

# ACTIVITY REPORT 2021



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**77**

MILLION EURO  
TURNOVER

**67**

COMPANIES  
INVOLVED IN  
ICON PROJECTS

**247**

NEW RESEARCH  
PROJECTS  
STARTED



OVER

**750**

EMPLOYEES  
IN TOTAL

**9186**

LINKEDIN FOLLOWERS

**21%**

GROWTH IN  
MEMBER COMPANIES  
(FROM 144 TO 174)

**16**

NEW COVENANT  
PROJECTS

**174**

POSTS ON  
LINKEDIN



## Key figures 2021

Flanders Make performs high-tech research with and to the benefit of companies. This contributes to product and production innovation for vehicles, machines and factories. In this way, we help companies to be competitive in a globalised market. Here are a few key figures.

In this report, we will elaborate on the results Flanders Make realised in 2021, in its 3 co-creation centres, drone cluster EUKA and in its core labs at the five Flemish universities.





## PREFACE OF CEO

If we refer to 2020 as the 'corona year', then 2021 can definitely lay claim to being the year of resilience. Many of our companies responded to the opportunities and showed their decisiveness, creativity and flexibility. Our industry continued to embrace innovation, and in particular digitalisation and technological solutions that fit within Industry 4.0. It is precisely this strategic choice that will strengthen the competitiveness of our Flemish companies in the years to come.

By 2022, many companies expect to be back to normal. Difficulties in the supply chain and the availability of raw materials are systematically resolved. However, the existing shortage of suitable manpower remains a sore point. In 2022, it will therefore remain important for companies to make a strategic investment in qualified staff with advanced digital competences. Flanders Make wants to play an important part in this.

### Embracing workable work

If we zoom in on the labour market for a moment, we can be proud of our recent developments to promote workable work in production environments. In early

“

By sharing information and working together, our wider industry will gain more clout.”

– Dirk Torfs, CEO Flanders Make

2021, we had discussions with VLAIO about this, which led to a pilot project focusing on the combination of both the technological and social aspects of work. Workable work is also fully in line with the pursuit of increased sustainability. There is enough work for everyone, so we want to come up with solutions that make work in production companies much more efficient and comfortable, both physically and cognitively. In this way, we can also retain workers longer in employment and get others to work. We also want to use this living lab project to accelerate the training of workers. Workable work will therefore continue to set our agenda in 2022.

## Increased impact through accelerator programme

In recent years, our companies have shown themselves to be resilient and motivated to embrace technological innovations to enhance the success of their organisation. Flanders Make wanted to support them even more strongly to boost and accelerate progress. That is why we took the initiative to set up an acceleration programme within the scope of the European recovery plan. With this, we want to accelerate investments in end-to-end digitalisation and automation. The project was granted 11 million euros of additional support from the Flemish government for companies and Flanders Make, with the aim to completely renew our manufacturing industry while at the same time – with a view to the future – making it more sustainable. This programme got a very positive evaluation and could already be started at the end of 2021. In the accelerator programme, we bring 6 industrial innovation leaders (Vandewiele, Picanol, Atlas Copco, CNH, Crops, Sabca) together in an ecosystem with technology developers and suppliers from Flanders and Europe. The 6 leading companies, in turn, invested 53 million euros in the project. Each company will reap the benefits of this ecosystem by sharing information about its own development steps in end-to-end digitalisation and automation.

## Sustainability as the trend of 2022

In 2021, data and algorithms continued to gain in importance. The use of artificial intelligence in combination with domain knowledge, virtual applications (such as digital twins) and data came more prominently on the agenda, indicating that the transition towards Industry 4.0 is in full swing. The increased interest in investing in sustainability also stood out. Rising energy prices and shortages of raw materials make companies realise even more that it pays to be more frugal with the available resources.

Thanks to our extensive domain knowledge, we are able to use AI and data to tailor all new innovations to the sustainability needs of the industry. We use data and algorithms to extract information from product use and adjust the production process accordingly: this is how we achieve product & production intelligence. This will make the hugely important customised and high-mix, low-volume production smarter and more sustainable. Our focus is also on green energy, carbon

neutrality and the aforementioned workable work. In addition, we are continuing our research into digital twins to extend the life span of machines through simulations and planned, predictive maintenance. Finally, we also focus on digital prototypes to make production more sustainable and consume fewer materials. We are able to make technological advances thanks to the strong collaboration ecosystem that we have been building up in recent years.

## Broadening the field of action

Finally, I am proud to say that the impact of Flanders Make is growing. The innovation ecosystem that we have built works efficiently. It leads to more and more results and collaborations, so its impact is both direct and indirect. In recent years, we have been working more and more transversally, helping companies beyond the manufacturing industry to overcome challenges. Our accumulated technology found its way into the healthcare sector, among others, primarily because of the corona crisis. We are also increasingly cooperating with the pharmaceutical, logistics and food sector as, after all, these sectors also have manufacturing challenges. Our strength here lies in the technology pull: we are really looking for innovative solutions to common challenges, which will help the whole industry to move forward.

We must maintain our focus here and continue to seek connections with other innovation actors in the industrial landscape. Companies that come to us should be aware that they will be immediately integrated into our wide network of peers, spearhead clusters, colleges of advanced education and other initiatives. These kinds of close partnerships contribute to new, fruitful ecosystems, such as in our accelerator programme. The reusable results coming from these partnerships are useful for all companies and the entire Flemish region. And so we come to that circular story again, which will give our industry a lot more clout in the years to come!

**Dirk Torfs**  
CEO

**When we look back at 2021, the operational flexibility of our companies is striking, as it was in the first corona year. Companies are recovering from the corona crisis and are going full steam ahead for sustainability. Also Flanders Make continued to grow strongly, as an ever-increasing group of production companies has picked up on our technological valorisation potential.**

### Resilience creates post-crisis growth

After the severe impact of the corona crisis in 2020, the resilience of our companies continues to stand out. Our biennial Industry 4.0 survey in the summer of 2021 showed that 75 percent of the participating companies expect their turnover to return to pre-crisis levels by 2022. Nine out of ten of them are convinced that their turnover will return to the pre-coronal level by 2023 at the latest. When it comes to employment, their estimate is even more optimistic: 85 percent estimate that it will return to normal in 2022, thanks, amongst other things, to supportive government measures. Nine out of ten companies estimate that by 2023 at the latest, they will be operating with the same workforce level as before the crisis. However, companies are finding it increasingly difficult to recruit new employees due to the tightness of the labour market.

The current economic recovery should be viewed with cautious optimism. Entrepreneurs are positive, but the disruption of supply chains continues. Next to the prices of materials and components, the logistic costs also rose sharply. In addition, there are still shortages of computer chips, which is not about to change any time soon. Furthermore, energy costs have risen sharply and higher inflation is also pushing up labour costs. Companies with strong market positions can pass on these higher costs, at least in part, in their prices. For other companies, the impact of all these elements will weigh negatively on their margins and consequently on their growth potential. That is why two-thirds of the responding companies use digitalisation mainly for cost control and efficiency gains.

### Maintaining the digital lead

Flanders Make systematically monitors the digital evolution of our (manufacturing) industry. Since 2017, we conduct every two years a specific survey on the implementation of Industry 4.0 and digital transformation. Last year, 80 percent of the participating companies considered themselves equally or more competitive than their competitors, compared to 70 percent in 2019. As such, the corona crisis did not have a negative impact on their Industry 4.0 readiness. On the contrary, it is a boost to report that now 45 percent of the surveyed companies believe they are (much) stronger than their competitors in Industry 4.0 applications, up from 32 percent in 2019. The top priority here remains the further automation of shop floor applications. Numerous sensors and the processing of acquired data further optimise the operation and uptime of innovative product cells.

### Sustainability sets the agenda

What else stands out as the next step in the deeper implementation of Industry 4.0 in our manufacturing industry? That sustainability has found its way into the strategic agenda of our companies. The future agenda and roadmap of our companies is now determined by the triptych of digitalisation, competitiveness and sustainability. Here, digitalisation acts as an essential lever for both competitiveness and sustainability. Note that we are talking about sustainability in combination with competitiveness, not at the latter's expense. Companies are increasingly realising that they cannot be top players in the future if they do not develop their products, processes and organisation in a sustainable way.



“

Sustainability is coming to the forefront: it is now part of the strategic agenda of Industry 4.0”

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

Meanwhile, banks and investors also expect companies to consistently address the ESG agenda: the environmental, social and corporate governance challenges.

How can companies achieve sustainability? There are three main areas of action, the first being CO<sub>2</sub> and climate neutrality. This applies to products as well as the entire supply chain. Secondly, there is the social dimension. Sustainable companies are replacing repetitive work with automation through robotisation, or are using co-bots to reduce the workload of operators. Technologies such as digital instructions also simplify work. Reskilling and upskilling their employees is another main focus point of companies. Finally, sustainability also revolves around the circular aspect: extending the life span of products, reusing products and reducing waste flows to zero waste. Companies want to limit their energy and waste flows as much as possible and thus drastically minimise their environmental impact.

### Strong growth of our activities

Finally, it is important that Flanders Make remains the pacesetter and partner in the implementation of digitalisation and Industry 4.0 with companies established in Flanders. During the corona crisis, we achieved a strong business growth of 35 percent: we are increasingly deepening and broadening our cooperation with our customers. Moreover, the valorisation of our technological solutions does not only apply to our core members, but extends to the wider industry through collaborations and partnerships. Every sector with production systems now acknowledges how we can take their competitiveness to the next level.

#### Urbain Vandeurzen

Chairman of the Board of Directors of Flanders Make



# Which ten trends stand out?

After conducting a survey among our member companies in 2021, we got a razor-sharp picture of their digitalisation and Industry 4.0 strategy. Thanks to the increasing importance of sustainability, this factor is also becoming decisive for the competitiveness of our companies. In addition, many companies see digitalisation as a cost-saving measure, yet it remains difficult to interpret big data into actionable information. We provide an overview of the ten most important trends related to Industry 4.0.

## 1. SUSTAINABILITY IS THE MOTOR OF THE INDUSTRY

Sustainability is no longer an option: it is a necessity. Companies understand that creating sustainable products, services and production systems will become the new norm for survival in the manufacturing industry. The participating companies show that sustainability is high on their agenda, awarding an average importance of 70 percent to its various aspects.

## 2. COMPANIES ARE MORE THAN EVER READY FOR INDUSTRY 4.0

No less than 45 percent of our companies are ready for Industry 4.0 (an increase of 13 percent compared to 2019). They give themselves an average rating of 76 percent. This is promising, as they act in a rapidly evolving context. Surprisingly, company size has hardly any impact on their Industry 4.0 readiness.

## 3. THE MAIN DRIVERS FOR DIGITALISATION ARE BASED ON COST REDUCTION

Especially among larger companies, the main drivers for digitalisation are now cost-based (62 percent), whereas in 2019 there was a clear balance between cost-based and revenue-based drivers. The experience gained gives companies important insights into the return on their digitalisation actions.

## 4. COMPANIES ARE AGAIN FOCUSING MORE ON INNOVATION AND DIGITALISATION

After a difficult year in 2020, the majority of companies are resuming their focus on innovation (66 percent). Virtually all companies (96 percent) place digital transformation high on their agenda. Both innovation and digital transformation are therefore indispensable to remain competitive in a very challenging global market.

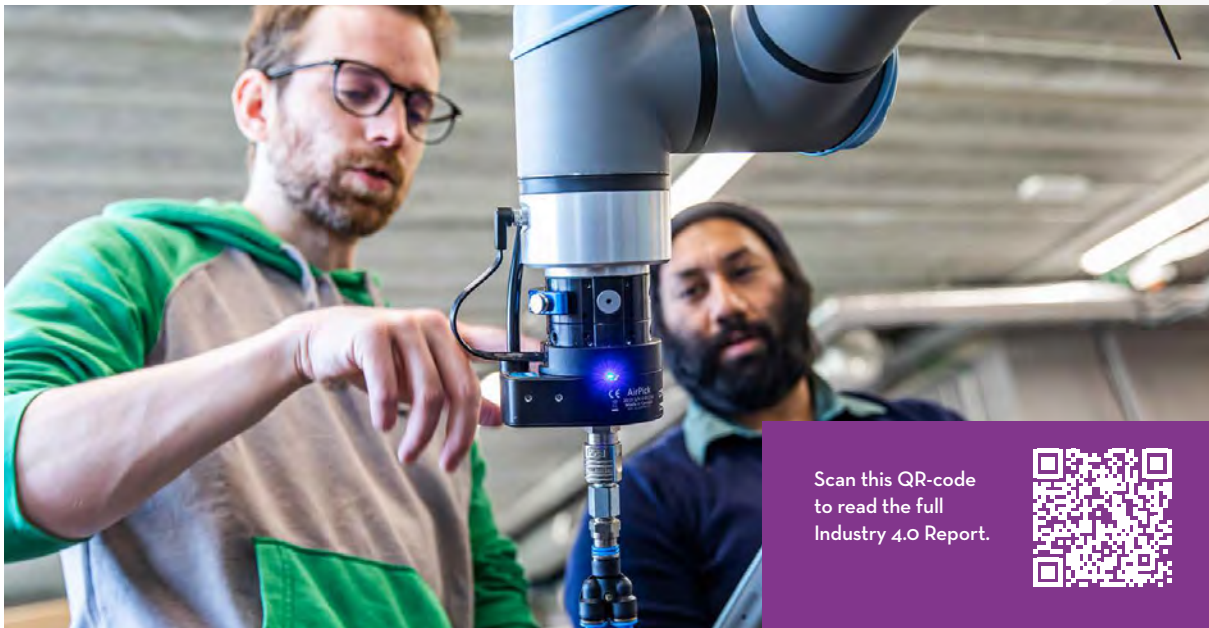
## 5. COOPERATING ECOSYSTEMS ARE INCREASING

So far, only a quarter of the participating companies recognise the benefits of collaboration in ecosystems, which is a key driver of sustainable growth. Increased awareness and active commitment can make a big difference to the competitiveness of our industry.

## 6. COMPANIES HAVE MOST CONFIDENCE IN AI AND BIG DATA

Compared to 2019, artificial intelligence and big data are still the technologies that companies trust the most. Now robotisation has also made it into the top three.





Scan this QR-code  
to read the full  
Industry 4.0 Report.



## 7. THE USE OF DIGITAL TWINS FOR PRODUCT DESIGN IS BECOMING INCREASINGLY IMPORTANT

Up to 34 percent of the responding companies use digital twins, with half of them using it to validate product designs. More than a quarter of them rely on digital twins for maintenance support and scenario analyses. It is therefore high time for our companies to further embrace this disruptive technology.

## 8. FOR MOST COMPANIES, A DIGITAL WORKPLACE IS THE BIGGEST OPPORTUNITY

Around 45 percent of the companies believe that a digital workplace is the biggest opportunity of digitalisation. However, over 60 percent also believe that the search for the necessary digital talent remains the biggest challenge for a successful digitalisation of their business processes. It is therefore crucial for our industry to invest in developing the working population. Only in this way, we will be able to achieve a competitive advantage that truly puts people at the centre of production.

## 9. BIG DATA ARE AN IMPORTANT ASSET, BUT MANY COMPANIES ARE STILL STRUGGLING WITH IT

About 8 in 10 companies collect data, but almost 60 percent of them are still struggling with the implementation of those data. Moreover, only 28 percent of the responding companies have an OT (Operational Technology) department. This department should take a leading role in a successful Industry 4.0 implementation, starting with the installation of a solid Internet of Things (IoT) infrastructure.

## 10. STOCK MANAGEMENT TAKES MORE ACCOUNT OF PRODUCT SCARCITY

As a result of the corona crisis, the focus is shifting from inventory management to the effective availability of products. This means that 22 percent of the companies deliberately keep more stock in order to be less dependent on delays in the supply chain. Almost half of the companies are even considering changing their supply strategy.

# Man & machine: hand in hand on the shop floor of tomorrow – and even today

The increasing automation on the shop floor offers many benefits. By allowing man and machine to work together, we are arming the industry in Flanders for the future. At Flanders Make, we help companies to fully embrace digitalisation and Industry 4.0, while also paying a great deal of attention to the human aspect. Below, you'll find a selection of the wide range of applications that companies in Flanders are already using.

## An abundance of information

The factory of the future generates a continuous flow of data that help us to increase the efficiency of our work. These data enable, amongst other things, a faster and error-free production, as well as a decreased use of raw materials, energy and water. Data allow us to predict maintenance periods and avoid unnecessary machine downtimes. This increases productivity and reduces labour costs. Production processes that moved abroad on account of high labour costs may even return to our country. Thus, by meticulously analysing this wealth of data and implementing the results in the production process, we can maintain our competitiveness and prosperity.

## Man or machine?

Both man and machine have specific individual advantages. Machines, for instance, operate day and night and achieve a high level of accuracy. They are therefore ideally suited for carrying out routine work tasks. People, on the other hand, are much more flexible in dealing with change and have a higher ability to adapt. People also bring in innovation and creativity. In the industry of the future, therefore, people will definitely continue to play a central role. We can complement machines with human knowledge and competences. A good example is the home computer: it was far from commonplace forty years ago, but in the meantime this technology has become an indispensable auxiliary tool.

## The many applications of new technologies

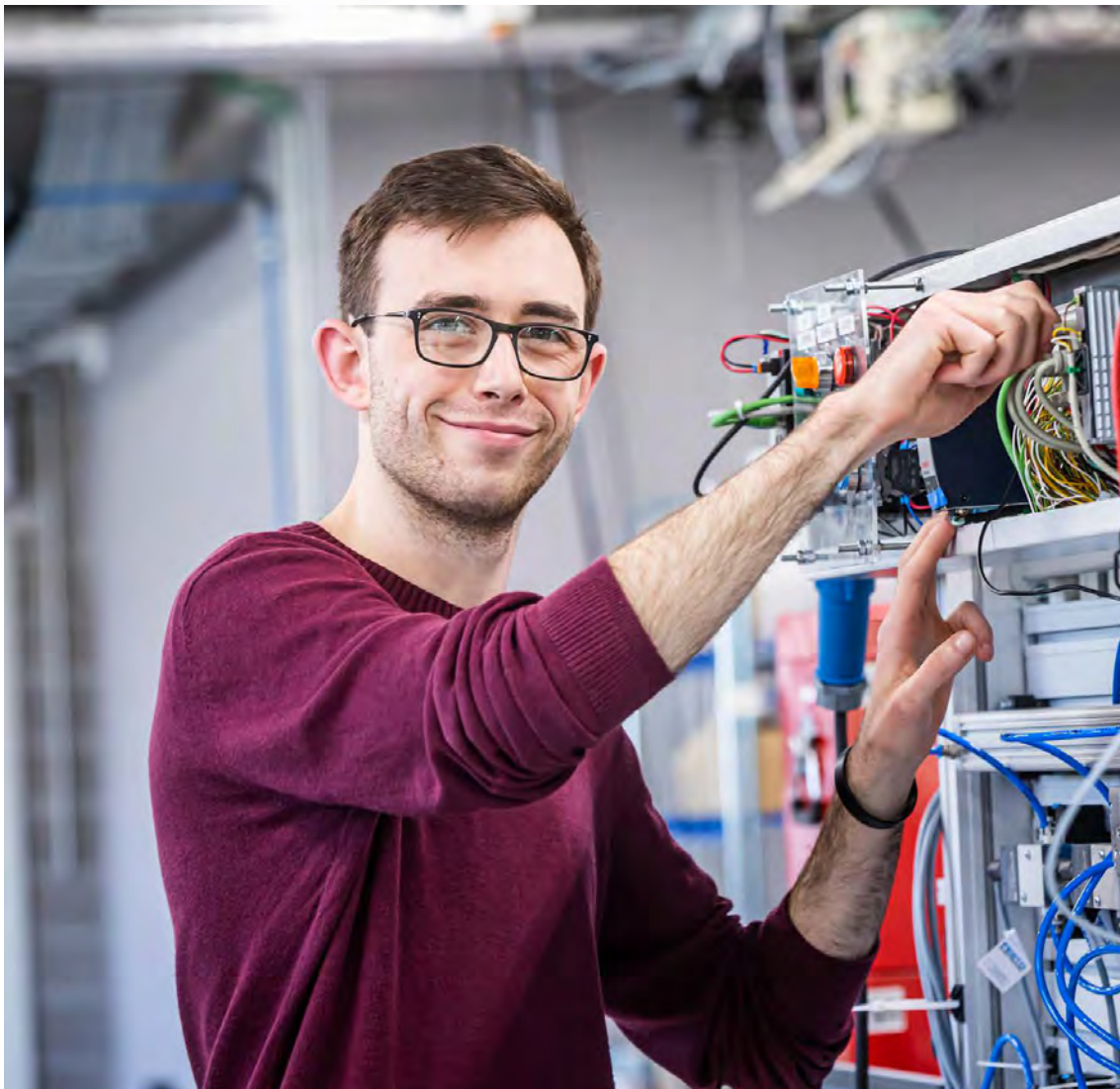
Commitment to sustainable, high-quality workable work is a win-win for both employers and employees. For employees, new technologies make work more exciting and easier to perform. In turn, organisations can count on motivated, competent and productive employees. And machines? They not only help in the literal sense: they also support numerous Flemish companies through their computing power. An overview:

- Through **digital instructions** on the worktop, projected by beamers, production workers receive clear instructions on how to assemble parts. Also, a message is triggered whenever operations are carried out incorrectly, allowing operators to assemble different products more quickly. This also provides opportunities for people with physical and mental disabilities, who will thus be able to carry out more complex tasks.
- With **augmented reality glasses**, an on-site expert can simplify the training and support of workers on the shop floor. This expert can communicate with technicians and make notes on the screen of their glasses.
- **Collaborative robots or cobots** are designed to work safely with humans in the same work environment. A cobot is the ideal assistant: it can take over repetitive and heavy tasks and even provide a third hand during production. The addition of artificial intelligence to these robotic systems will revolutionise the way humans and

robots work together. It may seem futuristic, but a worker can even demonstrate an action, allowing the cobot to learn the task and take over.

- It is increasingly difficult to find workers in agriculture and fruit growing, such as fruit pickers. A **strawberry-picking robot** can help here. The robot sees which strawberries are ripe and is even able to pick the fruit without crushing it. Drones can help here as well: thanks to artificial intelligence, they can count the number of strawberries from the air. Crop growers can thus predict their harvests much more accurately and plan their processing better.

Thanks to expertise, vision and know-how in partnerships, Flanders Make is able to offer innovative answers to the biggest technological challenges of today and tomorrow. It may therefore come as no surprise that we contributed to the development of each of the aforementioned examples in our companies. The future is now!



# Product∞ion intelligence

In consumer-oriented applications, AI algorithms are already well established. They recognise our voice commands and what is in our photos, or predict what you will buy in the shop. However, the industry needs to approach this technology differently. Whereas in consumer-oriented technology we often look for the similarities between countless different examples (e.g. recognise a car independently of its make and type), in industry we want to look for the small, rare differences between countless identical examples (e.g. pinpoint small production errors in a series of identical products). To make this practically possible, AI algorithms must be combined with domain knowledge about the product, the production process and/or the product-production process interaction. Flanders Make focuses entirely on this product-process intelligence or in short product∞ion intelligence.

## Why Product∞ion Intelligence?

We use the infinity symbol '∞' in this brand new term because we at Flanders Make strongly believe in an approach where data and domain knowledge are used to allow product development, production and after-sales service to interact with and learn from each other "infinitely". In this way, a company can continuously improve its product or service and at the same time extend its lifespan. Even an individual product, with its unique digital twin, can be further optimised throughout its lifecycle thanks to this approach. Product∞ion intelligence not only gives the company a competitive advantage. It is also a major step towards a circular economy, where economic development is more balanced with caring for our planet.

Compared to consumer-oriented industries, the amount of data available in manufacturing companies is much more limited. Interruptions to the production environment are exceptional and deliberately avoided. Therefore, there is little data available to analyse why interruptions may occur. Only product tests are different: customers - rightly - expect the delivered products to be reliable and therefore free of defects. Manufacturers therefore carry out a great deal of quality control on their finished products. But here too, the objective is to avoid errors, which means that the fewer errors a company makes, the less training data it has. For training AI algorithms, this is unreliable: the lack of data can lead to misinterpretations and have a huge negative impact in an industrial environment. The consequences of a consumer-oriented AI recom-

mending the wrong book are much more limited than those of an industrial AI misreading a series of defective products.

### Applying algorithms differently

AI algorithms are therefore already being extended with simple rules that further improve the output, for example by including limits on certain physical properties (such as maximum speed or temperature). Nevertheless, these results can still be greatly improved. Our manufacturing industry needs robust, explainable and reliable results and useful insights. AI algorithms should therefore be used differently: they should no longer be central, but used as a tool to improve the available domain knowledge and thus obtain product∞ion intelligence.



This table describes the difference between the characteristics of AI in consumer applications and more industrial applications.

Type	Consumer cases	Industrial cases
DATA-points, Training sets	MANY	FEW
Probability of occurrence	High - Medium Common	Low
Type	Common	Anomaly detection/estimation
<b>Impact (€)</b>	<b>Low</b>	<b>High</b>
<b>Impact</b>	<b>Low to no casualties, no to low production losses</b>	<b>High, severe casualties, high production losses</b>
When using trained AI algorithms	Trained cases	Frequently untrained cases - corner cases
Data ownership	Available	Company dependent/critical
Extrapolation of insights	Easy & safe	Difficult - beyond trained data set - potentially unsafe

## From models to domain knowledge

Production intelligence is based on knowledge of the product and/or the production process and their interaction, also called domain knowledge. Products and production processes are combinations of physical systems with digital logic, also called cyber-physical systems. By digitally modelling the physical behaviour and logic, we create a reliable blueprint of the product or production. Based on measurement data of the cyber-physical system, we can allow this model to evolve with the changes of the system during its life cycle, so that we obtain a living model or digital twin. As a concrete example, let us take an electric motor. We know the proportions, accelerations, speed and position of its components. AI algorithms help to predict friction and ageing based on measured data, and can therefore immediately correct the digital twin. This digital twin can then be used for further calculation and analysis of what-if scenarios (e.g. the impact of a short overload) and decision support (e.g. maintenance planning).

## Operator interaction as support

When we implement AI algorithms as a supporting technology in digital twins, we can integrate the results immediately into the product or production. But the AI can also serve as a decision support tool for the operator. If the operator sees that the AI algorithm's suggestion has a negative impact on production, he or she can reject it. In this case, the intervention creates new data that the AI can reinterpret and thus learn from. This shows once again that human interaction will continue to play an important role in the production environment of the future.

# Comprehensive data management

**More and more companies are collecting (production) data, but it remains a challenge for many to also process these data efficiently to make the production process more cost-effective and sustainable. Through comprehensive data management, a company can fine-tune itself in view of increasing its Industry 4.0- and even 5.0-readiness.**

Reliable data analyses generate innovative insights into:

- The needs of users and the market.
- Product usage.
- Product optimisation opportunities.
- The realisation of production processes for customised production.
- The right criteria for maintenance contracts and services.

When companies apply the obtained production data to their production process, their products will also become more sustainable, for instance because they will have an optimised weight. By reducing the weight of a component, we often use fewer raw materials and both production and subsequent transport will become more energy-efficient. Authorities are also increasingly considering legislation that would impose the extension of the life span of products and production data can contribute to this by making products easier to recycle.

## Faster results through external service offerings

In order to achieve results faster, we at Flanders Make are convinced that companies should consider engaging external services. This creates the following benefits:

- By implementing processed data, a company can make better predictions about product usage and consequently take firm, well-considered decisions. This, in turn, will create huge added value for their customers.
- By using automation through domain knowledge, sensors and artificial intelligence, companies can create environmentally conscious, adaptive and self-organising machines. This will optimise the production process, improve efficiency and reduce the risk of downtime.

- By being constantly connected to the shop floor and the world of the user/consumer, a company ensures that it is always up-to-date. The systems thus continuously learn in a robust and predictable manner.
- Customer access is perfectly possible through a secure connection for bi-directional interaction and co-creation between cooperating parties.

## From data to services

A company that uses its data to work towards a new model of service provision must be prepared to invest time in this. Everything starts with the collection of data, which are used to improve the product and the production process. The insights thus gained make cost-efficient design and development changes possible. Finally, these data can be shared across sectors as a service, enabling any type of business to improve its products and production processes.

(Predictive) maintenance and field services derive huge benefits from usable data. Data make it possible to repair or upgrade products and production systems in a timely manner, within a pre-scheduled period that does not at all affect production planning or product usage by the customer. As a result, operational efficiency is significantly improved and, over time, the added value will continuously increase, which in turn will lead to better services.

## Pitfalls of data management

Although the potential is enormous, it remains particularly important to choose the right service partner to help upgrade your data management. Companies should take the following factors into account:

- Go for a partner whose services are compatible with your own maturity level. In this way, improvements will be implemented gradually and be fully in line with the needs of your own customers and the required service level.
- Deploy suitable employees who perfectly understand the supporting partner's offer and who can seamlessly link this offer to your own market offer.
- Pay attention to cyber security: data breaches and cyberattacks are on the rise. The larger the company, the more likely it is to have a comprehensive cyber security strategy. A detailed plan ensures the best preparation here.

# **SERVICES SUPPORTING A SUCCESSFUL DIGITAL TRANSFORMATION**

Together with companies, we perform 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 high-tech research facilities.

### LCV TRINITY



The Flanders Make team created huge added value for the TRINITY cascade project: both as a sounding board during project application and as a coach during its execution. It is great that today the cooperation continues to further develop LCV's unique technology."

— Tom de Bruyne, CEO Laser Cladding Venture

### Robotised laser cladding makes its entrance

Laser Cladding Venture (LCV) specialises in laser cladding: a technique using laser technology to melt metal powders onto an object. Amongst other things, expensive components that are sensitive to wear and tear can be made more durable this way. Think of objects such as bearings, valves, extruder screws, excavator teeth or drill bits, which get a longer life with an extra metal coating. This technique can also be used to build up parts layer by layer, so-called 3D printing.

An important step in the production process of LCV is therefore the placement of the part and its alignment with the robot performing the laser cladding process. Until recently, this step

was carried out entirely manually, which is very labour-intensive. Together with Flanders Make, a project has been set up in which a robot with a vision system can pick the parts itself and align them completely autonomously. Subsequently, this robot works together seamlessly with another robot that carries out the laser cladding process.

This project opens the way to small-volume production of complex parts at the price of larger volumes, as LCV can now produce 24/7 using autonomous robots. As long as these robots are fed with raw materials and parts, the process can continue to run automatically.



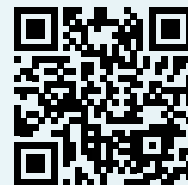
## Cooperation for machine upgrading

Many companies in the manufacturing industry have machines or installations that are no longer quite up-to-date but have not yet reached the end of their service life. They are no longer efficient enough, lack some digital features or have parts that need replacing. This does not necessarily mean that these companies have to renew their machinery: existing machines can often be given a new lease of life with an upgrade. That is why Flanders Make works together with VINTIV, a machine builder that also provides machine upgrading in its service package. Flanders Make, in turn, brings in digital upgrades from its living lab projects. The cooperation has led to a number of webinars and a highly interesting white paper that help companies in their own upgrading process. In this way, we contribute to innovations in the manufacturing industry without extensive investments and excessive use of raw materials.

“The partnership with Flanders Make is a very conscious choice for VINTIV and is crucial in our permanent development as a machine developer and builder.

— Timen Floré, Director VINTIV

More information? Read the comprehensive white paper that we developed together with VINTIV (only available in Dutch).



“Through Flanders Make, we always have access to objective knowledge and expertise in technological evolutions such as vision, artificial intelligence, digitalisation, etc.

— Timen Floré, Director VINTIV



### UGANI

## Reliable low-cost prostheses for developing countries

Ugani Prosthetics is a Flemish start-up that wants to lower the prices of prosthetics to make them more widely accessible to low-income countries such as Benin. A prosthesis is complex, with successively an artificial foot, a connector, a shin tube, a second connector and, finally, the sleeve fitting the residual limb. By 3D printing this sleeve to size, Ugani after a stroke reduced the price and delivery time, while increasing comfort. Ugani then called on the expertise of Flanders Make to also develop a low-cost version of the shin tube. During the project, we tested several design iterations in our lab for torsion, load and durability using state-of-the-art equipment. Meanwhile, Ugani tried out the proposals in Benin to ensure the feasibility of local production. We finally found the ideal intersection of durability, affordability and simplicity in Ndōtī, a tibial prosthesis that can be produced anywhere with standard materials and minimal welding. In terms of strength, adjustability, feel and comfort, it meets all requirements and, with a price between 10 and 20 euros, it is a lot cheaper than commercial products. This low-cost product thus offers a high-quality and reliable alternative for developing regions and poorer countries.



This is a revolution! So simple yet effective.

— Serge Alladagbe, Prosthetics specialist in Parakou, Benin



**DECEUNINCK**

## **Integrating employee knowledge into the smart manufacturing process through a data-driven approach and algorithms**

Deceuninck is among the world's three largest manufacturers of PVC window profiles, with more than 4,000 employees and establishments in 17 countries. In Belgium, it is market leader in designing, developing, extruding and recycling plastic systems and profiles for the construction industry. The company systematically works on process optimisation to increase its productivity and cost efficiency. In doing so, they do not want to compromise on flexibility as they want to be able to continue manufacturing smaller quantities of a certain profile within a short period of time. Deceuninck uses new methods to shorten the changeover times, which reduces production costs. For example, in its production planning, the company wants to better group its profiles by formalising the product and process knowledge of its employees. As part of our

Innovation Boosting project, Flanders Make conducted a preliminary study to determine how this data-driven approach can reduce changeover times while maintaining flexibility. We helped Deceuninck by programming two concrete building blocks. The first used an algorithm to determine the optimal order for applying plastic adhesive strips on profiles. A second algorithm helped here to estimate the changeover time by analysing production drawings. Currently, we want to test the adapted profile sequences for a selection of product families and production lines, and efficiently secure the linked data and information. We are extending this data-driven approach even further to integrate new product families and ensure flexibility in this fast-paced production environment.



### CNH INDUSTRIAL

#### Automatic baler increases yield and sustainability

Agricultural machinery manufacturer CNHi is responsible, amongst other things, for the production of the New Holland machines. The company from Zedelgem has been working together with Flanders Make for years to support the autonomisation of their machines. CNHi recently received the Agritechnica 2022 Silver Medal for their New Holland Baler Automation System. This cutting-edge innovation significantly improves the productivity of the baler. The operator sets the desired bale weight using an advanced feature, after which the system predicts the weight per bale en route and constantly adjusts itself on the basis of an algorithm. The automatic guidance of the baler then ensures an even filling of the bale chamber. As a result, the press always uses the maximum capacity without exceeding the limit. This increases productivity, resulting in more bales per day, even in varying crop and yield conditions. By maximising the processing capacity, we also reduce fuel

consumption while increasing the sustainability of the baler. Furthermore, the system prevents overloading, making manual unblocking unnecessary. In this way, CNHi is taking a further step towards a fully automated agriculture.



This prestigious award for our Baler Automation System clearly demonstrates the strength of our partnership with Flanders Make.”

— Paul Snauwaert, Vicepresident Advanced technology and Innovation CNH Industrial.





## SIEMENS INDUSTRY SOFTWARE

### Software for generating and evaluating system architectures during the early concept phase

The far-reaching cooperation between Siemens Industry Software and Flanders Make started in 2014, when Siemens as a global world player in industrial software was initially looking for our support for a specific case for a customer. The first joint research projects between Flanders Make and Siemens around the automation of system configurations and physical system design formed the basis of much more. The results of that first research led them to set up a completely new research group that would develop software around generative engineering. The result of our many years of collaboration is a completely new tool, Simcenter Studio, developed in Flanders, which can generate countless variations of systems and then also provides the necessary tools for system architects and developers to select the most suitable variant. Whereas in the past a certain architecture was chosen and then evaluated with the help of simulations, this working method has

now been completely reversed. This approach gives companies a unique competitive advantage in product design by finding the best possible system architectures to meet all the necessary requirements in a shorter time.

Meanwhile, the tool is used worldwide in the automotive, aviation and aerospace industries, for all kinds of systems. Organisations such as Renault and leading aerospace companies use it to improve the configuration of powertrains, landing gear, aircraft power systems and many other applications. To make the tool so universally applicable, a lot of research has been done in the past eight years, including a whole series of research projects with Flanders Make. In the coming years, the cooperation will be continued strategically with research topics on digital twins, artificial intelligence and sustainability.



Flanders Make continues to bring ideas that confirm what we are doing, tools that help us improve our product and academic partners with whom we can go even deeper into more fundamental aspects.”

— Jonathan Menu, Research manager  
Siemens Industry Software



### VITALO

#### Optimisation of thermoforming

Vitalo Industries, located in Meulebeke, has more than 85 years of experience in the production of plastic and insulating parts. This is done by heating up a plastic sheet, after which one pushes a mould into it while sucking the air out. After cooling, the plate retains its shape. Vitalo uses this method to make vehicle panels and enclosures for industrial machines. Flanders Make helped Vitalo with the structural optimisation of their product design. Using an optimisation programme, we calculated the design of the mechanical structure considering the forces acting on it, as well as the requirements in terms of stiffness, strength and cost. Our optimisation programme is a multi-material topology optimisa-

tion. Here, the designer first provides us with a mesh file, with information about the geometry of the structure and the materials. Using our optimisation tool, it became clear that Vitalo could make the design for these panels 20 percent lighter. The required stiffness would be maintained, while production costs would be reduced by 15 percent. This enabled Vitalo to convince its client to roll out the modified design. Moreover, the company received 7 new orders as a result, which will increase turnover and create extra jobs, both in the R&D and production departments.



By combining Vitalo's technical knowledge with Flanders Make's project-based support, we have been able to considerably improve our design methods."

— Anne-Laure Lannoo, R&D-manager Vitalo Industries



## COOPERATION AGREEMENT

### Development of autonomous waste collection

Flemish companies create some 16 million tonnes of waste per year. A large part of it comes from production processes. This waste is often neatly separated in different containers that are sometimes emptied on a daily basis. So as to be able to make significant savings on these collection costs, Flanders Make devised an autonomous waste collection system, together with the Flemish Spearhead Cluster for Logistics (VIL), FTSolutions, DSP Automation, Pixelvision, Indaver and Antwerp University. Indaver provides services for collecting industrial waste and was already looking for automation applications, but automating waste collection is extremely complex. For example, several types of containers must be lifted and moved, both inside and outside.

Although such autonomous solutions do not yet exist, many basic elements were already on the table, such as a certified safety sensor for autonomous platforms that also works outdoors. In addition, AI algorithms are getting smarter by the day, making it easier to recognise containers in difficult weather conditions: a task perfectly suited for Pixelvision. Flanders Make is also working on data augmentation techniques to train these AI networks through computer-generated images. Combined with ultrasound technology from University of Antwerp, we integrated all elements into a robust solution. Together with FTSolutions and DSP Automation, we then analysed which design would be most favourable in terms of cost and robustness. This resulted in a proof-of-concept, in which our software combines all sensors with controllers that lift and transport the containers. We are currently demonstrating this proof-of-concept on our mobile research platform, which enables us to extensively test this autonomous system in realistic conditions.



This partnership combines developments and knowledge of seven partners. Together, we integrated sensors, automation, AI and software into a proof-of-concept, which we are now extensively testing for autonomy.

### DANA

## Advanced Cooling Methods for Electric Motors

Flanders Make and DANA Belgium, a developer and manufacturer of transmissions and motors, have already been working closely together for many years. Based on a previous project, we continued our collaboration to improve the cooling methods of electric powertrains. An electric motor has a number of components that require cooling to maintain constant performances, but to date these components often use different cooling agents or methods. The different cooling circuits inevitably result in additional components (and thus a lower power density), energy consumption and costs in the electric powertrain.

We were able to develop a toolbox that can cool and lubricate the entire engine with just

one oil circuit. The advantage of this cooling method is that other circuits (e.g. using water-glycol as coolant) can be eliminated. In addition, it allows direct contact cooling with oil, which can greatly improve thermal performances. As a result of this research, we were recently able to apply for a patent for a solution that we came up with for a specific problem. We also developed a test set-up to validate the model. The results of this partnership are already being applied by DANA and some other participating companies. The final completion is scheduled to take place soon.



The cooperation with the Flanders Make labs on oil cooling allows us to research and test different technological solutions much faster and in a more comprehensive way, compared to our internal labs. This gives Dana's Flemish location a not unnoticed advantage over other technical centres within our company."

— Laurens Van Eykeren, Simulation and Analysis lead DANA





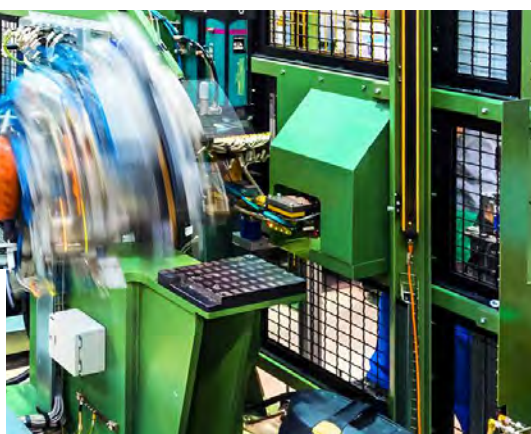


### Robots assemble air compressors at Atlas Copco

The manual assembly of air compressors at Atlas Copco used to be a labour-intensive process requiring a lot of resources and time from operators. The repetitive process with chemical glues also caused many ergonomic problems. Atlas Copco wanted to automate the assembly and created a use case of the entire assembly process. Together with KUKA, a supplier of industrial robots, they came across a specific problem. The robot had to perform a complex peg-in-a-hole manipulation, without which the whole process could not be rolled out on an industrial scale. Both companies asked Flanders Make to make this process more robust. Through several iterations, we succeeded in creating a test set-up in our Make Lab that could perform the operation

“Flanders Make’s research has had a clear impact on the realisation of the installation.”

— Luc Vastmans, Projectmanager KUKA



“We are currently investigating how we can extend this robotic assembly to large product variants.”

— Karel Vennens, Teamleader manufacturing processes Atlas Copco

flawlessly. Atlas Copco implemented the solution on an industrial scale in their factory and has been using the technology and software without any problems for some time now. What was once a labour-intensive and time-consuming assembly operation has been transformed, thanks to Flanders Make’s technology, into an elegant, automated work cell that manufactures air compressors completely autonomously. Flanders Make is now demonstrating the test set-up in its Make Lab to all interested companies that wish to automate their assembly lines.

### Liquid-cooled inverters

Bluways develops electrical energy storage systems, DC-DC converters and other electrical and hybrid systems. Inverters that convert direct current (from a battery, for instance) into alternating current, which is needed by an electric motor to set a car in motion, are an important product for them. This conversion requires a lot of energy and releases a lot of heat. It is important to control this heat in order to keep the component in good working order and prevent overheating. As a standard, this is done by a heat sink with a large contact surface area that dissipates heat

to the air coming into contact with it. Together, we performed research into an alternative way of cooling such parts and worked out a method to bring liquid coolants directly into contact with the parts to be cooled. Not only is this method more effective in extracting heat, it also allows to reduce the size of these components and place them closer together because they no longer need large heat sinks. Bluways started working with these findings to incorporate the method into its own products. The company developed new liquid-cooled inverters that



## 3D printed parts under the microscope

Materialise has over 30 years of experience in developing 3D printing software and services. Originating from the KU Leuven, this is a thoroughly Belgian company that in the meantime operates internationally. After a series of previous collaborations, Materialise contacted Flanders Make to further optimise their 3D prints. With our XCT (X-ray Computed Tomography) scanner, we examined their components in detail. It enabled us to investigate where in the printing process pores are formed that weaken the whole. This gave us a reliable picture of the conditions under which unwanted pores enter a component and also

taught us how to predict them. Materialise's software is now equipped with a module that can predict and improve the porosity of a component based on these results. RS Print, a division of Materialise that specialises in orthotics for sports use, was able to use this technology to immediately improve their insoles. In addition, new protocols have been developed to evaluate 3D printed parts with the XCT scanner. This will allow us to further improve 3D printed parts in the future.

“Materialise values its long-term partnership with Flanders Make, as their team combines deep knowledge of additive manufacturing with knowledge in other technical areas such as dimensional metrology and XCT. This case is a fine illustration of this combined strength.”

— Tom Craeghs, Research manager Materialise



“The guidelines, experimental data & issues identified by the Flanders Make MotionS core lab helped Bluways to design a direct liquid-cooled heat sink for a SiC inverter. This led to a faster market introduction of a liquid-cooled heat sink design.”

— Johan Lecoutere, CEO Bluways International bvba

use the already available cooling circuit to achieve higher energy density values. The first models of these inverters came onto the market as early as 2022.



### Social distance monitoring with cameras



### Social distance Monitoring



Warning : Social distance not respected

### Validating the quality of wind turbine gearboxes with accelerometers

ZF Wind Power develops and manufactures high-tech gearboxes for wind turbines. As market leader, the company is involved in the production of a significant number of wind turbines worldwide. In view of the ever-increasing

“It was again a great cooperation with the experts of Flanders Make. They helped us with their top-level expertise in programming and sensors. This allowed us to increase the validation speed of the NVH prototype and reduce its cost.”

— Sebastian Schmidt, Team lead Noise & Vibration ZF Wind Power

demand for wind turbines in the energy transition, ZF is permanently aiming to increase its efficiency and performance.

At the end of the production line, the manufactured gearboxes are tested and validated to make sure they meet the quality requirements. Until recently, this was done with encoders and adapters that had to be developed anew for each model, which also lengthened the production time. Together with Flanders Make, ZF has now developed a new method based on accelerometers to build standardised measuring equipment for all gearboxes. This method is now used as a new standard within ZF and saves a considerable amount of time and costs. This made it possible to shorten the delivery times of the products, which – obviously – generates added value for both ZF and its customers.



## Through 2D cameras and composite 3D images to sound signals for social distancing.

One of the major global players in the field of quality skincare, make-up, perfumes and hair care products had some hotspots in its Flemish establishment where social distance could not always be maintained during the corona crisis.

We developed a social distance monitoring system for this cosmetics player that uses ordinary 2D cameras. By combining the images of multiple cameras, we can determine the exact position of each depicted person in 3D. Then it is just a matter of calculating the relative distance between people and giving a targeted warn-

ing signal when it is less than one and a half metres. The camera-based social distancing system was active in the company restaurant throughout the corona pandemic, raising awareness of social distancing. The application only requires minimal investments and is a very good example of how research institutions such as Flanders Make and industrial companies in Flanders can work together very quickly to improve the safety and sense of comfort of employees.





### Adaptive training support in virtual reality

Operators on an assembly line are increasingly faced with shorter production runs of different products. Changing production possibilities and the demand for customisation mean that operators have to switch between work instructions more quickly. It is therefore extremely important that operators are well informed about any change in the assembly. This requires short training sessions, which should preferably be fast and productive to ensure a smooth changeover.

Rhinox builds applications for virtual and augmented reality, amongst other things to teach assembly operators new work instructions faster. By virtually simulating the working environment of operators in VR, they can go through instructions and practice actions in real working conditions before they actually have to carry them out. It is not easy to build a work instruction that makes sense to everyone. Some operators need some more explanation or an instructional video, others are satisfied with a short text and some instructions. We therefore worked together with Rhinox (and its customer CNH) to develop an additional feature in their VR training framework that intelligently predicts

“This project led to new functionalities in the Rhinox VR training framework. It allows us to have a better market position and also to offer these features to new and existing customers alike.”

— Leonard Tam, Managing partner Rhinox

training levels. For each training course, we look at the previous training courses taken by the operator, and how other operators have gone through this particular training course. This allows us to make a smart prediction of the desired level of training for each individual operator.

The recommendation system has been fully integrated with Rhinox's VR application for CNH. Rhinox is also considering next steps to include this system as a standard in their offer to other companies.

## Research into cancer treatment with heat therapy

ElmediX was founded in 2015 as a spin-off from the University of Antwerp. The company wants to develop a disruptive solution for treating (pancreatic) cancer and other life-threatening diseases. There is a specific

“Thermal Therapy by ElmediX is a safe and hopefully effective way to combat metastatic tumours. All our lab tests point towards a positive result for the patient.”

— John-Paul Bogers, CEO and Founder ElmediX

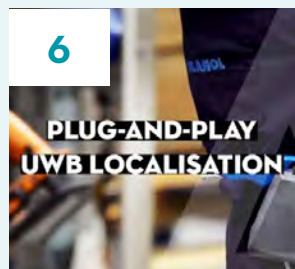
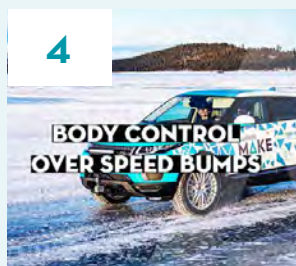
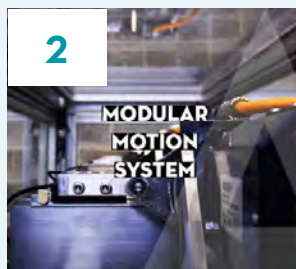
zone in which tumour cells are sensitive to heat. This is situated around 41.5 degrees Celsius, which has no negative effect on the normal body cells. With a special incubator, ElmediX can reach this temperature very precisely. The patient is first put under general anaesthesia in the incubator, after which the incubator warms up. The patient's temperature is then measured

with high-precision thermometers inside the body. This heat treatment results in the direct cell death of cancer cells (apoptosis, necrosis), stimulates the immune system, makes cancer cells visible to the immune system, reduces the cancer cell protecting stroma, increases the oxygen concentration and blood circulation in the tumour, and increases the sensitivity of cancer cells to chemo- and immunotherapy.

Flanders Make gave advice for optimising the control algorithms of a prototype treatment device and for modelling part of the physiological processes that occur during treatment. Current developments focus on pancreatic cancer, but research within ElmediX shows that this method is also effective against other cancers. This technology can help treat metastatic cancers in particular. After this study, ElmediX plans a global study with 100 patients. Flanders Make will also be involved in further developments at a later stage.







**TIP: DISCOVER ALL THESE INNOVATIONS BY SCANNING THE QR CODES**

**Every year, Flanders Make works out a number of demonstrations that we like to show to the outside world. COO Marc Engels is happy to tell more about the demonstrations that could convince him and produced the most promising results for the industry.**

**What is the purpose of these Flanders Make demonstrations?**

We believe that demonstrations are the best way for people to experience technology. They introduce people to our more mature research results and offer a glimpse into the near future.

**What will that future look like?**

There are several possible answers here, but in any case products and production systems will become more digital, smarter and more people-oriented. Their lifecycle is also being optimised. In our vision, there will eventually be a digital twin for every physical component, such as a vehicle or production machine, or even a product in a production process. This digital twin combines the knowledge of the assets, encoded in a model, with the data and measurement signals of these physical assets. Based on this information, analyses and what-if simulations can be carried out. In practice, however, data analysts spend 80 percent of their time on data collection and only 20 percent on carrying out the actual analyses.





Marc Engels, COO  
Flanders Make

“We believe indeed that new technology can lead to a digitally transformed, sustainable and competitive industry in Flanders. And I am proud of Flanders Make’s contribution to this future.”

— Marc Engels, COO Flanders Make

In our demo on the offline digital twin, we show how Flanders Make’s knowledge graphs solution can reverse this situation, leaving more time for the actual data analysis (QR code 3).

#### **And these data will make products smarter?**

Yes, definitely, but location awareness and over-actuation will also contribute to this intelligence. An increasing number of infrastructures, from autonomous guided vehicles to sensors, need to know their own situation. Indoor ultra-wideband location technology has good accuracy rates (less than 10 cm) but requires a time-consuming installation procedure. In our demo, we show a plug-and-play UWB system that reduces the installation time by 90 percent (QR code 6). A smart system always uses actuators to perform actions in the real world. The more actuators, the more possibilities you have to integrate smart actions. In our demo on a modular motion system, we show that replacing a single motor by a complicated powertrain with several direct drive motors increases the maximum speed by 40 percent and enables a fault-tolerant operation (QR code 2). Another example of an over-actuation in which we have been looking for improvements can be seen in our demo on speed bump body control (QR code 4). By cleverly combining control of the electric traction motors and the active suspension system, the impact when driving over a speed bump could be reduced by a quarter.

#### **All these examples show smartness in the operational phase of the product. So is intelligence limited to this phase?**

No, we believe that the entire lifecycle should be taken into account when designing an intelligent product: from production and use to dismantling and recycling. This is a long-term goal where much progress can still be made in the industry. Even the systematic weighing of product performance against manufacturability is an open challenge. We show a solution to this in our demonstration on designing products for optimum performance and assembly (QR code 5).

#### **With all these smart systems, for example in production, will we evolve towards human-free factories?**

We don’t think so. The flexibility of people is unparalleled and, with the growing importance of flexible production, people will continue to be essential. However, production technology can support these production workers towards a sustainable, workable and productive job. Two demos illustrate this trend. In the demo on robot programming, we show how programming through extended reality demonstration can reduce the programming time by half (QR code 1). In the other demo, we show a versatile mobile third-hand operator support that makes a second person unnecessary for certain tasks and avoids non-ergonomic operator postures (QR code 7).

#### **Your vision of the future of industry and technology seems very optimistic.**

We believe indeed that new technology can lead to a digitally transformed, sustainable and competitive industry in Flanders. And I am proud of Flanders Make’s contribution to this future.

# Increased sustainability and resilience thanks to Flanders Make's accelerator programme



We've chosen, very deliberately, for a cross-sector approach that considerably increases the practical applicability for the industry"

— Dirk Torfs, CEO Flanders Make

As a research institution that aims to bridge the gap between the research world and businesses, Flanders Make is constantly creating ecosystems in which the various parties reinforce one another. This is also the approach of the accelerator programme, which recently received a Flemish Resilience Grant worth EUR 11 million. By focusing this programme on 'High-Mix, Low-Volume' production, we help our manufacturing companies to become more competitive and flexible, and enable them to offer their customers more customisation at a lower investment cost.

We cannot stress it enough: thanks to smart technology and investments in Industry 4.0, companies are keeping their design and production costs under control. In addition, they remain competitive in the segment of customised work in smaller volumes. It is the perfect way to offer production companies from home and abroad every opportunity to establish and anchor their production here

in Flanders. It also makes our companies less dependent on suppliers from abroad and it increases their competitiveness.

## More impact through the combination of research and development

"Flanders Make's activities have always revolved around innovative technology for production companies", explains CEO Dirk Torfs. "Now, digitalisation has become more important than ever. In this post-Corona relaunch period, we want to help companies to benefit from accelerated digitalisation. We demonstrate the opportunities by having a number of leading companies work together on a complete research and development project. In this project, they share their insights so that projects lead to results faster."

## Six leading companies

Within the accelerator programme, Flanders Make creates a number of demonstration environments on the Flanders Make co-creation infrastructure. In addition, there will be pilot production lines on an industrial scale at the six participating lead companies: Atlas Copco, CNHi, Crop's, Picanol, Sabca and Vandewiele, each of them also working together with technology developers and suppliers. Their research and development tracks are shared across the six pilot production lines. Finally, we also use the research results of Flanders Make from the past six years.

"Such a coordinated initiative is unique and therefore also a real challenge. By achieving clear results in the pilot projects, other companies will be triggered to contact the lead companies. This in turn will create new, commercially interesting partnerships that can grow independently so that this project will benefit the wider industry", Dirk adds.

## New ecosystems

Flanders Make's typical approach as a bridge builder between the research and business worlds comes in handy here. "In fact, we are constantly building ecosystems in which partners and companies work together in a highly targeted way", explains Filip De Coninck, CVO of Flanders Make. "The lead companies in this project get more out of their R&D programmes through cooperation with others. Furthermore, the suppliers involved – integrators and technology companies – are challenged to develop new technological solutions and integrate them into their service offer."

## From island automation to end-to-end digitalisation

"In recent years, many companies have already invested in digitalisation, but they usually focused on only one aspect. As it requires large investments of time and resources, they often get stuck with 'island automation'. By working together within an ecosystem, much more is possible thanks to economies of scale. That is why we speak of 'end-to-end digitalisation', where all processes are coordinated: from product design to production control and management. With this accelerator programme, we can use this working method even better as leverage for the local market."

"This new research and development programme is therefore perfectly in line with the objectives of the Flemish and European governments in terms of the digitalisation, sustainability and transformation of the economy. People are also included in this broad picture: it is essential that organisations digitalising their processes also focus on workable work, the development of digital skills and the support of their employees. In this way, not only the production quality but also the satisfaction of each employee is increased", concludes Filip De Coninck.

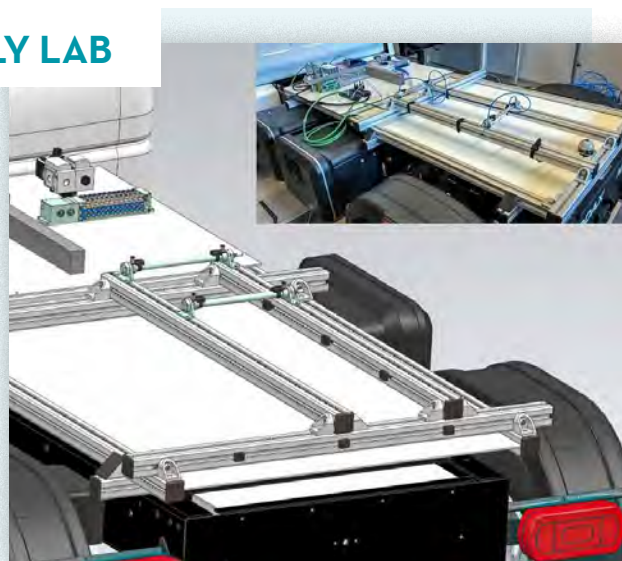
Making production companies more resilient and sustainable at an accelerated pace: that is what Flanders Make wants to achieve with its 'accelerator programme'. It also received a Flemish Resilience Grant of no less than 11 million euros for it. The top companies Van de Wiele, Picanol, Atlas Copco, CNH, Crop's and Sabca are fully committed and together invest another 53 million euros in the project.

## New infrastructure

Also in 2021, Flanders Make continued to invest in own infrastructure. This enables us not only to continue to support our own research, but also to assist companies in their technological innovations in product and production processes by offering a wide range of services. The objective here remains the same: digitally transforming the industry and helping it move towards an Industry 4.0 approach.

### SMART AND FLEXIBLE ASSEMBLY LAB

Our assembly lab consists of a controlled, realistic 100 m<sup>2</sup> environment for validating and demonstrating smart and flexible assembly solutions for large and highly variable products. This includes, amongst other things, a platform for digital work instructions, work cells with operator support, collaborative workspaces and monitoring systems for operators. We can evaluate workstation concepts, map out the impact of different operator support tools and assess the feasibility of flexible automation concepts for real, complex tasks.



### EVALUATION OF RUBBER BUSHINGS AND VIBRATION ISOLATORS



Bushings are components (often in rubber) that absorb vibrations in systems. They exist in different shapes and are subjected to different loads. We offer several test systems to distinguish between bushings in different contexts. These consist of different subsystems to allow for versatile test conditions. For example, we have various shakers that can generate vibrations in a wide range of frequencies, and we can also use customised moulds to exchange the connection interfaces for different bushing components/systems and operational configurations. Furthermore, we use highly accurate force transducers to take the necessary measurements in all possible directions.





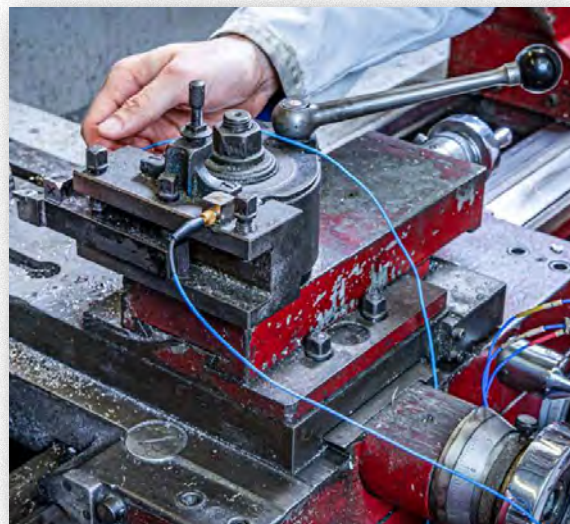
## VALIDATION TESTS FOR ENVIRONMENTAL AND VIBRATION REQUIREMENTS

The amount of electrical and electronic components in vehicles is increasing every year. All these components are subject to thermal and mechanical stress. To ensure a trouble-free operation, these components must be tested simultaneously. This is because certain malfunctions only occur with certain thermal or mechanical settings. Our EnViVa test lab is equipped with an electro-

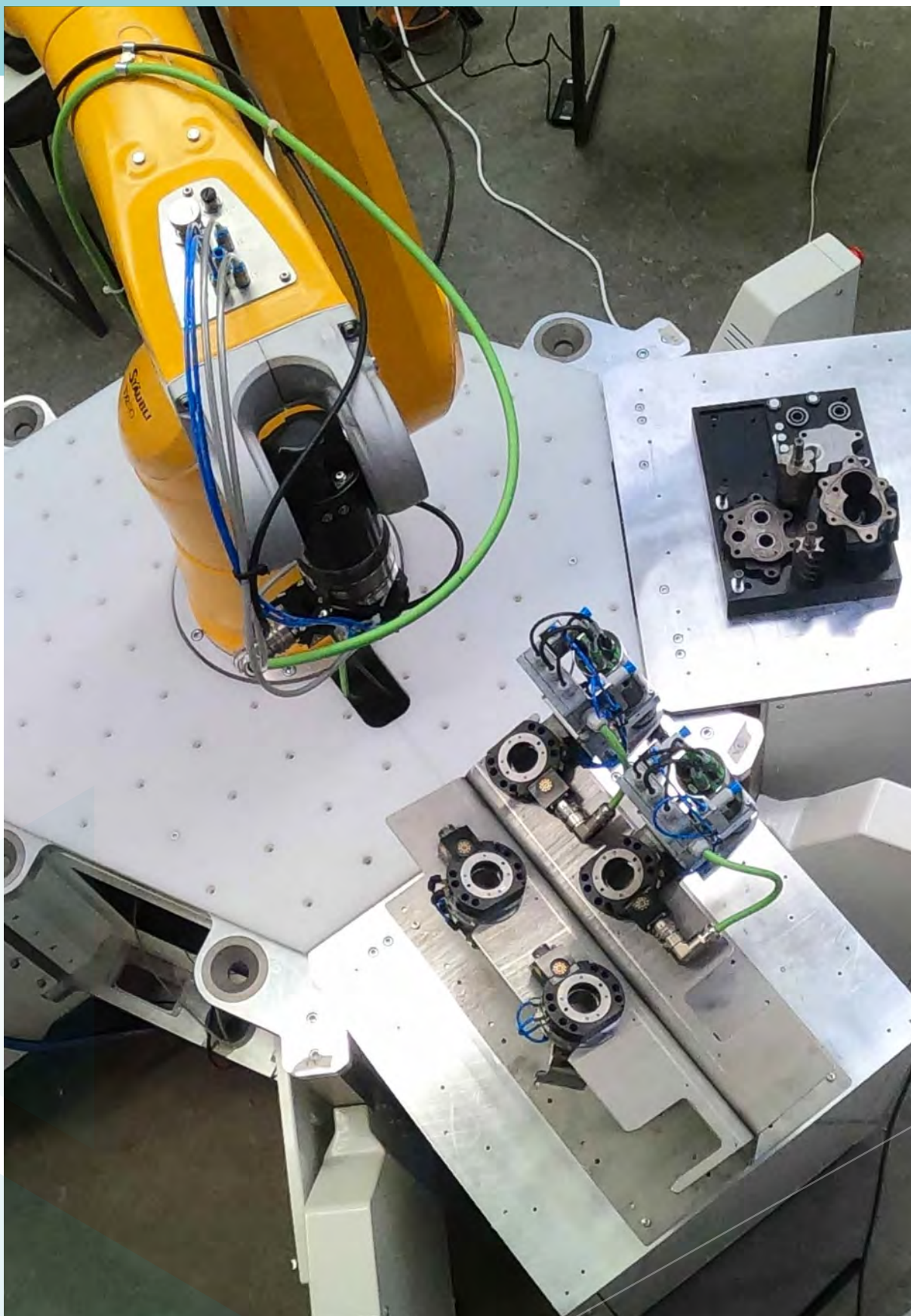
dynamic shaker, combined with a climate chamber and a sun simulation system. This enables us to perform comprehensive mechanical and thermal tests. These tests can realistically simulate a particular environment, but can also deliberately seek out the limits of a component in terms of vibrations, temperature, air humidity and UV radiation.

## PORTABLE SET-UP FOR MODAL ANALYSIS

Much of our infrastructure is immovable due to its size. That is why we also have a portable modal analysis set-up, including portable drives, vibration sensors and other sensors to collect data. This portable set-up allows us to perform the necessary resonance amplification tests on site or at structures that are difficult to reach, and to validate dynamic models.



## NEW TEST AND VALIDATION INFRASTRUCTURE



# New testing and validation infrastructure

Progress, discoveries and developments go hand in hand. Flanders Make also responded to the latest trends in 2021 with novelties in our test and validation infrastructure. Here you can read about the most striking and leading structural changes we realized in 2021.

## INFRAFLEX

A major challenge for our manufacturing industry is the growing demand for customized products, preferably at the same price as mass production. This requires more flexibility in the production and assembly process, without losing sight of cost efficiency and quality. Our manufacturing industry is therefore asking to be able to try out new production and assembly processes, preferably at a feasible investment cost and in a way that leaves the current productivity intact. Our Infraflex test environment was developed with this in mind. The goal of this infrastructure project is to build a reliable, flexible, next-generation industrial manufacturing environment that enables companies to prototype flexible assembly systems on an industrial scale. This will allow these companies to set up, test, validate, demonstrate and then also definitively implement an assembly process into their broader production process in a short period of time.

### Modular and flexible platform

Our Infraflex environment consists of an open architecture of multiple reconfigurable work cells for various assembly tasks and quality control. These cells allow for a flexible and reliable way to assemble, disassemble and achieve an optimal, uninterrupted one-piece flow of multiple customized products with short reconfiguration times. The infrastructure also includes extensive monitoring equipment, which collects valuable production data and also allows for in-depth evaluation of the process.

### Added value for companies

The objective of this infrastructure is to allow companies to test, validate and demonstrate new concepts to convince them of their Industry 4.0 initiatives. We work with a customer to develop a setup that can run a specific, analyzed process, with existing or newly developed components, across one or more cells. This setup can also be built virtually first, as a digital twin of the later physical setup that we can improve in faster iterations. The software that we develop for this digital twin can even be used afterwards for the physical setup. This physical setup can then be further tested and optimized until the company is convinced of its added value. Together with integrators, the company can then tackle the further implementation.

### Expansion of platform in Kortrijk

The new site that we are currently building in Kortrijk offers a lot more space for the further development of Infraflex. There is a hall where we can combine up to seven cells, which means that we can also work very concretely on the transport between different cells. This also makes more complex assemblies possible.



## NEW TEST AND VALIDATION INFRASTRUCTURE



### GROUND-BREAKING CEREMONY FOR NEW SITE IN KORTRIJK

On 9 July 2021, Flemish Economy and Innovation Minister Hilde Crevits symbolically laid the first stone of a third co-creation centre for top technological research in Kortrijk. By the end of 2022, state-of-the-art Industry 4.0 technologies and production methods will be tested in the new building. The site will be a model for research and innovation in the mechanical engineering sector, focusing on high-mix, low-volume production. Companies from all industrial sectors will find inspiration here for the necessary digitalisation of their production processes. This is important for sustainable production, workable work for employees and the prosperity of our country. “With this co-creation centre in Kortrijk, Flanders Make once again reinforces its leading role in the transformation towards a competitive, innovation-driven and sustainable industry in Flanders. Companies that develop production systems, machines, subsystems or process software are given the opportunity here to test the latest production technologies and processes in real conditions. This allows them to continue to invest in highly competitive plants in their own region. In terms of Industry 4.0 research infrastructure, Flanders hereby joins the top regions

in Europe”, says Urbain Vandeurzen, Chairman of the Board of Directors of Flanders Make. Companies can already go to Flanders Make’s current location in Kortrijk for advice on and tests for their Industry 4.0 production. The existing test infrastructure will be transferred to the new site this autumn.

“Here we will have the space to expand and to give companies a taste of the state of the art in sustainable production. We focus on digital twins, smart robotisation and automation. The operator continues to play a central role and is given the necessary support to ensure workable work. Machine builders and their suppliers can get straight down to work with it. And we can perfectly translate all innovations to many other sectors.”

— Dirk Torfs, CEO Flanders Make





## 11 MILLION EURO EXTRA FOR FLANDERS MAKE

During the ground-breaking ceremony for our site in Kortrijk on 9 July 2021, Flemish Economy and Innovation Minister Hilde Crevits also had an additional announcement to make: “The arrival of this brand new Flanders Make establishment in Kortrijk is of great importance. The new centre will be a showpiece. Together with many partners, our companies are leading the way in innovation, research and development and sustainability. The corona crisis, meanwhile, forces our companies to make important choices and consider innovations. Over the past few years, half of the West Flemish companies have chosen to make new products and a third have been looking for new sales markets. Flanders Make is ready to assist more than 11,000 companies and hundreds of thousands of employees in innovation processes. Today, I can also announce that we will give 11 million euro of extra support to Flanders Make. These resources are meant for a new project to further strengthen the digitalisation and automation within our manufacturing companies.”

With those 11 million euros in extra resources, 6 industrial innovation leaders (Van de Wiele, Picanol, Atlas Copco, CNH, Crops, Sabca) together with a consortium of technology developers and suppliers from Flanders and Europe) can further renew our manufacturing industry and make it more sustainable. The business world, in turn, will also contribute 53 million euro.

This investment will boost the digitalisation of Flemish and European industry. This will lead to an increase in the competitiveness of our manufacturing companies from very diverse sectors (mechanical engineering, agro-food, automotive, pharmaceutical, chemical, electronic components, etc.). Equally important is that the often small technology suppliers, who are closely involved in the development of a number of pilot lines, can further develop their technology and competence and thus strengthen their market position. In addition to increasing the competitiveness of our manufacturing industry, this project will also contribute greatly to the European Green Deal. Finally, the project aims at strengthening the digital human talent and establishing a digital culture in companies.

### INFRASTRUCTURE AS A SERVICE: PROJECT MAHI



“By supporting our project of passion at an early stage, Flanders Make has again contributed to the fabric of the Flemish manufacturing industry.”

— Pieter-Jan Note, Project Mahi

Project Mahi started as a project of passion of a number of engineers, including some (former) employees of Flanders Make. Their goal was to build an unmanned, autonomous vessel that would be able to cross the Atlantic Ocean entirely on its own using solar energy. With this ambitious goal in mind, they developed in record time the technology enabling the vessel to navigate autonomously and to generate and store energy, but also to consult data from other vessels in order to avoid them. On their second and as of yet final attempt, their vessel managed to cover a phenomenal distance of 8,000 kilometres across the ocean, surviving some heavy storms with three-storey waves and promptly setting a world record for the longest autonomous solar-powered cruise.

Flanders Make supported the project with the necessary test infrastructure, such as a climate chamber in which simulations of several climates, including sunlight simulation, are possible. This allowed Project Mahi to test the vessel's solar panels in representative conditions. This gave them a better idea of the energy the vessel would generate in open sea, in various weather conditions.

Meanwhile, Project Mahi has evolved into the start-up MAHI, where it uses the acquired knowledge to develop components and subsystems for autonomous vessels. They're marketing this technology to companies that develop vessels for transport, oceanographic research or, for instance, for inspecting wind turbines at sea. That is how a small project of passion developed into a high-tech Flemish company that supports international innovation.

# **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's network

## Antwerp

- Absolem
- Agfa Graphics
- Albatros
- Alberts
- Alinco
- Amnovis
- Artec
- Atlas Copco Airpower
- Bagaar
- Coffeeroots
- Corvus Solutions
- Daf Trucks Vlaanderen
- Digi-flow
- Easy Systems
- Edmire
- Exmore
- Faktion
- Grammer Electronics
- Gumption
- Janssen Pharmaceutica
- Reniver
- Reynaers Aluminium
- Scanbie
- Sego
- Signify
- Soudal
- University of Antwerp
- Van Hool
- Voxdale

## Limburg

- Aerobel
- AMS Belgium
- Arkite
- Aversa
- Bewel
- Bosal Emission Control Systems
- Buseloc
- Dentsply Implants
- E-Trucks Europe
- Enginity
- Esma
- Ford Lommel Proving Ground
- Hela
- Jabil Circuit Belgium
- Kerv Automotive
- Laser Cladding Venture
- Maex Precision - Production
- Meam
- Melexis Technologies
- Melotte
- Oerlikon Balzers Coatings Benelux
- Pixelvision
- Provan
- Punch Powertrain
- Tenneco Automotive Europe
- University of Hasselt
- Uperio
- Vansichen Linear Technology
- VCST Industrial Products
- Vintiv
- ZF Wind Power Antwerpen

## East Flanders

- 24Flow
- Ansomat
- Augnition/Proceedix
- Automotion
- Azumuta
- Buyse Metal Works group
- C-battery
- Defawes
- Dynamic Dimensions
- Hupico
- Inverto
- loos
- Knapp Benelux
- ML6
- Niko
- Objective International
- Ocas
- PSS Belgium
- SupportSquare
- Gent University
- Van Hoecke Automation
- Van Hoecke Consulting services
- Volvo Car Gent
- Volvo Truck
- Yazzoom

## Flemish Brabant

- 3D systems
- ABB
- Agoria
- Asco Industries
- Audi Brussels
- Bluways International
- Camco Technologies
- Capvidia
- Comate
- CommScope Connectivity Belgium
- Dataroots
- Eclair
- Elnor Motors
- Icare
- Intermodalics
- Ivex
- Kapernikov
- KU Leuven
- Leuven Air Bearings
- Materialise
- National Instruments
- Noesis Solutions
- Octinion
- Optidrive
- Powerdale
- Procter & Gamble Services
- RHEA System
- Robert Bosch Produktie
- Sabca
- Sentigrate
- SEW-Eurodrive
- Siemens Industry Software



## Liège

- Ateliers Pierre Cerfontaine

## West Flanders

- Addax Motors
- Altachem
- Assemblics
- AVC
- Balta Group
- Barco
- Bekaert
- Bombardier Transportation
- Cadcorner
- CNH Industrial Belgium
- Constructie Lambrecht
- Cronos aan de Leie
- D.Cloostermans-Huwaerts
- Daikin Europe
- Damatec
- Dana Belgium
- Deceuninck
- Dekimo
- Delaware Consulting
- dotOcean
- e-BO Enterprises
- Emerpoint
- Flagstone
- International Car Operators
- Konfidi
- Logflow
- LVD Company
- Magnax
- Mariasteen
- NiniX Technologies
- OptimaT
- Pedeco
- Picanol
- Savaco
- Squadron
- TE Connectivity
- Televic Rail
- Tremec
- Unilin
- Vandewiele
- Vaskon
- VDL Bus Roeselare
- Vero Duco
- Vintec
- Vitalo Industries
- Waak Sociale Werkplaats

- Siemens
- Sirris
- Spraying Systems Europe
- Terumo Europe
- Toyota
- Transport & Mobility Leuven
- Vision++
- Vlaams Gewest
- VUB
- Xenics
- Siemens Mobility



“Through our participation in the network of European Digital Innovation Hubs, we are making our mark on the digitisation of industry in Flanders and Europe.”

— Ger van den Kerkhof, Senior Account manager EU Affairs Flanders Make

No single research organisation can provide all the technologies and services needed by industry on its own. Innovation gains strength when it takes place in an ecosystem in which organisations that are complementary to each other work together.

That is why Flanders Make, as a provider of R&D services, has strongly embedded itself in a large network of Digital Innovation Hubs throughout Europe in 2021. Cooperation agreements were concluded with 19 of these innovation hubs. Through knowledge exchange with these hubs, we increase the potential of our manufacturing companies. In the future, this will also enable foreign SMEs to make faster and easier use of the services and technology offered by Flanders Make. Furthermore, thanks to these international contacts, we are able to help Flemish SMEs better with their digital transition.

In 2021, Flanders Make, together with Voka, LSEC, Howest, PXL and BPHOT, Imec and Sirris, worked on a project proposal with which - if it is approved - we will definitively establish ourselves as a European Digital Innovation Hub for industry in Flanders with an emphasis on SMEs. In this project proposal the focus is on:

- Offering test infrastructure to test new products and processes.
- Offering a package of courses on digitalisation, with an emphasis on AI, machine learning, photonics, connected systems and cyber security.
- Supporting companies in finding the necessary investments.
- Bringing end users together with potential suppliers and innovators, to develop new digital products or processes.

Moreover, this will bring additional European subsidies to which our SMEs can apply. In this way, we will hopefully take another big step forward in 2022.

# Ecosystems are conquering the world

## What are ecosystems?

Adner and Kapoor (2009) define business ecosystems as a value-oriented network with a large number of stakeholders and various transactions between these stakeholders (Bertassini et al., 2021). An article in the 'Journal of Business Research' (Gueler and Schneider, 2021) states that "business ecosystems represent an important form of cooperation between different organisations and can be a driving force for a company's success." To maintain sustainable innovation, cooperation between the key partners in the ecosystem is a must. A McKinsey study confirms this: it states that by 2030, the integrated network economy could account for around 25% of the total economy [...] with a global turnover of USD 70 trillion.

Forward-thinking companies not only want to survive, but also aim to lead the way in view of achieving global economic success. They want to make a difference and be able to follow or even determine the pace of the market. This calls for new future-proof working methods such as ecosystems. This type of partnership is highly future-oriented and comes in all shapes and sizes, depending on the status and strategy of the various participating companies.

## Trust as the foundation

The foundation of such ecosystems is trust, integrity and commitment. When these elements are present, an ecosystem offers huge benefits to each of the participating companies. Each of them gains access to the accumulated knowledge and experience of the various member companies. Every company creates added value, both individually and collectively.

## Which companies fit into an innovation ecosystem?

Companies with an open innovation culture are ideal candidates to participate in ecosystems: they work faster, are more resilient and experience increased creative influx. To be successful in an ecosystem, a company must have five key capabilities:

- **Absorptive capacity:** being able to learn from the other partners in the ecosystem.
- **Multiplication capacity:** being able to duplicate the absorbed knowledge into multiple products, processes and services.
- **Transformation capacity:** being able to apply knowledge from other sectors in one's own sector.
- **Integration capacity:** being able to combine multiple learning experiences and integrate one's own developments into a broader context.
- **Relational capacity:** being able to maximise and strengthen relationships within the ecosystem. In this way, the company will become a leader/catalyst within the ecosystem and create more added value.



“

Do you want to create a future-proof company? Then make sure you are part of an ecosystem.”

— Dirk Torfs, CEO Flanders Make



## Through ecosystems to an optimal circular economy

Only by working together, companies will be able to address today's challenges in terms of sustainability, circularity and climate change. Investment funds are also increasingly taking this into consideration. Companies in an ecosystem are more future-proof and help to make the world more sustainable. The following elements are important to be able to achieve a circular economy through ecosystems:

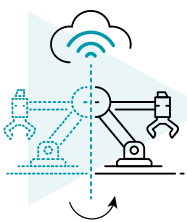
- Ecosystems take circular actions on four different levels:
  - Product level (recycling, redesign, remanufacturing...).
  - Process level (optimisation, less resources, adapted planning...).
  - Service level (second life model, use-as-a-service, predictive maintenance...).
  - Level of dematerialisation (virtualisation, validation...), according to the degree of dependence on digital technologies.
- Digital transformation promotes circularity in ecosystems. More specifically, through these three pillars:
  - virtualisation
  - optimisation of supply
  - optimisation of products
- Different types of ecosystems use different strategies. Solution-oriented ecosystems optimise products and processes, whereas transaction-oriented ecosystems focus on dematerialisation and providing access.





# **BUILDING ON THE ROAD TO INNOVATION**

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.



# Design & Optimisation

Paola Campestrini, clustermanager  
Design & Optimisation

The competence cluster Design & Optimisation 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 help to optimise design choices. The correct implementation of digital trends is key to this.

“Through multidisciplinary design methods, we help to optimise the design process without losing time.”

– Paola Campestrini, clustermanager  
Design & Optimisation

Nowadays, design problems mainly arise during the final phase of the design process, resulting in expensive adjustments. According to cluster manager Paola Campestrini, it is more crucial than ever to eliminate these problems in the earliest design phases. “Our cluster has developed supporting tools that evaluate a computer-aided design (CAD) in terms of manufacturability and assembly efficiency. With these tools, we can discover problems in assembly or production more quickly and correct them without having to develop prototypes. These tools therefore save a huge amount of time and resources. We’ve also developed a supporting tool to calculate the impact of design on assembly efficiency and product performance. This enables us to make the right decisions in the design phase and prevent problems during the assembly or use of the product. Again, this saves (financial) resources.”

## Two pillars

“Within our cluster strategy, we improve the design process in two ways. On the one hand, we standardise the available knowledge so as to be able to use it in objective design evaluations and optimisations. This also ensures better data management and provides easy access to a knowledge graph. On the other hand, we provide visualisation techniques to show designers the consequences of design choices on different

criteria (performance, cost, feasibility...) in an intuitive format. This is essential for a reliable production process, as the number of design parameters and product attributes is constantly increasing.”

## Optimisations: also for sustainability

“Our cluster continuously develops new tools and methodologies to test the impact of design choices on, for instance, sustainability. One example is the use of optimisation techniques, with which we optimise the quantity and placement of a particular material in a component. We are looking for the minimum amount that will still meet the strength and stiffness requirements. This has an impact on cost price and sustainability, as we use less materials and energy, both during production and in later use. A lighter car, for example, needs less energy to move.”

## Efficiency and people are central

“The design process is also becoming more complex due to the growing trend towards mass customisation and the subsequent exponential growth in the number of product variants. We want to manage this growing product family in a cost- and time-efficient manner. Therefore, we also offer support tools that effectively evaluate the cost and value of a new product variant, taking into account customer requirements. With these tools, this can already be done in the early design phases, whereas it usually only happens in the final phase – if at all. Finally, we work together with the Flexible Assembly cluster on workable work. Together, we’ve developed a method and accompanying tool to efficiently improve the ergonomics of workplaces.”



## Decision & Control

Andrei Bartic, clustermanager  
Decision & Control

**For the competence cluster Decision & Control, the focus is on innovations in localisation, navigation, adaptive controls and decision support.**

“Algorithms based on physics will upgrade the intelligence of industrial systems.”

— **Andrei Bartic, clustermanager  
Decision & Control**

“The industry is producing more data than ever before. In this cluster, everything revolves around the interpretation of the obtained data within the right context and maximum utilisation of expert knowledge”, explains cluster manager Andrei Bartic. “Despite this flood of data, there never seem to be enough or sufficiently qualitative data for what the industry wants to achieve with them. Simply generating and processing additional data does not always solve the problem. Moreover, it is simply not always possible to acquire additional data and costs can therefore increase considerably. In some cases, one has to wait a long time for data to become available, such as for the detection of faults and anomalies. So we need better methods to face this challenge.

### Localisation and navigation

Localisation and navigation techniques are essential in building autonomous vehicles, such as automated mobile robots and autonomous drones. “Thanks to Ultra-Wide Band or UWB radio waves, we can locate places with poor GPS coverage, for instance inside a building or between high structures. SLAM (Simultaneous Localisation And Mapping) is another revolutionary technology that requires no additional infrastructure. However, it is very challenging to make this technology reliable in dynamic industrial environments. In the next step, we want to make localisation more robust by combining different localisation technologies and adding semantics. For this, we use AI techniques to recognise fixed environmental elements such as walls, doors and other fixed points of orientation. In this way,

autonomous vehicles can navigate robustly in dynamic environments such as a warehouse, production hall or greenhouse.”

### Robust control using AI

Integration with AI technology is also crucial for the adaptive control of mechatronic systems. “Artificial intelligence promises better performance despite increased complexity. Current AI techniques, such as reinforcement learning, are too expensive for industrial applications in terms of hardware resources and training effort. One of our main research goals is to reduce the learning effort of these systems. Our expertise in modelling mechatronic systems will play an important role in this. Furthermore, AI techniques need to be tested and validated under strict industrial conditions. How this is to be achieved is still being studied. Nevertheless, there is huge potential in AI technology that we are not yet fully exploiting.”

### Assistance of operators

“Not everything can or should be automated. In many situations, we achieve the necessary flexibility only through human operators. Here, AI can support them in complex decisions and knowledge sharing. In terms of decision support, AI and digital twins help operators to make decisions. In an interconnected world, companies have the means to learn more about the operation of the mechatronic systems that they develop or use. Two major obstacles stand in the way of the widespread use of these technologies: the availability of both metadata and ground truths. So, above all, we need to acquire data and interpret them in their proper context. That is why we need to acquire knowledge of the operational environment and the interaction with operators. At present, we do not yet see adequate relevant data. Another priority is giving reliable advice to operators. We do this by giving them transparent and clear arguments for the proposed actions.”



### Flexible Assembly

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

“The main challenge for these companies is to combine a cost-efficient assembly system with the flexibility of customised production”, explains (acting) cluster manager Tom Munters. “By intelligently switching between operators and robotic systems, complex production in small series is possible without increased costs. This allows companies to better respond to changing customer needs and react more quickly to crisis situations. By offering more unique and even individualised products, they can also achieve higher margins.

It is important that an assembly plant can respond quickly to changes in volume and product mix without affecting costs, quality and/or performance. Our cluster examines how we can reduce the time required for introducing a new production variant and for converting the assembly line. In a customised production context, we aim to establish the system requirements for the next generation of assembly systems, in line with the industrial needs of the respective companies. For this, we generate and validate innovative assembly concepts, architectures and models.”

#### Value chain

“Our cluster works together with companies from various sectors, we mainly work out solutions for assembly plants but also for manufacturing companies. We also work together closely with technology companies to develop these solutions. The flexibility that is available is entirely based on the competences of the operators, so we’re still a long way off from real-time adaptive systems. We follow a value chain approach, linking the requirements of assembly plants to technology solution providers and integrators. Our cluster acts as a guide for manufacturing companies in Flanders and assists them in their evolution towards digitalisation and Industry 4.0. The implicit knowledge of experienced operators can also be an important source of information and efficiency gains. Through another area of research, we can use this knowledge and experience in a digital world.”



Tom Munters, clustermanager (a.i.)  
Flexible Assembly

#### Performance and adaptability

“With our research, we first want to increase the flexibility of assembly systems by making these systems easily adaptable. In the next step, these systems automatically adapt themselves. For this, they rely on their own data and take into account other systems as well as the environment. Our research is aimed at constantly increasing this adaptability and making it more effective. 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 robot skills, modular models and work instructions. Later, we will combine these developments into larger wholes. 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 us to automatically anticipate unexpected operational issues. Even the introduction of planned or unplanned changes can be easily validated digitally.”

#### The operator remains crucial

“Finally, let us not forget the operators: they are an important link in dealing with this increased flexibility in a qualitative manner, but they also need more support as a result (think, for instance, of customised work instructions). In addition, the increased scarcity on the labour market leads to challenges where operators must be quickly trained and supported in increasingly complex tasks. With our research, we therefore try to offer optimum support to operators, a/o by automating routine tasks and actions to the maximum extent possible. Because we deploy operators according to their best skills, we make better use of their strengths. This is how we get the most out of their insights into quality and in managing unplanned changes on the production floor. We can also use their experience here to train systems. Finally, making and keeping such jobs workable is an important issue, taking into account both the physical and cognitive aspects.”





# Motion Products

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

The Motion Products cluster focuses on companies that are active in the development, production and application of machine and vehicle drives. According to cluster manager Patrick Debal, the priorities are therefore clear.

“The long-term vision guiding our research and developments predominantly pursues the significant increase of cost efficiency and sustainability. We want to almost double the yield for the same cost.”

– Patrick Debal, clustermanager  
Motion Products

## Customisation

“Our companies are increasingly facing a demand for customised products, a trend requiring a wide range of production methods and drive technologies. This increasing demand for customisation also forces us to accelerate the development process for machine and vehicle variants. In the past, such a machine only had a central drive unit with several mechanical couplings for the individual motions. Over time, machines have evolved and smaller, individually controlled and electric drives have become more accessible. This allows for more flexibility through control and enables a company to better respond to the increased customisation and the needs of individual users.”

## Circular mobility

“Mobility is changing rapidly: an electrified car is no longer an oddity. Autonomous vehicles are becoming the next trend here. This technology may also make a mobility service model a reality within ten years: instead of individual vehicles, people will buy mobility.

Our cluster also contributes to greening our society with vehicles or machines that will be used more often in such a circular system. These machines are also becoming more and more sustainable with a lower consumption, less maintenance, a longer life span and a high number of recyclable materials.”

## Four research pillars

“The research of our cluster is based on four pillars: component and system improvement, artificial intelligence, design optimisation and digital twins. At component level, our research into electric vehicles has led to a constant flow of improved technologies such as new types of batteries, more efficient motors with less permanent magnetic material and a new generation of transistors for power electronics. The far-reaching integration of components in systems reduces costs, amongst other things by reducing the number of components, reducing losses and consequently increasing efficiency.”

“Our research in artificial intelligence in the competence cluster Decision & Control. We further develop their improved control concepts and apply them to drive systems. In this way, our robots are working increasingly autonomously and we are saving time by combining different motions.”

As for design optimisation, this cluster builds on the research performed by our competence cluster Design & Optimisation. “More customisation requires faster adjustments to the design, so we also focus on digital and partly automated design methods. Furthermore, we perform in-depth research into digital twins. This helps us to create a digital representation of a physical object, emulating system behaviour by using models and data. By running the digital twin in parallel with a machine, we can better monitor the operation of that machine. A better understanding of the operation, in turn, reduces wear, ensures timely maintenance and increases cost efficiency.”

Patrick Debal, clustermanager  
Motion Products

# Companies per competence cluster

## Decision & Control (26)

3D Systems  
Atlas Copco  
Bekaert  
CNHi  
D. Cloostermans-Huwaert  
Daikin  
DANA  
Dataroots  
dotOcean

Easy Systems  
I-Care  
Intermodalics  
Janssen Pharmaceutica  
Laser Cladding Venture  
Materialise  
National Instruments  
Picanol  
Punch Powertrain

Sabca  
Siemens Industry Software  
Televic  
Tenneco  
Vandewiele  
VCST  
Yazzoom  
ZF Wind Power

## Design & Optimisation (18)

Atlas Copco  
Barco  
Bosal  
CNHi  
D. Cloostermans-Huwaert  
Daikin

DANA  
Easy Systems  
Grammer Electronic  
Noesis  
Picanol  
Punch Powertrain

Sabca  
Reynaers Aluminium  
Tenneco  
Siemens Industry Software  
Vandewiele  
Voxdale

## Motion Products (17)

Atlas Copco  
Bluways  
CNHi  
DANA  
D. Cloostermans-Huwaert  
Easy Systems

E-Trucks  
Leuven Air Bearings  
National Instruments  
Picanol  
Powerdale  
Punch Powertrain

Sabca  
Siemens Industry Software  
Tenneco  
Vandewiele  
VDL

## Flexible Assembly (25)

ABB  
Arkite  
Atlas Copco  
Barco  
Bekaert  
CNHi  
Daikin  
DANA  
D. Cloostermans-Huwaert

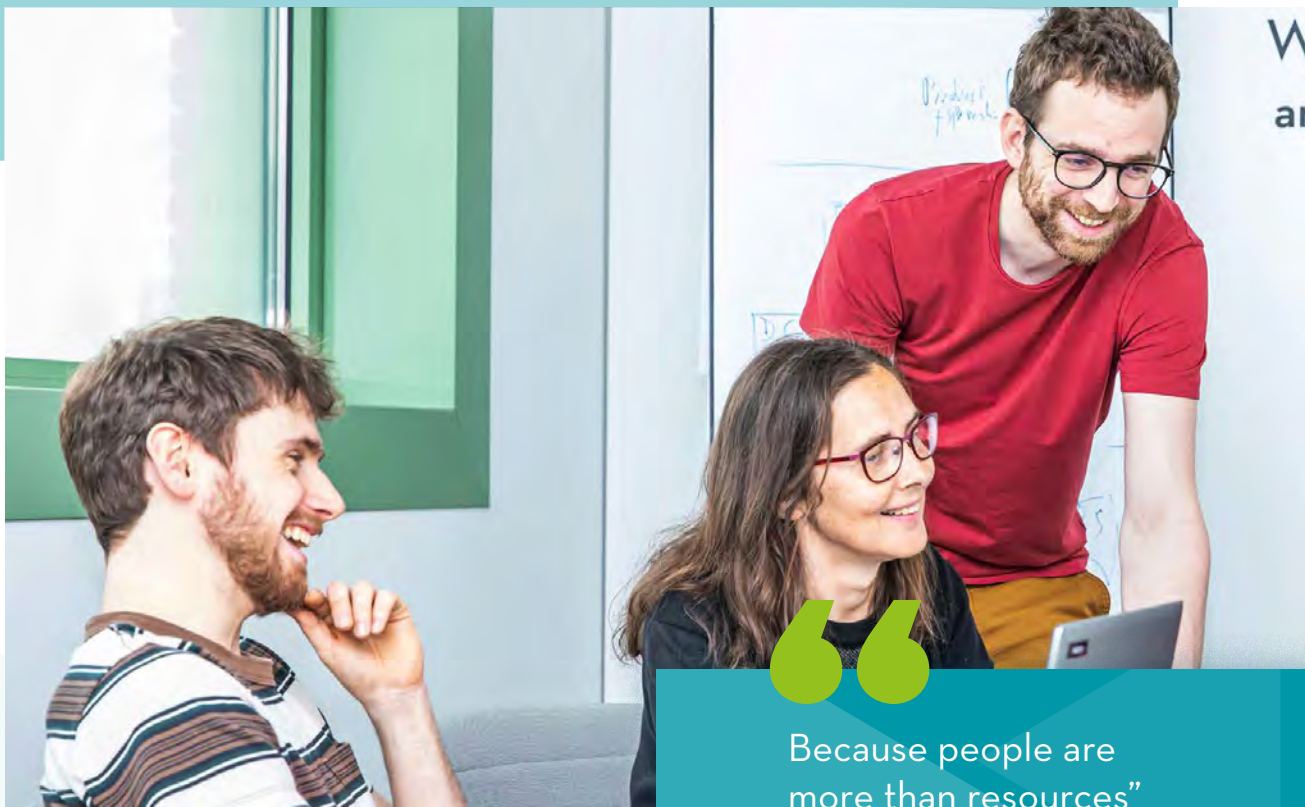
eBO-Enterprises  
Easy Systems  
Janssen Pharmaceutica  
Logflow  
Mariasteen  
Niko  
Picanol  
Reynaers Aluminium  
Sabca

SupportSquare  
Tenneco  
Terumo  
Vandewiele  
Vitalo  
Waak Sociale Werkplaats  
ZF Wind Power

# ORGANISATION

Flanders Make is the research centre for the industry and its digital or 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.





Because people are  
more than resources”

— Wim Teunen, Human capital manager  
Flanders Make

## Our people

**Flanders Make continued to grow internally in 2021. This brings challenges, but also opportunities. By further investing in a sustainable and future-oriented HR policy, with an increased focus on workable work and wellbeing, we want to support our people even better in their passion: industry-relevant research and innovation.**

“The fact that an increasing number of partners know how to find Flanders Make indicates that our focus on growth in Excellence is appreciated and is the right way forward,” says Wim Teunen, Human capital manager at Flanders Make. “However, this also means that recruitment is becoming increasingly challenging today. We therefore need to make the pool from which we fish bigger, even more international, because more and more fishermen are appearing around the current pond.”

“It remains important that we play on our strengths as a strategic research centre: flexibility, teamwork, room for initiative and personal development, a flat structure, close cooperation with industry and a broad scope of technology and research domains. In short, a playground for researchers who want to bring industry-relevant innovation from fundamental research to a level where it can be adopted. We notice that this keeps us attractive as an employer, both for

academics and for people from industry. A position we need to guard and strengthen.

### Wellbeing

Given the tight labour market and the investment that we as an organisation are making in the growth and development of our employees, retention is more important than ever. We are therefore focusing even more strongly on support, workability and wellbeing. Recently, we merged the traditional Human Resources team with some support services to form the Human Capital Services team with the baseline “because people are more than resources”. In this way, we want to provide even better service and support to the entire organisation in the future, both individually and operationally.”

“Even though research is the dream job for many of our employees, research requires a lot of energy, also mentally,” continues Wim Teunen. “We therefore have various wellbeing initiatives in the pipeline. We recently launched an online platform where people can easily and anonymously find support when they are experiencing stress, for example. But themes such as healthy eating, relaxation and sleep are also discussed.”

“Retention is more important than ever. We are therefore focusing even more strongly on support, workability and wellbeing.”

— Wim Teunen, Human capital manager  
Flanders Make

“Naturally, we also pay attention to the work-life balance. We try to employ employees at a workplace as close as possible to their home address and therefore recruit as much local talent as possible, for example for our new location in Kortrijk. Regular work from home is also one of the options, whenever possible and functional.”

## Equal treatment

“Gender equality is receiving more and more attention, and rightly so. For me, however, it is about more than just equal treatment,” says the Human Capital Manager. “It is about consciously embracing diversity and approaching its relevance empathically. Everyone deserves equal treatment and opportunities, regardless of origin, preferences, religion or gender. Even if we have the feeling that this is fine with Flanders Make, it is our intellectual duty to pay constant attention to this. In doing so, we can also go beyond looking at our own organisation. For instance, we are working on models in human-robot interactions that take diversity into account and not just the standard white, male operator. We want to strengthen the awareness of possible stereotypical thinking among our researchers. The internationalisation on the office floor and in our labs is therefore a good thing.”

## Working on the supply through schools

“The proportion of female researchers is still far from reflecting mainstream society. Obviously, this has to do with the limited supply from the typical specialisation areas in the study programmes from which we can recruit. Whereas in some sectors we see a catching up movement, Engineering studies are lagging behind both in Flanders and in the rest of the world. There is progress, but too slowly.”



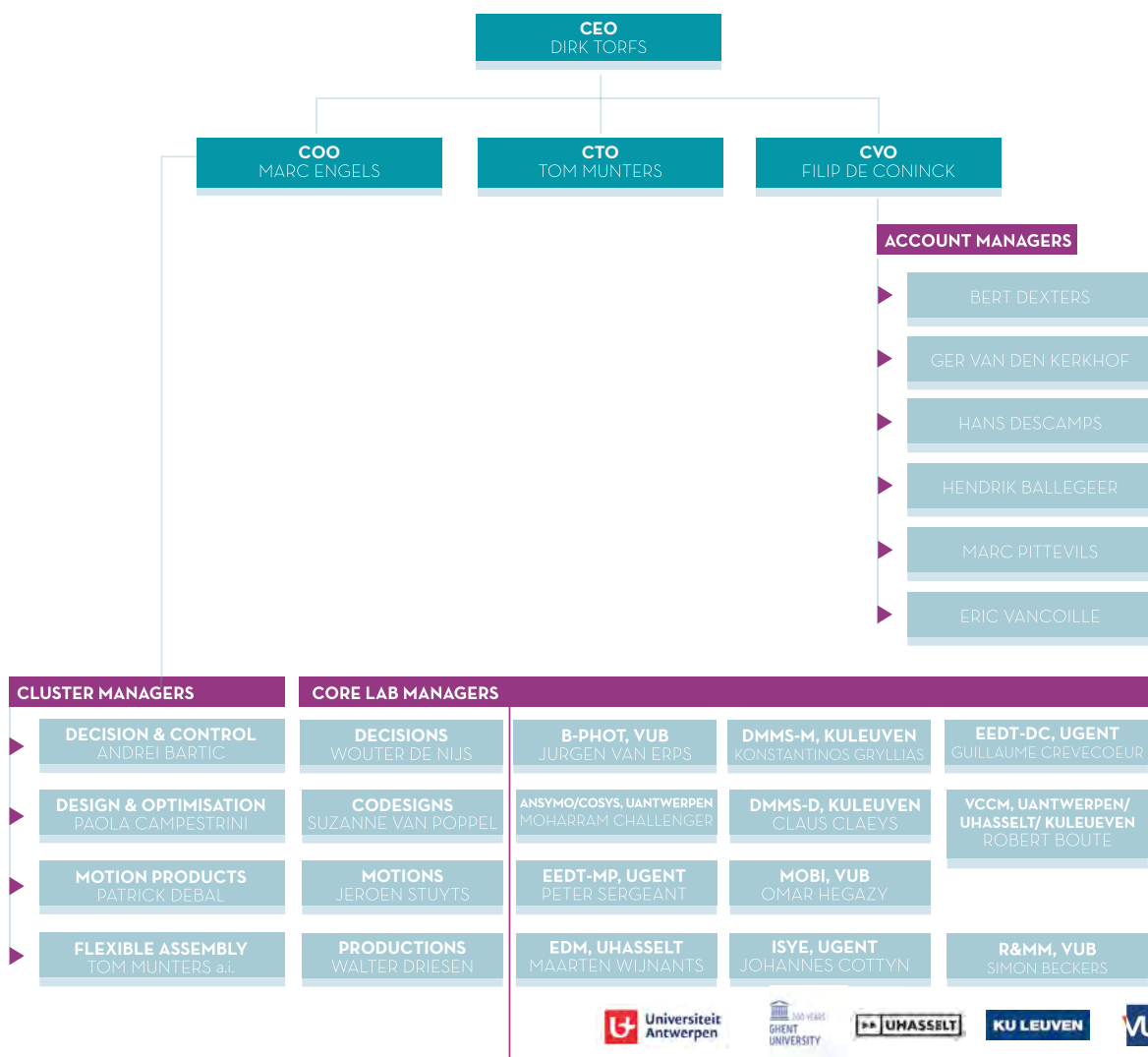
“Flanders Make is therefore continuing its efforts to encourage girls in particular to opt for STEM subjects (Science, Technology, Engineering, Mathematics) via targeted support, in addition to minorities. This is done via a number of partners with an offering to 7 to 14 year-olds, both via the normal school curriculum and via extra-curricular activities. Even though this is a long-term approach, it is there that the initial interest grows and the researchers of the future are formed.”

“However, we are also trying to give a boost in the shorter term, for example by putting female employees in the spotlight sufficiently in our external communication. We regularly notice during job interviews that this role model really works.”

## From functions to roles

“Flanders Make remains a rapidly growing organisation with a flat structure. That offers challenges, but above all opportunities. We already see many employees taking advantage of those opportunities and taking on additional roles and responsibilities. For traditional function houses, it is a challenge to provide the necessary framework for this. Adapting to this, while maintaining the flexibility that is so characteristic of Flanders Make and its employees, fits perfectly within the vision of a sustainable Human Capital policy. After all, it is through this correct framework that employees continue to find the necessary challenges for further growth, which offers the best guarantee for manageable recruitment, retention and promotion.”

# Board of Directors



### At the back, from left to right

- Katrien Wyckaert
- André Bouffieux
- Ignace Lemahieu
- Erwin Dewallef
- Sonia Van Ballaert
- Wim Verrelst
- Herman Derache
- Koenraad Debackere
- Paul Snauwaert
- Andy Pieters
- Inge Stoop
- Jochen Vincke

### At the front, from left to right

- Leo Van de Loock
- Dirk Torfs
- Urbain Vandeuren
- Silvia Lenaerts
- Geert Ostyn

MAPS, KULEUVEN  
JUN QIAN

DTAI-FET, KULEUVEN  
PETER KÄRSMÄKERS

CVAMO, UGENT  
DRIES BENOIT

ROB, KULEUVEN  
WILM DECRE

# Advisory Board

## Industrial advisory board

Miguel Dhaens	Tenneco, Driv
Carl Eeckhout	Televic
Goedele Heylen	Ramen Engels nv
Marnix Lannoije	Cargobull Telematics
Koen Maertens	Maertec, Duco
Dominique Maes	Vandewiele
Koen Reybrouck	Reycon
Paul Snauwaert	CNH
Frans Van Giel	ex-Beaulieu
Herman Van der Auweraer	Siemens Industry Software
Bart Vanderschueren	Materialise
Hans Vande Sande	Atlas Copco
Eric Verhelst	ex-TE Connectivity
Piet Wauters	ASML

## Observer industry

Geert Ostyn	Picanol
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## Scientific advisory board

Thilo Bein	Fraunhofer, Duitsland
Russel Harris	Leeds University, Engeland
Johann Hoffelner	Linz Center of Mechatronics, Oostenrijk
Werner Kraus	Fraunhofer, Duitsland
Minna Lanz	Tampere University of Technology, Finland
Felix Martinez	Ikerlan, Spanje
Dimitris Mavrikos	EIT Manufacturing
Anne-Lise Høg Lejre	Danish Technological Institute, Denemarken
Chris Gerada	University of Nottingham, Engeland
Jochen Deuse	TU Dortmund University, Duitsland

## Observer universities

Hugo Thienpont	VUB
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## Central office

Dirk Torfs	Flanders Make
Marc Engels	Flanders Make
Tom Munters	Flanders Make

## Observer government

Leo Van de Loock	VLAIO
Erwin Dewallef	EWI



# Flanders Make

3 co-creation centres, the Flemish drone federation  
EUKA and the labs of 5 Flemish universities



## 77 MLN

EURO TURNOVER

## 750

SPECIALISED RESEARCHERS

# FINANCIAL REPORT

# Balance and year results

<b>ASSETS</b>	<b>121.944.903 €</b>
<b>Fixed assets</b>	<b>11.579.834 €</b>
Intangible assets	87.235 €
Tangible assets	9.536.235 €
Financial assets	1.956.364 €
<b>Current assets</b>	<b>110.365.069 €</b>
Stocks and orders	20.906.477 €
Accounts receivable within maximum 1 year	15.248.339 €
Liquid assets	73.628.898 €
Regularisation accounts	581.354 €

<b>LIABILITIES</b>	<b>121.944.903 €</b>
<b>Capital and reserves</b>	<b>19.003.432 €</b>
<b>Provisions</b>	<b>53.905 €</b>
<b>Debts</b>	<b>102.887.566 €</b>
Debts falling due within maximum 1 year	50.658.535 €
Regularisation accounts	52.229.031 €

<b>REVENUES</b>	<b>24.967.873 €</b>
<b>Turnover</b>	<b>22.959.755 €</b>
FM covenant	14.526.256 €
FM non-covenant	8.164.549 €
Membership fees & other	268.950 €
<b>Other revenues</b>	<b>2.008.118 €</b>

<b>COSTS</b>	<b>24.265.052 €</b>
Salaries, social security charges and pensions	17.064.404 €
Operating costs	7.159.095 €
Other costs	41.553 €

<b>OPERATING RESULT</b>	<b>702.821 €</b>
<b>Financial &amp; extraordinary result</b>	<b>- 486 €</b>
<b>Use of reserves</b>	<b>233.388 €</b>
<b>RESULT OF FINANCIAL YEAR</b>	<b>935.723 €</b>

Flanders Make achieves an operating result of 702,821R for financial year 2021. This result includes the costs (233,388 EUR) linked to the approved projects for the use of historical reserves. These reserves were set aside in the past for specific research, some of which will take place in 2021. After using the historical reserves, we will end the year 2021 with a positive result of EUR 935,723.

## KPI 2021

	TOTAL 2020	TOTAL Q4 2021	TARGET 2021	%TARGET 2021	TARGET ANNUAL GROWTH	GROWTH 2021 VS. 2020	TARGET 2022
KPI 1.1 Publications	243	261	168	155%	5%	7%	183
KPI 1.1 Open access publications	161	187	142	131%	11%	16%	183
KPI 1.2 Conferences	247	280	218	128%	4%	13%	233
KPI 1.3 EU participation	13.416 k€	13.228 k€	3.942 k€	336%	9%	-1%	4.600 k€
KPI 2.1 Tech. capacity utilisation	16	24	20	120%	35%	50%	23
KPI 2.2a Reach among direct target group	60	66	44	150%	10%	10%	49
KPI 2.2b Whereof SME	29	33	15	220%	10%	14%	16
KPI 2.3 Industrial revenues	8.657 k€	9.680 k€	4.873 k€	199%	8%	12%	5.500 k€
KPI 2.4a Industrial reach	290	203	97	210%	10%	-30%	111
KPI 2.4b Whereof SME	72	53	32	166%	10%	-26%	37
KPI 3.1 Leverage							
Leverage income	46.938 k€	50.249 k€	35.608 k€	141%	26%	7%	44.400 k€
Leverage	4,1	3,5	2,0	182%	19%	-14%	2,0
KPI 3.2 Industrial leverage	7.140 k€	7.690 k€	2.436 k€	316%	8%	8%	2.750 k€
KPI 3.3 Strategic partnerships	5	7	3	233%	41%	40%	4
KPI 4.1 Cross-initiative projects	9	9	3	318%	41%	0%	4
KPI 4.2 Dissemination range	491	593	35	1709%	12%	21%	44
KPI 4.3 Joint publications	27	31	22	143%	4%	15%	23
KPI Basic subsidy cooperation projects.	2	5					
KPI Additional patent	6	5					
DMP Available		12.80%					
Colleagues with confirmed ORCID ID		33.90%					









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