

5 YEARS DRIVING INNOVATION IN MANUFACTURING

ACTIVITY REPORT 2019



FLANDERS
MAKE

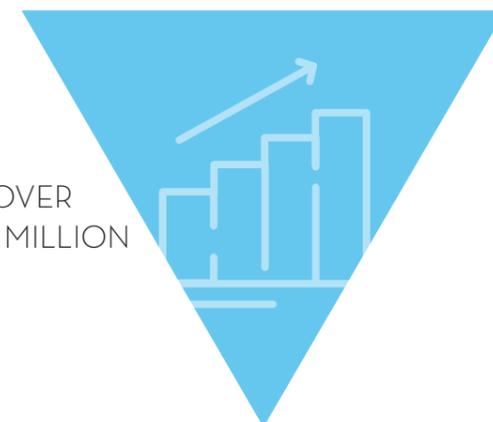
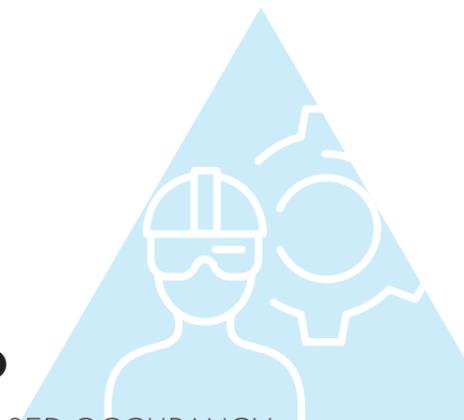
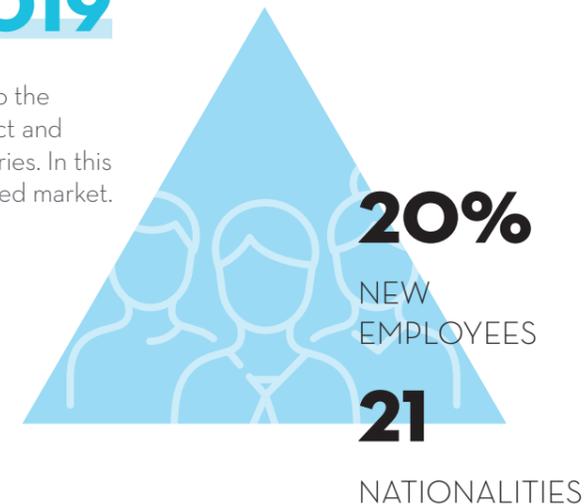
DRIVING INNOVATION IN MANUFACTURING

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KEY FIGURES 2019

Flanders Make performs high-tech research with and to the benefit of companies. As such, we contribute to product and production innovation for vehicles, machines and factories. In this way, we help companies to be competitive in a globalised market. A few noticeable numbers:



PREFACE

by the CEO and by the Chairman

2019 was a challenging and also exceptional year for Flanders Make and the manufacturing industry. Following a number of geopolitical issues, think of the Brexit and the protracted trade conflict between the US and China, the further development of our companies was somewhat held back. However, the impact on innovation was limited because Flanders Make geared its research optimally to the needs of the Flemish manufacturing companies. More than ever, Flanders Make helped the industry to anticipate important trends and take cost-effective steps towards the implementation of Industry 4.0. In this way, we co-create tomorrow's winners.

Over the past five years, Flanders Make doubled both its turnover and the number of employees. This had a strong impact on the level of innovation. Also the coverage ratio among Flemish companies has been doubled. What stood out here, was the lowered threshold for SMEs, which allowed us to set up more innovation projects. As such, we confirmed our role as a competence centre that focusses on all industries and helps them position themselves with regards to new trends.

Also the Flemish government continues to support innovation and even launched additional actions on artificial intelligence (AI) and cybersecurity. The importance of AI cannot be underestimated. Cybersecurity may well create a major impact soon, companies should be aware of this.

Industry 4.0: the future for production technologies

From Artificial Intelligence to Industry 4.0 is but a small step: Flanders Make organised a successful symposium on this topic in November last year. With over 600 attendees, "The Future of Manufacturing" was a powerful statement. The registered companies acquired knowledge on Industry 4.0 and were introduced into its applications, a.o. via 27 demonstration set-ups of our research that clearly visualise what Industry 4.0 can mean for companies. Networking was also an important part of this symposium as it stimulates internal and external cooperation. Flanders Make entertains a broad

interpretation of innovation: companies setting up external partnerships with knowledge institutions, public authorities or other companies or companies innovating internally through the input of their employees.

It is with this in mind that we also created our renowned whitepaper on digital transformation to reach a wide audience around this actual topic. Then, Industry 4.0 is not only about technology but also about adapting the corporate organisation and internal culture. Through our whitepaper, we want to make companies ready for the future and encourage them to think about the current trends: AI, augmented reality and digital twins. Step by step, we guide them towards smarter systems that can manufacture customised products and thus increase the maturity and competitiveness of their businesses. We look at these technologies in phases. The most important thing now is that we help companies to convert their data into actionable knowledge and to combine this knowledge with AI algorithms.

Spotting trends is crucial

In the future, the focus will be more on digital twins: the digital copy of a product or production system.



“In this digital revolution, we must embrace innovation.”

– Dirk Torfs, CEO

This is not about modelling but about virtual designs of products and the analysis of production technologies. This allows companies to make less physical prototypes and to develop them faster. As with updates on a smartphone, we gradually build systems and production processes so that they can be reconfigured, enabling companies to respond flexibly to the ever evolving market needs.

Large-scale customisation - resulting in products fully customised to the customer's requirements - may already be possible within ten years. Thanks to new prototyping methods, this can be done in a more cost-efficient way and on a larger scale. This may still seem a bit far on the horizon but it is important that we teach companies to recognise trends, initiate innovations and seize opportunities.

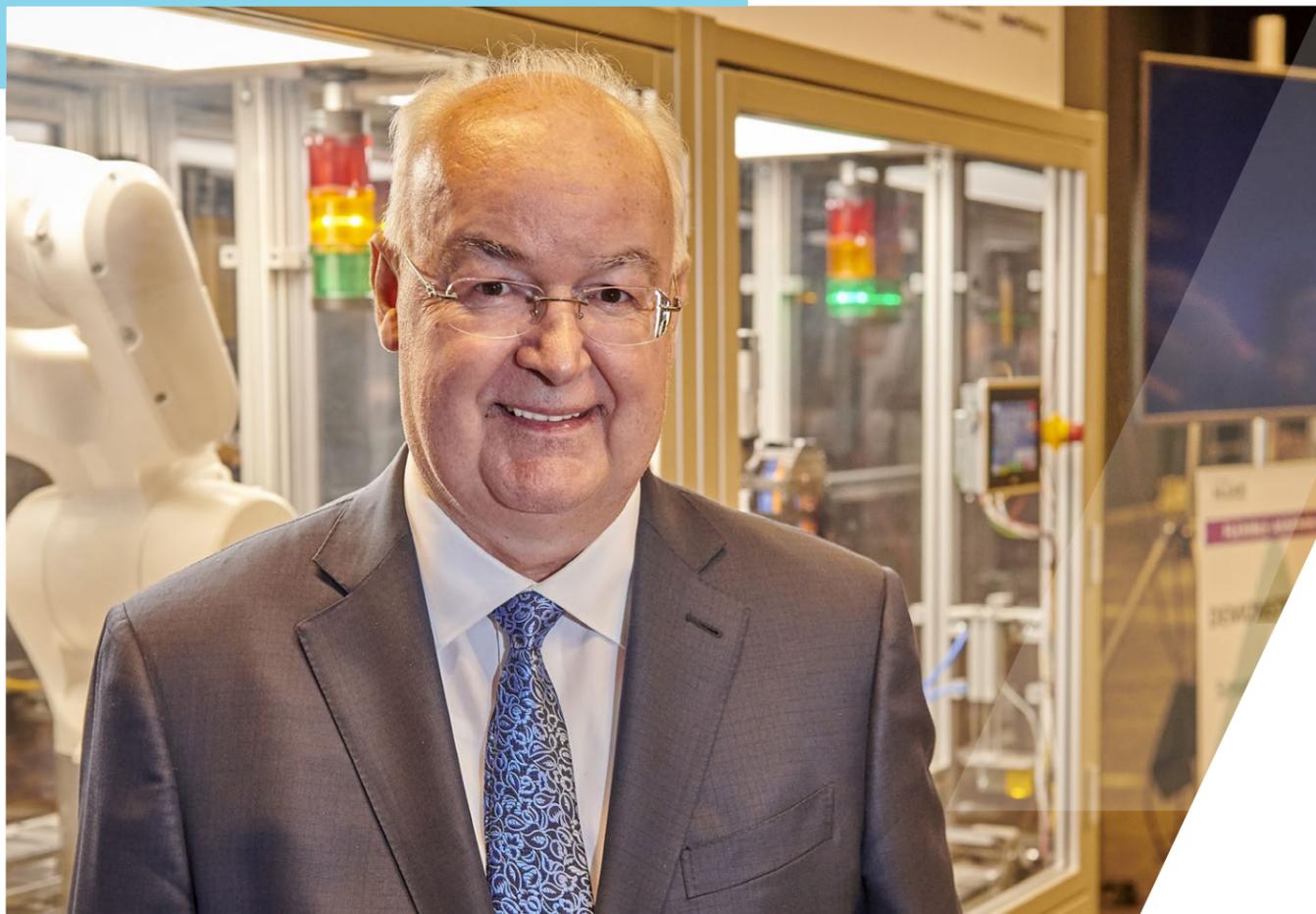
Sustainability pays off

Sustainability is an important aspect that we should not ignore when talking about innovation. Only by applying the available knowledge in the product development process, we can strengthen the ecosystem. By aligning the activities of all departments within a company, the

latter will be better able to make customised products. This will significantly strengthen the competitiveness of a company as it will stand out on the market, lower its costs and keep production local.

The digital story has no upper limits. Technology enables us to create more valuable jobs. It is a logical historical development: we evolved from horse to tractor and, more recently, from computer to smartphone. Evolution brings us more powerful solutions. Therefore, Flanders Make pulls out all the stops to identify opportunities in a world changing almost by the day. Only in this way, we will be able to systematically push back frontiers in this technological revolution.

Dirk Torfs
CEO



Flemish companies must embrace the digitalisation trend. Companies that do not digitalise their core processes, will lag far behind.”

– Urbain Vandeurzen, Chairman of the Board of Directors

“The Flemish manufacturing industry is still doing very well. In spite of the instability on a global economic scale, our companies are delivering great performances and employment remains stable. Compared to our prognosis for the 2017-2019 period, the manufacturing companies – in 2019 – effectively invested 50% more in their digitalisation. This appeared from a survey that we conducted among them in October last year. This survey also showed that they still intend to increase these investments. Companies supported by Flanders Make are also determined: nearly three quarters of them assesses itself as being equally or even more competitive than its competitors.

Considering the macroeconomic headwind, the progress made is not self-evident. Think of the trade conflict between the US and China, which exerts a major pressure on the European economy. Also the downturn of the German industry, faced with challenges for their vehicle and machine building industry, raises concerns. The Middle East is still plagued by the well-known geopolitical problems. All this and specific obstacles such as cyberattacks make the global economy volatile.

In spite of all these obstacles, the Flemish manufacturing industry again recorded growth figures in 2019 and that's something we can be proud of.

The manufacturing industry continues to grow

So, our members and the manufacturing industry are doing well: we're seriously catching up on the leading European countries. Germany, Switzerland and the Nordic countries remain in the lead but Flanders is coming very close. The Flemish government awards a considerable amount of innovation subsidies, which enables us to expand our activities in these difficult economic times. Our established member companies continue to innovate at a fast pace and claim market leadership, whereas young start-ups give a boost to the industry. These newcomers are essential: their innovation potential is extremely important and therefore they add value to our economy.

Flanders Make currently meets or outperforms the performance indicators of our five-year plan from 2017. In 2019, we realised 262 projects, ranging from research

projects to large-scale European developments. The impact and action radius of Flanders Make increase year after year. The ambition to sustain these efforts will bring us in the next decade alongside Germany and Switzerland among the leading countries of the European manufacturing industry.

Digital revolution

We cannot stop emphasising it: digital transformation is of crucial importance. A company that does not digitalise will have no chance of survival. 70% of our member companies is following a digitalisation trajectory, opposed to less than half of the non-member companies. The evolution towards Industry 4.0 is essential and pays off immediately. A survey on this topic showed that the investment pays for itself after an average period of 2.5 years. By digitalising the workplace, companies will increase their production efficiency as well as the occupancy rate of their production facilities. With a comprehensive digitalisation of product development and technology, companies will even be able to manufacture innovative customised products at

the cost of mass production.

And yet, a number of factors are still inhibiting and slowing down the digital transformation of Flemish companies, such as the recruitment of digital talents and the development of a digital culture. For this reason, the digital training of employees within companies but also improving the quality of our education system are hugely important to enable an optimum use of digitally talented people. The quality of our higher education worries us and the long-standing decline of our compulsory education, as confirmed by the renowned PISA surveys, is alarming.

The global digital developments are going fast and we have no alternative but to act on them. The competitiveness and growth potential of our companies depend on the quality and commitment of their employees. Flanders therefore must urgently pursue a revival of our once prized education and training system.

Urbain Vandeurzen

Chairman of the Board of Directors
Flanders Make

MARKET SURVEY

is Flanders ready for Industry 4.0?

In September and October 2019, Flanders Make conducted a survey among 122 Flemish companies to check whether they are ready for the transition to Industry 4.0. More than half of these companies are member of Flanders Make and are probably already developing digital technologies. Almost 60 percent of the members was implementing a strategic plan for the digitalisation of applications.

To increase the efficiency of their production facilities, companies are embracing the digital transformation. Flanders Make helps them to realise this pioneering role: apart from the 58 percent of businesses that are already in their transformation stage, another 24 percent of the member companies have outlined a detailed plan. Among the participating companies that are not a member of Flanders Make, only 20 percent is currently in a digital transformation phase and almost one third has drawn up an Industry 4.0 plan.

Stimulating innovation

There is, however, an underlying problem that already came to the surface in a previous survey: more than half of the companies with less than 50 employees makes no or hardly any innovation efforts. Furthermore, almost half of them has no digital plan and 10 percent thinks that innovation has no use: this really puts their survival at risk. The essential building blocks for innovation are artificial intelligence, smart sensors and the Internet of Things. To be able to implement these elements on the shop floor, it is recommended to first develop a digital culture with the help of specialists, which appears to be a major obstacle. We therefore need a separate action plan because both the government and training bodies should realise that we must set up digital training programmes to be able to realise economic growth. That is why Flanders Make works together with the Flemish FabLabs, where young people are encouraged to follow

a STEM education. A young generation of digitally skilled scientists, technicians, engineers and mathematicians is what we need to help our companies to innovate.

Step-by-step support

Flanders Make supports all companies to remain competitive. Through a clear roadmap, we assist companies step by step in their technological innovation and focus on technologies and applications that enable mass customisation. By offering small series at the cost and speed of mass production, companies can make a difference. Our support starts with a model-based approach of products and production systems.

“We simplify the production and open doors for new product variants.”

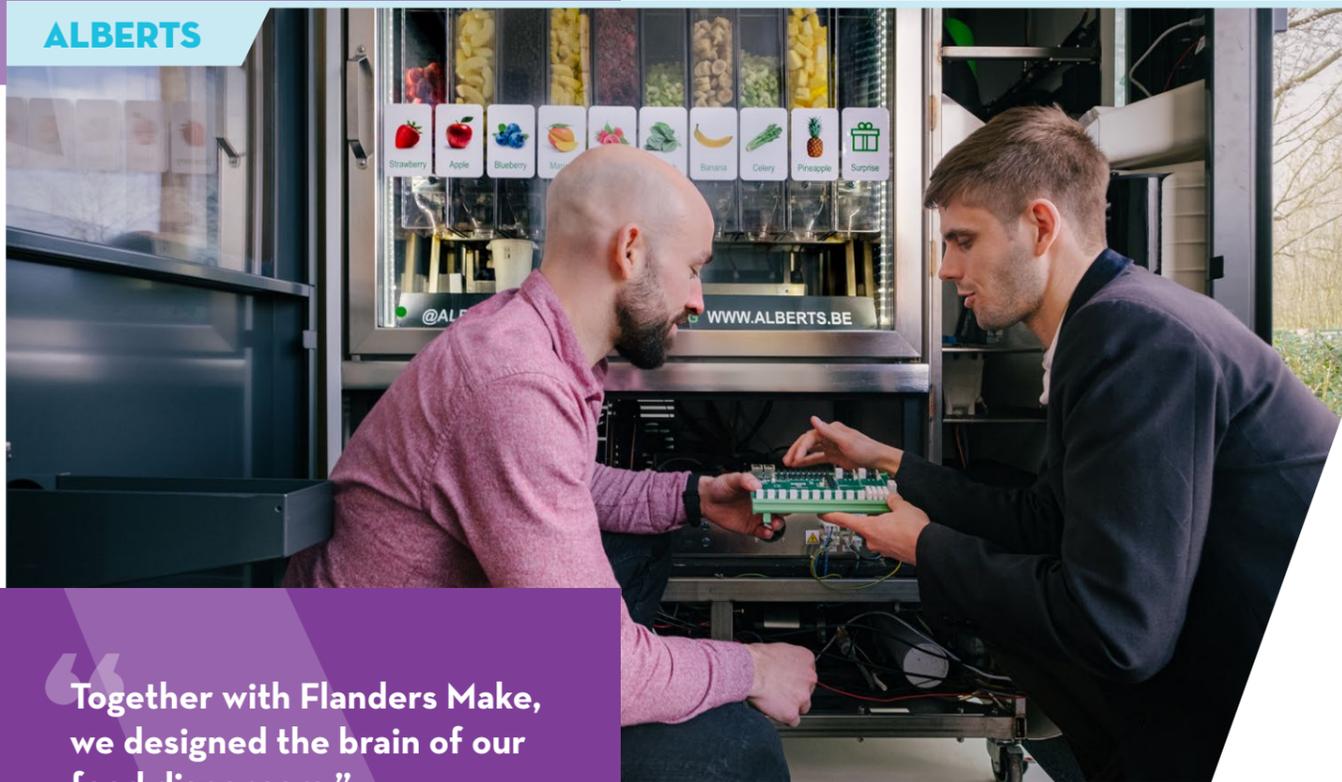
By casting the entire life cycle of a product into a model, we not only improve its quality, we also simplify the production and open doors for new product variants. The next step is the introduction of digital twins for both products and their production system, which also allows creating new business models. By 2028, we will hopefully see the first hybrid work cells in action, with a strongly increased interaction between man and robot. The use of intelligent data in the production process and the virtualisation of the product life cycle will allow to cope with the increasing demand for mass customisation and will support companies to capture or retain their place at the top.

SERVICES SUPPORTING A SUCCESSFUL DIGITAL TRANSFORMATION

We perform, together with several companies, pre-competitive research into shared challenges. In addition, companies can also appeal to us for specific research issues. They can call upon our knowledge and services to develop a new concept, validate a solution of their own or perform extensive tests in our unique, high-tech research facilities.

COMPANY TESTIMONIALS

ALBERTS



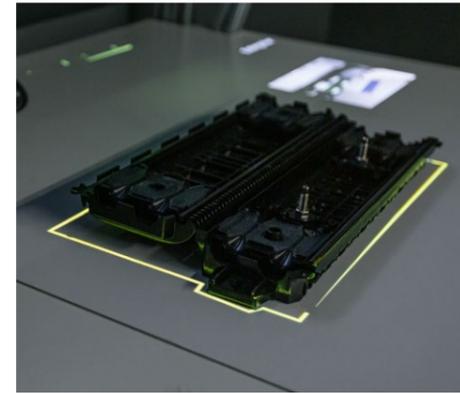
“Together with Flanders Make, we designed the brain of our food dispensers.”

Healthy communication protocols

Making healthy food easy and sexy: that is Alberts' mission. With their unique food dispenser, you can make yourself a fresh, personalised smoothie in no time. The robotics lab of Flanders Make gave us the right inspiration for the language spoken by the food dispensers. As recommended by Flanders Make, Alberts based the electronics on EtherCAT: a communication protocol for real-time controlled systems. As a result, every dispenser can be controlled individually and remotely, which is a great help for its maintenance and automation. At present, Flanders Make helps them to improve the ergonomics during the assembly of the dispensers: with a cobot, this task will become a lot easier for their operators.



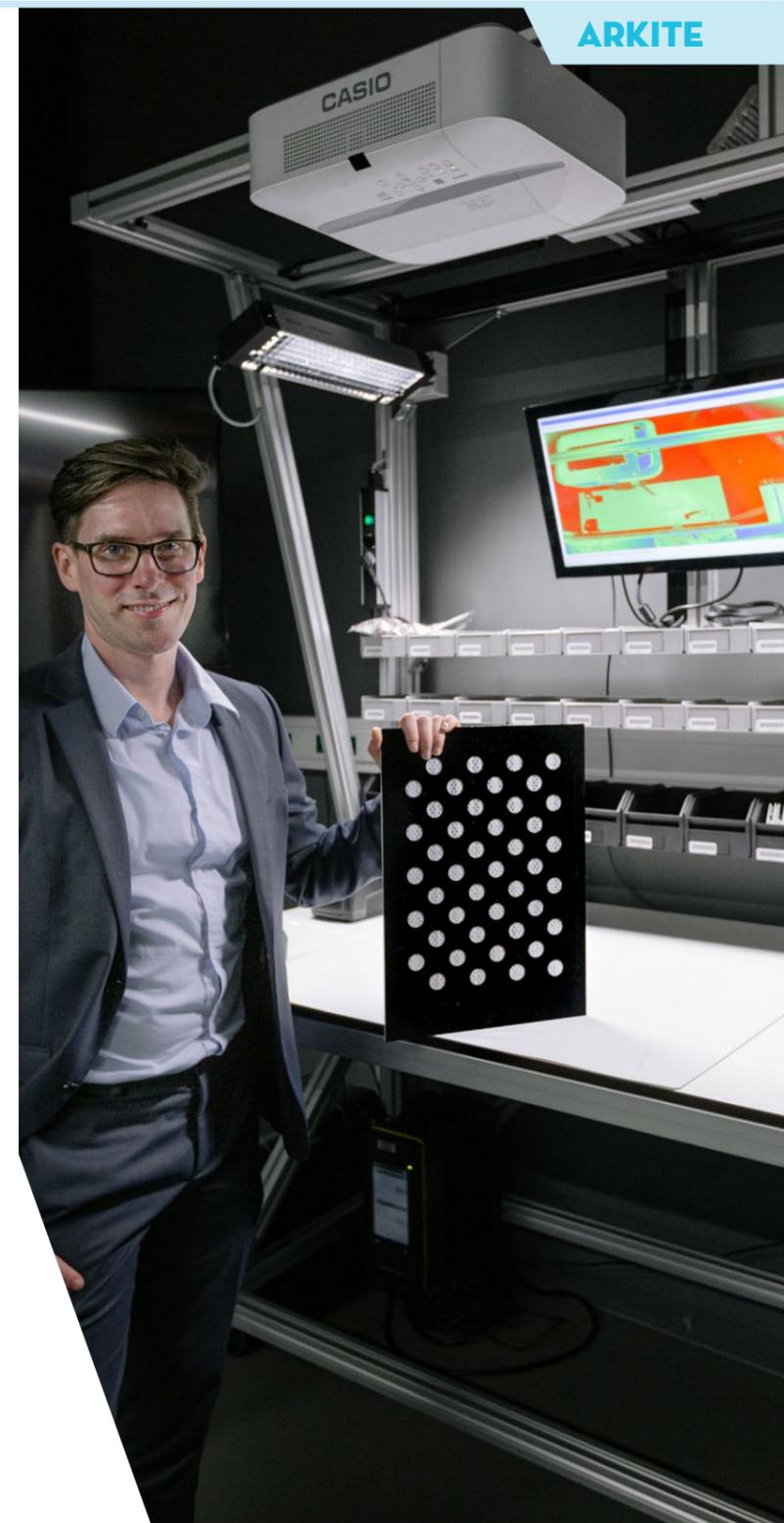
ARKITE



“Thanks to the high-quality calibration tool of Flanders Make, we have been able to improve our product.”

Injection of knowledge by our experts

Arkite developed its Human Interface Mate, a software platform offering assistance to operators through augmented reality. The consecutive tasks in the assembly process are highlighted one after the other and the corresponding instructions are projected onto the work platform. This will enable companies to increase the flexibility of their production and move towards customised mass production. First, Arkite gained a detailed picture of production environments thanks to comprehensive analyses of Flanders Make. Subsequently, Flanders Make supported them with an injection of knowledge: an expert in computer vision familiarised himself with the system and developed a special calibration tool. This cross-fertilisation allows Flanders Make to rapidly respond to new challenges, which to us is the most efficient way of outsourcing towards Industry 4.0.





“Cobots make the work of operators more enjoyable by taking over tasks that require a lot of concentration or are very repetitive.”

A successful cobot application at Audi

Until recently, the quality control of adhesive joints on the outside and inside of car doors was carried out manually at Audi, where the parts to be checked had to be taken apart and then scrapped. In the Flanders Make research project studying the intuitive programming of cobots, a successful cobot application was developed by FRS Robotics and Audi Brussels,

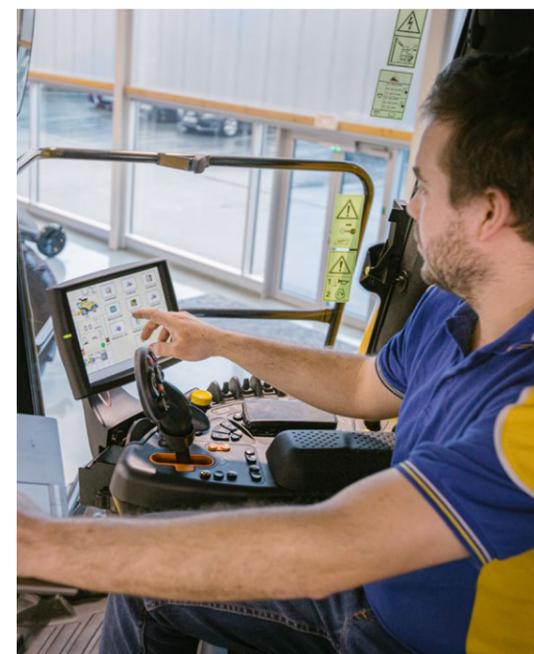
based on a new programming method developed by the Robotics Research Group of FlandersMake@KULeuven. By equipping a cobot with an ultrasonic sensor that detects the lack of glue and an external force sensor, the quality control is now carried out in a completely new way by the cobot in cooperation with the operator. The installation is simple, without additional tools such as cameras, and does not require much space, which makes the innovation factor of this project even higher. Cobots make the work of operators more enjoyable and safer by taking over tasks that require a lot of concentration and that are physically demanding and/or very repetitive. Moreover, the high quality of the inspection is guaranteed and Audi can save on its scrapping costs. The results of this very first industrial application are very encouraging and there is strong interest in using cobots in other production units as well.



“Flanders Make helped us with concrete evaluations that significantly upgraded our working methods.”

The search for a uniform mowing height

A combine harvester mechanises the mowing and threshing of seed crops. The result depends to a large extent on the condition of the ground level. To compensate for uneven surfaces in the soil, the newest models contain improved sensors and controllers. Flanders Make performed structured long-term research into the performances of the mowing height control system in combine harvesters from New Holland. With the hydraulic test set-up at Flanders Make, New Holland obtained clear information on the necessary adjustments to the mowing height control system. As a result, the cutting height is no longer affected by the impact of pits or bumps and remains the same at all times. Furthermore, New Holland also implemented a new working method: rapid control prototyping, again thanks to the assistance of Flanders Make. By no longer executing the control logics in real time on the machine processor but on the computer, they have been able to accelerate the testing and implementation of adjustments.





“Flanders Make extracted the essence from high fidelity software and built a workable analysis tool for us.”

More effective assistance tools for cars of the future

For Toyota, the European R&D headquarters are established in Zaventem, where Toyota Motor Europe (TME) supports development and production by applying the knowhow of European partners. Flanders Make, for instance, helped them to optimise the in-house simulation platform to be able to predict the performances of cars more quickly. The performance requirements for drive systems are becoming increasingly complex and production lines require faster and more extensive analyses. To anticipate the various updates in parts, companies use simulation models based on so-called high fidelity software.

Flanders Make applied the expertise and soon detected the problem areas. Our lab extracted all relevant factors from the software and implemented it in a brand new, workable analysis tool. With these data and the simulation platform, TME is able to better adapt the products to the wide variety of conditions in which these will be used. It's only logical that the cooperation continues: at the moment, Flanders Make and TME are building a test bench to be able to accelerate the validation of its new models.



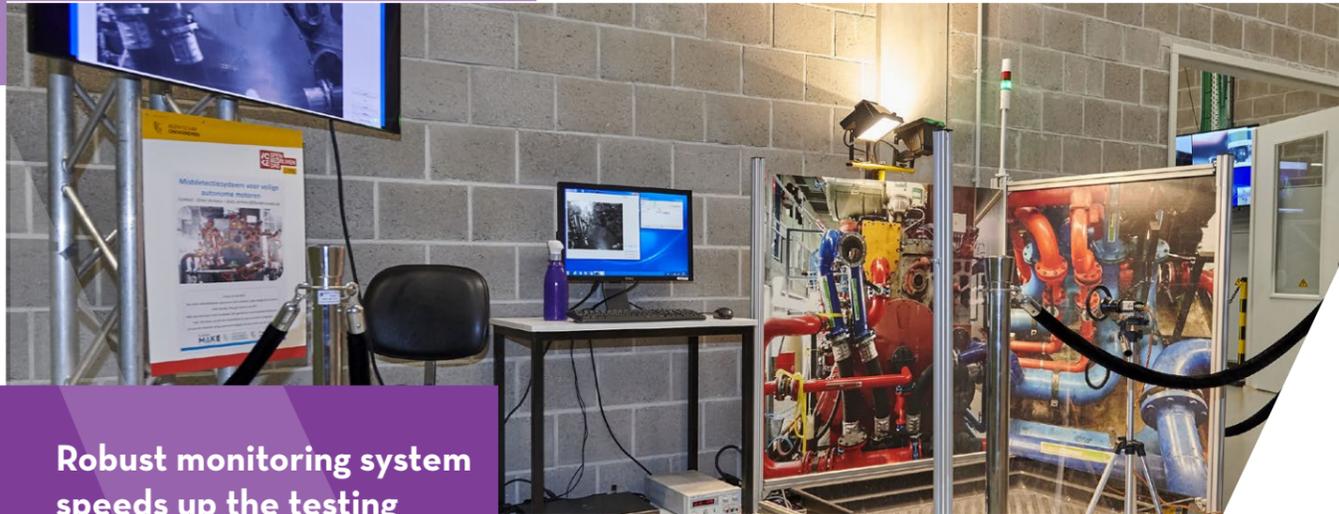
“With the help of Flanders Make we could grow from start-up to scale-up.”

Striving for ultimate energy-efficiency

Powerdale develops, builds and sells innovations in energy management and electric mobility. In a world in which the demand for energy-efficient products rises every day, the company focuses on developing sustainable solutions. FlandersMake@VUB assisted in the research into and the development of control strategies for the charging stations of their revolutionary NexxtGEM platform. Charging stations use these strategies to distribute the power capacity, giving priority to certain vehicles: the vehicle of

a visitor, for instance, is charged more quickly than the vehicle of an employee who will be present the whole day. FlandersMake@VUB performed extensive simulations and used artificial intelligence to be able to programme the logic more rapidly. It then translated the captured data and logic into a usable code in view of its application as an algorithm. Furthermore, Powerdale and Flanders Make@VUB are currently working together on fault monitoring in power systems and are jointly developing a new generation of on-board chargers.

COMPANY CASES



Robust monitoring system speeds up the testing process for ABC engines

Anglo Belgian Corporation (ABC) is European market leader in the production of engines between 600 and 11,000kW. Their R&D department is permanently investigating new ways

to improve the engines. To speed up the testing process for prototypes and thus optimise the efficiency of the design process, ABC wanted to make the engine testing process autonomous. Up to now, they always had to have an operator present to intervene whenever there would be a leak. Because of the high flow rates in the pipeline, conventional pressure

sensors do not qualify for monitoring such leaks. That is why ABC worked together with **Flanders Make** to develop a robust monitoring system for oil or fuel mist detection.

The toolbox works on the basis of online images. In the calibration phase, a background model is being trained. During this process, the

model learns to distinguish a normal situation from a situation in which the room is filled with mist. Even when the set-up in the room is changed, the model can cope with this. The model continuously learns and compensates measurement inaccuracies over time. The safety system automatically receives a warning signal whenever an anomaly is detected.

“The model continuously learns and compensates measurement inaccuracies over time.”

In a subsequent assignment following the research project, the toolbox that was developed was optimised in view of its deployment in ABC's production facilities in Ghent. The vision-based monitoring system works fully autonomously, enabling continuous testing with less supervision and an enhanced validation of new prototypes.

Automatic processes for identification of vibration damper models optimise the design process of Toyota Motor Europe

It is quite a challenge to set up vibration damper models in digital vehicle prototypes. It is very time-consuming to develop the models and the results are not sufficiently consistent. That is why Toyota Motor Europe contacted FlandersMake@KULeuven to develop a method for vibration damper model identification.

A rubber bushing is a type of vibration damper commonly used in vehicles. The bushing connects

two parts. These can move with some freedom with respect to each other and dampen shocks, noise and vibrations while driving. From virtual prototyping point of view, it is important to model them correctly for their specific application. The behaviour of bushings strongly depends on their design and material but also on the loads they are exposed to and on the environment in which they are used. It is therefore of crucial importance to consider them as

crucial components and this in an early design stage.

Toyota Motor Europe teamed up with **FlandersMake@KULeuven** to develop a methodology to identify the parameters for a vibration damper model on the basis of design or experimental test data. This methodology and related scripts were then integrated into Toyota software so that the engineers of Toyota Motor Europe could set to work with them themselves.

Toyota Motor Europe has now at their disposal an automated, robust and efficient process to identify the parameters of rubber bushings. The framework is based on Matlab scripting and it generates necessary data files for use with high end multibody solvers, therefore integrating with their existing processes. The research is currently being extended to anisotropic characterisation. By considering the direction dependency, the models can be made even more realistic.

Arcelor Mittal valorises waste heat from steel production using ORC technology

On its site in Ghent, **Arcelor Mittal** produces steel products for various applications. The production of steel is very energy-intensive. In line with the policy of the European Union, Arcelor Mittal does everything possible to reduce its CO₂ emission. One of the possibilities that are being considered is the recovery of waste heat.

Experts believe that the annual potential for unused industrial waste heat in Europe alone already amounts to 140Twh, which could yield a CO₂ reduction of 14 million tonnes per year (figures: UGhent). This waste heat can be recovered as electric current using ORC (Organic Rankine Cycle) technology. The production of steel requires high temperatures (up to 2000°C). Part of this energy is always lost in the form of heat. This waste heat is (partly) re-emitted into the environment, through the chimney or a cooling tower, for instance. However, these waste heat flows predominantly consist of waste gases that still have a considerable energy content. Today, new methods are studied to re-use the energy from waste heat.

Arcelor Mittal works together for this with **FlandersMake@UGhent**, heat exchanger manufacturer Timmerman and ORC manufacturer BEP Europe. First, we mapped the heat flows and studied the potential of ORC technology combined with heat storage as a solution for recovering the energy from these specific flows. We used a simulation tool to calculate the outcome in terms of energy recovery. This showed that in the colder months the most cost-effective solution was using the recovered energy directly to heat the production halls. In the other 6 months, when the demand for energy is almost nil, the waste heat is converted into electricity using an ORC machine.

By using ORC technology, Arcelor Mittal can further improve the energy efficiency of its production. As a next step, the company is considering to optimise the heating system to as to be able to directly use the available heat.

Digitalisation of chocolate production at Prefamac for customised pralines.

Belgium is not only renowned for its chocolate but also for its chocolate production machines. Prefamac builds confectionery machines for the chocolate industry and for industrial manufacturers of cookies, biscuits, waffles and cakes. The production of chocolate pralines with complex shapes is not obvious for Prefamac's customers because the conventional chocolate production machines have been designed for making many, exactly the same pralines (mass production). So, whenever smaller amounts had to be made, this was still being done according to traditional methods. Obviously, this involved a highly time- and cost-intensive process requiring specific skills.

Therefore, **Prefamac** and **Flanders Make** worked together to develop a modular and flexible machine for manufacturing multi-layered chocolate and nut clusters. The machine can be easily reconverted so that various kinds of pralines can be made on one single machine. Besides, the machine also allows to create more complex shapes, which so far could not be done mechanically.

“So, whenever smaller amounts had to be made, this was still being done according to traditional methods. Obviously, this involved a highly time- and cost-intensive process requiring specific skills.”

The machine consists of a chocolate dosing module, a nut dosing module and a camera-based detection system that monitors the production. This machine is now being integrated in the new co-creation hall of Prefamac in Lummen, where the chocolate production machines are optimised together with the customers.



Daikin Europe tests the potential of exoskeletons at the workplace

Companies are increasingly looking for ways to relieve their workers from heavy and repetitive tasks. Exoskeletons may well offer a solution to this problem. That is why **Daikin Europe** tested industrial exoskeletons at the workplace. The manufacturer and supplier of

heating, ventilation and air-conditioning systems wanted to know, on the one hand, if the physical support offered by the skeleton suffices. On the other hand, it was also important to assess how its employees would react to the new technology. They sat together with **FlandersMake@VUB** to screen the production process and to assess where exoskeletons would offer most potential. In the next stage, some of the employees could set to work with them.

“The test, which was also performed in other companies, showed that 75% of the employees had a positive attitude towards the tested exoskeletons.”

The test, which was also performed in other companies, showed that 75% of the employees had a positive attitude towards the tested exoskeletons. The strain on shoulder and back muscles, in particular, was relieved. However, for a broad industrial implementation, the user comfort and usability should still be improved. The results of the test are therefore used to optimise the design of new exoskeletons. Daikin Europe continues to closely monitor the further developments in the field of exoskeletons.

Saab Aeronautics' software teams increase their agility thanks to new test automation method

Mutation testing is the most advanced method for measuring the quality of a software validation package. Through this method, minor changes are made to an existing programme. Such changes may for instance consist of typical errors. Every altered version is a mutant. If the validation package

does not detect the mutant, the package is inadequate. However, mutation tests are expensive as it takes very long to test all mutants. For an average piece of code, this may easily take several days.

Saab Aeronautics develops, tests and services aircrafts. They evaluate mutation testing to meet the very strict safety standards within the aviation industry. However, software development should go faster, without cutting into quality.

Therefore, testing developed software is (partly) automated.

FlandersMake@UAntwerp and Saab Aeronautics performed joint research into new ways to accelerate mutation analyses. For this, we've created a plug-in for Dextool Mutate for C++ projects. This plug-in implements mutation schedules that accelerate mutation tests by a factor 4 up to 11. Saab Aeronautics is currently testing the application.

This research has been financed through the **TESTOMAT project**, an **ITEA project** with 34 partners from 6 different countries. In this same project, Ericsson, the Swedish telecommunications giant, is working on a model to improve test automation procedures. The model builds on actual test data and allows users to assess the maturity of their testing processes.

Innovation Boosting is a joint project of Flanders Make and the Flemish Government that aims to lower the innovation threshold for Flemish companies through subsidised feasibility studies. Together, we search for solutions for company-specific technological challenges in view of making businesses more competitive. Two cases.

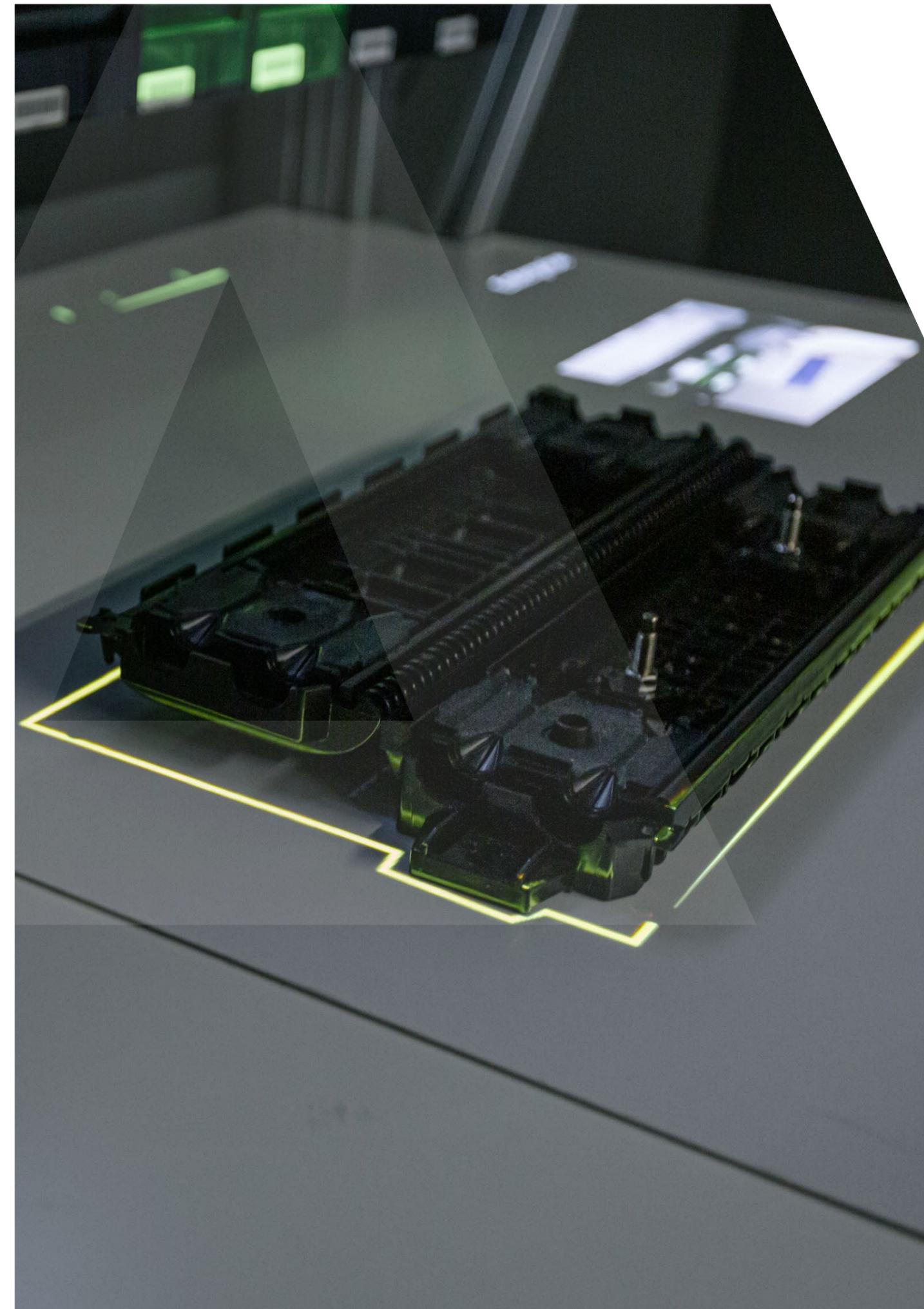
Albatros gets support for implementing Industry 4.0 technology

Albatros is the reference supplier for orthotic seats and standing, lying and seating aids for people with physical disabilities. Such orthopaedic tools are always custom-made to size. Today, taking a person's measurements is always done manually by placing the customer in a vacuum-formed seating bag, thus creating a mould. The measurements are then converted into a 3D representation, after which a robot is used to cut out the seat shell. However, this is quite a labour-intensive process, regularly requiring additional measurement sessions, which, considering the customers' physical disabilities, is not at all obvious. That is why Albatros is already experimenting with a depth camera. This camera generates a 3D representation of the mould as input for programming the robot. However, the current solution still has inaccuracies.

Flanders Make is currently developing sensor technology for ultra-accurate seat shell measuring. This will speed up the production process and reduce the risk of errors so that less adjustments will be required.

“The data gathered during the production process are re-used to objectify the sitting comfort.”

The data gathered during the production process are re-used to objectify the sitting comfort so that, more than ever, Albatros will be able to offer its customers first-time-right products. In a following step, the rest of the production process will be digitised further, including the introduction of digital work order forms to streamline the process.



Arkite's virtual guardian angel is given wings

De Human Interface Mate (HIM) of tech company Arkite is a virtual guardian angel for production environments. The digital application follows and guides the acts of operators, enabling them to carry out complex tasks as accurately as a robot. In this way, the company has taken major steps towards zero-fault production. However, the detection of the manual operations is currently taught through demonstrations. As a result, the configuration must

be renewed whenever the sensor position changes. So, calibration is definitely called for.

To take the HIM to the next level, **Arkite** and **Flanders Make** have explored various technological solutions for improving the detection capabilities. The aimed at result is realising a major improvement in the detection rate and reducing the number of false positives or negatives at the lowest

possible implementation cost. We examined, amongst other things, the potential of machine learning as well as the possibility to generate more context data from the raw sensor images such as, for instance, hand detection. In this way, Arkite has been able, within a short period of time and with relatively few efforts, to gain important insights about potential improvement tracks. Today, we are assessing how we can use these insights as efficiently as possible.



IN THE SPOTLIGHT

NEW TEST AND VALIDATION INFRASTRUCTURE



We are constantly expanding our infrastructure to meet the evolving demands from the industry. This will enable us to help companies to optimise their production processes and test (components) of their products (vehicles and machines) in industrially relevant conditions. Visit our website for an overview of our test infrastructure.

<https://www.flandersmake.be/en/testing-validation>

At vehicle level, we performed in 2019, amongst other things, durability tests for BMW, Toyota Motor Europe, Nissan and Saris. At component level, the increase of electric and hybrid applications clearly results in a higher demand for test infrastructure. In this context, we performed battery tests on the electrodynamic shaker and end-of-life tests in our climate chamber, a/o for FEV Group. This resulted in 2019 for the whole of our test infrastructure in 400 effective test days.

WHAT WAS NEW IN 2019?



Electrodynamic shaker in combination with a climate chamber and sunlight simulation set-up

Flanders Make Lommel

In addition to our large 4+2 poster for accelerated lifetime testing of vehicles, Flanders Make now also offers mechanical and thermal tests at component level.



Next-generation machine for research into the production process of metal printing

Flanders Make Leuven

An open and modular manufacturing platform to closely monitor and improve the laser melting process. Companies can test new mechatronic modules within an industrial application.



Additional test set-up for advanced (oil) cooling of electric motors

Flanders Make Lommel

In our E-Powertrain Lab, we test components for energy-efficient vehicles and machines. The infrastructure integrates hardware in-the-loop (HiL) facilities that enable companies to accelerate the development of new products. This infrastructure is now extended with thermal (oil) cooling.

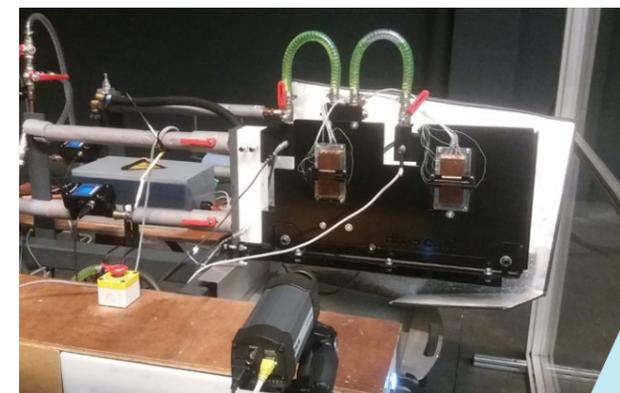


Extension of the pilot line for free-form optics

FlandersMake@VUB

- 7-axis polishing machine for creating free-form optics in glass
- 5-axis milling machine and micro-injection moulding machine

On the pilot line for free-form optics, we create customised optical components and systems as well as optical and photonic sensors. This contributes a/o to innovation in laser-assisted manufacturing, smart sensors and projection systems. In the past year, the pilot line was further extended to include grinding and polishing functionalities and for the production of polymer objects.



Infrastructure for the validation of thermal systems

Flanders Make Leuven and FlandersMake@UGhent

High-performance systems generate heat. To ensure optimum performances, we are developing methods to select the best possible cooling for the drive components. As a complement to the existing infrastructure at FlandersMake@UGhent, we've also set up a cooling test facility in Leuven.

Open test infrastructure for road vehicles

Flanders Make Lommel

Flanders Make equipped a vehicle with an in-house developed electric drive, with each wheel being actuated separately. The car also includes all functionalities for autonomous driving. Suppliers can use this test infrastructure to build knowledge on the integration of components in new vehicle architectures. They can also validate new algorithms and components using the open hardware and software. The platform has a modular construction so that we can perform tests with both front-wheel, rear-wheel and four-wheel drive.



Autonomously driving tractor, with operating feature

Flanders Make Leuven

We're expanding our research into autonomous vehicles towards the logistic and agricultural sector. On these autonomous platforms, we test new features and applications and companies can validate sensors and algorithms on them. Within this scope, we adapted an agricultural tractor using perception sensors to enable it to drive and stop autonomously before objects on the selected track.



AGV fork-lift truck as an open research platform

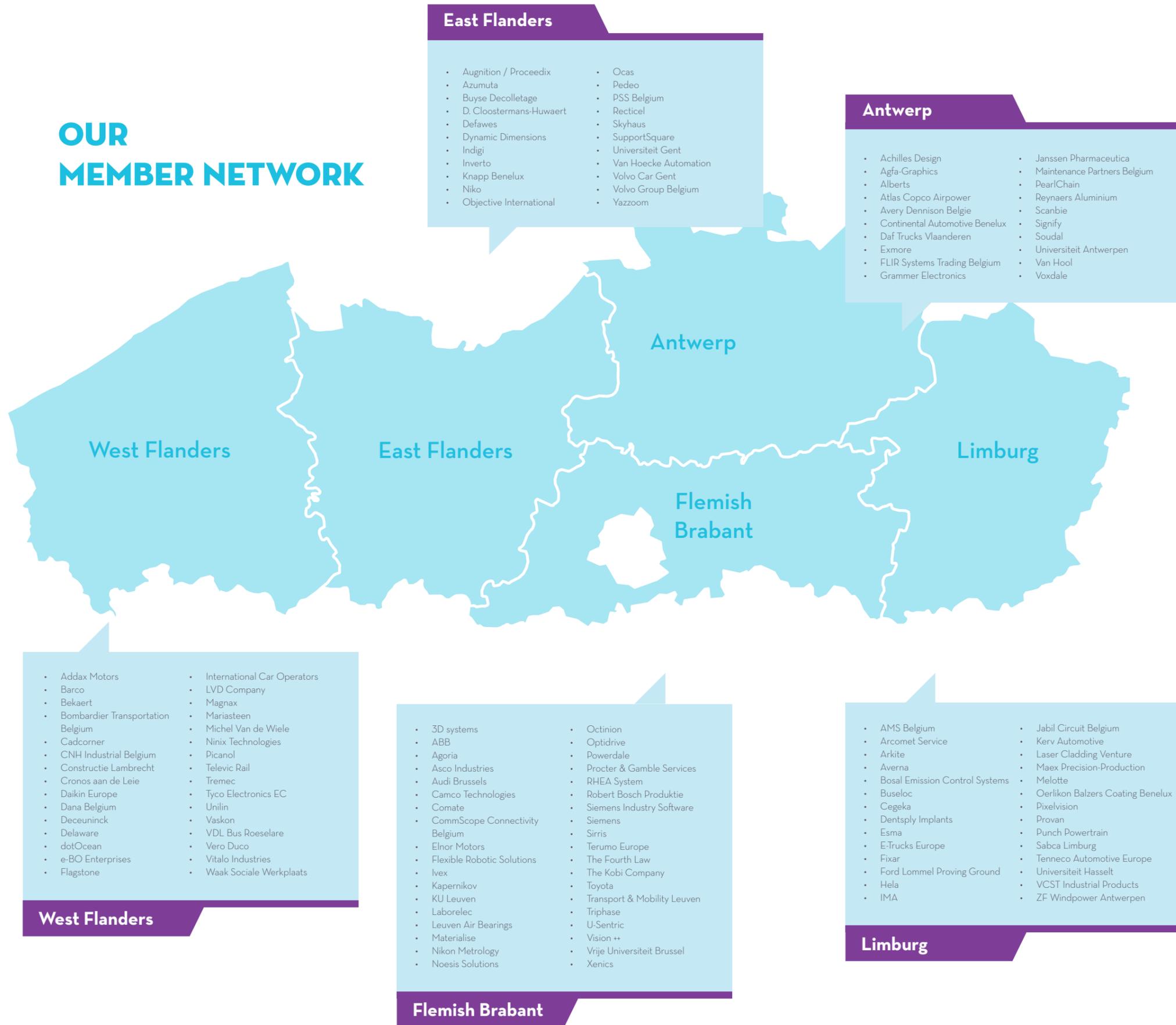
Flanders Make Lommel

We use commercially available mobile guided vehicles and mobile robots to test navigation and localisation solutions. In 2019, we expanded our fleet with an autonomous fork-lift truck.

LONG-TERM PARTNERSHIPS

Flanders Make works together with companies, knowledge institutions and other research organisations. Under the impulse of the Flemish Government, we join forces in one single innovation ecosystem. This significantly narrows the gap between theory and concrete applications matching the actual needs of companies.

OUR MEMBER NETWORK



Working together in Europe

The knowledge, infrastructure and support of Flanders Make not only serves the Flemish industry. We have a tradition of opening our infrastructure for international companies. In 2019, we took part in no less than 114 European projects. "These partnerships complement our Flemish initiatives", explains Ger van den Kerkhof, Senior Account Manager EU Affairs at Flanders Make. European projects are often multi-annual action programmes tackling shared priorities and challenges and aiming at sustainable growth and job creation. "A good example is the COTEMACO Interreg project.

The objective is to increase the competitiveness of SMEs in Belgium, the Netherlands, Germany and the UK through a sustainable human-robot cooperation. In test laboratories, their knowledge of collaborative robots is increased, which stimulates the actual implementation.

By taking part in European projects, we position ourselves as a reference for the manufacturing industry on a European level. Still, these projects are only one piece of the jigsaw. "Sharing knowledge and policy development are a second pillar. A third pillar consists of partnerships on a European level, such as SmartFactory^{EU}. Within this organisation, Flanders Make, Brainport Industries (the Netherlands) and SmartFactory^{KL} (Germany) work together on connected digital lead plants. The final pillar is validation through our test and validation infrastructure."

European projects offer concrete opportunities for local businesses, large and small. In most of these projects, European research organisations and companies set up a joint venture. By joining such projects, companies gain access to European financing to develop a use case of their own. They also get the opportunity to establish interesting contacts with other companies in other European countries. The network resulting from this, again, creates new opportunities.

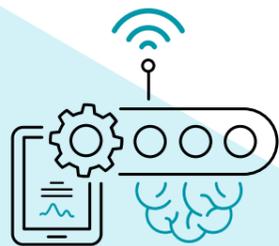
"As a business manager, you must dare to think across borders", concludes Ger. "In a European project, this can be done without taking too big a risk and with the necessary support."



THE INNOVATION ECOSYSTEM



BUILDING THE INNOVATION HIGHWAY



DECISION & CONTROL

To help the very diverse range of manufacturing companies in their innovation efforts, Flanders Make has subdivided its high-tech research in four dedicated competence clusters. Every cluster focuses its research on specific domains.

For the Decision & Control competence cluster, the focus is on innovations in localisation, adaptive control and decision support for operators.

“Within this cluster, everything revolves around the interpretation and application of acquired data to align intelligent systems in a more efficient way with their environment”, explains cluster manager Andrei Bartic. “With our cluster, we mainly focus on three pillars: visual context perception, adaptive control, and intelligence operation and maintenance. This is translated into localisation technologies, adaptive controls for machines and digital decision support. In all these research fields, data acquisition is key: does it generate the right data, what will we do with them and how can we implement the acquired knowledge in other systems?”

Localisation

In visual context perception, everything revolves around localisation techniques. “Thanks to ultra-wide band radio waves, we can localise in places where GPS is not possible, for instance in buildings. SLAM is another revolutionary technology: it refers to simultaneous localisation and mapping; this means that we literally draw a map while determining a location. Our next step is making the localisation more reliable by combining both systems with GPS. For this, we are developing artificial intelligence and algorithms to combine the available localisation technologies. As a result, an autonomous vehicle or a robot, for instance, will navigate faultlessly in dynamic environments such as a warehouse where boxes or pallet boards have just been moved. The AI will rapidly draw an adjusted map using fixed elements such as walls, lighting fixtures and girders.”

Control techniques

Also for the adaptive control of equipment, expanding the AI technology is crucial. “Current control techniques are too expensive to be applied within the industry. Even in optimal situations, the calculation of algorithms still takes too long, this must be done a lot more efficiently. Thanks to reinforcement learning, this can be done quicker; with this technique, we come close to the changing and unknown situations within AI. In other words, we put AI under pressure so that it learns itself within a much shorter time how the production process or system works from within. The huge potential of AI has yet to be fully exploited.”

“We need more informative data to eliminate faults and bugs in AI. This will result in reliable algorithms.”

Operator assistance

For this cluster, a lot of work is still on the shelves in the field of digital choice assistance for operators. “Intelligence operation and maintenance is all about supporting an operator in his or her decisions thanks to the use of digital twins. We’re already learning more thanks to the data that we generate from mechatronic systems but we will also start working with metadata: what is the location of the sensor, how sensitive is it and what are its limits? This helps to better interpret relevant data. Also the maximisation of all acquired data must be improved. At the moment, we’re still receiving too many unusable data taking up unnecessary storage space. Our highest priority is making the existing AI more efficient in view of its subsequent implementation so that an operator can make better choices when carrying out his or her job.”



DESIGN & OPTIMISATION

The Design & Optimisation competence cluster focuses on innovations that support designers during the design process. As products become increasingly complex, it is essential for this cluster to develop methods and tools that optimise design choices. The correct implementation of digital trends is key to this.

“The design & optimisation cluster is active in very diverse industries”, explains cluster manager Paola Campestrini. “We work on applications for machine builders and suppliers for the automotive industry, but also for software vendors, automation companies or manufacturers of smaller components. On the whole, products are becoming increasingly complex as they entail cyber-physical systems: a combination of mechanical engineering, electronics and smart control algorithms. This poses huge challenges to designers and developers.”

Cost optimisation

“To counter this complexity, we help companies with the design and development of a particular product. We support designers or product developers with methods and prototype tools that enable them to make the right design choices. We have, for instance, cost/benefit analysis tools that provide insights allowing to take substantiated investment choices. We also offer prototype tools for generating concepts, after which we can test these concepts against numerous criteria such as energy efficiency, assembly complexity and cost. The increase in customised products requires a cost-efficient approach: the challenge already starts in the design phase and that’s where our knowledge comes in. Cost optimisation is, after all, one of the main motives for companies.”

Design for lifecycle

“We also want to focus more on ‘design for lifecycle’ by evaluating a product design in terms of recycling potential and easy maintenance. A practical design lasts longer and reduces the maintenance costs. We help companies that work on new developments to increase the efficiency of their production, amongst others by performing an impact analysis to predict the effect of a new product variant on the existing assembly line. Another focus point in our cluster is the digital twin: a digital duplicate of a physical product. This opens new possibilities such as monitoring how a product is used. With this information, we can help to improve the next

“In this digital revolution, the challenge already starts in the design phase.”

generation of products.”

“It is clear where one of our priorities lies: data analytics to optimise the next generation of products. Artificial intelligence or AI brings us to the heart of the problem. The challenge is in the correct gathering of data by taking into account the conditions in which the measurements take place. We also aim to formalise and digitalise the knowledge that is held by the engineers themselves. Only in this way, we will be able to add their experience to the AI logic. In this way, we can analyse in a more targeted way and offer maximum support to designers in their design processes.”



MOTION PRODUCTS



Moving parts in machines and vehicles: that is the domain of work of the Motion Products competence cluster. Improving drive systems and the switch to a fully electric fleet are only two of their motives. In a mobile world, this cluster also strives for increased efficiency by digitally assisting transmissions and motors.

“Only by focussing on electric drives, we tackle our mobility problem in a sustainable and cost-efficient way.”

The Motion Products cluster mainly works together with businesses within the machine building industry or manufacturers of vehicle parts. According to cluster manager Marc Engels, the cluster has a guiding long-term vision. “We go for electric: only in this way, we can realise cost-effective and green solutions. Thanks to our research, we will in ten years’ time have an electric drive that will work twice as well at the same cost. In other words, we will ensure more output per euro. The cluster also works hard on supporting mass customisation. Apart from the available mechanical connections, we also want to implement more electric controls in a drive so as to facilitate the switch to customisation.”

Circular mobility

Within the domain, a lot will happen in the long run. “Considering the general trend and the many specialisations, a mobility service model could become reality within ten years: people will purchase mobility instead of vehicles. We contribute to greening our society with vehicles or machines that in such circular system will be used more often. These machines also

become increasingly sustainable and the lowered consumption will also lower the costs. Then there is the increasing demand for customisation: we are working on a rapid design process for machine and vehicle variants that are tailored to the customer’s needs and on flexible machines that will enable manufacturers to accelerate the conversion of a production line according to the specific needs of customers.”

Cost-effective

The cluster performs research into the integration of four key technologies: component improvement, artificial intelligence, design optimisation and digital twins. “At component level, our research into electric vehicles has led to a constant flow of improvements: new types of batteries, better coolants, new materials for power electronics, stronger magnets and so on. In artificial intelligence matters, we work together with the Decision & Control competence cluster. We apply their input to drive systems: we assist a motor through communication with a GPS. This enables the motor to anticipate a slope and to optimally charge the battery on descending tracks. These improvements increase the drive’s efficiency and extend its useful life span.”

As for design optimisation, this cluster builds on the research performed by our Design & Optimisation competence cluster. “More customisation requires faster adjustments to the design, so we also focus on digital design methods. Furthermore, we perform in-depth research into digital twins. This helps us to create a digital representation of every physical object. Such experiments generate a permanent flow of data, which provides us with a much better understanding of how systems operate. We can then start to optimise the physical component: less wear and maintenance increase the cost-effectiveness.”



The Flexible Assembly competence cluster performs research to support assembly and manufacturing companies on their path to digitalisation and customised production.

“The main challenge for these companies is converting their traditional manual and automated assembly lines into flexible assembly systems”, explains cluster manager Sonia Vanderlinden. “This will enable customised production in small series without higher costs. We examine how we can reduce the time required for introducing a new product variant into the production system and for converting the assembly line. It is important that an assembly plant can respond quickly to changes in volume and product mix without affecting costs, quality and/or performance. In a customised production context, we aim to establish the system requirements for the next generation of assembly systems, taking into account the industrial needs of the respective companies. For this, we will generate and validate innovative assembly concepts, architectures and models.”

“More customised production requires modular and flexible production lines”

“The Flexible Assembly cluster works with companies from various sectors, we mainly work out solutions for assembly plants but also for manufacturing companies. Currently, most of these companies are not yet sufficiently flexible to manufacture customised products. The flexibility that is available is entirely based on the competences of the operators, so we’re still a long way from real-time adaptive systems. Furthermore, we also work with integrators: high-tech developers that develop

FLEXIBLE ASSEMBLY

specific software or hardware for assembly factories. This cluster acts as a guide for manufacturing companies in Flanders and guides them in their evolution towards digitalisation and Industry 4.0.”

“With our research, we first want to increase the flexibility of assembly systems by making these systems easily adaptable. In the next step, the systems automatically adapt themselves. For this, they rely on their own data and take into account other systems as well as the environment. Both companies that assemble everything manually and companies with a semi- or fully automatic production system will benefit from our research. We also strive for maximum modularity with modular models, robot skills and work instructions in view of combining these results later on into larger entities. This exchangeable, modular approach helps companies to manage the complexity of customised production. Also interoperability plays an important part: by connecting all systems with each other, they will mutually exchange information and become more intelligent. In the future, digital twins will also become crucial. This digital, virtual copy of a real workplace setting allows to already conduct simulations in the design phase, even before an actual mock-up has been made. In a next stage, this will also allow to automatically anticipate unexpected operational issues.”

“Finally, we shouldn’t forget the operator: he or she remains essential within the assembly process. With our research, we try to offer optimum support to operators, a/o by automating routine tasks and actions to the maximum extent possible. As such, the operators’ strengths are better used as we can deploy them for tasks that best meet their skills.”

COMPANIES PER COMPETENCE CLUSTER

DECISION & CONTROL (28)

3D Systems
Atlas Copco
Bekaert
CNHi
D. Cloostermans-Huwaert
Daikin
Dana
dotOcean
Janssen Pharmaceutica

Laser Cladding Venture
Maintenance Partners
Materialise
Van de Wiele
Nikon
Octinion
Picanol
Punch Powertrain
Scanbie

Siemens Industrie Software
Televic
Tenneco
The Fourth Law
The Kobi Company
Triphase
VCST
Yazzoom
ZF Wind Power

DESIGN & OPTIMISATION (18)

Atlas Copco
Barco
Bosal
CNHi
D. Cloostermans-Huwaert
Daikin
DANA

Grammer Electronic
Noesis
Picanol
Punch Powertrain
Recticel
Reynaers Aluminium
Siemens Industrie Software

Tenneco
Van de Wiele
Van Hoecke Automation
Voxdale

MOTION PRODUCTS (15)

Atlas Copco
CNHi
Dana
D. Cloostermans-Huwaert
E-Trucks

Inverto
Leuven Air Bearings
Picanol
Powerdale
Punch Powertrain

Siemens Industrie Software
Tenneco
Triphase
Van de Wiele
VDL

FLEXIBLE ASSEMBLY (27)

ABB
Achilles Design
Atlas Copco
Barco
Bekaert
CNHi
Daikin
Dana
D. Cloostermans-Huwaert

eBO-Enterprises
Flexible Robotic Solutions
Janssen Pharmaceutica
Johnson & Johnson
Mariasteen
Niko
Picanol
Reynaers Aluminium
Sabca

SupportSquare
Tenneco
Terumo
Procter & Gamble Services
U-centric
Van de Wiele
Van Hoecke Automation
Vitalo
ZF Wind Power

PROUD OF OUR VALUES

The strength of an organisation depends on the people working for it. Flanders Make therefore defined four values that underpin our work and corporate culture.



Excellence

The fact that we pursue optimum quality is obvious. However, excellence to us means so much more. This is reflected in clear plans with ambitious targets, in our partnerships with partners from our comprehensive network and in the practical translation of our research to the benefit of the industry. We continue to learn and to improve, with a clear focus and absolute dedication.

“Within one project, people from very different fields of expertise come and work together. It is my role to ensure that this cooperation goes as smoothly as possible. That is a fascinating job, an ideal mixture of technical content and working together with other people. Besides, I supervise several projects, all with different teams, so that I come into contact with many colleagues and many companies. In this way, new innovative project ideas are created through which we continue to realise progress for industrial businesses.

It goes without saying that we do not always start from scratch. Because I keep an overview of the projects within my technological domain, I know which earlier results might come in useful. As such, we continue to build on the innovation highway, day after day.”

– Ellen Van Nunen,
project manager Flanders Make



Customer value

We create added value for our customers through our solution-oriented approach. From our privileged position close to Flemish companies, we help them to overcome obstacles and identify their specific needs. As such, our research contributes to concrete technological breakthroughs in various domains.

“What I like best at Flanders Make is the constant contact with different companies and industries. It is very motivating to see the positive impact of our top-quality research.

We really care about our customers and create added value for them by thinking out-of-the-box, combining the latest academic research with the industrial state-of-practice to define our projects and taking the industry's interests at heart. I always try to look at things from a company's perspective. What do they need? How can Flanders Make help them? Then I start thinking of possible solutions or ideas to help them. Customer value is in the DNA of all our colleagues. When we work together, we go in the same direction because we know that the ultimate goal is to provide useful results to our corporate customers.”

– Carlos Lopez,
research engineer Flanders Make



Working together

We work together in multi-disciplinary teams to warrant the best possible results. By working together with experts from all levels and within several areas of expertise, you can grow as a team. This open approach is also reflected in the contacts with our partners.

“Since the start of Flanders Make, the number of employees has strongly increased. Meanwhile, we have over 600 employees, divided over 3 co-creation centres, core labs at the 5 Flemish universities and the Flemish drone federation (as from early 2020). A close cooperation between all these research groups is crucial. All core labs have their own expertise and try to complement one another. Comprehensive expertise on the one hand and working together efficiently on the other are the keys to success.

Thanks to Flanders Make, there are a lot of research projects going on in cooperation with companies and other organisations. This allows us to acquire new knowledge, which we use to the benefit of companies by improving the performances of their products and production systems, increasing their reliability and making them smarter. We are pleased to see that, today, companies are getting to know us ever better and start contacting us themselves for research challenges in areas in which we have solid expertise.”

– Peter Sergeant,
core lab manager, FlandersMake@UGhent



Empowered people

People are the real capital of an organisation. That is why we try every day to bring out the best in our colleagues and to help them to further develop their talents. After all, Flanders Make builds on the joint knowledge and expertise of its over 600 employees.

“It is my role to connect the Flanders Make network with companies. So, I come at many different places. Flanders Make also encourages me to take initiative in this regard. To set up these partnerships with companies, I rely on the input from my colleagues. They tell me about research results or potential opportunities. Such committed employees taking initiative make my job a lot easier. By appreciating each other’s work and helping one another to valorise it, we bring out the best in ourselves.”

– Hans Descamps,
account manager Flanders Make

THE ORGANISATION

Flanders Make is the research centre for the industry and its digital and Industry 4.0 challenges. We stimulate innovation, both in SMEs and large companies, through excellent research in the field of mechatronics, methods for developing products and technology to make them. The results are applicable to a wide range of companies that often face similar technological challenges. Together, they can innovate better and faster. We also take this approach across national borders. We set up international innovation partnerships and participate in European research projects. Flanders Make consists of three co-creation centres (in Lommel, Leuven and Kortrijk), the Flemish drone federation EUKA in Sint-Truiden and labs at the five Flemish universities.

BOARD OF DIRECTORS



At the back from left to right:

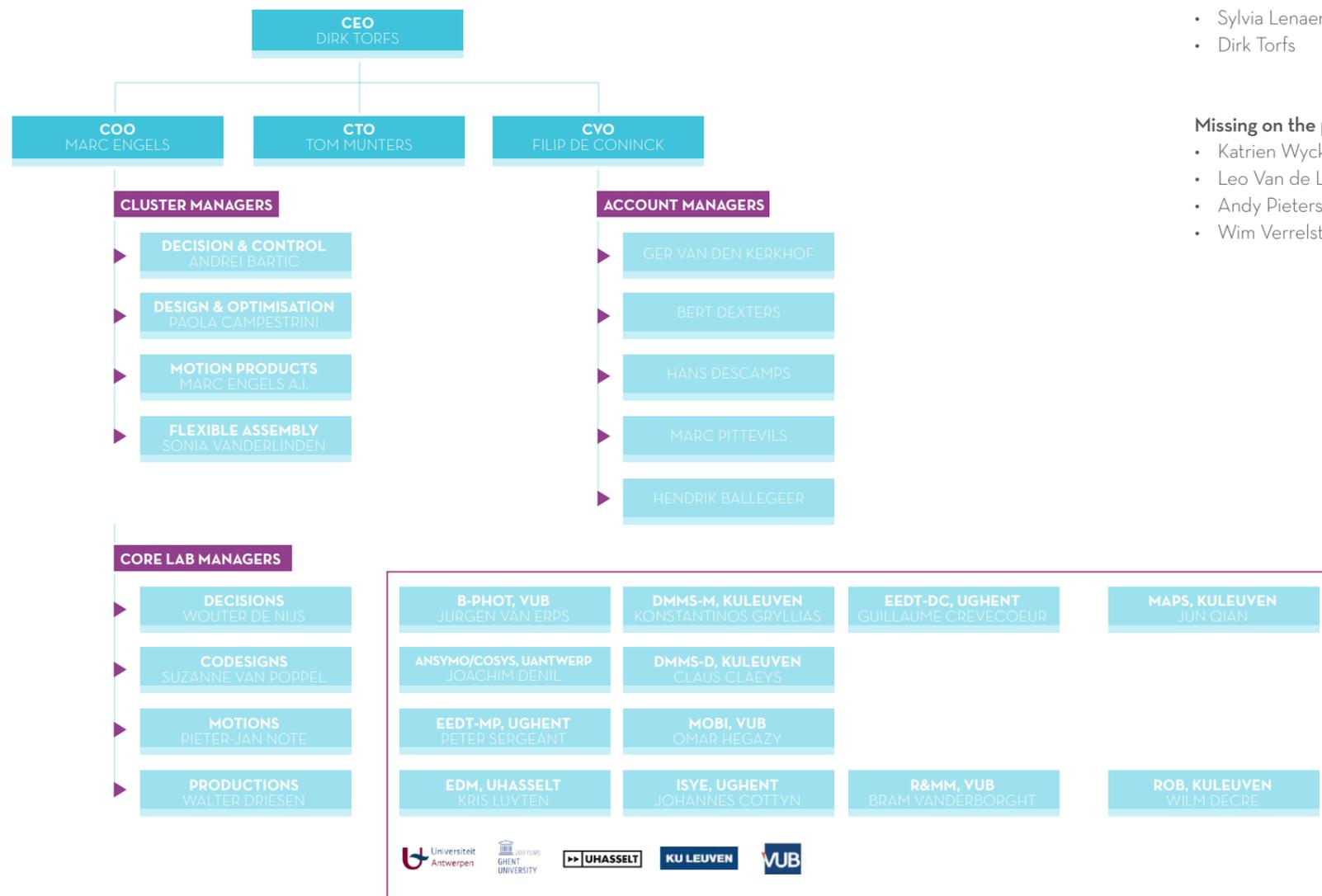
- Carine Smolders (until 05/20)
- Eric Sleenckx (until 05/20)
- Ignace Lemahieu
- André Bouffioux
- Inge Stoop
- Erwin Dewallef
- Koenraad Debackere
- Paul Snauwaert
- Herman Derache
- Jochen Vyncke

At the front from left to right:

- Geert Ostyn
- Sonia Van Ballaert
- Urbain Vandeurzen
- Sylvia Lenaerts
- Dirk Torfs

Missing on the picture:

- Katrien Wyckaert
- Leo Van de Look
- Andy Pieters (starting 05/20)
- Wim Verrelst (starting 05/20)



ADVISORY BOARD

Industrial advisory board

Miguel Dhaens	Tenneco, Driv
Carl Eeckhout	Televic
Goedele Heylen	Ramen Engels nv
Marnix Lannoije	Web
Koen Maertens	Maertec, Duco
Dominique Maes	Van de Wiele
Jos Pinte	
Koen Reybrouck	Reycon
Paul Snauwaert	CNHi
Frans Van Giel	ex-Beaulieu
Herman Vanderauwaeraer	Siemens Industry Software
Bart Vanderschueren	Materialise
Hans Vandesande	Atlas Copco
Eric Verhelst	ex-TE Connectivity
Piet Wauters	ASML

Observer board of directors industry

Geert Ostyn Picanol

Scientific advisory board

Thilo Bein	Fraunhofer, Germany
Russel Harris	Leeds University
Johann Hoffelner	Linz Center of Mechatronics, Austria
Werner Kraus	Fraunhofer, Germany
Minna Lanz	Tampere University of Technology
Chris Merveille	Ikerlan, Spain
Dimitris Mavrikios	EIT Manufacturing (05/20)
Anne-Lise Høg Lejre	Danish Technological Institute (05/20)
Chris Gerada	University of Nottingham (05/20)
Jochen Deuse	TU Dortmund University (05/20)

Observer universities

Hugo Thienpont VUB

Central office

Dirk Torfs	Flanders Make
Marc Engels	Flanders Make
Filip De Coninck	Flanders Make
Tom Munters	Flanders Make (06/20)

Observer government

Leo Van de Look VLAIO
Erwin Dewallef EWI

FLANDERS MAKE

3 co-creation centres, the Flemish drone federation EUKA and the labs at the 5 Flemish Universities



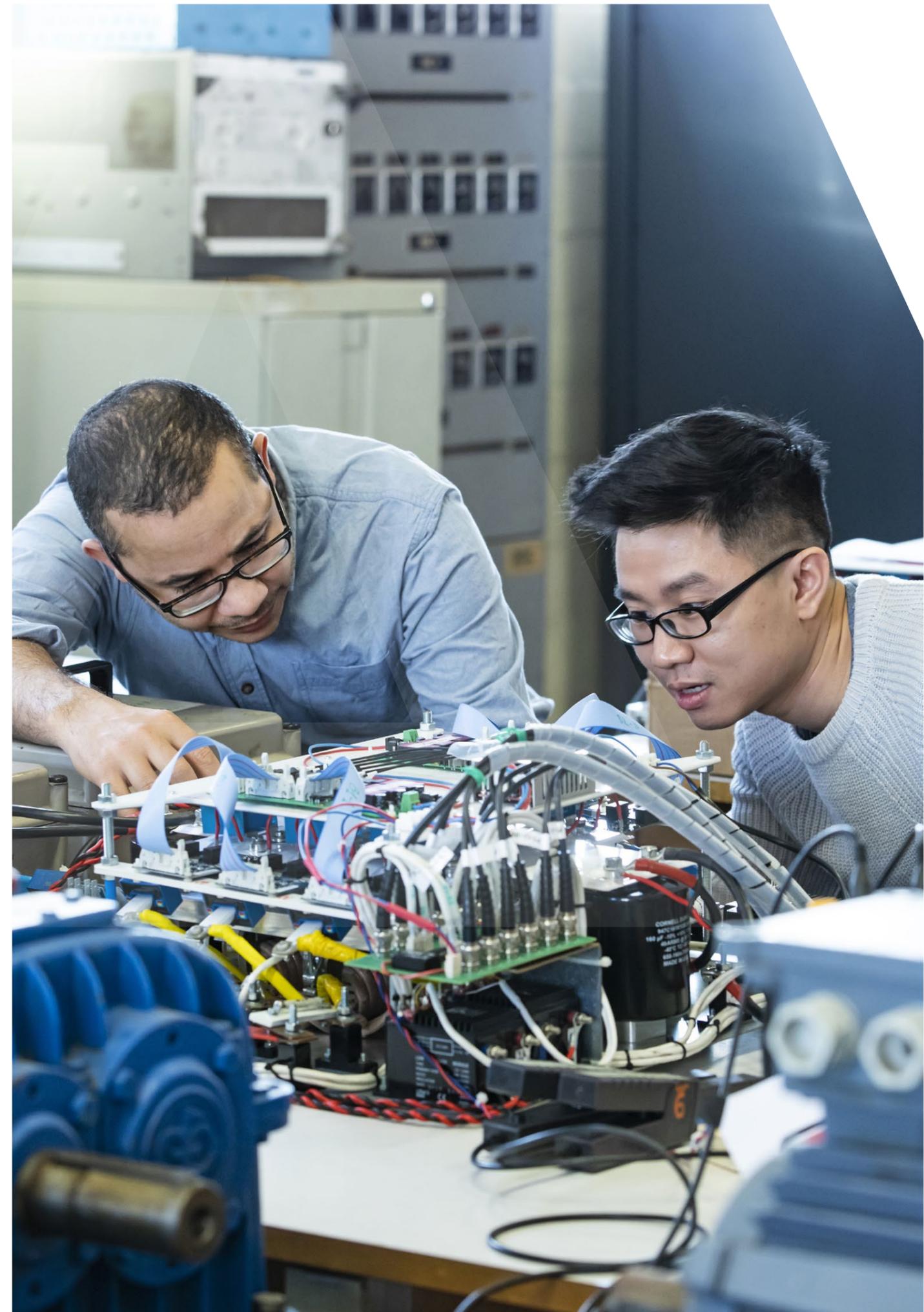
65 MLN
EURO TURNOVER

>600
SPECIALISED RESEARCHERS



To be able to assist companies in their digitalisation efforts, Flanders Make starts in 2020 with the construction of a third research centre in Kortrijk. R&D Manager Gregory Pinte: "This ultra-modern establishment in Kortrijk proves that with a top-notch infrastructure we pull out all the stops to optimise the production technology towards Industry 4.0. It will be absolutely state-of-the-art with the focus on mass customisation, human-machine interaction, cobots and automation. With these highly specialised assembly labs, we will validate production methods much more efficiently and be able to create any test set-up. We hope being able to open this state-of-the-art research centre by the end of 2021."

Gregory Pinte, R&D Manager



FINANCIAL REPORT

BALANCE SHEET AND INCOME STATEMENT

ASSETS	93.448.335,00 €	REVENUES	18.674.378,00 €
Fixed assets	11.833.033,00 €	Turnovers	17.224.255,00 €
Intangible assets	272.022,00 €	FM covenant	11.590.030,00 €
Tangible assets	9.599.647,00 €	FM non-covenant	5.351.261,00 €
Financial assets	11.364,00 €	Membership fees and other	282.964,00 €
		Other revenues	1.450.123,00 €
CURRENT ASSETS	81.615.302,00 €	COSTS	18.895.848,00 €
Stocks & orders in progress	16.859.442,00 €	Salaries, social security charges & pensions	12.534.852,00 €
Accounts receivable	17.448.614,00 €	Operating costs	6.294.798,00 €
Liquid assets	46.687.362,00 €	Other costs	66.198,00 €
Deferred charges & accrued income	619.885,00 €		
LIABILITIES	93.448.335,00 €	RESULT FROM OPERATING ACTIVITIES	-246.220,00 €
CAPITAL & RESERVES	20.281.339,00 €	USE OF RESERVES	292.652,00 €
PROVISIONS	0,00 €	RESULT FOR THE FINANCIAL YEAR	46.432,00 €
CREDITORS	73.166.996,00 €		
Creditors amounts falling due within 1 year	33.639.534,00 €		
Deferred charges and accrued income	39.527.462,00 €		

KPI 2019

	TOTAL Q4 2018	TOTAL Q4 2019	GROWTH 2019 vs. 2018	TARGET 2018	TARGET 2019	ANNUAL GROWTH	% TARGET 2019
KPI 1.1 Publications	154	223		150	160	5%	139%
KPI 1.1 Open access publications		135			136	5%	99%
KPI 1.2 Conferences	279	285		200	210	4%	136%
KPI 1.3 EU participation	8.788 k€	11883	3.095 k€	3.200 k€	3.600 k€	9%	330%
KPI 2.1 Technological utilisation	16	21	5	7	11	35%	191%
KPI 2.2a Reach among direct target group	33	47	14	33	33		142%
KPI 2.2b Whereof SME	14	22	8	11	11		200%
KPI 2.3 Industrial revenues	8.013 k€	10.315 k€	2.302 k€	4.000 k€	4.500 k€	8%	229%
KPI 2.4a Industrial reach	324	339		76	76		446%
KPI 2.4b Whereof SME	115	130		25	25		520%
KPI 3.1 Leverage							
Leverage income	35.008 k€	45.014 k€	10.006 k€	14.720 k€	21.165 k€	26%	213%
Leverage	4,0	4,1		1,8	1,85	3%	223%
KPI 3.2 Industrial leverage	6.380 k€	8.018 k€		2.000 k€	2.250 k€	8%	356%
KPI 3.3 Strategic partnership	1	5		1	1		500%
KPI 4.1 Cross-initiative projects	13	10		1	1	41%	1000%
KPI 4.2 Dissemination range		144		28	30	12%	480%
KPI 4.3 Community publications	30	35		20	21	4%	167%

2019 IN PICTURES



FEBRUARY 2019

Announcement SmartFactory^{BNL} at Indumatation



JULY 2019

Launch of AI initiative of the Flemish government - AI is used by Flanders Make on 7 relevant proof-of-concepts for the manufacturing industry



JULY 2019

Biggest knowledge sales contract ever

AVA project with CNH



NOVEMBER 2019

Symposium of Flanders Make - with 26 live demonstrations



DECEMBER 2019

Approval of first pre-competitive research project of Flanders Make with spearhead cluster Logistics



2019

Central variability model for the automatic generation of controller variants and their verification within a particular product family

JUNE 2019

Acceptance of ITHACA infrastructure for advanced thermal characterisation and validation of driveline and components

FlandersMake@UGhent



JULY 2019

Announcement of construction of new co-creation centre for customised production and Industry 4.0

Kortrijk



OCTOBER 2019

Announcement of the integration of the Flemish drone federation EUKA in Flanders Make



DECEMBER 2019

Acceptance of E-Powertrain Lab at Flanders Make Lommel



2019

Rapid development of robust context-adaptive control - tangible result - toolbox for optimal path planning and monitoring





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