up and running and delivering on their mission to support SMEs, start-ups and mid-caps according to their needs. In addition, three marketplaces providing one-stop-shop services for manufacturing SMEs, start-ups and mid-caps are already operational and others are under consideration.

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 560 current contractors **406 are from industry.**

An **increased 84% 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.

Almost **70 experiments** have already been launched in phase 2 either at the outset of the projects or in 4 open calls carried out so far. 2 more open calls are to come for some 15 more experiments.

OPEN CALLS TO PROMPTLY RESPOND TO EMERGING MARKET CHALLENGES

More than €26 million funding were so far distributed predominantly to SMEs and mid-caps in 15 calls during phases 1 and 2. This includes 2 calls to enhance the role of RTOs and Competence Centres to also become regional Digital Innovation Hubs (DIHs). 2 more calls are expected to be launched in 2017 with a volume of about €1.6 million.

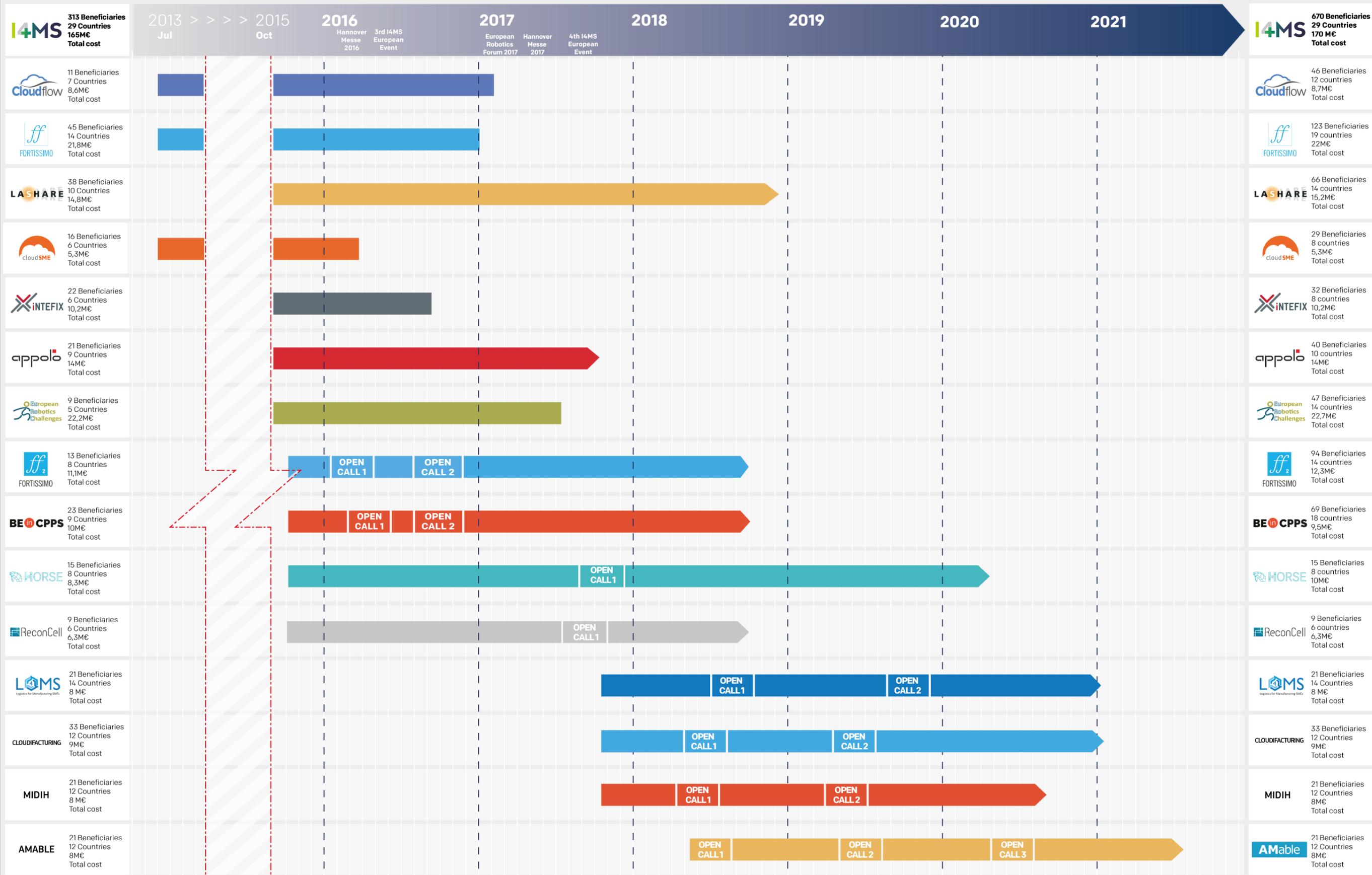
Light, **SME friendly application scheme:**

- 10 page proposal
- Calls tailored to market challenges
- Very short time to experiment start

Interest of SMEs and mid-caps has strongly increased, e.g. doubling the proposal numbers from one call to the next and receiving up to 100 proposals per call.

ENLARGEMENT BEYOND TRADITIONAL MANUFACTURING

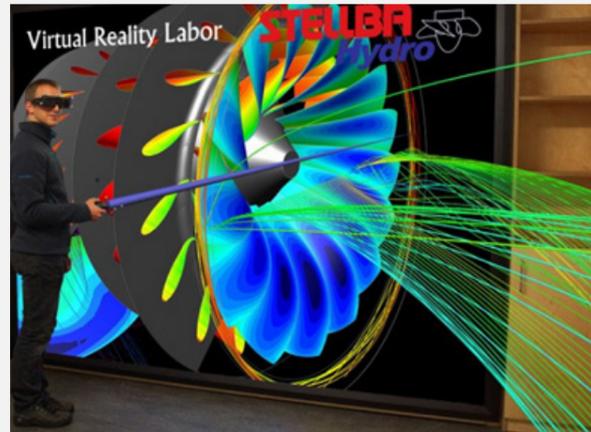
The I4MS experiments extend recent advances of ICT beyond the traditional European manufacturing sectors (e.g. automotive, aerospace and machine tooling) to other **industrial sectors such as in food, textile, printing and health care**, in which efficient use of advanced ICT would enable SMEs to play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



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 a solution, but requires specialised know-how that is not available in STELLBA.



The role of the DIH

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 DIH 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)*

COOLING AIRFLOW-OPTIMISATION 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.



The role of the DIH

The project CloudFlow enabled an affordable access to HPC resources of the DIH ARCTUR 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 €2M 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 €5M 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)*

ADDITIVE MANUFACTURING FOR IMPROVING GEARBOX PRODUCTION

Problem and solution

There are many application areas (automotive, aerospace, heavy industries) that would strongly benefit from a certain type of gearboxes, namely cycloidal gearboxes, as they are particularly efficient (high torque increase), compact and highly resistant against torque peaks and shocks. It is estimated that the market for cycloidal gearboxes exceeds €600M.

However, the classical engineering and production of those gearboxes is nowadays based on subtractive manufacturing (i.e. small pieces are mill-cut out of a rather big block of metal with a lot of metal scrap), which makes them prohibitively expensive. Additive manufacturing (e.g. by 3D printing) could overcome this dilemma, as much less material is needed and the preparation and machining times would be drastically reduced. Additive manufacturing, however, requires very accurate simulation of the production process. Such simulations create enormous data volumes that need to be computed in a timely fashion.

In this CLOUDFLOW experiment the existing simulation technology FEMPAR was augmented with a simulation model that captures the physics of the thermal process of a metal printing machine. Thereafter, the software was "cloudified" so as to run it on HPC resources in the cloud to exploit the full power of scalable resources. The experiment resulted in impressive technical figures of merit:

- Up to 66% of scrap material saved
- Simulation time reduced by 65%
- The transmittable torque is increased by 20%
- The engineering and production time and cost for a new gearbox is reduced by 30%

The role of the DIH

The collaboration of the manufacturing SME STAM with the technology provider CIMNE and the HPC DIH CSUC has led to a highly sophisticated solution for manufacturing leading edge gearbox technology. This could only be achieved by the efficient use of HPC resources that can neither be managed nor afforded by SMEs. The software solution will soon become available in a one-stop-shop called the CLOUDFLOW marketplace as "software as a service" (SaaS), i.e. pay-per-use.

Impact

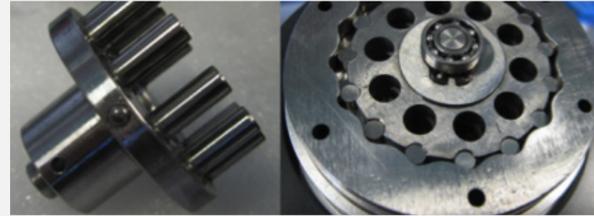
Using the acquired new technology capacities STAM saves 30% product costs and can react 30% faster to market needs. This enables them to offer more powerful products at a more competitive price, which makes cycloidal gearboxes the best solution for many more applications. Exploiting their superior position with respect to their competitors STAM expects to triple its market share in the existing markets and to extend their business to new markets. It is estimated that the revenues will increase by 320K€ and their staff by three employees within the next three years.

The independent software vendor CIMNE will further advance FEMPAR-AM for additional industrial applications. Offering the software on the CLOUDFLOW marketplace, CIMNE hopes to increase its market share by 50% and the related revenues by €64K within three years. CSUC will offer new and better services through the CLOUDFLOW marketplace. CSUC expects to have 20 new customers 3 years after the experiment equalling to €180K additional revenue. This will allow for creating one additional job position after 3 years. Finally, saving up to 66% of scrap material in the gearbox production has also a considerable environmental dimension.

End-user: STAM (SME, IT),

Technology provider: CIMNE (RTO, ES)

HPC centre: CSUC (PUB, ES)



HIGH PRECISION PRODUCTION OF PLASTIC FOILS

Problem and solution

The Austrian SME EMO builds machines that produce plastic foils used for e.g. packaging or garden ponds. The production process is very complex, as different mixtures of materials are to be processed into foils of different thickness and robustness levels. In order to have a perfect product multiple machine parameters such as e.g. pressure, temperature and the overall mechanical design need to be set exactly. The problem in the past was that the mechanical design and the process parameters of the machines were configured based simply on the experience of employees, leading about 12 times to machine malfunction. Produced foils were either too thick or too thin. This required recalls that are very costly due to the size and weight of the machines (17 tons, 9m width).

In the CLOUDFLOW experiment the software provider DHCA developed a solution that can now much faster (speed-up factor of 10) and much more precisely configure EMO's machines, as a high number of parameters can be accurately simulated. In order to run the simulations in reasonable time, this software was customised for HPC processing by INO in order to be executed in the cloud on the HPC resources of ARCTUR.

The role of the DIH

The collaboration of DHCAE and INO as technology providers and ARCTUR as DIH furnished the manufacturing SME EMO with a solution that they could have never afforded. They have neither the knowledge nor the financial resources to buy and maintain HPC resources in house. Furthermore, they do not have the knowledge on how to run complex simulations that provide them with the necessary feedback on their machine design. All this can now be bought from the CLOUDFLOW one-stop-shop on an affordable pay-per-use basis.

Impact

The economic impacts are impressive. For EMO just avoiding recalls saves already about €1.2M per year. As commissioning time is reduced down to 70%, time-to-market is accelerated by several weeks. It is expected that production costs can be reduced by up to 25% due to savings of energy, raw materials and personal costs. As a consequence of better products, faster time-to-market and lower production and after sales service cost, EMO expects to double their market share from 5% to 10% in a €100 Mio market.

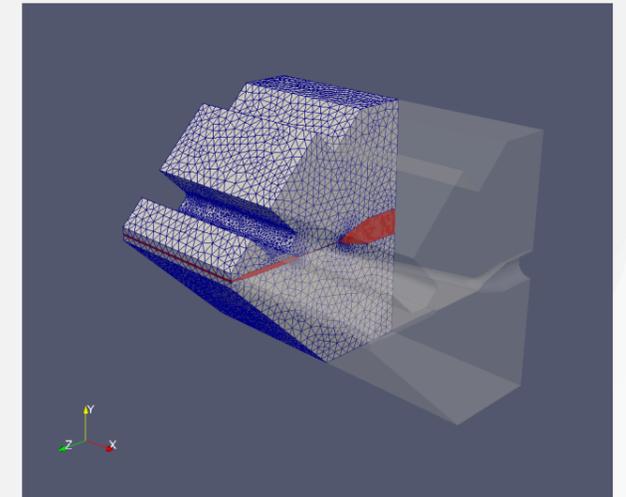
The two technology providers will extend their business considerably thanks to new software features, which involve customising and cloud services (for DHCAE) and additional training and consultancy services (for INO). DHCAE expects 10 new customers within the next 3 years increasing their revenue by 20%. One additional engineer will be hired. INO expects to have 500 new customers in the same time frame tripling their sales and increasing their staff by two engineers.

The HPC centre ARCTUR will profit from new services for industrial applications on their HPC cluster ultimately leading to a higher workload on the existing infrastructure

End user: EMO (SME, AT)

Technology providers: INO (SME, DE) and DHCAE (SME, DE)

HPC DIH: ARCTUR (SME, SI)



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.

The role of the DIH

During the experiment in the I4MS project FORTISSIMO the HPC DIH ARCTUR and the technology service provider XLAB provided PIPISTREL with the HPC resources and the knowhow 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 upskilled 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.

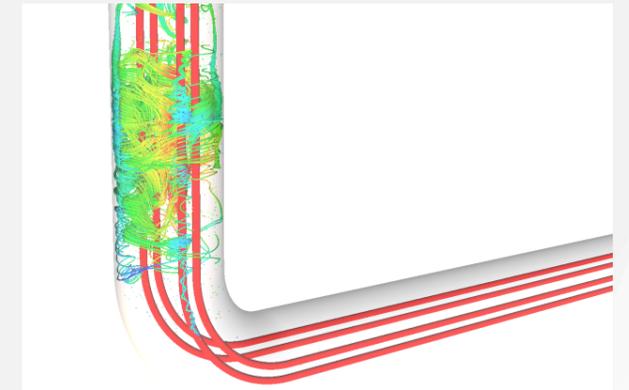
End-user: Pipistrel (SME, SI)

Cloud and HPC technology Providers: XLAB(SME, SI), Arctur(SME, SI)

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.



The role of the DIH

In the FORTISSIMO experiment the DIH 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)



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.

The role of the DIH

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, DIH CINECA providing advanced HPC facilities and expert advisors from another DIH, namely 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.

The role of the DIH

In the Fortissimo Project, the DIH CESGA has triggered the right mix of domain expert (Unimetrik), independent SW vendor of metrology software (Datapixel) and end-user (EPC) to have access to their 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

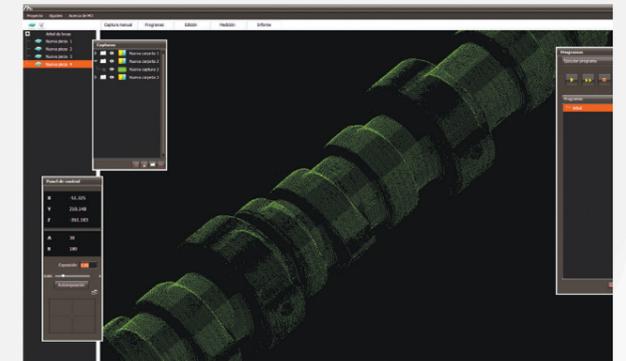
As an outcome of the experiment Unimetrik will increase its service provision by 30% and its portfolio of international customers by 20% within the manufacturing sector, based on its current scanning capabilities, particularly where there is a need for high-resolution measurement and analysis. An increase 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.

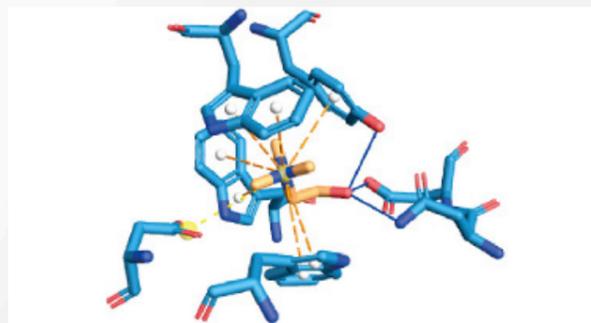
End-user: EPC (SME, ES)

Technology provider: UNIMETRIK (SME, ES)

ISV: DATAPIXEL (SME, ES)

HPC centre: CESGA (ES)





NEW DRUGS – FAST AND AT LOWER COST

Problem and solution

The journey for a drug from invention to market is a long one. It has been estimated that the time required to develop a new drug ranges between 10 and 17 years - if it ever makes it. The chance for a new drug to actually make it to market is only 1:5,000. These slim chances are accompanied by the high cost for

developing a new drug, which may reach an average of US\$ 403 million. These rising costs threaten to make the development of new drugs increasingly unaffordable for both companies and patients. Moreover, costs are prohibitive to develop drugs for very rare diseases.

Repositioning existing drugs for new diseases could deliver the productivity increases that the industry needs. The most prominent case was when a drug against high blood pressure was repositioned to become VIAGRA. Whilst this was a discovery by accident, reconfiguring existing drugs to target new diseases can be done in a structured and targeted manner. However, this requires enormous computing resources (supercomputers) to simulate different molecule compositions. The typical analysis of one drug reconfiguration would take 70 CPU years on a powerful workstation. The use of an HPC-Cloud infrastructure was combined with algorithmic improvements in a FORTISSIMO experiment. More specifically, optimised algorithms were run on HPC resources also with a new more efficient use of memory. This resulted in a significant reduction in the time. What was before 70 CPU years can now be achieved in 3 months. This obviously results in tremendous cost savings in the development of new reconfigured drugs.

The role of the DIH

The SME TRANSINIGHT that developed the improved algorithms in collaboration with the technical University of Dresden was helped by the Harokopio University and the HPC centre UEDIN of the University of Edinburgh as DIHs to run the new algorithms in an optimised way on HPC resources. The resulting service for e.g. pharmaceutical companies is now available on the FORTISSIMO marketplace.

Impact

TRANSINIGHT has already received very strong interest of big pharmaceutical companies. They estimate that there are hundreds of potential users of its proposed service. Each user represents around 4,000 queries regarding protein matching. For TRANSINIGHT this represents a potential increase in profits of around 3% per annum. The developed solution has been so attractive that TRANSINIGHT has been taken over recently by a big European group. This provides the SME with a much wider network of potential customers, more efficient marketing instruments and a clearly improved competitive position. Further profits can be expected for UEDIN thanks to a better use of their HPC infrastructure.

The most important impact of this experiment is, however, on the health care side. Shortening the drug development considerably will ultimately result in saving lives. The reduction of development costs will help dropping the consumer prices for medicine and may well enable the development of drugs for rare diseases, something that today is too expensive to make economic sense.

End-user: *Transinsight (SME, DE)*

Domain Expert: *Technical University of Dresden (RTO, DE)*

HPC Expert: *Harokopio University (RTO, EL)*

HPC Provider: *UEDIN (RTO, UK)*

CLOUD-BASED DESIGN OF HIGH-PRESSURE VESSELS

Problem and solution

The SME MIKROSAM produces machines that build high pressure cylinders (vessels) from composite materials. Those are much lighter, more flexible and more robust than conventional vessels made of steel or aluminum and thus well suited for e.g. the on-board storage of natural gas as a fuel for automotive vehicles. The challenge for MIKROSAM is that their machines produce vessels that satisfy the various applicable safety standards in a timely fashion avoiding trial and error loops. For each filament winding machine used in the production of high-pressure vessels, different combinations of materials and winding angles for the composite need to be considered. Therefore, the design of such a machine and achieving first-time-right to avoid a high number of physical prototypes before achieving an acceptable end result requires the processing of an enormous amount of data, which cannot be done in an acceptable timeframe on a hardware infrastructure affordable to an SME.

A computer model was developed by XLAB to design composite laminates and simulate their properties using the software OCTAVE. This model was adapted to be run as parallel computation on the ARCTUR HPC cluster. The conducted HPC-based simulation reduced composite-design time by about 30% and testing time by nearly 10%.

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The role of the DIH

The collaboration of technology provider XLAB and ARCTUR as DIHs in this FORTISSIMO experiment provided the manufacturing SME MIKROSAM with a solution that they could have never achieved. They have neither the capability nor the financial resources to buy and maintain HPC resources in house. Furthermore, they do not have the knowledge how to develop complex simulation models that provide them with the necessary feedback on their machine design. All this can now be bought in from the one-stop-shop FORTISSIMO marketplace on a pay-per-use basis.

Impact

With the simulation code developed in this case study it is possible to shorten the design time and to reduce the number of physical tests and prototyping costs. As a result, MIKROSAM will be able to reduce its production costs by a total of about €150,000 over the next 5 years. More importantly its product offering (production machines for high-pressure vessels) will give each of its customers an advantage in production costs of around a total €1.5 million per machine over the next 5 years for machines that are currently on the market. The considerable advantage of MIKROSAM's products over those of its competitors will, as a conservative estimate, increase the company's revenue by a total of around €2 million over the next 5 years. This is a significant amount for this SME. The experience gained in this experiment together with reduced production costs for both MIKROSAM and its customers constitutes a base for further growth of the company and the resultant creation of new jobs.

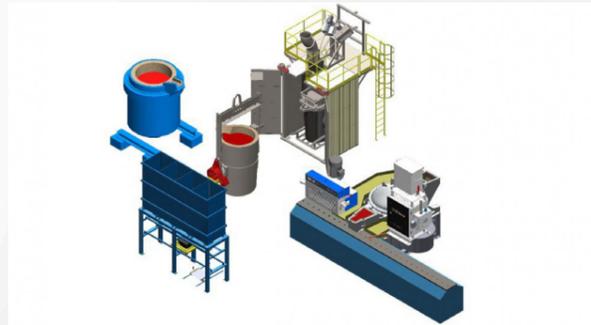
It is expected that XLAB and ARCTUR will benefit from the new service offer on the marketplace in terms of OCTAVE software customising services (XLAB) and sold cycle times (ARCTUR).

End User: *Mikrosam (SME, MK)*

HPC Expert: *Xlab (SME, SI)*

HPC Provider: *Arctur (SME, SI)*





OPTIMISING CAST-IRON PRODUCTION BY HPC CLOUD-BASED ADVANCED SIMULATION

Problem and solution

In order to produce casting without defects an iron-cast foundry needs to accurately calculate and control the chemical and thermal properties of the molten iron mixture. This mixture is different for each batch and the properties need to be calculated from

scratch each time. In a foundry, one of the key factors affecting the viability of the plant is the scrap rate. A typical foundry has a scrap rate of around 3%. Lowering the scrap rate is more and more mandatory as this will increase profits and reduce waste. In order to significantly improve the efficiency of the foundry process adjusting the process in real time is required. To do so a service is needed which could process large amounts of historical data and predict the behaviour of the current batch. Processing this amount of data would HPC resources are imperative to realise real-time performance. As an SME, ProService (as well as most foundries) does not have the resources to build its own HPC infrastructure in-house, and needs a cost-effective way to access these. Noesis and ProService collaborated in a FORTISSIMO experiment to tackle the problem. Based on Noesis' software product ITACA, Noesis supported ProService in the creation of a model, based on historical foundry data, and provided the required expertise to deploy such a solution on the FORTISSIMO infrastructure. Thermal analysis software was used to collect production data. The calculations were done on the HLRS infrastructure and then returned to the foundry system, where the correction was calculated and applied by the operator. Using the developed solution it can realistically be expected to reduce the scrap rate of a foundry to 2.5%.

The role of the DIH

Collaborating with Noesis and the University of Stuttgart's HLRS as DIH provided ProService with an affordable solution for which this SME does neither have the know-how in terms of software tools nor the financial capacity to run an HPC infrastructure in-house. Offering the solution on the FORTISSIMO marketplace will grow the DIHs eco-system to the benefit of other European iron-foundries of SME size.

Impact

For ProService, reducing the scrap rate to 2.5% translates to an annual saving of anywhere from €50,000 to €500,000 per year depending on the plant size and production volume. As a consortium, ProService, Noesis and Fraunhofer SCAI plan to offer the foundry optimisation tools as a service. The pricing model is based on different service levels depending on foundry size, and is expected to provide an annual revenue of €236k for ProService. Demand for cast metal products is increasing in the moment and it is key to ensure the competitiveness of European foundries to tapping into a global market. If just 10% of Europe's more than 1,900 foundries were to use the developed solution, saving only the minimum of €50,000, this would mean savings for the sector in excess of €9.5M per year. The potential of this service is therefore extremely high. Saving scrap in production has also an environmental dimension that is enormous in view of the billions of tons of iron cast being produced every year.

End User: ProService (SME, IT)

HPC Expert: Fraunhofer SCAI (RTO, DE)

ISV: Noesis (LE, Belgium)

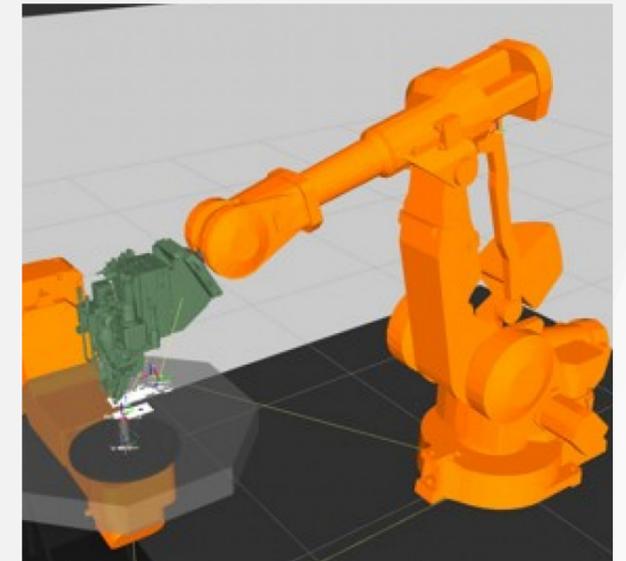
HPC Provider: HLRS (RTO, DE)

CLOUD HPC-BASED OPTIMISATION OF MANUFACTURING PROCESSES

Problem and solution

The repair of large metal parts caused by poor manufacturing processes or aging of the components is a rapidly growing sector, as it can be done by additive manufacturing techniques (e.g. 3D printing via laser metal deposition). However, this requires having online and real-time control of the quality of key features such as heat, as overheating leads to part deformation.

In the FORTISSIMO 2 experiment a new technology was developed, called CyPLAM. It leverages the latest advances in Artificial Intelligence research for image analysis, together with recent advances in data acquisition from images of the process. Using deep learning principles huge data volumes are to be processed in short time to enable online and real-time control of the manufacturing process. This can only be achieved on an HPC infrastructure. CyPLAM has been ported to run on FORTISSIMO cloud-based HPC resources and has been validated successfully by testing on a moulding repair application such that quality issues often seen in deposition-formed parts can be avoided.



The role of the DIH

The research organisation AIMEN provided EMO in collaboration with the DIH CESGA with a solution that makes additive manufacturing an industrially valid option for the repair of large metal parts. For this latest leading-edge research results had to be combined with a powerful HPC infrastructure, a combination of skills and computing facilities that an SME does not have at hand. The developed solution will become an offer on the FORTISSIMO marketplace so as to benefit also other European SMEs in this market segment.

Impact

The CyPLAM solution is putting EMO at a considerable advantage. EMO expects to cut production times by over 30%, as well as producing a higher-quality product with the need for less reworking and saving waste materials. Overall, end users can expect a 20% saving in operational costs and a 30% reduction in lead-time, compared to traditional approaches. The 30% time saving equals to over 2,000 hours of machine time. Operational cost savings will allow EMO to place itself more competitively in the market and service more customers.

AIMEN will license the CyPLAM technology to reinforce its recently launched CLAMIR system, a commercial process control system for Laser Additive Manufacturing. It also expects to boost its R&D capabilities by extending the approach to other industrial and civil applications.

CESGA is offering a new service based on the TensorFlow machine learning framework. The service has been tested and validated using the industrial case from this experiment. The experience and knowledge acquired during this experiment have allowed CESGA to develop other projects and contracts within the industry. They have also created a training course on Machine Learning.

End User: EMO Orodjarna d.o.o (SME, SI)

Domain Expert and ISV: AIMEN (RTO,ES)

HPC Provider & Expert: CESGA (RTO, ES)

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.



The role of the DIH

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) as DIHs 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 micro-breweries 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)

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.



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The role of the DIH

In this experiment of the CloudSME project the fully automated "3D Scan Insole Designer" was developed in collaboration of DIH INGECON with the end-users Base protection and Podoactiva 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)



VISUAL INSPECTION OF WIND TURBINES

Problem and solution

Wind energy is impressively growing in the EU. As any machine the wind turbines must be inspected regularly so as to determine when they need to undergo maintenance or repair. The problem nowadays is that for any inspection the wind turbine is to be stopped leading to a loss of energy production. The solution called "BladeHunters" developed in the EOLO experiment of the EUROCC project is using remotely piloted micro aerial vehicles (MAVs) to do the visual inspection

whilst the wind mill continues its operation. This required tackling several challenges. First of all, inspection experts are untrained in piloting micro aerial vehicles (MAVs). Therefore an autonomous system was developed that automatically pilots the MAV in the proximity of rotating turbine blades. Secondly, the MAV has to operate in very windy conditions. To cope with this situation robust control algorithms for MAV stabilization had to be design and implemented so as to have an optimal path planning for specific wind turbine inspection tasks. The EUROCC DIH ETH Zürich provided facilities including a dedicated reconfigurable arena, where special paths with narrow passages or obstacles were created for the evaluation. Typical blade defects, provided by the industrial partner DIAGNOSTIQA, were emulated as visible markings on the blades. During the verification done at a wind turbine mock-up at University of ZAGREB 9 and 10 out of 10 introduced defects have been detected highlighting the effectiveness of the system. Therefore, the inspection can now be done during operation with the same results as if the turbine was stopped. Furthermore, the inspection time is reduced by 30 minutes and the report writing by another hour.

The role of the DIH

In this EUROCC experiment three DIHs, namely ETH Zürich, University of Zagreb and the University of Dubrovnik collaborated with the end-user SME DIAGNOSTIQA. The combined expertise of University of Dubrovnik on stability and state estimation with Uni Zagreb's knowledge on MAV localization and mapping, operator's interface development and system integration using the test facilities of ETH Zürich made this sophisticated solution possible for DIAGNOSTIQA that has 20 years of experience in the field, but is lacking the specialized expertise of the Croatian universities and does not have access to test facilities such as the one of ETH Zürich.

Impact

The developed solution is unique on the market and thus puts DIAGNOSTIQA in the pole position on the wind turbine inspection market. The value proposition of DIAGNOSTIQA is that the wind turbines can be inspected during operation in less time. Apart from the power production gain through continuous operation, the reduction of inspection and reporting time amounts to a saving of 100€ per wind turbine and inspection. Given its unique offer DIAGNOSTIQA conservatively estimates to increase its market share to 25% by 2022. This equals to an increased revenue of about 350k€ in the next 5 years.

The three academic partners benefitted from the experiment using and increasing their knowledge solving real world industrial projects at the same time experimenting with leading-edge technologies of the others. This will ultimately foster their collaboration as DIHs and future research endeavours.

Last but not least, there are also environmental impacts. The correct operation of wind turbines thanks to lower cost and proper inspection and maintenance will contribute to extend the expected lifetime of wind farms. An improved life span of such plants allows lowering the cost of electricity from wind, making it more competitive with respect to fossil fuels.

End user: DIAGNOSTIQA (SME, ES)

Technology providers: University of Zagreb and University of Dubrovnik (RTO, HR), Eidgenössische Technische Hochschule Zürich (RTO, CH)

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.

The role of the DIH

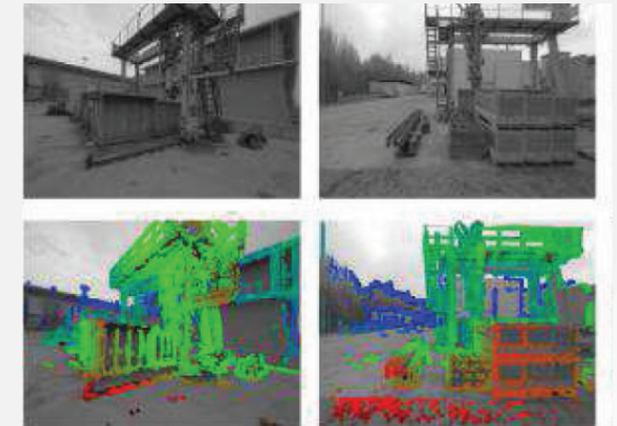
In project EuRoC the TUM Flyers Challenger Team, acting as DIH, was able to use the excellent facilities of the Challenge Host Eidgenössische Technische Hochschule Zurich, another DIH in robotics, offering a dedicated arena of 8mx10mx4m with movable, reconfigurable scaffolding to create narrow passages, movable obstacles, fans and lights to create varied test conditions. Technology Developer Ascending Technologies GMBH offered the special version of its EuRoC-UAV (unmanned aerial vehicle), 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.

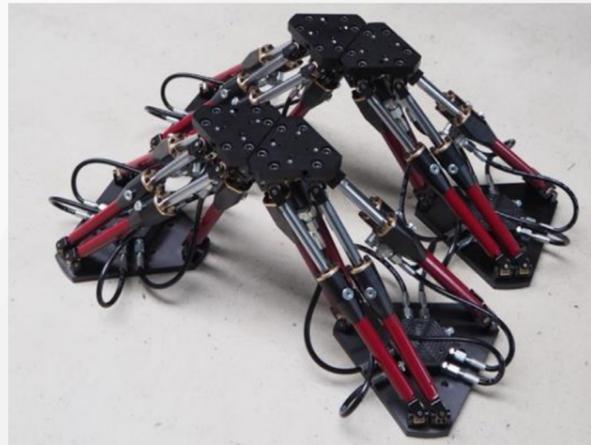
Impact

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: Schällibaum AG Ingenieure und Architekten (SME, CH)

Technology provider: Computer Vision Group of Technische Universität München (TUM) (DE)





FLEX HEX

Problem and solution

Manufacturing is increasingly facing the challenge to produce highly customized products. This implies changing the production system several times a day as only small batches are to be produced. In the production process fixtures and jigs play a major role. Today, existing ways of having fixtures and jigs are both very inefficient. The time imposed by changing the fixture in the manufacturing line several times a day increases the leading time, slows down the production process and is therefore an important cost factor.

A solution called the Flex Hex concept has been developed in the RECONCELL project. It consists of several Hexapods. The Hexapod is a robot fixture which requires no motors, no cables and no wires. The Hexapod is completely integrated with robot activities in production lines which leads to an economical, flexible and high-quality fixture that ensures higher stiffness and accuracy in fixating workpieces. The Hexapod allows for an automatic reconfiguration and adaption of jigs and fixtures. This reduces considerably the time to change the system for another batch of products and thus ultimately accelerates the production process and lowers production cost. It also avoids storage needs for the fixtures.

The role of the DIH

The Jožef Stefan Institute as DIH in the robotics domain has long lasting experience in developing and testing robotics solutions with industrial actors. Within the RECONCELL project this experience has been utilised in collaboration with Blue Ocean Robotics to develop an industry relevant solution that is the business base for the start-up company FLEX HEX.

Impact

The value proposition of FLEX HEX is production cost savings through accelerated production line adaptation, lower storage cost for fixtures and finally better products thanks higher accuracy of fixtures. For an average production line this is estimated to bring about €60K of savings per year. FLEX HEX conservatively estimates the market in the European manufacturing industry to be more than 90.000 hexapods. Depending on the market penetration of the solution this equals to a market volume of up to €800M of which FLEX HEX hopes to gain a considerable share thanks to their unique solution.

End user: Flex hex (SME/start-up, DK)

Technology providers: Jožef Stefan Institute (RTO, SI) and Blue Ocean Robotics (SME, DK)

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.

The role of the DIH

The experiments about intelligent fixtures in the INTEFIX project allowed CEDRAT TECHNOLOGIES as DIH 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)

TRADITIONAL MOULD SHOP BECOMES A CYBER-PHYSICAL PRODUCTION SYSTEM (CPPS)

Problem and solution

N. Bazigos S.A. is a mould manufacturing firm specialised in high precision components for many application areas such as household (all kinds of home appliances), medicine (e.g. syringe), personal health-care (e.g. shavers) or packaging (e.g. Tupperware). Current production methods limit the company's capacity to expand and cope with increasing demand due to sub-optimal scheduling of work, insufficient shop floor operators support and limited monitoring capacity.



In this BEinCPPS experiment the company CASP developed a software solution for Bazigos called MStoCPPS. This software uses cyber physical systems (CPS) components and demonstrates how a traditional manufacturing system can be transformed into a CPS system by enabling autonomy, local intelligence and decentralised decision making providing the following improvements:

- 20% increase of resource utilisation due to knowledge based, automated scheduling and rescheduling.
- 80% reduction of extra working hours spent on scheduling/rescheduling due to automated scheduling.
- 60% reduction of time spent by engineers in operating machines in complex.
- 90% reduction in documenting production monitoring information due to automated monitoring.
- 30% reduction in projects failing to meet delivery times because of improved status information
- 60% reduction in human related production errors by better informing the operators.
- 80% reduction of time spent in documenting efforts and time spent on a project.

The role of the DIH

In this experiment the Greek software and consulting company CASP, experienced in business solutions, acted as DIH and helped Bazigos to digitise its production by providing them with an affordable CPPS-based solution.

Impact

The savings in overall production cost are conservatively estimated to be around 5%. The solution was applied on high precision parts, but it is foreseen to be extended to the rest of Bazigos' business areas e.g. injection moulds for healthcare & consumer products, injection moulds for thin-walled packaging, progressive forming and cutting dies and unique development automation & industrialisation projects. About €150K of production cost savings are envisaged by Bazigos in the coming 5 years, which is a considerable competitive advantage for an SME of their size. Furthermore, they are provided with the required capacity to deal with bigger demands that need flexibility in the production processes.

CASP estimates to have an additional revenue stream with the developed solution amounting to about €400K over the next 5 years.

End user: N. Bazigos S.A. (SME, EL)

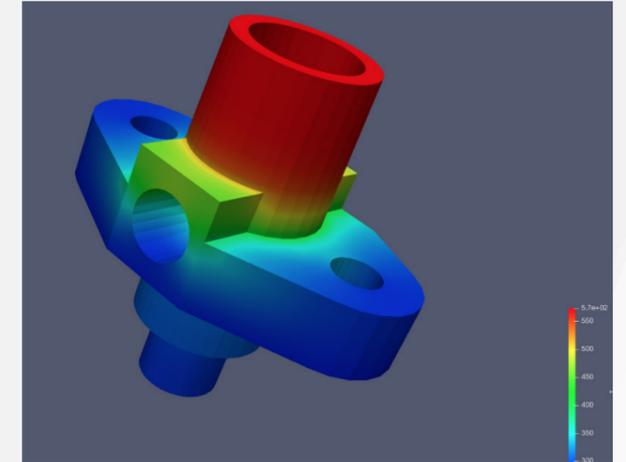
Technology provider: CASP S.A. (SME, EL)

HOW TO BETTER PRODUCE PLASTIC PIECES WITH CPS TECHNOLOGY

Problem and solution

The majority of plastic parts (e.g. for the car manufacturers) is produced by moulding. This requires highly accurate machines that produce the moulds. In classical production processes the quality of plastic parts is only checked after production, leading to a relatively high amount of defect pieces that are basically plastic waste.

In the BEinCPPS project a solution has been developed to enable real-time monitoring of the production process. A cyber physical system (CPS) of sensors and actuators has been integrated into the mould to measure the relevant production parameters such as pressure and temperature. The gathered information is sent to the cloud, where sufficiently powerful computing resources analyse it compile it. Then this data is fed into the 3DRTM software developed by EUROB, allowing a 3D visualisation of the product that indicates anomalous parts and triggers actuators in the mould to take corrective action. This technology allows to produce plastic parts in higher quality and with considerably less scrap. The statistical analysis of the collected data also allows for preventive maintenance of the moulding machines and thereby for an important reduction of machine down time. Furthermore, this solution saves 20% of energy consumption in the production process.



The role of the DIH

In the BEinCPPS project the PERNOUD Group (a mould manufacturing SME) teamed up with the injection machine manufacturer BILLION (SME), the actuator provider HPS (SME), the technology provider EUROB (SME) and CEA-LIST and ESSMOTTECH acting as DIHs. Without the leading-edge knowledge of CEA-LIST and the test facilities of ESSMOTTECH it would have been impossible to develop such a highly sophisticated solution integrating many components.

Impact

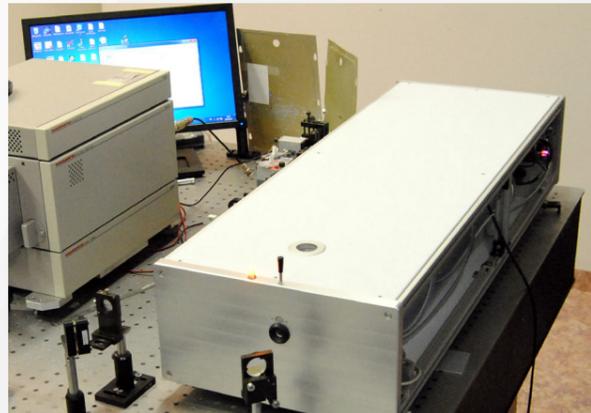
The Pernoud Group now offers CPS enabled mould manufacturing which is a clear competitive advantage. The company estimates to increase their revenues by over €1.1M in the coming 5 years and intends to create 2 new jobs.

BILLION and HPS will benefit from Pernoud's success as they are suppliers of pieces for the new machine. EUROB, as software provider, will use the new solution to leverage new business. It is expected that as a result a team of 7 new people will be assembled over a period of 3 years to cover the new client needs. CEA-LIST and ESSMOTTECH got skilled in the experiment in order to apply their research results and test facilities to real world industrial projects.

The environmental impact is also considerable. Taking 20% energy consumption savings into account and considering the number of plastic parts manufactured with this technology in 5 years, 15 000 KWh of energy consumption will be saved, which equals to almost 7 tons of CO2 in the European average electricity mix. The solution also provides benefits for quality assurance, reducing scrap rates down to 2.5% (today at 4%), which represents around 7.5 tons of plastic resin saved.

End users: Pernoud Group (SME, FR), BILLION (SME, FR), HPS (SME, FR)

Technology providers: EUROB (SME, ES), CEA-LIST (RTO, FR), ESSMOTTECH (SME, FR)



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 work-horse 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 synchronised 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 femto-second 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).

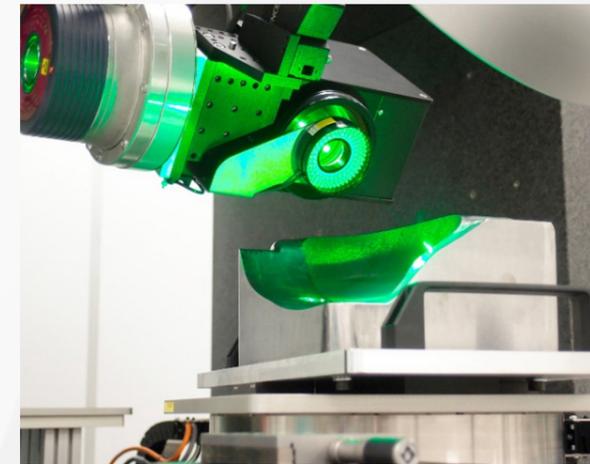
The role of the DIH

The laser equipment assessment experiments in the I4MS project APPOLO enabled EKSPLA, a spin-out of laser DIH University of Vilnius, 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 more than €5M 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)



NEW HIGHLY SOPHISTICATED SURFACES MANUFACTURED BY LASER TEXTURING

Problem and solution

There is a high demand for plastic surfaces with new functionalities such as low friction, anti-glare, silky soft-touch, water repelling and curved e.g. in the automotive, consumer and medical products sector. To manufacture plastic surfaces like that a basic 3D texturing technology was available which required many manual steps with yet unsatisfactory results. The challenge was to improve the workflow and to have a more automated process in order to produce those

highly sophisticated surfaces in good quality and in a cost effective manner, thus making them industrially viable.

A new technology has been developed in the APPOLO project based on the use of laser texturing. The optimised machining system makes it possible to apply functional surface textures to large 3D curved surfaces. Surface textures on micron and sub-micron scale can now be machined into the surface of a mold and then are copied to plastic parts by a mass production process (injection molding). Compared to existing (laser) texturing technology, much finer textures can be applied that achieve the targeted highly sophisticated surfaces.

The role of the DIH

Lightmotif, the machine manufacturer, improved in collaboration with the DIH Bern University of Applied Sciences the machine control software, developed a texturing toolkit that makes the generation of texturing programs much easier, and designed new systems and processes to increase the accuracy and the safety of the machine. Scanlab was involved as technology development partner. A new scanning system for fast micro-milling was developed and tested. The results were validated by Centro Recherche Fiat (CRF) as the end-user for the automotive application. SKF, as second end-user, learned how surface textures can improve the performance of their products.

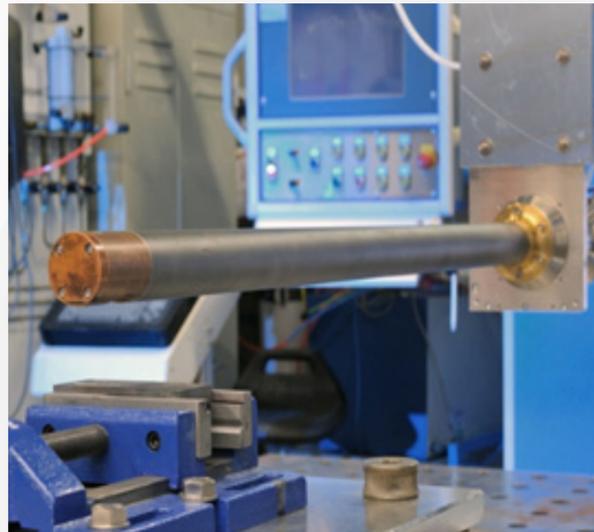
Impact

Lightmotif will be supplying textured molds as a service (or other products) and sell 3D texturing and micromachining systems. In the first stage after introduction of the technology, it is expected that the texturing services generate a turnover of €100.000/year. On the longer term Lightmotif will focus on selling micromachining and surface texturing machines. The company expects to sell about one (customised) machine per year in the upcoming years. They have already sold one of these machines to a Dutch medical and consumer products manufacturer. Lightmotif expects that the revenue of selling these 3D texturing machines will amount to €2-5 M/year.

SKF now can take a next step towards industrial implementation of this technology in order to offer new products. Scanlab will offer a new scanning system for fast micro-milling of surface textures on the market. Centro Recherche Fiat (CRF) has gained knowledge about a new mold texturing technology, and can apply it to improve the performance of car interior components.

End users: Lightmotif (SME, NL), CRF (LE, IT)

Technology providers: Scanlab (SME, DE), SKF (SME, NL), Bern University of Applied Sciences (RTO, CH)



**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 diameters below 100mm and with a depth of more than 1.5 meters.

The role of the DIH

The INCLAD laser equipment assessment within the I4MS project LASHARE teamed up the DIH 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.

End user: Oerlikon Metco (mid-cap, CH)

Technology provider: Fraunhofer Institute for Laser Technology (DE)

Supplier: IXUN (SME, DE)

Launching Phase 3: widening the pan-European network of DIHs

The third phase of I4MS starts in autumn 2017. This includes 4 new Innovation Actions and another CSA to support the existing and new DIHs into forming a coherent pan-European network of hubs. A special focus is on reinforcing the role of the DIHs in skilling SMEs, start-ups and mid-caps to digitise their business in order to reap the full benefits of the Digital Single Market, which is the overarching goal of the DEI strategy.

Focussing on the European dimension

In phases 1 and 2 the European Commission facilitated the creation of DIHs and their expansion to a European dimension. This gave the member states the time to develop and implement their national and regional digitisation strategies. A main pillar of those strategies is to establish a sustainable infrastructure of DIHs funded from national and regional budgets including European funds such as EFSI.

Therefore, phase 3 of I4MS is entirely focused on the support of the European dimension of the network of DIHs. The Coordination and Support Action (CSA) has an important role to play in integrating new DIHs in the existing network organising networking events e.g. back to back to relevant world class events such as the Hannover Messe. Focussing the Innovation Actions on fostering the European dimension of the DIHs is achieved in exclusively selecting experiments that truly strengthen collaboration on European level. This in particular requires the experiments to be cross-border.

The 4 Innovation Actions will launch 9 more open calls for experiments and innovation hubs across 2018 and 2019. 55 DIHs will lead 170 cross-border application experiments involving about 750 SMEs and mid-caps which are mostly newcomers to European Research and Innovation programs. These experiments bring together cross-value chain collaborations between commercial suppliers, innovative end-users and one or more DIHs. Typically several of these actors are an SME or mid-cap.

Skilling SMEs in digitising their business

A major role DIHs have to play is to deepen the understanding of the decision makers in SMEs, start-ups and mid-caps about which opportunities the digitisation provides for their company. This goes clearly beyond just technology transfer or offering digital services in an affordable manner. DIHs are tasked within the Innovation Actions to provide the relevant staff in manufacturing companies with the skills to use digital technology in order to improve their way of working and to digitise their products and services, processes and business models. This skilling should comprise two aspects, namely to first understand where and how digital technology increases the efficiency of the company's processes, and second that the relevant staff has the skills to master the digital tools. The target is that at least 10-20% of the efforts in experiments are devoted to the skill development. DIHs are best suited to provide such training, as they ideally incorporate technological and business competences, which are the major ingredients needed to prepare SMEs, start-ups and mid-caps for digitising their business.

The CSA will take stock on how the Innovation Actions have expanded the skills of the involved SMEs, start-ups and mid-caps to reap the benefits of digitising their business.

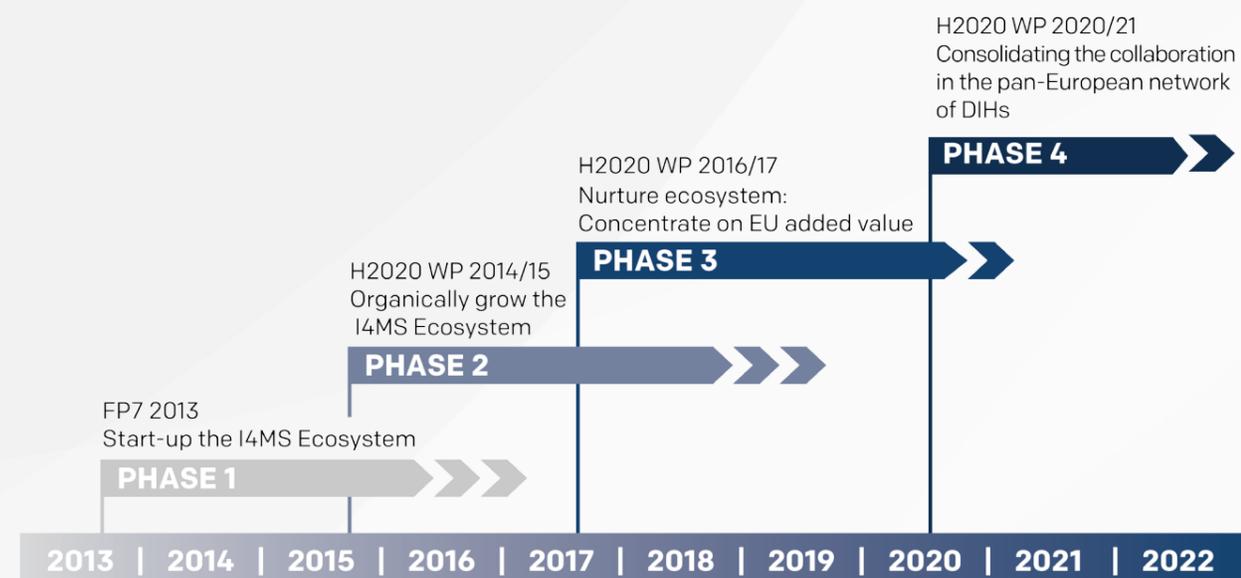
Finally, collaboration with players such as EIT Digital is reinforced in order to create synergies between various programmes. EIT Digital is a leading European digital innovation and entrepreneurial education organisation driving Europe's digital transformation and is one of the leading partners in the Innovation Actions of phase 3.

Tackling new technological challenges

Phase 3 also continues extending the existing I4MS networks in the previous technology areas, while tackling newest technological challenges relevant in the manufacturing sector. Cloud-based HPC is geared towards helping SMEs, start-ups and mid-caps to benefit from the big data challenge. This will help them face the challenge of analysing and exploiting big data, as it requires enormous computing power that SMEs can only afford on a pay-per-use base. Moreover, work of phase 1 on laser-based equipment has evolved into additive manufacturing (e.g. 3D printing) as a new manufacturing paradigm. Finally, phase 3 is geared to enlarge 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 particular challenge is also to integrate the DIHs that spring from the increasing number of national initiatives and dedicated actions growing in new Member States or less developed regions.

Further supporting SMEs and mid-caps

The total EU funding of Phase 3 is €34M, of which about 70% will be spent in directly supporting SMEs and mid-caps, either as direct funding or as services by DIHs. Those services comprise access to infrastructure or transfer of leading edge solutions and technologies to SMEs, allowing them to offer new and more competitive products and services. About 50% of the total funding will be allocated through 9 open calls in 2018-2020.



In addition, 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. The existing marketplaces will also be further enriched with new service offers and a new marketplace for additive manufacturing services will be established.

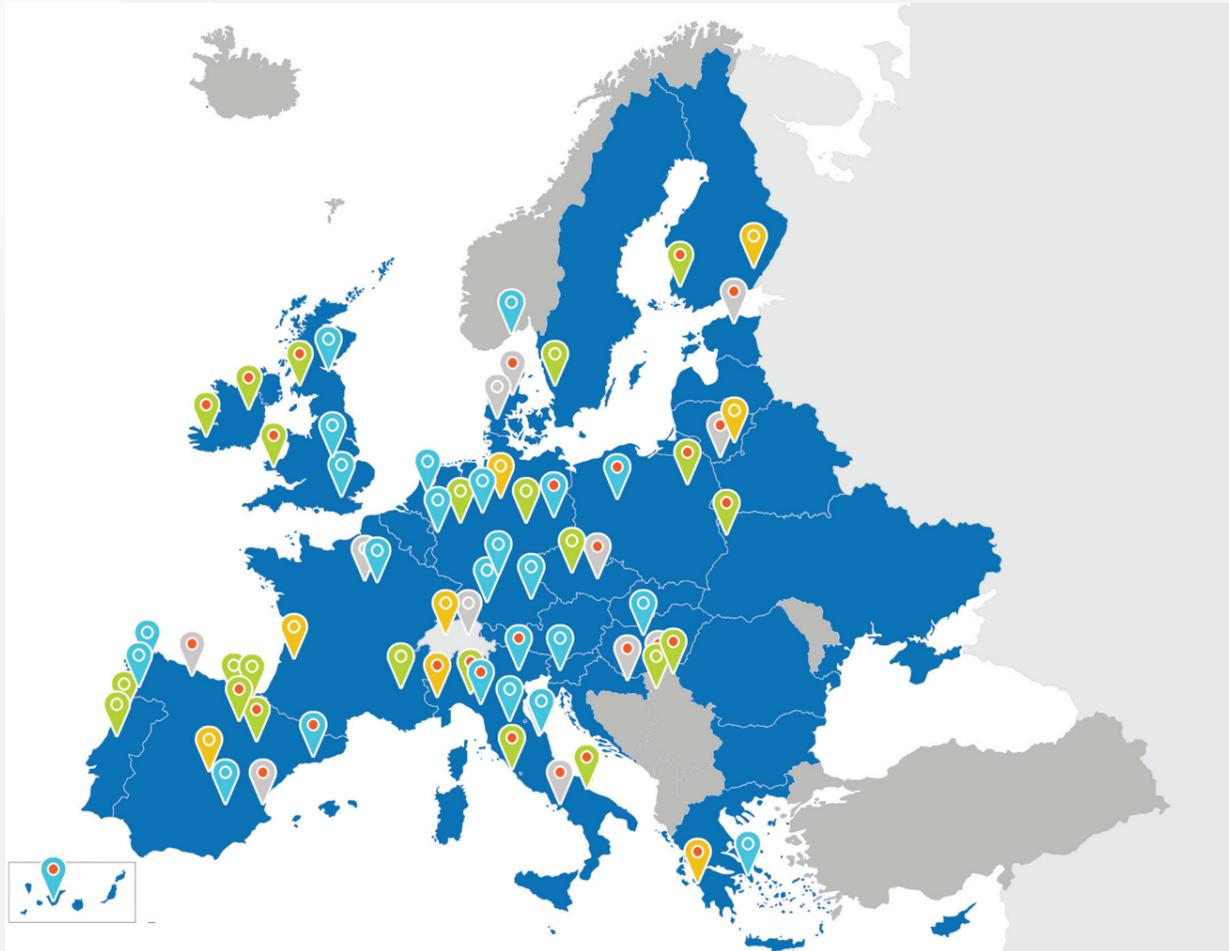
The achievement of these goals will be a major step towards the successful implementation of the DEI strategy, namely to give any industry wherever located access to digital facilities and other services that can help them to reap the full benefits of the Digital Single Market.

Phase 4: Consolidating the collaboration in the pan-European network of DIHs

Following the successful implementation and impact of the previous phases of I4MS, the European Commission plans to further invest H2020 resources in this initiative. This will strengthen European SMEs and midcaps by helping them to adopt innovative business models and also by bringing them into contact with actors that can provide access to finance or advanced training to reskill workers. The I4MS Phase 4 is planned to be called in the Work Programme 2020 with deadline for submission of proposals in end 2019 or early 2020. The focus will be on consolidating the pan-European network of DIHs and supporting the next generation of digital advances.

All in all, the European Commission plans to continue investing €100 per year from 2016 to 2020 in fostering DIHs as a main pillar of its Digitising European Industry strategy. Apart from I4MS, calls for DIHs are envisaged to be launched for other related initiatives such as Smart Anything Anywhere (SAE) (2019), for Photonics technologies (2020), for Robotics technologies (2018), for Big Data (2020) and for their overall coordination (2019).

DIGITAL INNOVATION HUBS PHASE 1 AND 2



I4MS

I4MS phase 1
and 2

Coached
DIHs

HPC Cloud-Based Simulation

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Laser and Additive Manufacturing

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Sensors, Cyber Physical Systems, Internet of Things

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Robotics

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