FLANDERS MAKE

DRIVING INNOVATION IN MANUFACTURING

# 4

# 4 YEARS DRIVING INNOVATION IN MANUFACTURING

## ANNUAL REPORT

# CONTENT

# KEY FIGURES 2018

A year of growth, evolution and
innovation, summarised in 6 highlights.

**40%**

growth in staff

**20%**

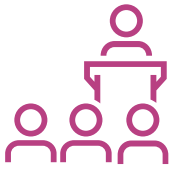
growth in member companies

**13.700 M²**

research infrastructure

**160**

ongoing research projects



**1.000**

attendees at our events

**250**

mentions in the media

How was 2018 for the manufacturing industry? Which role did Flanders Make play in the increasing digitisation of manufacturing companies? Which challenges does the future hold for us? A word from our CEO and Chairman.

**Dirk Torfs,**
CEO

**"Flanders Make looks back on a successful 2018, both for our own organisation and the Flemish manufacturing industry as a whole. Companies performed well, often expanding their product range, and set up many new initiatives. However, it is important to continue to focus on innovation. Only in this way, we can create a sustainable (manufacturing) industry. Another item requiring attention is the fact that the opportunities offered by digitisation for improving products and production equipment are still insufficiently seized.**

## Accumulated knowledge applicable in ever more sectors

In the past year, our organisation concluded a new covenant with Innovation Minister Muyters. Flanders considerably invests in innovation, giving a clear and very positive signal to the industry. It's the task of Flanders Make to support companies in their innovation efforts with basic and applied research on the one hand, contract research and infrastructure for validation and testing on the other. We've noticed to our great pleasure that in the past year many innovation-reinforcing projects with large AND small companies have been set up within the sector.

Furthermore, the technology and knowledge of Flanders Make appears ever more often to be applicable not only in the manufacturing industry but also in other industrial sectors such as the food and pharmaceutical industry. As a result, the knowledge that we acquire - for instance in the field of autonomous systems, augmented reality or predictive maintenance - can be used for a broader range of applications. This allows us to increase our impact on the industry and to create extra added value.

## More than ever one strong brand: Flanders Make

Internally, we've continued to streamline our organisation in 2018. We concluded agreements with universities, created clusters and reinforced them with new companies, set up core labs and adapted our branding so that today, more than ever, we present ourselves as one strong brand: Flanders Make. For every cluster, roadmaps have been defined and approved of by the Board of Directors. Because we attach great importance to local anchoring, we also concluded a contract with the Flemish government to erect a new building in Kortrijk in 2019. Here, we want to focus on production research. In 2019, we've started with the preparatory works for the building and production infrastructure. In Leuven, we

> **FLANDERS MAKE IS NOW MORE THAN EVER THE CONTACT PERSON FOR THE FLEMISH AND EUROPEAN INDUSTRY.**

# INNOVATION BY AND TO THE BENEFIT OF THE MANUFACTURING INDUSTRY

already moved at the end of 2018 into another building with more lab space for our researchers. A first company is already using the space to accelerate its research through co-creation. Finally, we've made major steps in aligning our organisation on a strategic, commercial and operational level so as to be able to present ourselves as one entity. The result is a strong internal joint venture that brings the concept of an ecosystem for innovation into practice.

## Single point of contact for the industry

By working together with other initiatives in Flanders, Flanders Make is now able to act ever more often as one single point of contact for the industry. Even on a European level, we notice every day that our reputation is growing, witness the increasing number of inquiries from across Europe about our working methods but also about our knowledge and the way it could be used in a European context. Our ecosystem is unique in Europe: diverse knowledge actors structurally and actively working together with the industry. The first contacts with European companies to set up joint research projects have already been established. At the annual symposium that we also organised in 2018 for CEOs, R&D managers and business managers of large and small companies, we succeeded through various demonstrations in showing to businesses the potential promising applications of our research. Meanwhile, we've set up projects worth about 144 million euro and that's definitely something we are very proud of.

Now in 2019, Flanders Make can no doubt be referred to as an important research player in the implementation of Industry 4.0 and the major partner in Flanders and within all new living labs that have been set up over the past two years. In 2018, we could expand our workforce to over 500 enthusiastic employees and generate a turnover of give or take 52 million euro. We owe all this for a part to the strong growth in leverage revenues (both on an industrial and European level), generated by us to complement government funding.

## Growth ambitions

In 2019, we would like to maintain this momentum. Not only will we continue to strengthen our operational organisation, we also want to remain sufficiently ambitious so as to be able to make a difference towards the future. By way of cooperation initiatives, for instance in the area of artificial intelligence, digital twins, etc. we aim to focus even stronger on our role within the Industry 4.0 context. In this way, we want to enable companies, thanks to the use of smart production systems, to produce locally at the cost of mass production and, as such, to manufacture smart products as well. The Innovation Boosting campaign, a two-year project supported by Innovation Minister Muyters, provides us with extra leverage for this. Thanks to this project, we now have disposal of a coordination budget that we can use to apply the available knowledge in one-on-one relationships with companies to further improve their products and production processes.

Our growth ambitions include both our revenues, cooperation projects with companies and our workforce. Our revenues should be increased thanks to the knowledge that we've accumulated on an industrial and European level and by focusing on a wider field of application in all our partnerships with existing and new businesses. This will result in increased leverage revenues. With, among others, the Benelux initiative SmartFactory - which pursues a European smart factory and smart production alliance - and an innovation ecosystem that is implemented internally, externally and on a European level, we continue to explore ways to promote cooperation. As a third, we wish to evolve from a project-based organisation to the structural accumulation of research results that are re-usable so that one project is also the start of a new one, enabling us to build an innovative and sustainable future.

Finally, we permanently strive for operational excellence. Whatever we do, we should always do it well. This is reflected in high-quality projects, roadmaps that are in line with the outlined strategy, excellent research and one distinct and uniform presentation of Flanders Make in all our promotional material. It is the only way to strengthen the industry and respond to the challenges that we face today. If we strengthen innovation today, we can make maximum use of future growth opportunities and market our products on a global scale. Obviously, the war for talent remains a challenge for us as well but we are convinced that the challenging content of our job opportunities and our excellent reputation will guide interesting profiles to Flanders Make."

**Dirk Torfs,**
CEO

**Urbain Vandeurzen**,
Chairman of the Board of Directors
of Flanders Make

**"2018 was a good year for the Flemish manufacturing industry. Our companies succeeded in realising growth again. According to Agoria, the industry also created a few thousand extra jobs. Still, we notice that the overall economic growth is starting to slow down, a phenomenon that is expected to continue in 2019. The growth prospects for Europe have already been downgraded by the European Central Bank. In 2019, a 1% growth is expected for the whole of Europe and this figure has also been forecasted for Belgium by our National Bank. We also see a number of risk factors announcing instability starting to emerge at the same time. Think, among others, of the Brexit but also the trade wars between the United States and China, for instance, play a role here. In addition, there is still the threat of high American import duties on European cars.**

**Because China and the United States are major export markets for the German and thus also for the Flemish manufacturing industry, this will not remain without consequences for our region. Every slowdown in the global economy has repercussions in Flanders.**

## COUNTERING ECONOMIC SLOWDOWN THROUGH AN INCREASED FOCUS ON THE INDUSTRY 4.0 STRATEGY

### Cost competitiveness, lower labour cost and focus on innovation

As from 2019, we will thus be pedalling with a little less tailwind. This implies that, more than over the past few years, the good news will have to come from the companies themselves. An important element in this regard remains their cost competitiveness. In Flanders, the wage cost but also the energy costs play a crucial part in this. At the same time, companies have increasing difficulty finding the right people for their vacancies. Additional labour market reforms are therefore urgently called for. Furthermore, Flemish companies will have to increase their focus on innovation. Then, real competitiveness is not only reflected by cost competitiveness but also by the ability to create new products, such in a very efficient way through digitally optimised processes.

Industry 4.0, something we press very hard for, encourages new products and production processes. With success, as is proven not only by our increasing number of members and projects but also because our pool of talented people has grown to about 500 employees. Also the ecosystem around our organisation is getting stronger and stronger.

We work together with the five Flemish universities and much confidence has been created between Flanders Make and our 150 partner companies. This increases our clout and our impact. That is why, in the past year, we've invested in our co-creation centre for the vehicle industry in Lommel and moved into a new co-creation centre for machine building in Leuven. In 2019, works will be started for the construction of our third major research centre in Kortrijk, where we will operate a state-of-the-art research centre for Industry 4.0 production.

Our existing strong companies export worldwide and are competitive. They make the difference through full-fledged innovation. A recent survey has shown that they are strongly committed to the strategic challenges of Industry 4.0. These businesses know that the future cannot be conquered with yesterday's products and production processes. And, thus, that they will have to invest in new technology. Artificial intelligence, big data and digital twins are key supporting technologies that can increase production efficiency and result in even smarter products.

## New Flemish world leaders in the making

At the same time, we witness the incorporation of quite a few new technology companies, which gives us hope for the future. This innovation in the form of start-ups and scale-ups gives us confidence that there is a next generation of world leaders in the making that goes international from the very start, creating extra momentum in Flanders. For Flanders Make, it is an important challenge to reach out to these growing young businesses, today and tomorrow. By involving them in research projects, we support them and bring them into contact with large existing players. The dynamics that they bring with them can also enhance innovation in these larger companies.

## Co-shaping the future

Flanders Make wants to co-shape the future of the Flemish manufacturing industry – both large and small – through a wide range of activities that we've developed over the years. We want to continue to involve businesses in Flemish and European research projects. We also want to offer direct services to companies and help them, through co-development, to make new products and production processes. We have comprehensive in-house knowledge and expertise, with which we can really make a difference for the industry. For this, we work closely together with national and international partners. 'Partnering' is a key word for us: towards customers and businesses but also towards local and international research institutions.

For the period from 2018 to 2023, we've received considerable investment resources from the Flemish government. We use these funds to further expand our workforce, our competences and our talents but also to expand and renew our infrastructure.

A major concern that we wish to raise towards the future is the quality of our education. More efforts are needed here considering our declining position in international rankings. From a long-term perspective, Flanders needs excellent education that creates talented young people who show commitment and are interested in technology, have had a broad and multidisciplinary education and are capable of teamwork.

If we want to keep our industry competitive, talent development and excellent education are probably the most important contributing factors. This is primarily a mission for our education institutes but also for our companies, which - through increased cooperation with schools, among others through twin-track learning systems – can and will have to contribute to this.

By showing ambition to belong to the international front-runners, by investing in full-fledged innovation and through cooperation and top-class education, we can continue to co-shape the future of our industry and the future of Flanders."

**Urbain Vandeurzen,**
Chairman of the Board of Directors of
Flanders Make

# MILESTONES OF 2018

**This was 2018 for us.**

**JANUARY >**

Start VLAIO Industry 4.0 living lab projects
Heart Safe label

**FEBRUARY >**

Patent for 3D-printed end face of an optical connector
Virtual design platform for formed sheet material products

**MARCH >**

First public ride for our self-driving bus
Patent for smart clamping mechanism for composites

**APRIL >**

MAKE LAB at Hannover Messe
Patent for magnetic spring for electric motors

**MAY >**

New establishment in Kortrijk
Potential of learning control algorithms

**JUNE >**

Optimal test strategy for control algorithms

**JULY >**

Generate and absorb high power peaks in drives

**AUGUST >**

We are preparing for the fall

**SEPTEMBER >**

Innovation Boosting initiative
Co-curator at the SuperNova festival

**OCTOBER >**

New labs in Lommel

**NOVEMBER >**

Flanders Make Symposium
Platform for cost-effective post-processing of composites

**DECEMBER >**

New offices and research labs in Leuven

## JANUARY >

We join the first VLAIO Industry 4.0 living lab projects through which companies can experiment with new techniques and business models in an easily accessible manner. Flanders Make contributes to a living lab on Smart Connectivity, the workplace of the future (CollWork 4.0) and Smart Maintenance.

Flanders Make is awarded the Heart Safe label from the Red Cross. Since a couple of years, we have an AED device available on a central location. In the autumn of 2017, several colleagues followed a resuscitation and AED training course. In this way, we continue to promote safety.

## FEBRUARY >

Optical communication systems use optical glass fibres that have a core that is smaller than 10 micrometre. Glass fibre connectors must thus be able to align these optical fibres very carefully to minimise losses. FlandersMake@VUB applies for a patent for the design and 3D production of structures that enlarge the beam diameter on an optical connector end face in view of increasing the alignment tolerances and lowering the sensitivity of connectors for ambient pollutants such as dust.

We develop a virtual design platform for engraving in sheet material. With this platform, we can determine the effect of the printing process on product parameters such as sheet thickness as well as the properties of the final product.

## MARCH >

During our annual network event for our members, visitors can for the first time hop in for a ride in our self-driving bus. We focus our research on the development of specific control algorithms for avoiding obstacles and use this knowledge in other applications for autonomous systems.

When processing large components in composite material, it is very important that the panels are securely clamped. Flanders Make develops a smart clamping mechanism and registers it in view of obtaining a patent.

## APRIL >

For the first time, Flanders Make takes part in the Hannover Messe. This trade fair also marks the first international presentation of our MAKE LAB, the mobile co-creation lab bringing knowledge and technology to companies.

We develop a magnetic spring that offers solid support to electric motors at high torque impulses and file a patent application for it.

# MILESTONES OF 2018

**MAY >**

The Board of Directors of Flanders Make announces the decision to expand its operations in West Flanders. From Kortrijk, Flanders Make supports manufacturing companies in their production research and innovation efforts.

Learning controllers continuously improve their performances on the basis of experiences from earlier task executions. We optimise learning control algorithms for industrial applications. This will help companies to accelerate the development and calibration of advanced controllers.

**JUNE >**

Experimental tests for the validation of controllers are both time-consuming and expensive. We therefore develop virtual controller tests and extensive test strategies which offer a solution.

**JULY >**

Rapid energy storage is important for drivetrains of machines making back-and-forth motions to avoid major speed variations on the drive shaft or energy flows between machine and electricity grid. We therefore develop a model-based design tool to select the best possible energy technology and corresponding drivetrain components.

**AUGUST >**

We are currently developing brand new state-of-the-art infrastructure

**OCTOBER >**

Flanders Make opens new state-of-the-art infrastructure in Lommel. Representatives of both large companies and SMEs can experience live how 3 brand new living labs with state-of-the-art (robot) technologies can help them to test and optimise their new products. They are also introduced into the latest production technologies that are needed to jump on the Industry 4.0 bandwagon. The general public can visit the new labs and other research infrastructure during 'Open Bedrijvendag'.

**SEPTEMBER >**

Flanders Make could not remain absent from the technology fair SuperNova. We demonstrate innovative technological solutions at our own stand on the SuperNova Tech Fair. We also co-curate the pavilion 'The Future of Work' at the SuperNova Expedition, where Flemish companies demonstrate tomorrow's working methods to the general public through the use of interactive installations.

To lower the innovation thresholds for Flemish companies, we launch the 'Innovation Boosting' initiative. Together, we look at the potential technological and commercial innovation potential and, once established, proceed with feasibility studies and much more. In this way, we accelerate growth within the Flemish manufacturing industry.

**NOVEMBER >**

On 27 November, we organise our annual Symposium with almost 450 registered visitors. CEOs, R&D Managers and engineers from both large and small companies discover what the future has in stall for the manufacturing industry through inspiring presentations, concrete success stories and accessible demonstrations.

The finishing of large components in composite material for aerospace applications is difficult and expensive. Our research achieves a breakthrough in the process for vibration-supported machining operations, reducing production time and cost and raising the quality of the final product.

**DECEMBER >**

On 5 December, we open our brand new offices and research infrastructure in the Science Park of Leuven in the presence of Flemish Innovation Minister Philippe Muyters. With this new infrastructure, we will be able to support the industry in Flanders even better with the innovation and digital transformation that they need to jump on the Industry 4.0 bandwagon, the fourth industrial revolution that is taking place as we speak.

# OUR ORGANISATION

**Flanders Make is the research centre for the manufacturing industry. Discover our organisation.**

## 3 CO-CREATION CENTRES AND LABORATORIES AT THE 5 FLEMISH UNIVERSITIES

## ADVISORY BOARDS

## ORGANISATIONAL CHART

## THE INNOVATION ECOSYSTEM

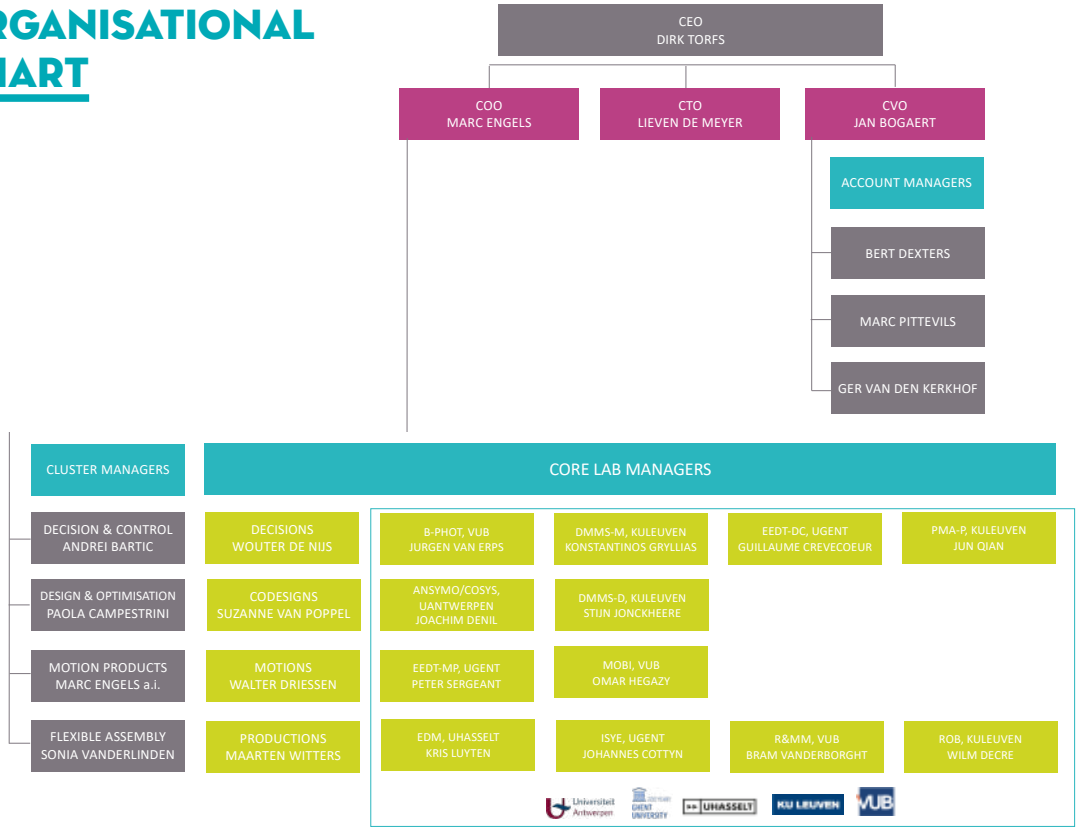
## BOARD OF DIRECTORS

# 3 CO-CREATION CENTRES AND LABORATORIES AT THE 5 FLEMISH UNIVERSITIES

# BOARD OF DIRECTORS

**Front left to right:** Carine Smolders, Karin Coninx, Ann Aerts, Geert Ostyn, Urbain Vandeurzen, Inge Bruynooghe, Dirk Torfs, Sonia Van Ballaert
**Back left to right:** Eric Sleeckx, Herman Derache, Paul Snauwaert, Erwin Dewallef, Jozef Ghijselen (replacing Leo Van de Loock), Patricia Ceysens, Koenraad Debackere
**Missing in the photo:** Herman De Bode, Dominiek Verkammen, Rik Van de Walle, Hugo Thienpont, Fleur Maas, Philippe Miclotte

# ORGANISATIONAL CHART



# ADVISORY BOARDS

## INDUSTRIAL ADVISORY BOARD FLANDERS MAKE

| | |
|---|---|
| Bart Vanderschueren | Materialise |
| Carl Eeckhout | Televic |
| Dominique Maes | Van de Wiele |
| Filip De Coninck | Bekaert |
| Goedele Heylen | Niko |
| Hans Vande Sande | Atlas Copco |
| Herman Van der Auweraer | Siemens Industry Software |
| Jos Pinte | Independent expert |
| Koen Maertens | Maertec |
| Koen Reybrouck | Reycon |
| Marnix Lannoije | Schmitz Cargobull |
| Paul Snauwaert | CNH Industrial |
| Piet Wauters | Punch Powertrain |
| Geert Ostyn | Picanol |
| Dirk Torfs | Flanders Make |
| Erwin Dewallef | EWI |
| Leo Van de Loock | VLAIO |

## SCIENTIFIC ADVISORY BOARD FLANDERS MAKE

| | |
|---|---|
| Alain Bouscayrol | Université de Lille |
| Alex Bengoa | IK4 - TEKNIKER |
| Chris Merveille | IK4 - IKERLAN |
| Hugo Thienpont | Vrije Universiteit Brussel |
| Johan Stahre | Chalmers University |
| Johann Hoffelner | Linz Centre of Mechatronics |
| Martin Haegele | Fraunhofer IPA |
| Minna Lanz | Tampere University of Technology |
| Rik Dedoncker | RWTH Aachen |
| Russel Harris | Loughborough University |
| Thilo Bein | Fraunhofer LBF + TU Darmstadt |
| Urbain Vandeurzen | Flanders Make |
| Dirk Torfs | Flanders Make |
| Marc Engels | Flanders Make |
| Lieven De Meyer | Flanders Make |
| Erwin Dewallef | EWI |
| Leo Van de Loock | VLAIO |

## THE INNOVATION ECOSYSTEM


## OUR MEMBER NETWORK

**NUMBER OF MEMBERS**

2014 **#56** > 2018 **#150**

Our member companies are spread all over Flanders. As a member, you can choose to join one or more cluster consortiums. A cluster is a competence domain in which we deliver concrete technological innovations, share knowledge and bring together partners. Within a cluster consortium, you will - together with other companies and research institutions - guide our research from the front row.

## MOTION PRODUCTS

- Atlas Copco
- Cloostermans
- CNH Industrial Belgium
- Dana Belgium
- Inverto
- Leuven Air Bearings
- Michel Van de Wiele
- Picanol
- Powerdale
- Punch Powertrain
- Siemens Industry Software
- Tenneco Automotive Europe
- Triphase
- VDL Bus Roeselare

## FLEXIBLE ASSEMBLY

- ABB
- Achilles Design
- Atlas Copco
- Barco
- Cloostermans
- CNH Industrial Belgium
- Daikin Europe
- Dana Belgium
- e-BO
- Flexible Robotic Solutions
- Janssen Pharmaceutica
- Johnson & Johnson
- Mariasteen
- Niko
- Picanol
- Procter & Gamble
- Reynaers Aluminium
- Sabca Limburg
- SupportSquare
- Tenneco
- Terumo Europe
- U-Sentric
- Van Hoecke Automation
- Vitalo Industries

## DECISION & CONTROL

- Atlas Copco Airpower
- Bekaert (Bekaert Engineering)
- CNH Industrial Belgium
- DANA Belgium
- dotOcean
- Laser Cladding Venture
- 3D Systems
- Maintenance Partners Belgium
- Materialise
- Michel Van de Wiele
- Nikon Metrology Europe
- Octinion
- Picanol
- Punch Powertrain
- Siemens Industry Software
- Televic Rail
- Tenneco Automotive Europe
- The Kobi Company
- Triphase
- VCST Industrial Products
- ZF Wind Power Antwerpen

## DESIGN & OPTIMISATION

- Atlas Copco Airpower
- Barco
- Bosal Emission Control Systems
- Cloostermans
- CNH Industrial Belgium
- DANA Belgium
- Grammar Electronics
- Michel Van de Wiele
- Noesis
- Picanol
- Punch Powertrain
- Recticel
- Reynaers Aluminium
- Siemens Industry Software
- Tenneco Automotive Europe
- Van Hoecke Automation
- Voxdale

# OUR RESEARCH

**Flanders Make performs high-tech research for applications in the manufacturing industry. Here, you can discover how we stimulate the digitisation of manufacturing companies, read some interesting success stories and learn how we encourage young people to choose for a science and technology study.**

## ROADMAPS

From adaptive systems to digital twins.

## JOINT INNOVATION RESEARCH

Four companies about the results we achieved together

## STEM

Science, Technology, Engineering & Mathematics

# ROADMAPS

**From adaptive systems to digital twins. New business models and operational improvements. We outline the roadmap of the manufacturing industry.**

## THE FUTURE OF THE FLEMISH MANUFACTURING INDUSTRY: DESIGNING, MANUFACTURING AND THINKING DIFFERENTLY.

**Smart, connected products and systems, customisation at the cost of batch production and sustainable, operator-supported production: these are three distinct trends that will mark the future of the manufacturing industry. Flemish and European companies are preparing themselves for a new way of creating, producing and thinking. Flanders Make supports them in this transition process with customised innovation, research and infrastructure. An interview with CEO Dirk Torfs and CTO Lieven De Meyer.**

**Lieven De Meyer,**
CTO

**Dirk Torfs,**
CEO

Dirk Torfs: "We talk about sustainable industrial production whenever a company develops research-based high-quality products and manufactures them in an efficient production process at an acceptable cost. Another important criterion is that the company uses its knowledge to adapt the product or production process whenever needed." It is exactly in these areas that Flanders Make aims to support and strengthen companies. It does this among others by investing in research and infrastructure that is close to the industrial context so that companies can begin to understand the added value and potential of our research, which – in turn – can be the start of an interesting interaction process. Gearing to the industrial needs is deeply rooted in Flanders Make's DNA.

Since about one year, Flanders Make is organised in four competence clusters. Their task? Putting our strategy into practice and bringing it in line with the needs of companies, taking into account three distinct trends in the manufacturing industry. "First of all, there is a trend towards smart products and production systems. Secondly, the production of customised products at the cost of batch production and, finally, the trend towards sustainable operator-supported production", explains Dirk. "These trends are visible on the longer term and therefore our roadmap doesn't cover one but ten years. We examine which logical steps a company can take to be ready for connected products and the complete digitisation of its production within five or ten years. Within our clusters, we build knowledge that we use to help companies to conceive and manufacture better, smarter and connected products in an efficient and rapid production process."

### Intelligent products, cleverly assembled

No single competence cluster works on its own, they all work closely together. To start with: the cluster Motion Products focuses on the 'product' segment. Lieven De

Meyer explains: "Our focus here is on improving machines and vehicles. Using our intelligence, we want to make them as smart and connected as possible. To this purpose, we define validated architectures, for instance to make machines and vehicles both more efficient and adaptive by storing kinetic energy in a magnetic spring that, at a later time, can be re-led into the system in a smart way. We always consider functionalities for tomorrow as well so that we can already integrate them today. For instance, machines will soon be connected and adapt themselves to changing conditions. All this requires a very different approach for designing, testing and validating the intelligence of a machine or vehicle."

In line with the Motion Products cluster, we also have our Flexible Assembly cluster, which studies the way in which companies will in future manufacture these products in a smart way. "Our ultimate goal is enabling customised production at the cost of batch production", says Lieven. He refers to the fact that a production environment must ever more often be able to create individual variants. "In future, a product line will barely exist. Every product will be conceived in a customised way", continues Dirk.

"Infrastructure should not only be able to make your product but also my product, which may be something completely different. For this, we need other assembly solutions, which we conceive and study in this cluster. In 2019, Flanders Make started with the construction of new infrastructure for this cluster in Kortrijk, integrating technologies such as robotics, automation, virtual and augmented reality, etc. We aim to create flexibility so that the production environment of a company can switch from one product to another without each time having to reconvert the entire installation or, if this cannot be avoided, with a reconversion that can be executed very quickly."

### Anticipating the needs of the market

Both clusters are closely linked to one another. "A company that already in the design phase of its product thinks about future new features - also for needs not yet known at that time - and conceives a production system that is able to make these currently still unknown products at an economically correct cost and using the right technology will tomorrow be able to anticipate very rapidly the needs of and changes in the market. And - upon such request - to manufacture a great many varieties of these products", argues Dirk.

In this process, Flanders Make considers the entire life cycle of a product, including its assembly and disassembly (dismantling). "We make sure that a product can not only be manufactured but can be maintained in a good condition as well and we take into account the circular aspect", says Lieven. "Furthermore, we want to enable companies to evolve along with the needs of their customers by using the same assembly and disassembly technique. In this way, they are able – together with the customer – to make adjustments or updates, digitally or physically, during the life span of the product. As such, product and production knowledge will be combined in an excellent customer service."

The concept of 'digital twins', i.e. the creation of a digital copy of a physical product or production process, comes in very handy in this context. Dirk again: "Thanks to such digital twin, we can validate, test and lead the product through the entire production process in advance so that companies can already adapt a design decision before the actual design of this product has been completed. This digital twin of the physical reality is always synchronised with the physical product and can also be developed for a production process. It allows companies to considerably shorten the time-to-market of an innovation. One of the techniques used for this is augmented reality."

### Managing design complexity

Because in this context the design process doesn't get any easier, we also set up the Design & Optimisation cluster, which helps companies to manage this increased design complexity. Lieven explains: "In future, we will use all available data to improve the digital twins. It concerns a huge amount of information about how customers actually use a product, what goes on during the production process, how the product behaves, etc. We want to use this knowledge to capture all solutions generated by a company into design models." This will enable designers to control the complexity of a design and focus on generating these specific products and production processes of the future. This means that the knowledge built in this cluster can be used in the above-described clusters so that they can complement one another.

Finally, within the Decision & Control cluster, Flanders Make wants to help companies to develop smarter systems thanks to the application of system intelligence. "If a machine is sufficiently intelligent, operators can be offered maximum support and less simple human interventions will be needed, adding value to the system", concludes Dirk. "Thanks to artificial intelligence, we can make progress in this regard more rapidly than ever. As a result, systems will be able to anticipate events. In case of a connected system, this may even lead to a system intervention in one car after another car on the road has had a particular problem."

# JOINT INNOVATION RESEARCH

**How do companies work together with Flanders Make? What are the results of this cooperation and how does it offer companies a competitive edge? Testimonies from four partners.**

## > DECISION & CONTROL

**"For people who are not familiar with our business, steel will most probably be anything but sexy. And yet, we discover new opportunities every day." We are talking with Filip De Coninck, senior engineering manager for exploration projects at steel wire manufacturer Bekaert. "However, new opportunities come with numerous challenges. Flanders Make supports us in a number of these challenges", confirms Filip.**

"Our products are becoming ever more complex, which means that also the complexity of our production process and the requirements set to its accuracy and quality increase. This in turn increases the need for control. Powerful, fast and cheap sensors play a very important part in this."

"For one particular application, we needed to make a high-quality sensor more robust. Flanders Make helps us with this. This is only one of the research projects in which we participate. We are working intensively together for quite some time now. The best proof of our pleasant cooperation? The fact that we are always eager to join new projects, not only in connection with sensors but also for instance for projects exploring control skills."

"Our roadmaps show more and more interfaces. We discuss ideas, questions and challenges with our colleagues of Flanders Make. They, in turn, will try to set up relevant synergies with other industrial players and academic partners. By the time that an idea has been developed into a full-fledged research project, it is also on our roadmap."

"This whole process is getting an increasingly synchronous course. The mutual dialogue and interaction get better. Every 6 months, colleagues from Bekaert and Flanders Make come together for intensive consultations, not only to discuss ongoing projects but also to keep our finger on the pulse. Could there be other interesting research projects that have a link with our challenges?"

"

**OUR ROADMAPS SHOW MORE AND MORE INTERFACES**

**Filip De Coninck**
Senior engineering manager Bekaert


# METHODOLOGY FOR SIMPLIFYING THE APPLICATION OF FUNCTIONAL SAFETY STANDARDS AT DANA

**> DESIGN & OPTIMISATION**

Vehicles and machines must meet ever more and increasingly strict safety requirements. They are becoming increasingly complex and contain more software. When this software fails, functional safety makes sure that safety remains warranted. Such functional safety requirements are not limited to countries in which the vehicle or machine builder is active. Also the European legislation concerning product liability is applicable, to name but one. Standards also differ from industry to industry: the mining industry, for instance, imposes other requirements than the logistics sector.

This is confirmed by machine builder Dana Belgium, an important strategic supplier in the automotive industry with a production unit and engineering department in West Flanders:

"Thanks to FLAME, Dana Belgium has developed into the functional safety competence centre of the global Dana Group", says Bjorn Aelvoet, Team Leader Embedded Systems & Functional Safety. "FLAME ensures that our variety of products realises a high safety and quality level for the variety of markets that we serve. Dana and its functional safety team have fully embraced FLAME and translated it into company-specific processes (dFLAME). At this moment, these processes are being introduced into all other Dana business units under the title 'One Dana Mechatronic Standard'."

Flanders Make is working for a considerable time already on setting up a functional safety reference process for various applications such as passenger cars, machine building and agriculture. In this way, companies can, for instance, map differences between their current processes and the relevant ISO-standards and take an important step forward in defining and rolling out their processes according to these standards. This development method, FLAME, can be applied independently of the type of vehicle or machine.

"Thanks to the online platform FLAME, we are not only certain that we meet the prevailing standards. We can also rest assured that, when we carry through changes to a design, we immediately know whether or not this will have an impact on functional safety matters."

How does this work in the day-to-day practice? We depart from functional requirements and examine how, with which architecture we will be able to meet them. FLAME can be applied both to a traditional powershift drivetrain for off-highway vehicles and to an on-road vehicle with a complete electric drivetrain. FLAME will then tell us which safety requirements we must meet to limit the risks.

The application of this design methodology for safety-critical systems will support Flemish vehicle and machine manufacturers to meet in an efficient way the requirements set by functional safety standards. Besides, the methodology can also be applied to product families. In this way, companies can considerably lower their overall development costs and efforts.

As this methodology covers a wide range of different international standards, its use will enable companies to assess in a much easier way whether they meet the standards and corresponding certification requirements for other markets.

> **ACHILLES DESIGN PUTS MAN AT THE CENTRE WHEN DESIGNING TOMORROW'S PRODUCTS AND SYSTEMS**

**Lukas Van Campenhout,**
Project manager Achilles Design

## > FLEXIBLE ASSEMBLY

**For more than 20 years already, Achilles Design helps companies to develop innovative and smart products and systems. Because digital technology is omnipresent, the bulk of the products and systems that they are currently designing has a digital dimension.**

Lukas Van Campenhout, project manager with Achilles Design, explains how they take the user experience to the next level: "The interface with new products and systems that we develop, the way in which we deal with it, has both physical and digital dimensions. The design discipline focusing on hybrid interfaces is called Design for Interaction and Achilles Design wants to develop unique expertise in this area. Thanks to our cooperation with Flanders Make, we can realise this ambition."

### How will men and robots work together in future?

Together with Flanders Make, Kuka and Audi, Achilles Design studied the interaction between operators and cobots (collaborative robots) in a production environment. New, digital technologies such as Augmented and Virtual Reality were used to design this interface.

We developed a demonstrator in which a cobot performs quality control measurements on an object. The results of these measurements are visualised in real time and projected on the object itself, which makes the task for operators much more intuitive and easier.

The software that was developed for this project is now being optimised to increase the flexibility of robot technology. As a result, it will become easier and take less time to re-programme robots and cobots, which will facilitate their implementation in Flemish companies.

### Results

In addition to a fruitful collaboration with the consortium partners, this project delivered for Achilles Design two very concrete results. They set up a new competence centre for digital design - with a specific focus on hybrid products and growing rapidly - and also started with an in-house research group, Ground Eight. Within Ground Eight, professional designers perform exploratory research into interactions with hybrid products and systems.

> MOTION PRODUCTS

# FLANDERS MAKE AND LAB MOTION SYSTEMS JOIN FORCES FOR MACHINING COMPOSITES

Machining parts in composite material requires special attention. The material is not only very specific, being composed of layers and fibres, it often concerns large and flexible surfaces intended for, among others, the aviation industry. As a result, machines must be adapted time and again for machining one single part or a small series, making the machining of composite parts both difficult and expensive. Furthermore, these composite parts all too often become delaminated or defragmented when being drilled or ground if the cutting conditions are not optimal.

For LAB Motion Systems, a high-tech company from Leuven set up as a spin-off of KULeuven, this was an interesting challenge. They are specialised in developing high-precision air bearings. To develop special centrepieces for machining parts in composites using vibration technology, they set up a partnership with Flanders Make.

“Delamination of composites is a problem”, says Wim Van de Vijver, CEO of LAB Motion Systems. “Because the layers composing the material become separated, the strength of the component is affected. Impact from drilling or grinding operations can already result in minuscule internal flaws. For critical applications as used in aviation with its very strict quality requirements, this is unacceptable.”

**Vibrations on the right frequency**

The research partners realised a process development for vibration-supported machining because vibrations on the right frequency can keep the composite material smoother and machining neat. This is not only better for the material, it also accelerates the machining process and considerably extends the life span of the cutting tool. In this way, machining costs can be lowered.

The developed test platform is able to optimise the frequency and amplitude of the applied vibrations. It creates optimal conditions for machining different materials, such as drilling composites on titanium.

Flanders Make can boast comprehensive experience in control engineering. Its researchers played an important part in the development of controller software for the modules of LAB Motion Systems. For LAB Motion Systems, this technology opens doors towards machining centres:

“We combined Flanders Make’s knowledge of vibration patterns with our own expertise in high-precision machining. The developed prototype may prove to be a promising solution for application in existing CNC machines. It would then be possible to mount the centrepiece as an additional module. This could generate significant added value for our customers.”

# STEM

**It is important for Flanders to stay on the map in the field of science and technology. Only a strong focus on knowledge will enable companies to innovate. That is why as a research centre we find it important to promote STEM study areas (Science, Technology, Engineering & Mathematics) among young people, encouraging them to choose for science and technology.**
**Our comprehensive approach also target girls, top talents and scholars from disadvantaged groups, who traditionally are not directly inclined to choose these study areas. For this, Flanders Make works, among others, together with the Flemish FABLABs.**

- We support Ingegno Maker Space (non-profit organisation 'De Creatieve Stem') with the organisation of STEM workshops for students in the sixth grade of primary school 'De Speling' in Lommel, through which they can taste from science and technology at a young age.

  The workshops took place on 14 and 15 June 2018. The result was encouraging. Children made 3D-printed fridge magnets and programmed an Arduino computer.

- On 'Open Bedrijvendag', companies across Flanders open their doors to the general public. So did Flanders Make. We were very proud of our over 1400 interested visitors for our virtual reality rooms, climate chamber and robots as it was the first time that we showed our three new living labs to the public.

- The last Sunday of November marks Science Day. Flanders Make pulled its weight with a stand at our colleagues from FlandersMake@UGent.

# OUR SERVICES

**We offer active support to companies in the manufacturing industry for developing and optimising products and production processes. We do this both for individual companies (customised high-tech innovation services and testing and validation of technological solutions) and together with several organisations (pre-competitive research).**

## CUSTOMISED INNOVATION

## TESTING AND VALIDATION

## RESEARCH

# CUSTOMISED INNOVATION

When the demand for customised products at the cost of mass production increases, many companies are faced with very specific challenges. Still, the price tag of products is not the whole story. To remain competitive, companies must market new, innovative products and continuously optimise their production methods. We help them with all the necessary aid and expertise, as is shown by the following examples.

## > ABSOLUTE CYCLING

**Algorithms result in the development of an innovative bicycle computer at Absolute Cycling.**

Sensors in bicycle computers are very sensitive to a correct positioning and calibration. The installation procedure is therefore quite complex and, in practice, not really user-friendly. To make bicycle computers more accurate, Absolute Cycling wanted in first instance to study the use of sensors with an inertial measuring unit for improved GPS positioning. Secondly, they wanted to use these already available sensors to determine the pedalling frequency. Finally, they also searched a solution for measuring the travelled altimeters and gradient. The Dutch product development company started looking for a partner to tackle these challenges for designing an innovative bicycle computer.

Flanders Make and Absolute Cycling developed an accurate GPS positioning system based on a sensor fusion algorithm with data from inertial measuring unit sensors. They also developed an algorithm that allows to eliminate the use of a pedalling frequency sensor and instead makes use of the already available inertial measuring unit. In an ongoing follow-up project, the robustness and reliability of this algorithm are being optimised, particularly for cycling on poor-quality pavements or when uneven forces are exercised on the pedals. Flanders Make is also studying the feasibility of an algorithm for accurately measuring the travelled altimeters and gradient. Thanks to the already developed functionalities and comprehensive tests with a prototype specifically developed for this project, the new bicycle computer of Absolute Cycling should become more user-friendly and more accurate than what the current market has on offer.

**“In an article on GPS positioning, Flanders Make emerged as a reliable partner with comprehensive expertise in sensor fusion, signal processing and the development of algorithms”, says Harm Giesen, CEO of Absolute Cycling. “They built on this expertise to tackle our challenges and, meanwhile, we’re already executing our second cooperation project.”**

**Absolute Cycling started in June 2019 with a crowd funding campaign through Indiegogo.**

## > TENNECO

**Management and employees of Tenneco test cobots and digital work instructions in our MAKE LAB.**

Tenneco, a manufacturer of shock absorbing devices, wanted to examine the possibilities to integrate cobots (collaborative robots that are able to work together with people) and digital work instructions in their manufacturing line. For some time now, Flanders Make has a mobile living lab, the MAKE LAB, available for this. First, several types of cobots were tested to check their functionalities against the specific requirements. The selected model was then implemented in the MAKE LAB and complemented by a digital instruction system.

The functional demonstration set-up could literally be brought to Tenneco's workplace so that both management and employees could try the new technologies.

**"We were looking for a partner that could provide us with independent expertise and had the necessary infrastructure to bring this project to a successful conclusion", explain Stefan Peerbooms, Sr. Advanced Manufacturing Engineer, and James Richard, Sr. Advanced Manufacturing Technician with Tenneco. "The biggest challenge was to convince our entire organisation. Because everyone could participate in the demonstrations and could in an accessible manner familiarise themselves with the cobots and the new way of working, we definitely succeeded in this."**

TENNECO

## > VANHOOL

**Support to Van Hool for implementing functional safety standards for bus and coach manufacturers.**

Bus and coach manufacturer Van Hool starts with the implementation of functional safety processes in their product design. They set up a partnership with Flanders Make, which has the necessary experience in the application of functional safety standards.

Using a case study within the ISO26262 process for bus and coach manufacturers, we go through the various stages in the process to implement the correct functional safety requirements. The partnership enables Van Hool to gain expertise and develop the necessary methods and tools to integrate the ISO standard into their current product design process in a transversal manner.

In the case study, the risks linked to passenger door functionalities were mapped. We defined the corresponding ASIL level (Automotive Safety Integrity Level) and, based on this, established the safety requirements that the system must definitely comply with in order to achieve this level. We also set up a framework for developing the necessary hardware and software.

In this way, Van Hool acquires a complete survey of the main functional safety requirements for a bus or coach as well as the corresponding HARA analysis methods (Hazard Analysis and Risk Assessment), a hardware reliability assessment and an adapted and consistent software development method. Finally, we performed an ISO26262 gap analysis to identify further improvement actions.

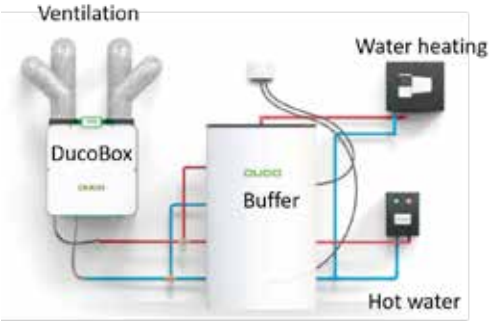
VANHOOL

**> DUCO**

**More energy-efficient systems for Duco thanks to the application of machine learning and advanced control.**

Since 1991, Duco is a leading European manufacturer of ventilation and sun protection systems. In response to the increasing demand for energy-efficient solutions, interaction with renewable energy sources and eco-friendliness, Duco launched its DucoBox Eco. This ventilation heat pump ensures the efficient supply of hot water, heating and fresh, healthy air in houses. Duco established contact with Flanders Make to examine to which extent its DucoBox Eco could respond even better to the comfort wishes of residents and to varying climate conditions.

The expertise of Flanders Make was used for implementing an advanced control strategy. To make sure that the capacities of the concept would be optimally used, the research centre developed an optimisation-based controller. The new algorithm makes use of models of the different Duco systems and of the actual residents and actual house. In this way, it can predict the impact of the different control actions on both comfort, cost and energy consumption. We also used Flanders Make's expertise in machine learning to analyse the impact of the behaviour of the residents on the actual energy consumption.

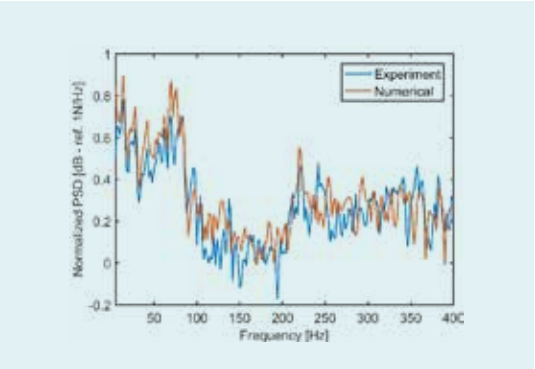



**Thanks to this study, Duco will be able to assess more accurately the energy and costs that a family will be able to save through the installation of a DucoBox Eco ventilation heat pump, either in an all-electric or in a hybrid set-up. Similar analyses and the newly developed control techniques will also be applied to future Duco systems as a stronger focus on renewable energy sources combined with a reduction of gas connections will generate complex energy issues.**

DUCO
Ventilation & Sun Control

## > GOODYEAR

**A more efficient design process thanks to the use of advanced and efficient models for designing Goodyear car tyres.**




When optimising the design of a car tyre, one must consider more than 50 criteria that the tyre must meet: behaviour during braking and driving, fuel consumption... All these performance criteria cannot be considered separately but must be optimised simultaneously. On top of this, vehicle manufacturers continuously want faster development times. Reliable, predictive simulation techniques therefore offer a distinct benefit compared to traditional time-consuming physical (experimental) tests.

Goodyear Innovation Centre Luxemburg (GICL) established contact with FlandersMake@KULeuven for developing an efficient, predictive numerical simulation method to calculate the dynamic forces between tyre and road surface and thus improve the efficiency of the design process for car tyres in terms of noise and vibrations.

Developing and validating new car tyre designs is a major challenge. Results from simulations can be used to assess the performances of a car tyre design. Because of the complexity and huge quantity of performance criteria, both advanced models and mathematical techniques must be applied to ultimately realise an efficient numerical design process. FlandersMake@KULeuven can boast comprehensive experience in advanced model reduction and was thus the optimum research partner.

A doctorate project was set up to develop the targeted tool, with the financial support of the Fonds National de la Recherche (FNR) Luxemburg.

GOODYEAR
MADE TO FEEL GOOD.

**The efficient, fully predictive numerical tool allowed to reduce the lead time of the car tyre design in terms of noise and vibrations from - initially - months to - currently - hours or days as it is no longer needed to build and test physical prototypes.**

**> SIEMENS PLM SOFTWARE**

**Siemens PLM Software makes maximum use of datasets thanks to virtual models.**

To develop new suspensions for vehicles or improve the life span of existing systems, it is crucial to be able to measure the forces on and stress in crucial suspension parts. Traditionally, sensors that are used for this, are either expensive or difficult to mount correctly. Siemens PLM Software, a specialised software company, therefore performed research, together with Flanders Make, in ways to improve this process.

The goal was to use simpler and less expensive sensors that are also easier to mount. These sensors don't measure forces or stress directly but link the measurement data with virtual models to enable estimating the targeted parameters through a so-called 'virtual sensing' approach. This significantly accelerates the validation process, thus considerably shortening the time-to-market of new suspensions.

SIEMENS

**Siemens PLM Software is currently considering the commercial integration of this approach in its Simcenter software portfolio and services.**

## TESTING AND VALIDATION

We have high-tech test and validation infrastructure at our disposal, which is not only used for our own research. Companies can call upon our services to develop a new concept, validate their own solutions or perform extensive tests on component or system level. We also have workshops, tools and materials available to build and adjust prototypes in all confidentiality. Discover our infrastructure on our website and read the testimonials below.

**> DANA**

**Vehicle manufacturer Dana from Bruges uses the modular multi-load drivetrain at Flanders Make to validate a new rear-wheel drive.**

The modular multi-load drivetrain simultaneously simulates a wide range of wheel speeds (> 2,000 rpm), engine speeds (> 2,000 rpm) and loads (> 1,500 Nm). This corresponds with the wide range of performance requirements that Dana's rear-wheel drives must meet in the real world.

These tests focus on the one hand on the accuracy of the direction of the torque that is generated by the drive. On the other hand, we look at the controller parameters to ensure maximum performances in all operating conditions.

PICTURE: concept design of active rear-wheel drive
SOURCE: brochure Dana

**Validation of new rear-wheel drive of Dana.**

DANA

## > VERWATER TANK & INDUSTRIAL SERVICES

**Verwater Tank & Industrial Services wants to glue a double roof platform onto one of its tanks with explosive material. In its Joining & Materials Lab, Flanders Make performs validation tests on the pre-set adhesive system. Verwater Tank & Industrial Services delivers samples for these tests, with and without coating.**

The purpose of these tests is measuring the strength and stiffness of the glued samples so that the results of these tests can be used to validate the adhesive system before it is used for this challenging application. The samples delivered for both shearing and tensile tests are tested on the draw-bench in our Joining & Materials Lab.

The first tests clearly show the need to thoroughly roughen the surface to be glued together. Further tests will study the impact of the surface roughness on the selected adhesive system. In these tests, the surface characteristics are measured to enable mapping out as many process parameters of the adhesive bonding process as possible.

**Validation tests for the adhesive system for a tank of Verwater Tank & Industrial Services.**

## > SARIS

**SARIS trailers stand for quality. The Dutch family business continuously innovates to ensure optimum performances.**

They recently adapted the concept of several of their models, among others for quality improvement reasons. To validate this adapted concept, they called on the knowledge and expertise of Flanders Make.

The trailers were placed on the 4-poster automotive test system or vehicle shaker to perform accelerated lifetime tests. Accelerated lifetime tests are a cost-effective method for validating a product within a short time frame.

**Accelerated lifetime tests on a SARIS trailer.**

# RESEARCH

We perform research in support of the manufacturing industry. Below, you can read about how we help companies to innovate by way of very concrete and practical applications of results from pre-competitive research projects.

## > ATLAS COPCO AND VCST

**Manufacturing companies continuously try to increase their productivity, among others by avoiding machine downtimes. Early fault detection by monitoring the vibration pattern of components such as bearings and gears enables to realise a serious cost reduction and to gain considerable time.**

FlandersMake@UAntwerp therefore developed a compact data acquisition and processing system that supports low-cost condition monitoring. Through a smart combination of low-cost hardware and software optimisation, this system is able to replace the expensive data acquisition systems that are conventionally used for condition monitoring. The system developed in the research project offers similar performances at one tenth of the cost.

The data acquisition system that we designed for vibration-based condition monitoring was successfully tested on typical applications of the industrial project members, such as the online monitoring of production machines at Atlas Copco and the grinding process for gears at VCST.

**A smart monitoring system for early error detection eliminates machine downtimes at Atlas Copco and VCST.**

## > CONNECT GROUP

**Tests have shown that the useful life span of electrolytic capacitors can be very variable.**

That is why Connect Group, a technology provider offering completely assembled systems and industrial PCB and cable assemblies, implemented a new methodology for determining the quality of the capacitor components that it has in stock.

Capacitors are very scarce and therefore come with long delivery terms (4 to 5 months). Sometimes, a rapid delivery is possible if stock components can be used. Obviously, they must be sure that the quality of these components is still satisfactory.

Connect Group, has developed, together with Flanders Make, a relative measuring method to measure the capacity of capacitors using a method based on two specific frequencies. Connect Group, applies this method on 2 motherboards for industrial applications (equivalent to 100 capacitors), thus avoiding delivery terms of 20 weeks and more. Thanks to this measuring method, Connect Group, is able to raise its competitiveness by offering high-quality products within shorter delivery terms and avoid penalties linked to late deliveries.

**Connect Group increases its competitiveness with a new measuring method for determining the useful life span of capacitors.**

## > JABIL

**Flanders Make developed a methodology for the accurate testing and validation of supercapacitors.**

This methodology includes:

- an optimal design for accelerated lifetime tests
- techniques for establishing performance parameters of supercapacitors
- techniques for performing reliability analyses

Based on this information, Jabil, a company manufacturing electronic devices, set to work to build a cost-effective test set-up for determining the useful life span of supercapacitors. Comparing the test results of Flanders Make and Jabil showed the reliability of the applied test methods so that Jabil's new test set-up for the validation of supercapacitors could be implemented within a relatively short period.

The test set-up is now used for performing tests for their customers.

**Jabil offers new services for testing and validating supercapacitors with a newly developed test set-up.**

JABIL

## > SIEMENS PLM SOFTWARE

**Sound radiation and unintended vibrations are important differentiating characteristics for power-trains in vehicles and machines. Often, these noise and vibration phenomena are caused by gear contacts.**

FlandersMake@KULeuven and Siemens PLM Software worked in the past few years on advanced simulation methods to correctly predict gear contacts in powertrains so as to map the dynamic behaviour of drives.
One of the technologies that has been developed is a parametric mesh generator for building finite element models. This parametric tool allows to quickly and effectively build suitable 'meshes' (or element networks) from the powertrain components, such as gears, which in a next step are used in applied contact modelling algorithms.

This method allows to simulate the dynamic behaviour of complex systems, in this case (components of) powertrains. In this way, designers can realise a validated design in a much more efficient way.

Siemens PLM Software already integrated the technology in its Simcenter 3D, a new-generation software tool for designing powertrains.

**Siemens PLM Software helps designers with first-time-right solutions for the design of powertrains.**

SIEMENS

## > DAIKIN

**Machines and devices must become increasingly silent and show ever better performances. This also applies to heat pumps. It is still a frequently occurring misconception that (the outdoor unit of) a heat pump may cause noise nuisance in one's own garden and for the neighbours as, in the event of an outside air heat pump, it houses the compressor and fan.**

Daikin, a multinational specialist in air conditioning, refrigeration systems, chemicals and defence systems, continuously invests to make its products even quieter. They worked closely together with Flanders Make to develop their Low-Sound Cover, a compact and multifunctional cover that is easy to install and limits the noise impact of (existing) systems without affecting their performances.

FlandersMake@KULeuven helped Daikin to select the material, optimise the design and assess its operation. We jointly designed a methodology and procedure to easily establish and improve the acoustics of the elements in the Low-Sound Cover.

**Smarter heat pumps give Daikin a competitive edge.**

## > BEKAERT

**Bekaert is a global market and technology leader in steel wire transformation and coatings and was in search of a cost-effective and accurate production monitoring system. For this, only expensive sensor systems are currently available on the market.**

**Cost-effective quality assurance solutions tailored to Bekaert's requirements.**

The research objective was designing a cost-effective solution that still meets all quality requirements for continuous online product quality monitoring.

Flanders Make developed a methodology for selecting the right sensors. Subsequently, we developed adaptive algorithms that are able to handle variables within production environments such as ambient factors and different product types.

The research model was validated on a Flanders Make demonstrator. The system that has been designed is up to 20 times cheaper than commercial solutions, with equivalent results. Bekaert already validated this new-generation online monitoring platform for the quality assurance of steel wire products in their production facilities.

## > MARLINKS

**Offshore power cables are buried into the seabed to protect them from damage caused by, for instance, anchors or fishing nets. However, the seabed is not a static landscape but is continuously in motion.**

Therefore it is crucial for owners of power cables to know the actual depth at which their cables are buried. Marlinks wanted to develop a new method for monitoring the depth by using temperature measurements. Algorithms were developed by combining a sensor system detecting the heat profile of the entire cable with historical data and knowledge of the seabed and its morphology.

These algorithms must be able to process a great many data. Then, in between the coast and wind turbines, about 50km of power cables must be monitored, with another 50km between the different wind turbines.

**Marlinks has the wind in its sails with correct localisation data of offshore power cables.**

FlandersMake@UGent and Marlinks developed and implemented the following technologies:

- a thermal cable model of the power cable
- a thermal model of the seabed
- a procedure for identifying parameters in both models
- a virtual sensor assessing the burial depth of cables
- a method to accelerate the processing of registered data

MARLINKS

## > MAGNAX

**From its facilities in Kortrijk, Magnax develops axial-flux electric machines. Two years ago, the company developed the first prototype of a generator for the use of wind energy. Meanwhile, Magnax moves up a gear with a clear focus on the ongoing electrification of the automotive industry, proceeding with the design, manufacturing and integration in powertrains of compact, efficient and high-speed electric machines.**

So as to be able to attain these ambitions, Magnax complements its own expertise with knowledge from FlandersMake@UGent.

In 2019, the first batch production model of the commercial motor will be produced. It concerns a very compact machine with a diameter of a mere 275mm and an axial length of +/- 12cm for a peak power of 300kW at 8000rpm. The machine has an extremely high nominal efficiency of 95%, achieving this high power density (15kW/kg) among others thanks to the patented cooling principle. Flanders Make will test the motor on its test bench in Lommel.

**Magnax invests in electric motors.**

MAGNAX

## > MOVILITAS

**It is important for manufacturing companies to be able to monitor every component of their product - from the suppliers through the assembly up to the delivery to the end customer. Track & trace software plays an important part in this, particularly if this information is used to support operators in the assembly process with digital work instructions.**

Then, customers increasingly require personalised products, which obviously raises the workload of operators. They can no longer know every assembly process because the variation is simply too big.

FlandersMake@UGent therefore developed a generic system for sharing operator information (Generic Semantic Model for Assembly Information), which can be integrated in existing information systems such as Veri954MAKE, the track-and-trace software of Movilitas. Maximum compatibility is important in this context to realise an economically interesting solution.

Today, Movilitas, a global player in the field of MES solutions (Manufacturing Execution System) with comprehensive expertise in the manufacturing industry, traceability, warehouse management and mobility, markets this software.

**Movilitas goes for first-time-right assembly solutions thanks to operator support.**

movilitas

## SOME OTHER GREAT REALISATIONS...

**EcoNation established contact with Flanders Make for the optimisation of the LightCatcher, its signature skylight.**

EcoNation


**Flanders Make developed together with, among others, Michel Van De Wiele NV and Picanol Group a model-based design tool for selecting the right energy technology for a rapid energy storage in machine drives.**


**Reynaers Aluminium created together with Flanders Make a software tool to compose the ideal machine portfolio.**

**Televic Rail and Flanders Make developed an inexpensive and accurate position indication system for railway vehicles, which gives an estimate of the vehicle position with an error margin of 5 metre whenever the GPS signal is lost – for instance when driving through tunnels or valleys.**

televic rail

# OUR TEAM

**Flanders Make can boast the combined knowledge, expertise and enthusiasm of over 500 employees. A couple of members of this large and multi-disciplinary team explain their passion.**

## WORKING AT FLANDERS MAKE

## OUR TEAM HAS ITS SAY

# WORKING AT FLANDERS MAKE

**Greet Heylen**
HR & Business Process Manager

**"Also for the HR division of Flanders Make, 2018 was marked by growth. In first instance because our number of employees increased but also because the number of candidates applying for a job with us went up for the umpteenth year in a row. And also striking: among those applicants, more than ever before, many people living in Flanders. Not all Flemish people of course, but still a sign for us that Flanders Make's brand awareness and reputation in Flanders are on the up. And that there are a lot of people willing to contribute to our growth.**

Another noticeable trend is the increasing number of applicants from the industry. At the start of our organisation, we attracted above all people who had just obtained a doctorate's title but in 2018 no less than 44% of all our new recruits made the step from the industry to Flanders Make. This creates a mix of academic and industrial experience within our organisation, supporting us in our ambition to bridge the gap between both worlds. Personally, I am very proud of what our researchers create every day and of the smart things that they build. When I see they're happy whenever a company starts working with one of our solutions, I am happy too.

### Looking for additional competences

Also in future, we want to continue developing our organisation. Because in the past year we've expanded our research infrastructure and our labs, we are currently recruiting other profiles and additional competences as well. Application engineers, for instance, are very much in demand: they conceive, design and build new set-ups and perform research on it. Together with our research engineers – our creative minds at the computer – they are a strong team. And all of them work together with committed project managers, who make the decisions and set the technological course.

Obviously, the war for talent is no stranger to us either. But we believe that our organisation has all assets that are necessary to attract interesting profiles. We realise that we ask a lot from our staff. Creativity, guts, ambition, courage and the will to work together. But for their commitment they also get a lot in return. For instance, the satisfaction to contribute to the growth and further development of Flanders Make, in all areas: we are growing rapidly in Flanders and Europe in areas such as basic research, infrastructure and contract research and also in terms of demonstrations and publications. And they have many great opportunities to work with leading companies in Flanders, with new colleagues, academic partners and industrial team members.

### Teams spread across Flanders

2018 also marked cooperation across our sites. Over the past couple of years, our organisation has evolved from one team in Leuven and one team in Lommel to competence-based teams. This requires another way of working but a great deal of enthusiasm, managers commuting across sites and digital support enable us to make the switch. Besides, with the new site in Kortrijk, we are easily accessible to the major part of Flanders.

Our cooperative relationships are not limited to Flanders Make alone but are extended to our four competence clusters with three to five teams each. For cluster managers, it is quite a challenge to create close-knit teams. But during the two-day offsite meeting that we organised on this matter, we clearly felt the will to make it work, to build on the road, based on mutual respect and solidarity, with the overall purpose - each from his or her own strengths and interests - to contribute to the further development and growth of Flanders Make."

> **WE ARE LOOKING FOR TOP EMPLOYEES. WITH AMBITION, GUTS, SENSE OF INITIATIVE, COURAGE AND THE WILL TO WORK TOGETHER. ARE WE ASKING A LOT? YES. BUT TOP PERFORMANCES REQUIRE TALENT AND COMMITMENT.**

# OUR TEAM HAS ITS SAY

**BERT PLUYMERS**

**"Throughout the years, I've witnessed the birth and evolution of Flanders Make. Let me explain. I work, since 2000 already, for KU Leuven within the research group 'Dynamics of Mechanical and Mechatronic Systems', led by my colleague Wim Desmet, and I've experienced from close by its predecessors Flanders Drive and FMTC. Since 2008, it is my job as an IOF-funded industrial research manager to build bridges towards companies, other research organisations, universities and public authorities. This entails, among others, setting up valorisation activities concerning the research performed within our research group, think of service and research projects, patents, spin-offs and suchlike.**

Since Flanders Make's incorporation in 2014, I perform business development tasks on behalf of our DMMS core lab (Dynamics of Mechanical and Mechatronic Systems). In this same period, our team has grown from about 15 members when I started to almost 100 employees today.

On an organisational level, Flanders Make has made considerable progress. The initial structure with various virtual departments appeared to have its limits and was replaced in 2017 by a new structure with core labs, which now works much better. Flanders Make remains a somewhat complex organisation that still has some room for improvement but I am also convinced that this complexity is one of our strengths. We can use the diversity that characterises us to distinguish ourselves from other players on the innovation market.

For our Flemish - and by extension European - stakeholders, we've created throughout the years ever more visibility and brand awareness. Witnessing and feeling this progress is a strong incentive and motivator. We owe this evolution no doubt to the fact that we've chosen for a clear focus on our strengths: dynamics (vibration, noise, motion) of mechanical and mechatronic systems, developing and applying experimental analysis, identification, monitoring and control techniques and linking them within the scope of digital twins to a broad range of powerful physical behavioural modelling techniques.

In these domains, we and our core partners in Flanders and the rest of the world are pioneers in the international scientific state-of-the-art and in the industrial state of use. Our focus on and investments in these areas clearly pay off. We notice more and more that stakeholders from around the world come to us, encouraged by the solid reputation that we've built over the past 20 years.

It is good to see that companies are convinced of our added value and come to us themselves for the areas in which we are strong. We continue – today and tomorrow – to develop our comprehensive offer by working together with other internal Flanders Make core labs with complementary expertise. In this way, we and our stakeholders help to ensure that Flanders remains the top region that - with the available brains and work ethics - it deserves to be."

> **THE DIVERSITY AND COMPLEXITY THAT IS SO TYPICAL OF FLANDERS MAKE IS A MAJOR ASSET DISTINGUISHING US FROM OTHER PLAYERS ON THE MARKET.**

**Bert Pluymers**
industrial research manager KU Leuven &
business developer core lab DMMS

**GEERT MALFAIT**

**"I got to know Flanders Make and what it does when I was working with my previous employee. During my 25 years in the industry, I experienced first-hand that Flanders Make had interesting projects for our sector and that it was pleasant to work together with them.**

I noticed, working for a machine builder in West Flanders, that the distance to the office of Flanders Make in Leuven was often a limiting factor in the partnership. You can imagine that I was thrilled to hear that they would set up an additional site in Kortrijk. A location close to members in West Flanders offered huge opportunities. Also to me personally, because soon afterwards I became project manager with Flanders Make.

My tasks are twofold. On the one hand, I support from Kortrijk the process that must ensure that the new building will be erected within the legal framework and within the pre-set term. From the ProductionS core lab, a multi-disciplinary team is also planning the technical infrastructure of the labs. Today, this is still being done from the Howest premises but we hope being able to move to the new site in the fall of 2020.

Flanders Make's third hub will become a genuine flagship establishment. We will focus on everything related to flexible assembly. This means that we will have infrastructure that we and our members can use to execute projects studying the flexible assembly of various mechatronic systems and sub-systems. In other words: everything that must be built, screwed or glued together so as to create a mechanical and mechatronic structure with a size not exceeding

> **IN OUR NEW ESTABLISHMENT IN KORTRIJK, WE FOCUS ON EVERYTHING RELATED TO FLEXIBLE ASSEMBLY.**
>
> **Geert Malfait**
> project manager

300 x 300 x 300 mm and with a maximum weight of 30 kg. In principle, every system meeting these criteria can be assembled on our future infrastructure, which will be able to switch between different products in a very swift and simple way. For this project, we work closely together with FlandersMake@UGent. The department of Professor Johannes Cottyn is part of our project team and helps us to make our plans concrete.

For me, it's a real bonus being able to contribute to the dissemination of cutting-edge technologies. At Flanders Make, we create new things and try to introduce them in the industry. And it must be repeated again and again how important it is to keep the industrial fabric in Flanders alive. Because it's only through innovation that we can offer the manufacturing industry in Flanders a future."

**PAOLA CAMPESTRINI**

**"Industry 4.0 trends such as sustainable manufacturing, mass customisation, smart & interconnected products, etc. are making current products increasingly complex. We no longer talk about mechanical but about mechatronic and intelligent systems. This means that product designers not only need to combine different disciplines – mechanical engineering, electronics, control engineering, software... – but also different technologies.**

Furthermore, following the need for mass customisation, they must be able to design cost-efficient product families instead of one product, taking into account all stages of the product's life span. From manufacturing and assembling over use to recycling. Obviously, this hasn't made the design process for Flemish industrial companies any easier.

With the cluster 'Design & Optimisation', we want to support the manufacturing industry in Flanders in its design processes by developing methods and prototype tools that can help designers in the choices they have to make. We do this by exploring alternatives, making simulations and evaluating concepts. We have disposal of one internal lab, two university labs and a consortium of about twenty companies. The latter can be involved in different ways depending on the type of research.

Of course, this creates a great many challenges but that's what I like most about working for Flanders Make. As a cluster manager, I have a coordinating role. I try to align the work and developments in our three labs and to make sure that the work that we do is industrially relevant so that, in the end, we can help companies to take on the challenges that they face today within the context of Industry 4.0 and increasing digitisation. I feel satisfaction every time a company says that they've made progress thanks to Flanders Make and our developments.

Throughout the years, I've seen Flanders Make grow as an organisation in many different ways. On the one hand, there is of course the huge increase in the number of employees, a trend that will be continued in the forthcoming period. But, apart from this, it strikes me that we've grown from a research institution with our own people into a network of university and internal core labs. Obviously, working together within such a network is at times a major challenge, but I am also convinced that it makes us stronger. An initial exploration period, in which we get to know each other and each other's competences, creates confidence in a successful and productive cooperation.

Finally, our focus is - more than ever - on the longer term. Where, in the past, we predominantly worked on a project-per-project basis and received funds for a couple of years, our operational perspective is now longer and we use a roadmap as a guide to define our research projects. In other words, we have a long-term vision that is defined in consultation with our partner companies. This clear focus and course brings us - and the Flemish manufacturing industry - only benefits."

**"SATISFACTION? I FEEL IT EVERY TIME A COMPANY SAYS THAT THEY'VE MADE PROGRESS THANKS TO US.**

**Paola Campestrini,**
cluster manager Design & Optimisation

**PIETER DE CLERCQ**

**"After my studies in engineering sciences and electrical engineering and my master-after-master in artificial intelligence, I considered for a while going for a doctorate as I find research into new technologies very interesting. But I also realised that academic research is often of a general nature and cannot necessarily be applied for industrial applications.**

That's why I chose to start working as an associate research engineer within the DecisionS core lab of Flanders Make. Here, I get the opportunity to perform research that is specifically targeted at industrial applications. I find it very rewarding to know that my work can be used in practice.

Today, I'm working on three projects simultaneously. One project is about computer vision. In this project, we are studying efficient ways to analyse and understand camera images and, at the same time, select and test the right hardware. Another project is about optimisation: selecting the most optimal position for a sensor on an object. The third project studies autonomous agricultural vehicles. Here, I'm analysing the different types of sensors for detecting the field around the tractor as accurately as possible. All of my projects include a research section and a specific application for or request from the industry.

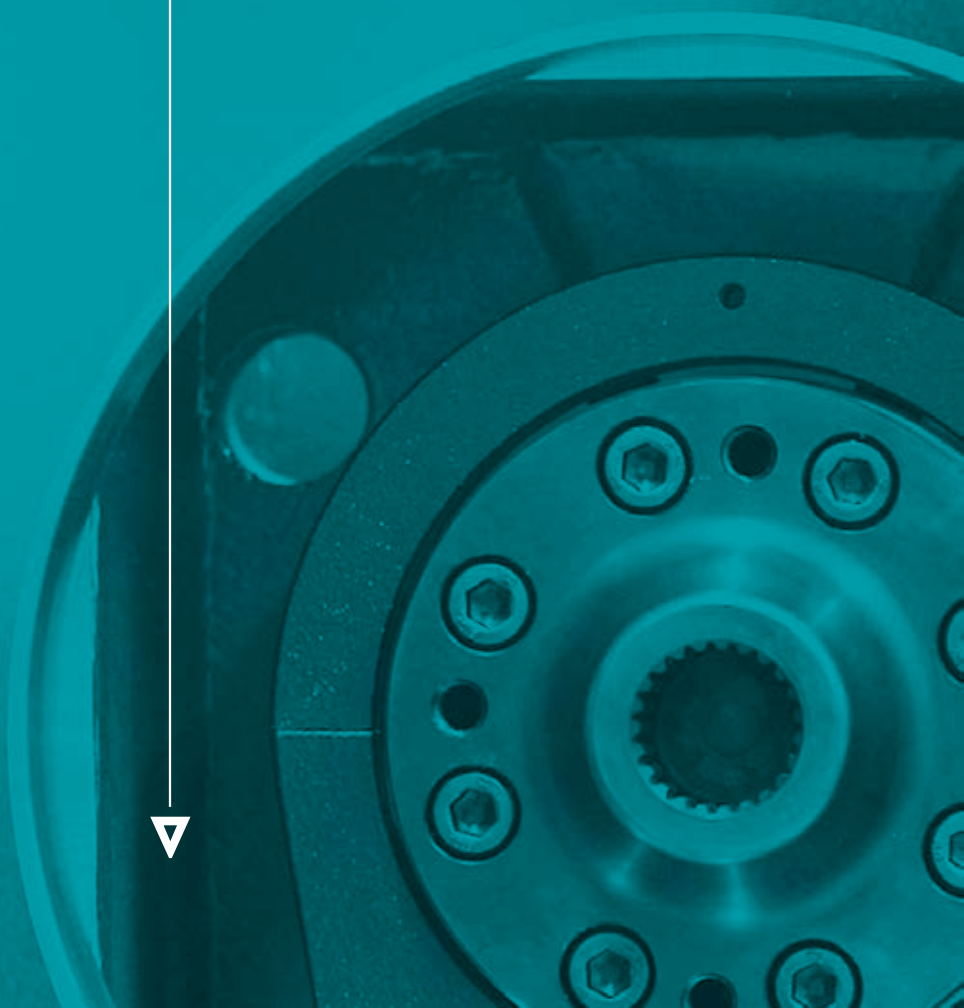
Apart from our industrial partners, university research groups are also involved in all of my projects. You can consider Flanders Make as the glue between academic research, which often finds good but general solutions, and the specific applications that the industry is looking for.

This implies that, often, we must find a turnkey solution for a customer within a relatively short term. But I like this dynamic, it's also something that typifies us. Since I started working here a couple of months ago, many other new colleagues have joined our team. So, we are definitely dynamic and have the ambition to continue to be so in future."

> **AT FLANDERS MAKE, WE BRIDGE THE GAP BETWEEN UNIVERSITY RESEARCH GROUPS AND THE INDUSTRY, WHICH IS EXACTLY WHAT MAKES MY JOB SO FASCINATING.**
>
> **Pieter De Clercq**
> associate research engineer

# 2018 IN FIGURES





# BALANCE & YEAR RESULTS

| ASSETS | € | 76.448.802 |
|---|---|---|
| Fixed assets | € | 10.103.048 |
| Intangible assets | € | 274.631 |
| Tangible assets | € | 9.817.673 |
| Financial assets | € | 10.744 |

| CURRENT ASSETS | € | 66.345.754 |
|---|---|---|
| Stocks & orders in progress | € | 5.015.019 |
| Accounts receivable | € | 21.342.132 |
| Liquid assets | € | 39.534.005 |
| Deferred charges & accrued income | € | 454.598 |

| LIABILITIES | € | 76.448.802 |
|---|---|---|

| CAPITAL & RESERVES | € | 20.162.096 |
|---|---|---|

| PROVISIONS | € | 167.698 |
|---|---|---|

| CREDITORS | € | 56.119.008 |
|---|---|---|
| Creditors amounts falling due within 1 year | € | 20.938.483 |
| Deferred charges and accrued income | € | 35.180.524 |

| REVENUES | € | 15.666.375 |
|---|---|---|
| Turnovers | € | 14.386.882 |
| FM Convenant | € | 9.629.219 |
| FM non-Convenant | € | 4.530.182 |
| Membership fees and other | € | 227.482 |
| Other revenues | € | 1.279.493 |

| COSTS | € | 15.828.495 |
|---|---|---|
| Salaries, social security charges & pensions | € | 11.114.965 |
| Operating costs | € | 4.679.073 |
| Other costs | € | 34.455 |

| RESULT FROM OPERATING ACTIVITIES | € | -148.574 |
|---|---|---|

| USE OF RESERVES | € | 159.643 |
|---|---|---|

| RESULT FOR THE FINANCIAL YEAR | € | 11.069 |
|---|---|---|

# KEY PERFORMANCE INDICATORS

| | | Total Q4 | Target 2018 |
|---|---|---|---|
| KPI 1.1 | Journals | 154 | 150 |
| KPI 1.2 | Conferences | 279 | 200 |
| KPI 1.3 | European participation | 8.788 k€ | 3.200 k€ |
| KPI 2.1 | Technological utilisation | 16 | 7 |
| KPI 2.2a | Range within direct target group | 33 | 33 |
| KPI 2.2b | SMEs | 14 | 11 |
| KPI 2.3 | Industrial revenues | 8.013 k€ | 4.000 k€ |
| KPI 2.4a | Industrial range | 324 | 76 |
| KPI 2.4b | SMEs | 115 | 25 |
| KPI 3.1 | Leverage | | |
| | Leverage income | 35.008 k€ | 16.750 k€ |
| | Leverage | 4,0 | 1,8 |
| KPI 3.2 | Industrial leverage | 6.380 k€ | 2.000 k€ |
| KPI 3.3 | Strategic partnerships | 1 | 1 |
| KPI 4.1 | Cross-initiative projects | 13 | 1 |
| KPI 4.2 | Dissemination range | 180 | 28 |
| KPI 4.3 | Joint publications | 30 | 20 |

# FLANDERS MAKE IN THE MEDIA

**Compelling projects, ambitious expansion plans, new social challenges for which technology can offer a solution. No wonder that our brand name is becoming increasingly familiar! Below are a few examples of the 250+ stories covered by the press.**


ACTUEEL

FLANDERS MAKE KIJKT IN GLAZEN BOL BELGISCHE MAAKINDUSTRIE

400 TOEHOORDERS VOOR TWEEDE SYMPOSIUM IN KINEPOLIS ANTWERPEN

Flanders Make opent drie labs

26 Limburgse bedrijven zijn lid van kenniscentrum maakindustrie

→1. Operating Support 4.0 Lab

→2. Joining & Materials Lab

→3. E-Powertrain Lab

DE OPMARS VAN DE NIEUWE MAAKINDUSTRIE

Hoogtechnol

ultra

Be

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