manu magazine

Impact from granted projects in the Manunet calls 2017-2020

manu net

Colophon

Lead partner Manunet

Innobasque - Agencia Vasca de la Innovación-Berrikuntzaren Euskal Agentzia (Spain)

Editorial team

Content: Ivo Klein Willink - Oost NL (Netherlands)
Design: Frank Rikken - adversa

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Contents

Preface

“After 15 years of cooperation between funding agencies, SMEs and knowledge institutions from different European regions and countries, MANUNET looks back on a successful project: numerous interregional innovation projects in the field of smart industry have been realised, resulting in sustainable collaborations.”

Garbiñe Larrauri
MANUNET Coordinator

MANUNET is a mature and experienced platform which has succeeded launching joint calls every year since 2007. It has provided a regular funding opportunity to the manufacturing industry, mobilising 141 million euro of public funding and with a very high involvement of small and medium size enterprises in calls. 78.3 % of the beneficiaries during the entire Manunet programme were SMEs. MANUNET fulfils one for its main objectives, which is to support industry and SMEs in particular by designing calls that are tailored to them.

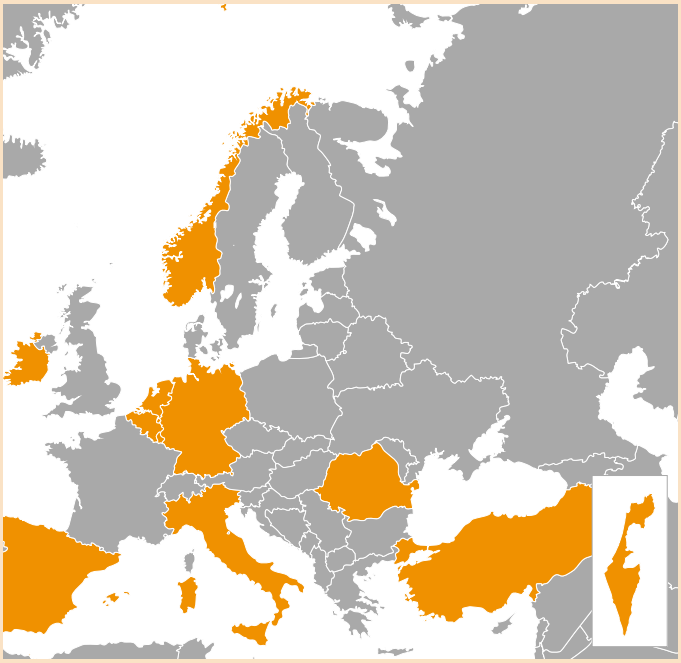
MANUNET has proven to add value to the need an international network, complementing other transnational funding instruments. MANUNET has proven to offer an easy way to apply for funding, with relatively little administrative effort, a wide geographical scope and relevant topics.

Applicants of the calls praise the functioning of the joint calls, with clear templates for proposals, guides for applicants, a simple website, an easy application process and constructive interaction with the national/ regional funding agencies. 95% of the beneficiaries stated that they had achieved some kind of result at the end of the project. The type of result was mostly a process (31%), a product (27%) or a method (23%), as well as licence agreements, patents or publications.

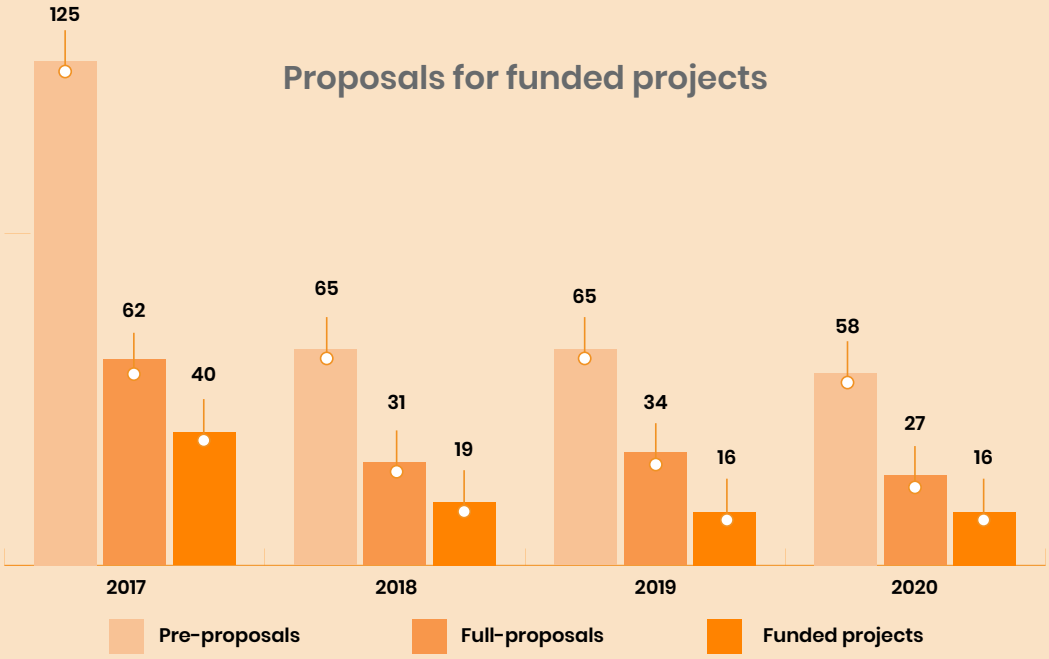
Funding agencies involved in MANUNET consider that the network demonstrates a clear added value for both call applicants and regional/national programmes. Considering the need for an international network, MANUNET has offered SMEs a space for innovation and boosted international cooperation, not only for the RTD community but also for funding agencies.

Now, at the end of this collaborative adventure between European regions and countries, we can only be grateful as coordinators to have shared knowledge, efforts, valuable support to SMEs and unforgettable experiences with our partners, enterprises and R&D agents.

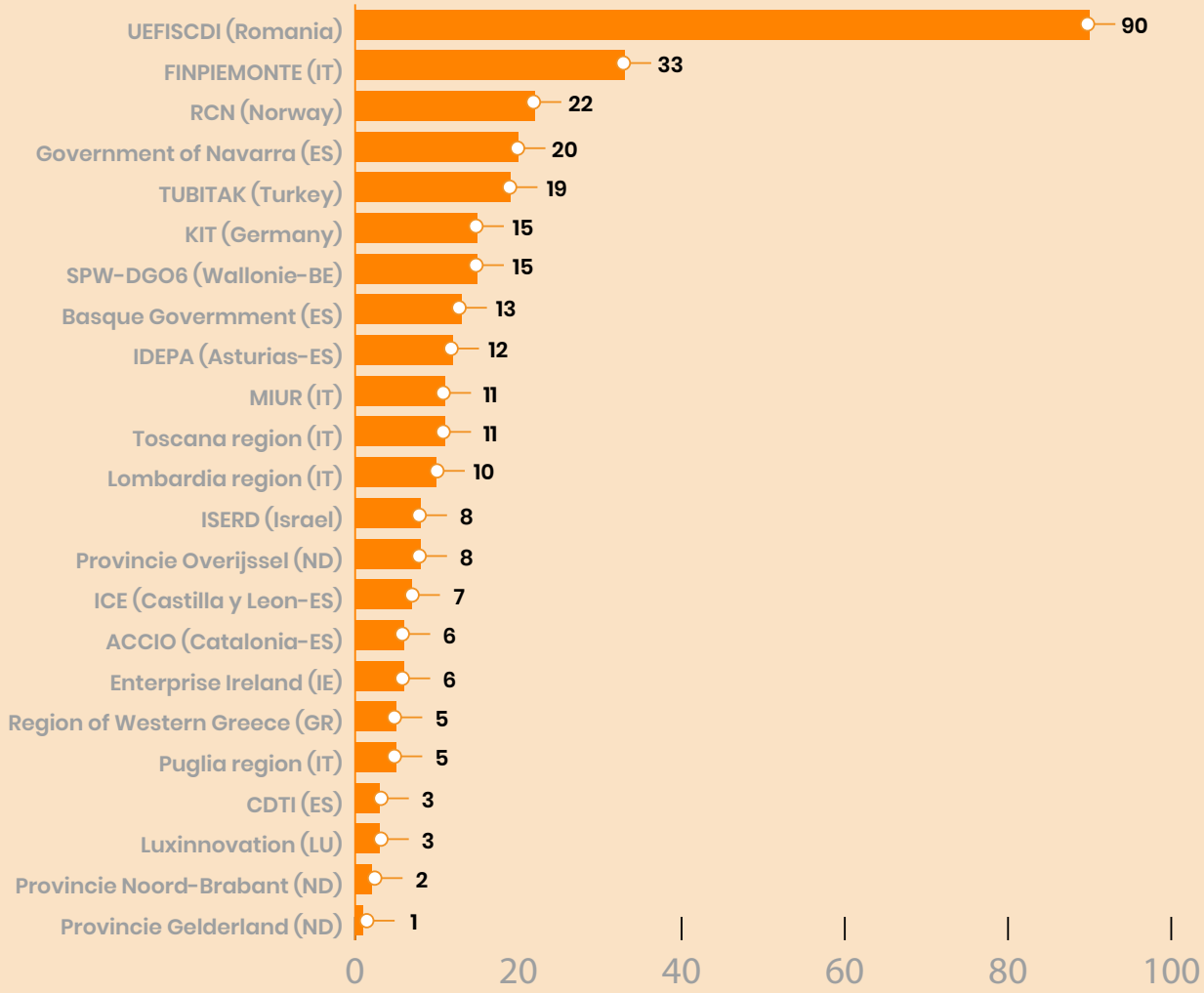
As coordinator of MANUNET, I proudly present the MANUNET magazine, which zooms in on the results achieved in the period from 2017 to 2020 and also highlights five successful projects that started in this period.



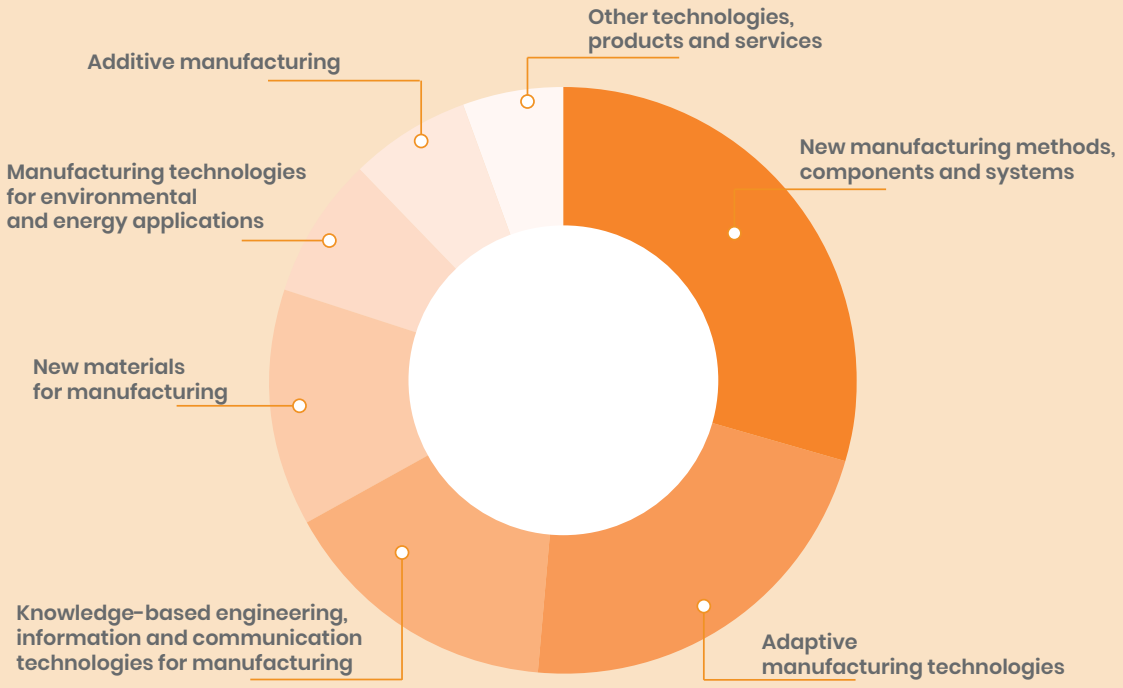
Facts & Figures MANUNET III Calls results 2017 - 2020



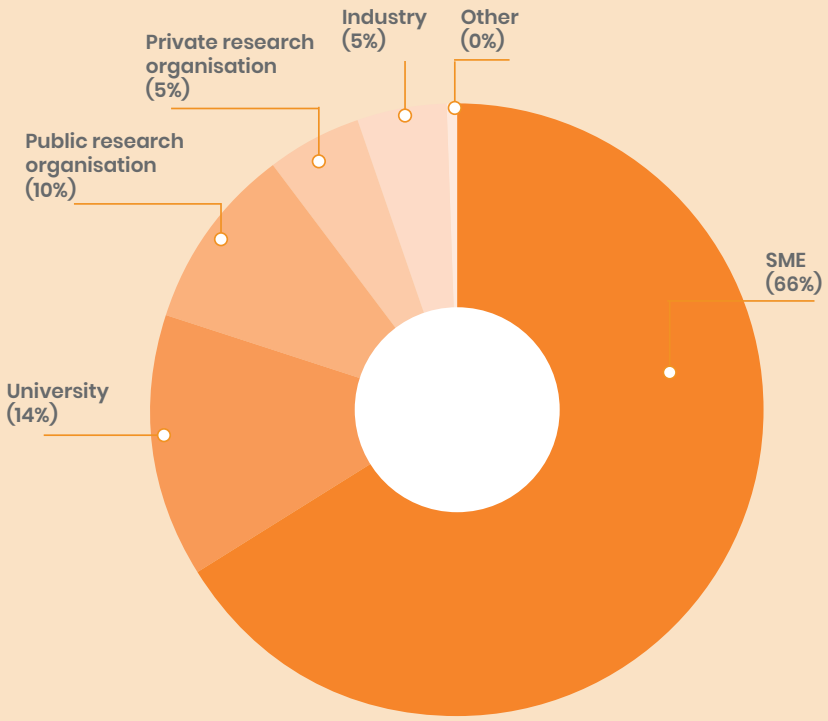
Number of projects per agency



Number of projects funded per topic



Number of projects funded per type of beneficiary



INNOVATION-DRIVEN, CLOSE-TO-MARKET RESEARCH AND DEVELOPMENT PROJECTS IN MANUFACTURING

MANUNET was launched in 2004 by the Basque Government as an initiative aimed at the manufacturing industry in European regions. This initiative resulted in the first ERA-NET (Horizon 2020) project in 2006. Three ERA-NET projects (MANUNET I,II & III) have been successfully implemented over a period of fifteen years. MANUNET was a network consisting of partners from regions in Italy, Belgium, Luxembourg, Germany, Norway, Romania, Turkey, Israel, Spain, the Netherlands and Ireland. The cooperation was built on two pillars: innovative manufacturing industries and regional funding support combined with European funding support.

The MANUNET project supported innovation-driven, close-to-market research and development projects in the manufacturing industry. MANUNET and its partners aimed to connect companies (especially SMEs) and knowledge institutions from the participating European countries and to support them financially in developing innovations that could be valuable for the manufacturing industry. MANUNET stimulated the transfer of knowledge from knowledge institutes to companies and vice versa, enabled companies to develop innovations that would have been very risky without financial support, and aimed to contribute to the competitiveness of the European manufacturing industry. 24 national/regional funding programmes participated in the MANUNET initiative.

In addition, MANUNET has supported SMEs by providing:

- The opportunity of funding R&D projects closer to the market
- Yearly calls for proposals
- A high success ratio of submitted proposals

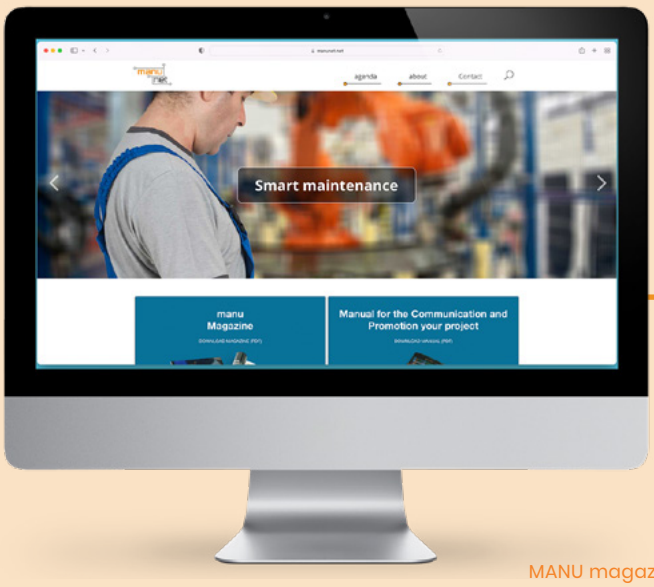
PROJECTS HAVE CLEARLY DEMONSTRATED THE FOLLOWING ATTRIBUTES:

- transnational collaborative research & development with a significant degree of innovation and scientific and technical risk
- strong participation of SMEs
- market orientation
- application and practical use of manufacturing technologies
- the expertise of project partners in their respective fields of competence
- added value through transnational cooperation
- the scale of impact and market positioning of the applicant

SMEs have carried out cooperation projects in the following manufacturing industry areas:

- KNOWLEDGE-BASED ENGINEERING, INFORMATION, AND COMMUNICATION TECHNOLOGIES
- ENVIRONMENTAL & ENERGY APPLICATIONS, INCLUDING RESOURCE EFFICIENCY AND RECYCLING
- ADAPTIVE TECHNOLOGIES, INCLUDING REMOVING, JOINING, ADDING, AND ASSEMBLING
- NEW MATERIALS AND COMPOSITES
- NEW METHODS, COMPONENTS, AND SYSTEMS
- TECHNOLOGIES, PRODUCTS, AND SERVICES RELATED TO MANUFACTURING

In the period 2007-2020, MANUNET received more than 1200 project proposals, funded more than 300 projects with an invested amount of more than 285 million euro and a high involvement of SMEs, which form the backbone of European industry. Over 15 years of annual calls have shown that MANUNET is an ideal complementary programme that creates synergies between Horizon 2020 and the national and regional funding programmes.



MANU magazine

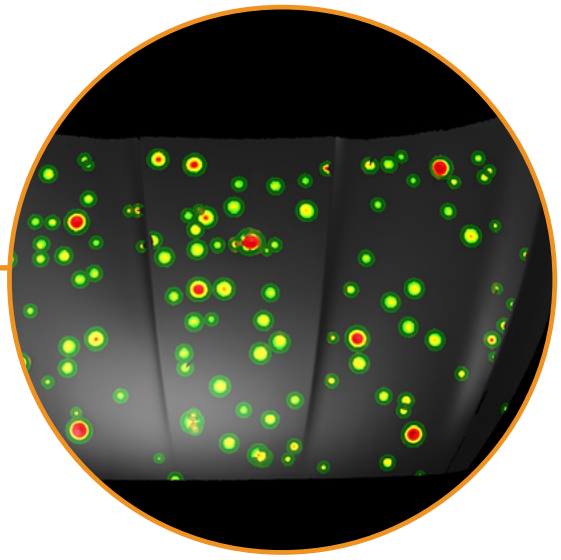
For more information, see manunet.net

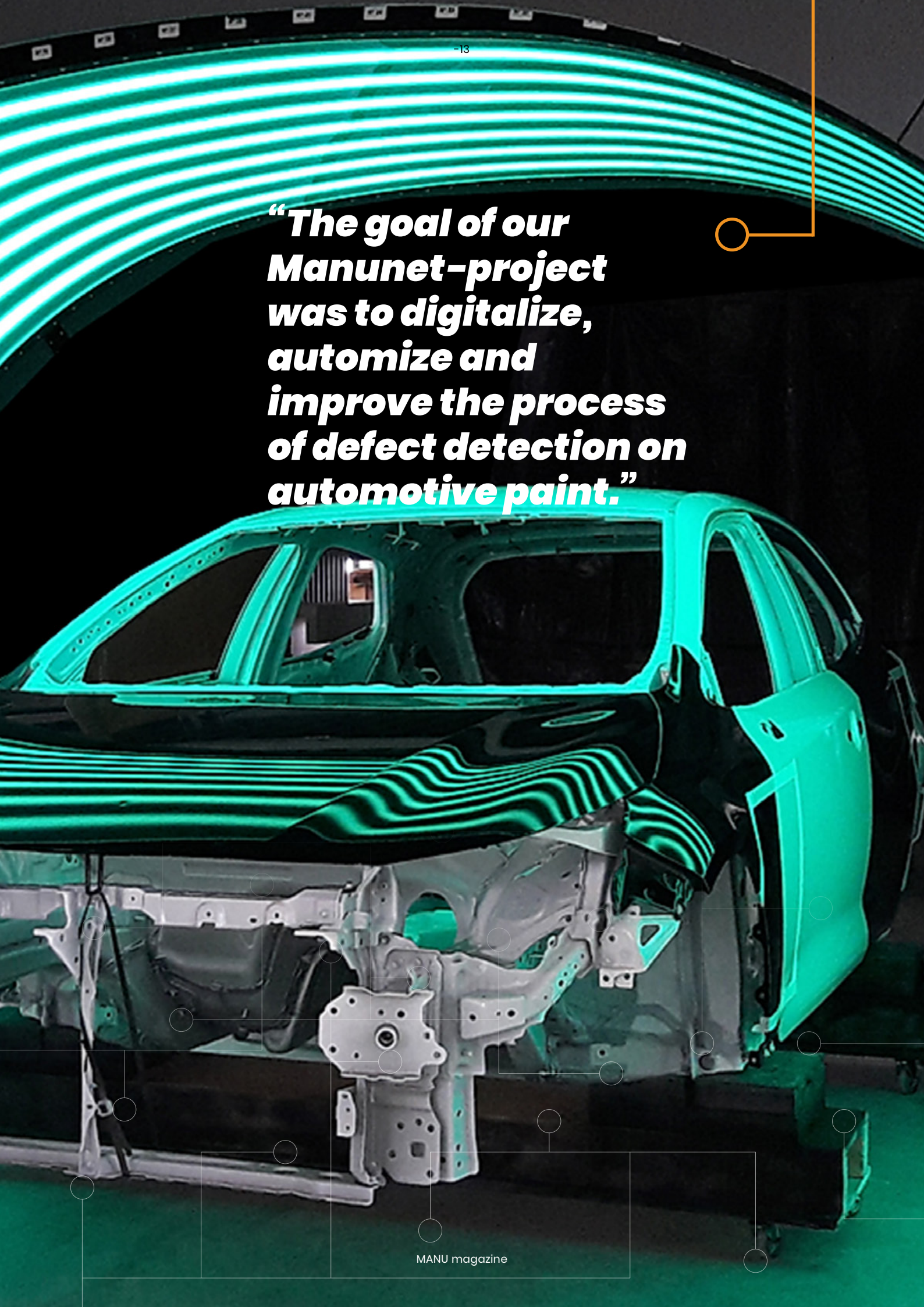
Add Ap

Automated Defect Detection in Automotive Paint

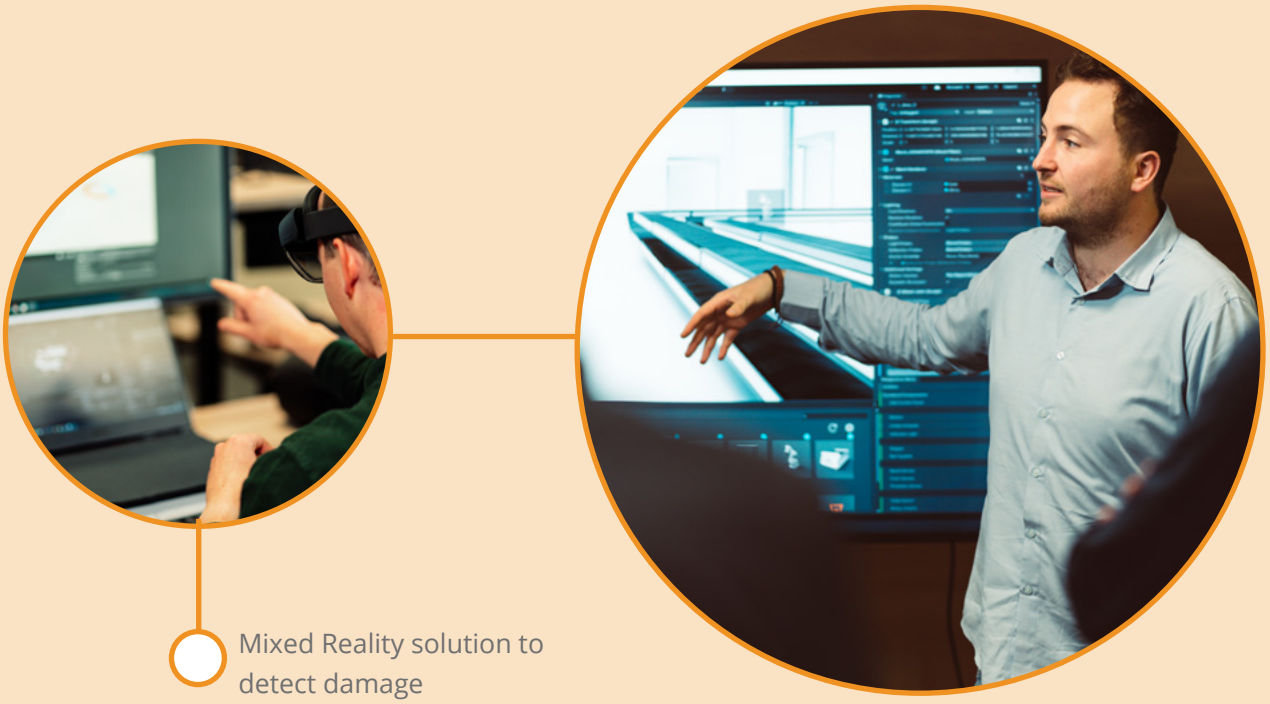
The quality of the paint is essential for the overall appearance of a vehicle, especially for passenger cars, and manufacturers therefore pay great attention to this aspect during quality control. The problem is that existing surface quality controls are often performed manually, are prone to errors and are time-consuming. As part of Manunet, a consortium consisting of the companies VIRELUX (LUX), DeRichard (FR), Unit040 (NL) and Zelitec (LUX) has therefore teamed up to develop an innovative light tunnel that can detect defects in the surfaces of automotive components accurately and automatically. The scans from the light tunnel are linked to an AR lens, which allows mechanics to immediately see where the imperfections are located. Gino van der Zijde, Commercial Director at Unit040, and Ron van den Ouweland, Virtual Prototyping Engineer at Unit040, talk about the innovation they developed with their partners within Manunet.

Defects on the surface of a bonnet





“The goal of our Manunet-project was to digitalize, automize and improve the process of defect detection on automotive paint.”



Mixed Reality solution to detect damage

A gap in the market

For car manufacturers it is important to deliver the best possible quality in the most cost-efficient way. Therefore, many manufacturers are constantly looking for innovative solutions for their quality control. Van der Zijde: "The automatic detection of defects, particularly small defects, on car body surfaces following the painting process is currently one of the greatest issues facing quality control in the automotive industry. Currently, manufacturers rely on so-called light inspection tunnels. During vehicle production, painted bodies pass through a light inspection tunnel on a conveyor belt. Then, using a specific light, the bodies are inspected by operators for any defects that need to be corrected at a later stage of production."

"However, this solution uses static light sources, which means that it is only suitable for flat surfaces and it is unable to inspect other parts of the surfaces, such as edges, corners and deep concavities. In addition, the control is mainly done manually by operators, which requires a lot of effort and concentration, is not good for their health in the long run and leads to a higher error sensitivity of the process."

Enhancing quality control

"The goal of our Manunet-project was to digitalize, automize and improve this process", says Van den Ouweland. "To do this, our partners developed a curved dynamic light display solution. The curved shape of this construction combined with innovative LED light technology, ensures that the entire surface of the car, including surfaces with a different shape, can be accurately inspected. A dynamic light source makes it possible to adjust the direction and size of the light beams, which is not possible with a static light source. This allows for detection of deviations - even small ones - in the patterns on the car's surface more quickly and accurately. By using the light source, intelligent cameras and advanced

LED light technology

software, a complete scan of a car body is generated as it passes through the test lane. The scan shows where on the car's surface the defects are located, and colors indicate how big and deep they are. In this way, operators do not have to mark the defects themselves, which is the case with conventional methods."

Mixed Reality

In order to further improve quality control, Unit040's expertise in Mixed Reality was used. Van den Ouweland: "The scan provides valuable information, but a quality control engineer still has to walk from the screen to the car and back again to determine where the defects are located on the car surface. Especially small damages are still difficult to detect. Within the project, our task was to complement the human eye with Augmented Reality. We converted the scan of the car body into virtual 3D objects, such as a bonnet, using our Prespective software. Just like in the

scan, we gave the defects a color, depending on their size and depth. We then transported the virtual 3D scan to HoloLens Mixed Reality glasses, allowing the digital defective object to be placed on top of the actual damaged object. In this way, a quality assurance worker can see at a glance where the damage is located. This is a good example of how man and technology can complement each other."

Commercialization as a next step

The next step is to bring the automatic defect detection of automotive paint to the market. Van der Zijde: "After this project, we started to implement prototype systems of our innovation in the processes of a few selected OEM customers, including a renowned car manufacturer. They were very interested in our technology from the very beginning. The results of the project can also be used for other products and technologies in the automotive industry, where manual control is still predominant. For example, a final visual check is carried out at the end of the car assembly line to detect quality defects, such as residual paintwork defects, assembly errors, dents, etc. This also applies to vehicle design centers, where quality control of cars in the final development phase often plays a major role. Our technology would provide a solid basis for such quality control. Finally, our technology could be used in vehicle repair shops. Suppose a car is damaged by hail, then the repairer can make a complete scan and see where the damage is by using the Mixed Reality glasses."

Manunet as a catalyst for innovation

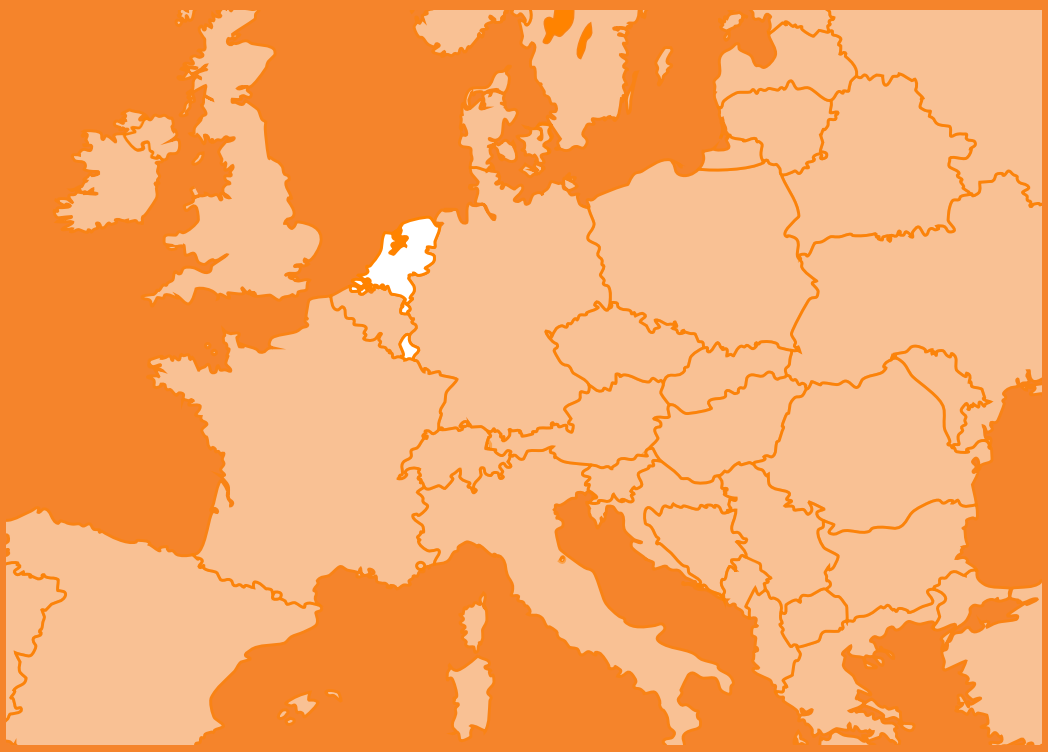
"Without Manunet, this innovation would not have been possible," concludes Van der Zijde. "The initial plan came from VIRELUX. They were approached by a major car manufacturer who had a specific question related to the quality control of automotive paint. VIRELUX then consulted the Manunet network to find partners with specific knowledge. This resulted in a project where VIRELUX developed the core technology for the automatic detection system, DeRichard the design of the light inspection tunnel, Zelitec the curved diffuser system and Unit040 the Mixed Reality solution. A possible next step could be to replace the expensive cameras, which are currently still needed to make a scan, with our Mixed Reality technology. This would enable us to speed up the process and further reduce costs."

Through the project, each partner gained new insights that can also be used in other application areas than the automotive industry. Van der Zijde: "We, Unit040, have not only received new orders from interested companies in the field of Mixed Reality through the project, but it has also given us the opportunity to enrich our Digital Twin software, called Prespective. Through Mixed Reality, we can visualize and test new systems and factories in a virtual world. This allows companies to see through these glasses what their future system or factory will look like, thus avoiding unexpected problems in the final realization process."

Cross-border cooperation

"The initial plan of the project came from VIRELUX. They were approached by a major car manufacturer who had a specific question relating to the quality control of automotive paint. VIRELUX then consulted the Manunet network to find partners with specific knowledge. This resulted in a project where VIRELUX developed the core technology for the automatic defect detection system, DeRichard the design of the light inspection tunnel, Zelitec the curved diffuser system and Unit040 the Mixed Reality solution."

Gino van der Zijde - Unit040



Acronym
Add Ap

Call
Call 2017

Coordinating Funding Agency
Luxinnovation (Luxembourg)

Participating partners
VIRELUX Inspection Systems sàrl (Luxembourg)
DeRICHARD sàrl (Luxembourg)
UNIT 040 (Noord-Brabant, The Netherlands)

Project duration
24 months

Total project cost
€ 702.251

Contact

VIRELUX Inspection Systems sàrl
Gerard Baseotto
+33 637 239 009
gerard.baseotto@virelux.com
http://www.virelux.com

Unit040
Gino van der Zijde
+31 40 767 6282
gino.vanderzijde@unit040.com
https://prespective-software.com/

"As an innovative region, the Province of Noord-Brabant is very pleased with the interregional cooperation between the different actors in the Add Ap project. A good example of how complementary competences can be transformed into combined forces, resulting in a new concept, almost ready for market introduction."

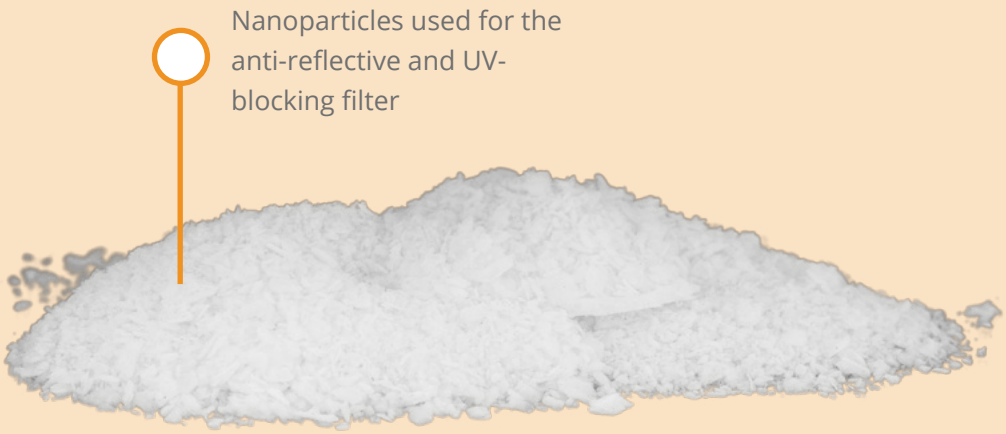
Coen de Graaf – Province of Noord-Brabant

ARUVFIL

Anti-reflective & UV blocking filter for museum showcases

Museum objects such as pictures, paintings and other works of cultural heritage need to be well preserved, otherwise they may be affected by natural elements. This also applies to objects in glass showcases, which must be protected from the harmful effects of light while at the same time ensuring optimal display. In the Manunet project ARUVFIL, the companies Tecnología Navarra de Nanoproductos (abbreviated as TECNAN) and Lurederra from Spain and RND Arastirma Gelistirme Tasarim Makine Sanayi ve Ticaret Ltd. Sti. (abbreviated as RND) from Turkey developed a coating based on nanotechnology that has anti-reflective and UV-blocking properties. Ibai Diaz Ruiz, who is involved in the project as a technical researcher: " What makes our coating especially interesting for museums and galleries is that it is cheaper than existing solutions, easy to apply and environmentally friendly."

"The main innovation of the ARUVFIL project is that it combines an anti-reflective functionality with UV protection in a single coating solution that does not exist on the market today."



Optimal display & maximum protection of cultural heritage

The purpose of museum showcases is the optimal display of works of art and cultural property together with maximum protection against external damage, such as light. Ruiz: "There are currently no solutions on the market that can guarantee both characteristics simultaneously. Existing solutions only focus on one of the two aspects. Anti-reflective coatings are widely applied to remove unwanted surface reflections on glass. For this purpose, different manufacturing methods are used: chemical vapour deposition (CVD), magnetron sputtering, CVD deposition or physical vapour deposition (PVD), with the most widely used techniques being those based on PVD and CVD. Although these technologies can produce excellent anti-reflective coatings, their main problem is that they require a large initial investment, high control of parameters and environmental conditions, as well as qualified personnel, which leads to high production costs."

"In addition, it is important to protect works of art and cultural goods from the harmful properties of light. UV radiation (short wavelength and high energy) plays an important role in the degradation of polymers, coatings and varnishes on works of art. Commercial solutions for UV protection in museums and galleries already exist, such as UV-blocking coatings or laminated safety glass solutions, but they do not provide anti-reflective protection."

All-in-one-solution

The main innovation of the ARUVFIL project is that it combines an anti-reflective (<1% reflection) functionality with UV protection (>99% protection) in a single coating solution that does not exist on the market today. Ruiz explains: "We developed a coating based on nanotechnology that not only has anti-reflective and UV-wavelength blocking properties, but our coating is also low-cost and can be easily applied to new and existing

Application and curing systems for the coating

displays and showcases in museums and galleries. We, TECNAN, were responsible for the sol-gel formulation of the coating. To obtain this, we synthesised and characterised a series of nanoparticles with the ability to block UV radiation, checking whether their properties were suitable to create a formulation combining UV radiation blocking and anti-reflection properties. Subsequently, our Turkish partner RND worked on optimising and adapting the application and curing systems to our new coating."

All-in-one solution

Searching the right formulation

"The main challenge was to find a coating formula that met both properties without compromising its efficiency and aesthetic qualities", says Diaz. "To achieve the right coating, we had to do a lot of literature research in advance to find nanoparticles with the characteristics we needed. We mixed them with precursors, dispersants and other

additives that enable maximum adhesion to the glass substrate without affecting stability. For RND, the challenge was to design an application system and a curing system that are suitable for this new coating and whose dimensions correspond to the types of glass to be treated. They had to take into account many parameters, such as the spraying method, atomisation level, speed and spraying dose for the application system and the temperature, curing time, and heating and cooling phases for the curing system. Through much testing and adjustment, we have found a coating with the right properties, thickness and strength that can be applied in a short time using inexpensive equipment. Another advantage of the coating and systems developed by us is that the environmental impact is low. We have performed an LCA (life cycle analysis) and the results obtained are positive compared to current solutions, coatings and systems."

Commercial opportunities

TECNAN and RND have developed a product and process that can be widely used in museums and galleries, and which removes the main barrier to this type of technology, which is usually the high cost of implementation. "We are happy with the result of the project. It has not only provided TECNAN and RND with an economically interesting innovation, but our project also has societal value due to the sustainable nature of our innovation and because it helps the cultural sector to optimally protect valuable objects. We are currently improving the transparency finish of the coating in order to obtain a final product with exceptional characteristics, which we can then commercialise. We will first focus on the Turkish and Spanish national markets, where we both have a large existing customer network. Once our product is accepted in these markets, we plan to extend to other European countries. In the future, our coating could also be used for other applications, such as food displays, shop windows and screens of electronic devices (smartphones, tablets, PCs, televisions, etc.) that require anti-reflective and UV-blocking properties."

Cross-border cooperation

"The Manunet programme offers the opportunity to cooperate with European companies and research organisations in the development of new processes and/or products in the field of advanced manufacturing technologies. A multidisciplinary consortium can be formed with other companies and knowledge institutions developing complementary activities with a common aim. The acquisition of new knowledge and the realisation of innovative technological developments make it possible to improve the competitiveness of enterprises."

Ibai Diaz Ruiz – Lurederra

Acronym
ARUVFIL

Call
Call 2018

Coordinating Funding Agency
Government of Navarra (Spain)

Participating partners
TECNAN, Tecnología Navarra de Nanoproductos (Navarra, Spain)
Lurederra (Spain)
RND Arastirma Gelistirme Tasarim Makine Sanayi ve Ticaret Ltd. Sti. (Turkey)

Project duration
24 months

Total project cost
€ 471.775

Contact
TECNAN, Tecnología Navarra de Nanoproductos
Ana Esparza
+34 948 640 318
ana.esparza@tecnan-nanomat.es
https://tecnan-nanomat.es/

"The Government of Navarra as funding agency has been closely involved in the support of the ARUVFIL project. We are delighted to see our SMEs cooperating at international level, and hope that this success story will encourage many more companies to participate."

Silvia Ojer Torres - Government of Navarra

DigiMan

Digital manufacturing technologies for the development of smart sensors

Agriculture and food production are expanding industries with significant environmental and resource impacts. In order to understand and anticipate the impact of these industries, comprehensive data must be collected. For this purpose, electrochemical sensors are well suited. In the DigiMan project the partners PV Nano Cell Ltd. (Israel), Fraunhofer Institute for Ceramic Technologies and Systems IKTS (Germany), CPC Solutions Ltd. (Israel), KERAFOL Keramische Folien GmbH & Co. KG (Germany), Fraunhofer Institute for Electronic Nano Systems ENAS (Germany), Chemnitz University of Technology (Germany) and National Research Nuclear University MEPhI have bundled their knowledge to develop innovative sensor platforms that can measure gas concentrations, humidity and temperature in various agricultural areas. Marco Fritsch, Dr. Ing. at the Fraunhofer Institute for Ceramic Technologies and Systems IKTS: “The digital production chain, based on additive printing technologies and nanomaterial inks, is particularly innovative. This makes it possible to minimize the size of the sensors, to achieve flexibility in the intended sensor properties and to realize these sensors at low cost, even for small quantities.”

"We have managed to produce sensors using innovative printing technologies and advanced materials."

Agriculture 4.0

The project targeted the agricultural and food industry, where many raw materials, fertilizers and pesticides are still being used today. This leads to significant environmental impact, such as polluted groundwater or increased energy consumption and associated CO2 emissions. “Companies and farmers often lack accurate data about their processes, which prevents them from reacting and anticipating adequately”, states Fritsch. Continuous process monitoring in agricultural areas, such as livestock breeding, fish farming, forestry, grain production and gardening, can contribute to and pave the way for a new and smart form of agriculture, which is also called “agriculture 4.0”. Fritsch continues: “In livestock breeding, for example, environmental conditions such as air contaminants concentration, humidity and temperature play an important role in the health and well-being of cattle and staff and must therefore be monitored and controlled. With our sensors, critical values can be monitored within certain limits to ensure human and animal safety and provide high farm productivity.”

Advanced materials

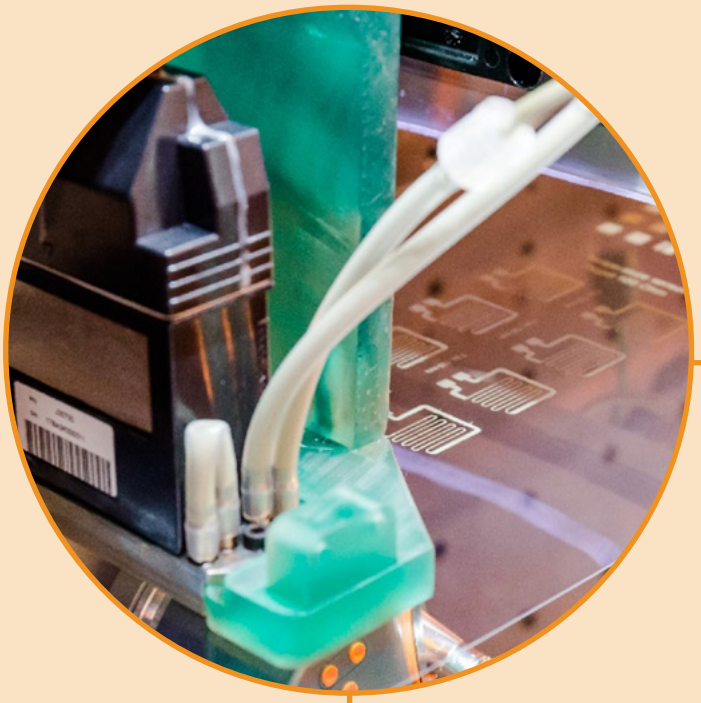
In the project the consortium developed two types of sensor platforms: sensors that can measure humidity and temperature and sensors that can measure gas concentrations. To produce the sensors, an innovative digital production process was developed based on additive printing technologies, which allow a resource-efficient printing of developed ink formulations consisting of nanomaterials. Each partner had its own specialty within the project.

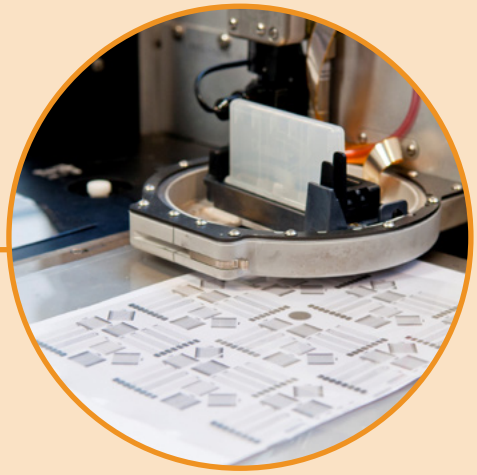
Fritsch: “First, the printing materials were developed. PV Nano Cell developed silver and copper inks. These are small particles dispersed in a solvent carrier that can be printed in the form of a thin liquid ink with an inkjet printer. IKTS has developed platinum inks and the company Kerafol has developed ceramic substrates for the heaters. These ceramics are so thin (< 40 µm) that they can better be called membranes. That’s quite extraordinary, because ceramics are usually relatively rigid. You can’t bend it because it would break. In our case, the substrate is thinner as a sheet of paper allowing it to be bent. The goal was to reduce the thermal mass and reach a very low power consumption of the sensor during operation.”

Affordable and scalable sensor platforms

“The first sensor platform, for measuring temperature (10 to 90 °C) and humidity (25 to 75 % RH), is printed on a substrate of polymer foil or paper. These are two low-cost substrates that can also be used for roll to roll printing instead of sheet to sheet, making it highly scalable. A developed low energy Bluetooth sensor board, with silver an inkjet printed antenna, was used to demonstrate a wireless communication of the developed sensors within a 50 m radius. Further, with a printed RFID NFC communication tag, it is possible to digitally label individual sensors in the field.”

“The second platform is a gas sensor (metal-oxide semiconductor gas sensor). The core is a thin ceramic membrane. A miniaturized platinum heater is printed on one side. When you pass electricity through it, you can locally heat up to 500 °C in a pulse mode by very little power consumption (< 100 mW). A gas-sensitive layer is printed on the back and it detects agricultural gases like ammonia, nitrogene dioxide, methane and hydrogen





Printing of the sensors on a polymer and paper substrate

Innovative printing

within a second by changing resistance with temperature. The whole thing is packaged in a robust ceramic housing and is very small, only a few millimeters, and needs only very little power (~ 1 W).”

Innovative printing technologies

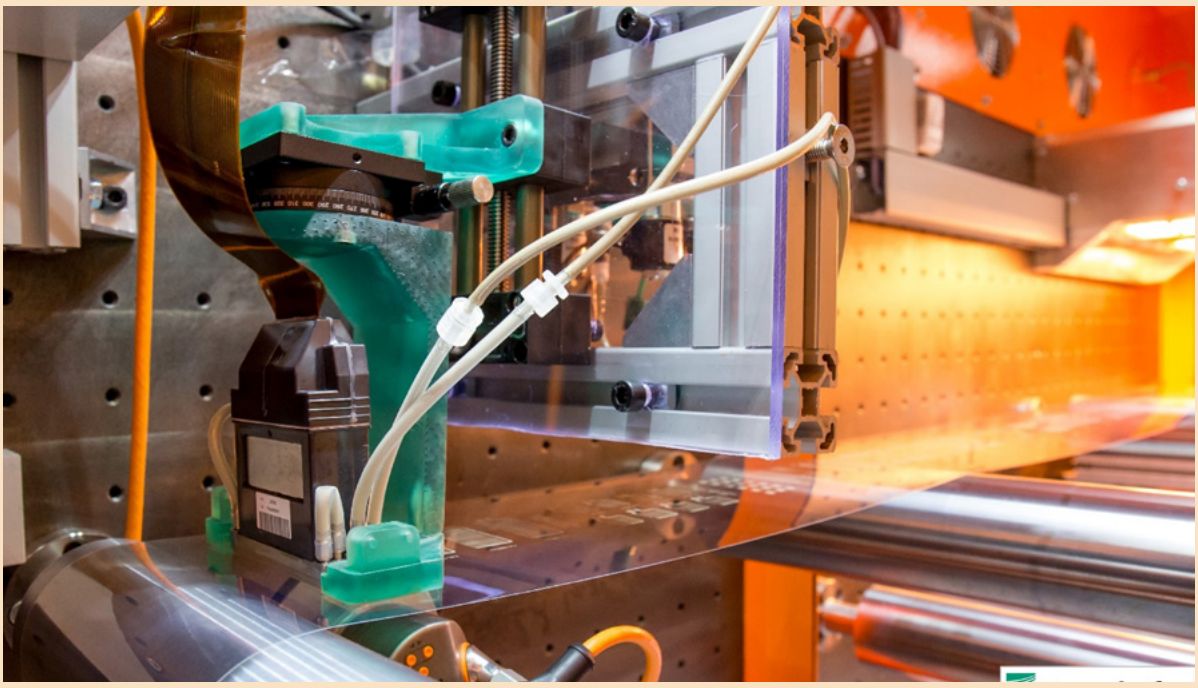
The innovative approach was to make the digital manufacturing process chain based on printing technologies, nanomaterial inks and laser processing. Fritsch: “Digital means that you can create the desired sensor layout as a digital file, which will be printed by inkjet”, Fritsch explains. “The inkjet prints materials directly without a printing form, which is usually needed in the case of other printing technologies. With screen printing, for example, you need a mechanical screen where a paste is squeezed through. With inkjet, you can change the layout of the sensors very quickly and you can combine it with other

processing steps like laser machining of the ceramic membrane and package."

"Another advantage is that we have used environmentally friendly printing technologies. We wanted to have as little waste as possible during the production process. The inkjet economically prints the precious metal based inks only on desired areas, reducing waste and costs. And we also wanted to be flexible. The sensor layouts must be able to be changed depending on the application and the user. Some would like to have this temperature or resistance range and others prefer a certain size on a certain substrate. This is different from existing solutions that are made in the cleanroom based on vacuum technologies, which are rather expensive, difficult to scale up and lack the flexibility in design changes, because it is not profitable."

Future steps

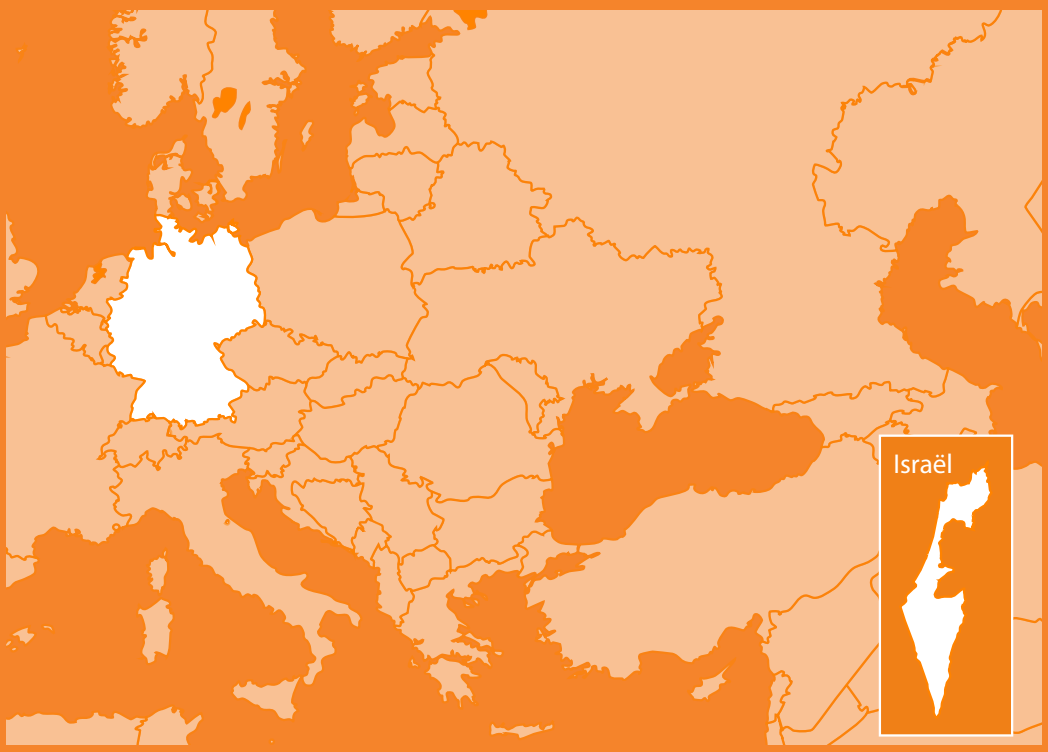
The next step is to disseminate the results of the project to reach potential customers and interested parties. Fritsch: "Originally, we wanted to present the results of the project at international congresses and trade fairs in order to reach a broad audience. However, this was not possible due to Covid. We gave online presentations and published papers instead. Although there is no concrete follow-up project with all of the consortium partners, we are still in contact with each other and are looking to initiate more projects together. Nevertheless, everyone has benefited from the Manunet project: We at IKTS have an R&D project running with printed gas sensors that we want to develop further. From a commercial point of view, PV Nano Cell has benefited from the nano inks that have been developed, enabling them to attract new customers from the Printing Electronics market. MEPhI has new projects in the field of gas sensors and cooperates with Kerafol to use their developed ultrathin ceramic membranes, which are also of interest in solid oxid fuel cells."



Cross-border cooperation

"The consortium consisted of seven partners from two countries: Germany and Israel. We benefited from the multinational character of the consortium. Some partners already knew each other before the project and during the project we had monthly contact with each other. It's mainly about the chemistry between each other. During the two-year project, we have published eight papers and presented ourselves at three international fairs."

Dr.-Ing. Marco Fritsch - IKTS



Acronym
DigiMan

Call
Call 2017

Coordinating Funding Agency
Karlsruher Institut für Technologie (KIT) (Germany)

Participating partners
C.P.C Solutions Ltd. (Israel),
PV Nano Cell Ltd. (Israel)
Fraunhofer IKTS (Germany)
Chemnitz University of Technology (Germany)
VIA electronic GmbH (Germany)

Project duration
24 months

Total project cost
€ 2.431.696

Contact
Fraunhofer Institute for Ceramic Technologies and Systems (IKTS)
Dr.-Ing. Marco Fritsch
+49 351 255 378 69
marco.fritsch@ikts.fraunhofer.de
www.ikts.fraunhofer.de/
www.digiman-project.eu

"On behalf of the Federal Ministry of Education and Research (BMBF), the Project Management Agency Karlsruhe (PTKA) supports the industry in innovating new manufacturing and production technologies in a holistic way. PTKA particularly promotes the participation of SMEs in research projects and appreciates the opportunity in MANUNET for SMEs to contribute their competences and gain experience in cooperating in small powerful transnational projects."

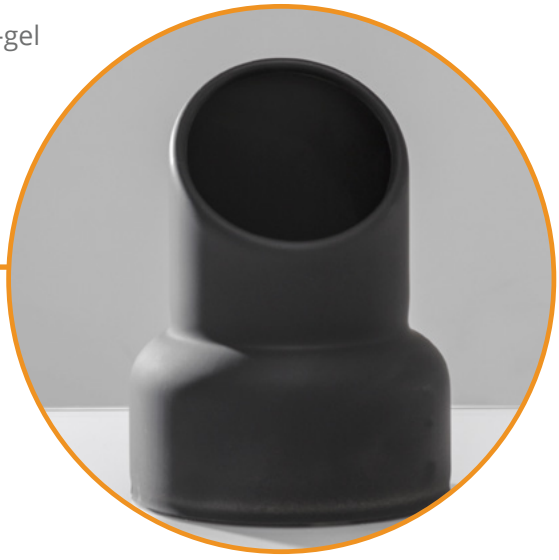
Dorothee Weisser - PTKA

Motoramic

New ceramic coatings for exterior automotive components

Ceramic coatings have become increasingly popular over the last 20 years, especially in kitchen appliances, electronics and the medical sector. In the automotive industry, on the other hand, traditional methods still largely dominant, whereas the demand from car manufacturers for new and better-performing coating technologies is increasing. Therefore, SIVE (Italy) and Graph Engineering (Ireland) have joined forces in Manunet to combine their knowledge and skills in the field of surface treatments in order to develop a new kind of ceramic coating that can be applied on external automotive components. The aim of this coating is to improve the performance of the automotive components and to bring their resistance to a higher level than that achievable by traditional coating materials based on organic resins. Fabio Paolini, technical specialist at SIVE, shares his experiences on the project.

Car exhaust with a sol-gel based ceramic coating



“We developed a hard, non-stick and heat-resistant ceramic coating for automotive components.”

Potential for the car industry

The company SIVE is specialized in surface treatments and coatings for metal and plastic products. Paolini: "For about ten years, we have been working with a sol-gel based ceramic coating that can be applied to electronics and kitchen utensils, such as pans. The advantage of this ceramic coating is that no harmful substances such as PFOA are used for it and it has superior physical properties such as high anti-adhesion power and high thermal resistance."

"Due to the physical properties of the sol-gel based ceramic coating, we have started to promote it for some parts of a car engine and for exhaust pipes. In the automotive market they still use silicon paint to cover parts. But the disadvantages of a silicone coating are that you can only achieve a matt effect, that little color variation is possible and that components with a silicone coating are difficult to clean. On the other hand, ceramic coatings can provide a glossy effect, there are plenty of color possibilities and the surface is easy to clean. This makes ceramic coatings interesting for the automotive industry."

Alternative for sandblasting

Within Manunet, SIVE together with Graph Engineering developed hard, non-stick and thermal resistant coatings for exterior automotive parts. Paolini: "We concentrated on four automotive parts made of steel and aluminum: car brake holders, engine heat shields, car camera housings and exhaustion pipes. One of the main goals of our project was to find an alternative method for sandblasting, a pre-treatment often used to clean and remove imperfections from components to enhance the adhesion of the coating on the substrate. Sandblasting is often expensive and it is difficult to achieve a homogeneous surface, especially when dealing with components that have a complex shape. In the latter case, it is difficult to develop an automated process and the treatment still has to be done manually."

"With the help of our partner Graph Engineering, which is specialized in industrial metal finishing, we have found alternative chemical methods for sandblasting like aluminum anodizing, steel pickling and ultrasound degreasing. These chemical processes make it possible to achieve the same desired surface properties compared to sandblasting, such as a clean surface for coating, protection against corrosion and good adhesion for coatings, but in a cheaper and more eco-friendly way. The biggest advantage is that these chemical methods ensure a homogeneous surface, because if a component is immersed in a chemical bath, for example, the liquids interact with the entire surface, even when complex shapes are involved. Also, compared to sandblasting we can offer almost all colors, which gives the components an attractive character."

Innovative ceramic coating

Not only the pre-treatment of the components is an important result of the project, but also the composition of the ceramic coating, Paolini states: "There are already ceramic enamel paints on the market, but the problem is that they do not achieve the desired properties of the coating. They produce a coating that is usually thicker than 150 micrometres, have a high curing time and do not have the desired thermal resistance properties. Based on our knowledge and contacts, we have developed

Ceramic coating

a coating that has a thickness of between 20 and 50 micrometres, the curing temperature is around 250 degrees and our coating can cope with temperatures up to 500 and 600 degrees, making it ideal for car components that can heat up considerably. In addition, the coating has a high hardness and provides chemical resistance to solvents, fuels, engine lubricant oils and corrosive exhausts."

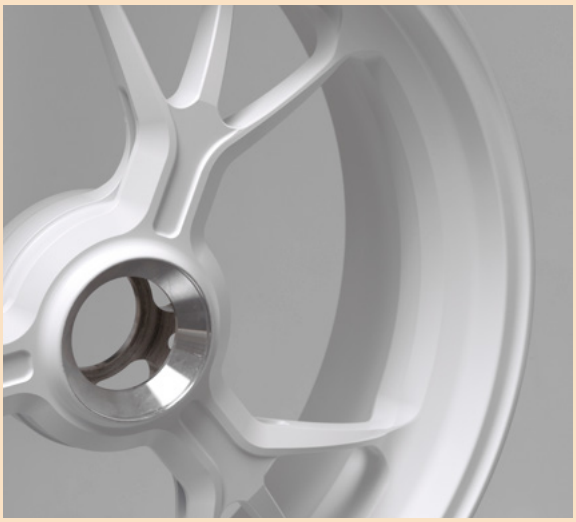
Clear division of tasks

SIVE and Graph Engineering came into contact with each other through the Manunet network, which resulted in successful transnational cooperation. Paolini: "There were some initial communication barriers, but these soon disappeared after we met for the first time at Graph Engineering in Dublin. The success of our project was mainly due to our clear division of tasks. We jointly researched the state of the art with regard to ceramic coatings and pretreatments, analysed

customer requests regarding substrate materials and examined the desired aesthetic and technical performance of the coating. SIVE then experimented with components and ceramic coatings, paying close attention to the parameters to be measured. Graph Engineering mainly looked at the pre-treatment of the components, a crucial point for the ceramic coating to stick properly to the surface of the component. In the end SIVE applied a ceramic coating to prototype components."

Future impact

The Manunet project offers SIVE and Graph Engineering additional commercial and scientific opportunities. Paolini: "The ceramic coating and related methods that we have developed within this project have given us (SIVE) and Graph Engineering valuable knowledge that we can use to enter new markets and generate new customers. Ten years ago, ceramic coatings accounted for one per cent of our turnover, now the percentage is 55 per cent and still growing. Currently, 99 per cent of our ceramic coatings are used for the white goods industry and kitchen appliances, such as coffee machines, gas burners and pans. The improved coating we have developed within Manunet enables us to offer even more applications in these sectors, such as coatings for sinks and extractor hoods. Of course, we also hope to gradually increase our share in the automotive industry with our ceramic coating. We are already in talks with a large Italian manufacturer of car parts to provide them with our coating instead of the silicone coating they currently use. The Manunet project has enabled Graph Engineering to try out different variants of pretreatment on a variety of materials, resulting in an interesting method that has commercial potential. The medical sector, for example, has already shown interest in the pretreated aluminum parts. The surface treatment offers advantages that other current solutions do not provide."



Cross-border cooperation

"The success of our project was mainly due to our clear division of tasks. SIVE and Graph Engineering jointly researched the state of the art with regard to ceramic coatings and pretreatments, analysed customer requests regarding substrate materials and examined the desired aesthetic and technical performance of the coating. SIVE then experimented with components and ceramic coatings, paying close attention to the parameters to be measured. Graph Engineering mainly looked at the pretreatment of the components, a crucialpoint for the ceramic coating to stick properly to the surface of the component. In the end SIVE applied a ceramic coating to prototype components."

Fabio Paolini - SIVE

Acronym
MOTORAMIC

Call
Call 2018

Coordinating Funding Agency
Finpiemonte (Italy)

Participating partners
Società Italiana Verniciatura Elettroforesi S.p.A. (Italy)
Graph Treatments Ltd t/a Graph engineering (Ireland)

Project duration
24 months

Total project cost
€ 659.000

Contact
Società Italiana Verniciatura
Elettroforesi S.p.A.
Fabio Paolini
+39 119 200 773
ricercaesviluppo@siveonline.com
www.siveonline.com

"Finpiemonte has supported the MOTORAMIC-project from the beginning and has also facilitated the formation of a project consortium between different countries. We are pleased to have been able to fund and support the project and we are convinced that the research results will further contribute to the technological progress of the companies. As a funding agency, Finpiemonte considers Manunet a great opportunity to support innovation and foster international cooperation."

Michele Vietti - FINPIEMONTE S.p.A.

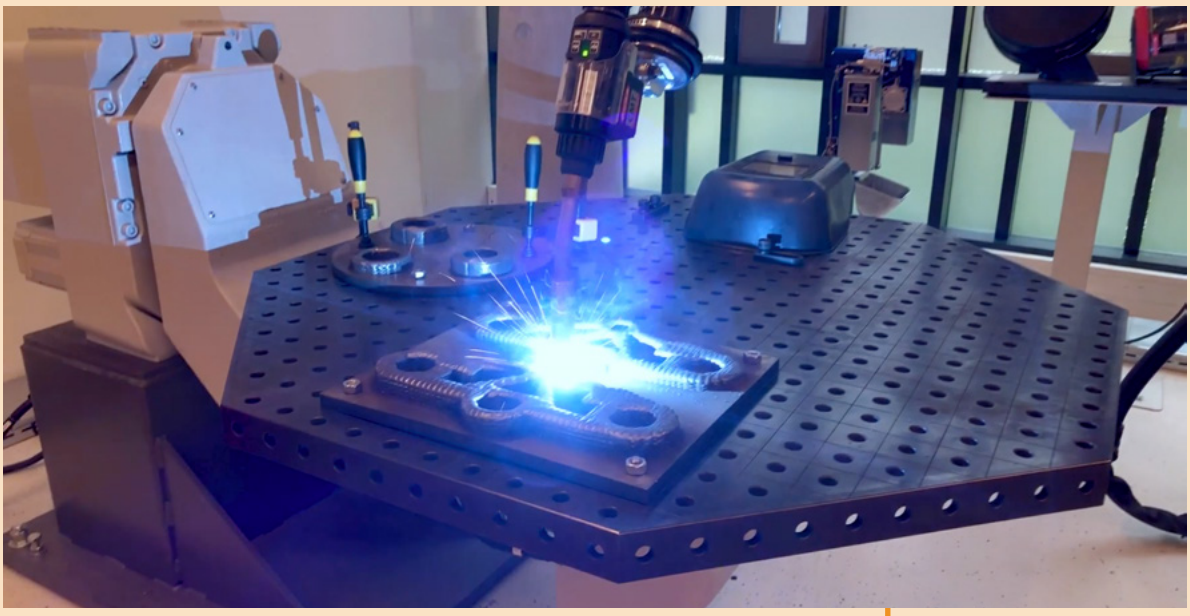
WAMECH

Welding technology for 3D printing of components

In the manufacturing industry, metal components can be produced by pouring materials into a mould or by turning and milling them. This is a time-consuming, resource-intensive and expensive process. The knowledge institute LAC from the Netherlands and the company LINQcase from Spain are developing a solution for this in their Manunet project called WAMECH: a 3D welding technique which, with the aid of an industrial robotic arm, can produce a component layer by layer. Cameras and sensors are used to assess whether the component meets the desired characteristics. Jeroen Wevers, who works at LAC and is the project coordinator of WAMECH, is excited about the preliminary results: “The technique we have developed offers companies in the manufacturing industry the opportunity to produce components in a cost-efficient, fast and environmentally friendly way.”

3D-printed component

"The technique we have developed offers companies in the manufacturing industry the opportunity to produce components in a cost-efficient, fast and environmentally friendly way."



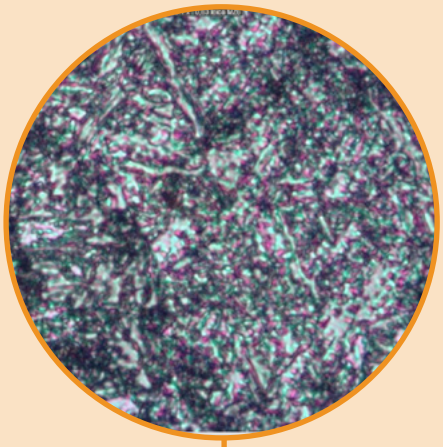
Industrial welding robot

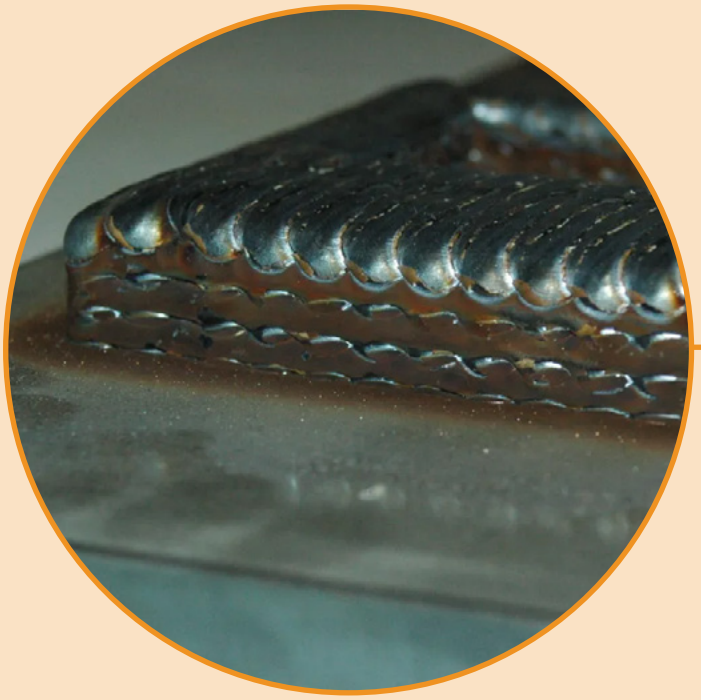
Cheap, fast and sustainable alternative production method

“The reason we started the project is that a large Dutch company, which produces metal components for various industries, approached us to find a solution for a question they had,” Wevers starts. “They produce several components with complex shapes that are currently manufactured in an expensive way using conventional methods. The disadvantage of these methods is that you have to process a large block of material until you have the desired shape of your component. Firstly, this technique makes it difficult to obtain components with a complex shape, such as concavities and curves. Secondly, it is not environmentally friendly because it generates a lot of waste and consumes a lot of energy. Another method of manufacturing components is by pouring liquid material into a mould, but this is also expensive because such moulds have to be specially designed for a particular component, which takes a lot of time and does not allow for flexible manufacturing. Together with our partner, we have found an alternative to these methods, which is interesting for many companies in the manufacturing industry.”

Wire Arc Additive Manufacturing (WAAM)

Within the framework of Manunet, LAC is developing a technique that allows them to produce a component layer by layer by using an industrial welding robot and a





3D metal printing

certain type of welding wire. Jort Dwarshuis, who works at the LAC and is responsible for the technical realisation of the project, explains: “We used a technique called Wire Arc Additive Manufacturing (WAAM). WAAM is basically 3D printing with steel or other materials. You start from nothing and the welding robot repeatedly deposits layers of material on top of each other until you have a 3D printed product. The advantage of this technique is that the welding robot only uses as much material as necessary to obtain the desired product. This results in potential cost savings for the company using this technique. This depends on various factors such as the rarity of the used material and the amount of waste that conventional methods would produce. To determine whether WAAM is a good alternative to conventional methods, it is necessary to make calculations first. The WAAM method is very sustainable compared to other methods because it uses less energy and there is less waste to process or recycle.”

A complex process

"There were quite a few challenges in developing the 3D welding technology, because you have to take into account many aspects and link many technologies together," Dwarshuis continues. "Before you can apply this technique, you have to do a lot of research and testing, which is a big threshold for many industrial companies. They often don't have the knowledge or the capacity. The biggest challenge was the programming and control of the welding robot. Beforehand, we examined several parameters that influence the process, such as the distance between the welded lines, the height of the layers and the welding speed. If the parameters have not been investigated thoroughly and the robot has not been programmed properly, imperfection (e.g. craters) may appear in the layers of the component or the material may drip over the outside edge of the printed part. By testing, you eventually get a certain component with the desired mechanical properties. It is important to obtain the right hardness, otherwise the component is fragile. By testing continuously and programming the robot differently, we were finally able to produce a component with the desired properties. Each material and each component requires different parameters and settings, which makes WAAM a knowledge-intensive production method."

Production, quality control & coating in one place

In Manunet, LAC cooperates with the Spanish companies Lurrederra and Linqcase. Wevers: "Lurrederra provides the components we produce with an anti-corrosion coating. This is important because our components are intended for the offshore industry, where they are constantly exposed to natural elements that can affect their shape and strength. The other Spanish company, Linqcase, helps us by checking whether the components we produce meet the desired dimensions and have the desired physical properties. Through laser technology and sensors, they can scan the component, which is useful to improve the quality of the components and the welding process. Currently, these processes take place on their premises, but we are working with them to integrate all the technologies into one process."

Mass individualization

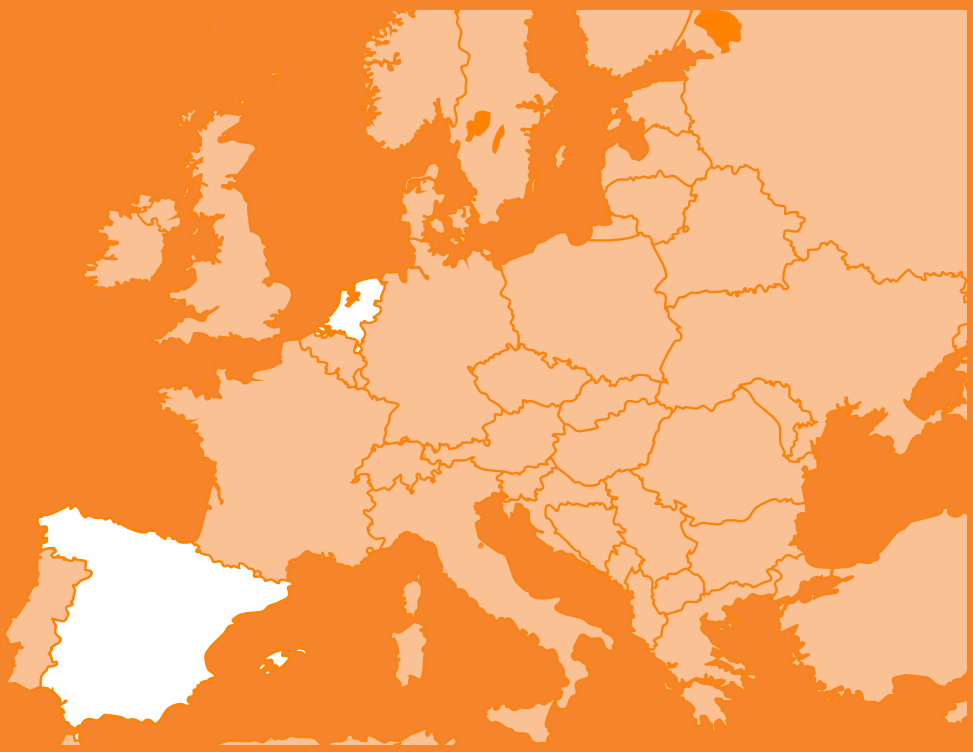
Although the partners have developed a technology for one particular type of component, it has the potential to be used on a larger scale in the manufacturing industry and even in other sectors. Wevers is convinced of the possibilities: "Customisation is becoming increasingly important, because that is what the consumer demands. To achieve this, you need machines that offer maximum flexibility, but which can produce in the most standardised way possible. Individualised mass production, that is our aim. That is what we want to achieve in the industry. If we can integrate Linqcase's quality control and Lurrederra's coating process into our welding process, everything takes place at one location. That way we can quickly produce high-quality complex components with a corrosion-resistant coating."

"We are still working together on this, but the project is also of great value for the partners individually. We, LAC, are a knowledge institute and our aim is to transfer our knowledge to companies. With the knowledge gained in this project, we hope to be able to help even more companies. Lurrederra has developed a special coating that is of interest to several customers in the offshore industry and Linqcase's laser scanner can be integrated into the production process of industrial companies that want to carry out their quality control in a fast and efficient manner."

Cross-border cooperation

"Through the Manunet network, we came into contact with two Spanish companies that are helping us to develop and improve the innovation we came up with: Lurrederra and Linqcase. We, LAC, focus on 3D-printing the component using an industrial welding robot, Lurrederra provides the components with an anti-corrosion coating and Linqcase has developed a quality control process for the components. The cooperation is running smoothly and will undoubtedly continue after the project."

Jeroen Wevers - LAC



Acronym
WAMECH

Call
Call 2020

Coordinating Funding Agency
Provincie Overijssel (The Netherlands)

Participating partners
LINQcase (Basque Country-Spain)
Stichting LAC, (The Netherlands)

Project duration
24 months

Total project cost
€ 368.031

Contact

LAC
Jort Dwarshuis
+31 74 852 53 89
dwarshuis@lac.nl
https://www.lac.nl/

”The province of Overijssel is responsible for regional economic development. We are a partner of Manunet because it enables us to support the involvement of our regional SMEs in an accessible way in international innovative projects and to establish connections with foreign regional networks.”

Bas Ramaker - Province of Overijssel

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