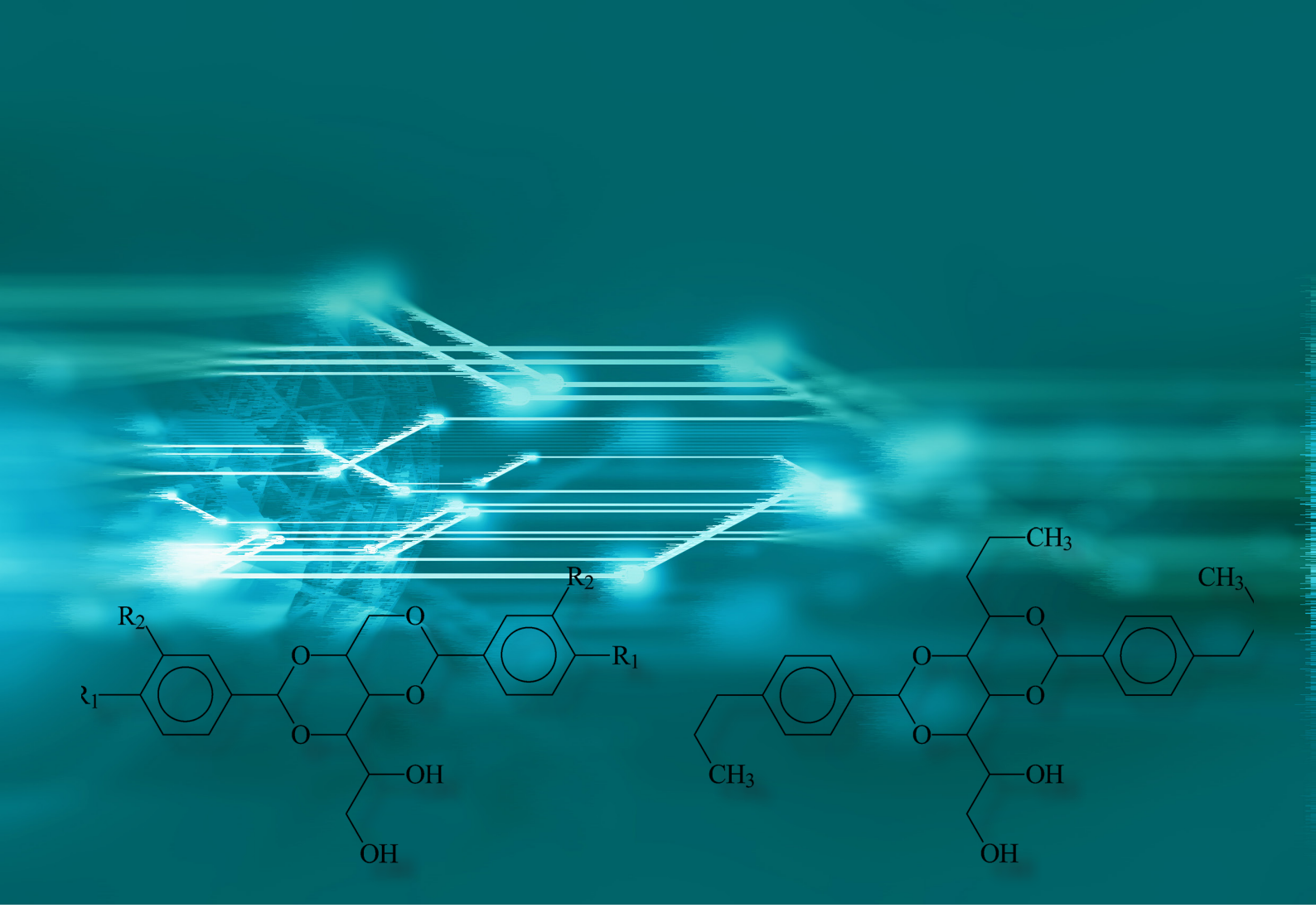

DIGICHEM

Route towards a digitized chemical and plastics sector in Flanders

END REPORT

CATALISTI
WE MEAN BUSINESS

CENTEXBEL

sirris
driving industry by technology

INDEX

FOREWORD

Industry 4.0, big data, predictive maintenance, cyber security. Day after day these words sound more familiar. Digitization is running at full speed and is changing the way we work, produce and finally how we run our business.

The chemical and plastics sector has been the driving force of the Flemish economy for many years. Our sector has faced different evolutions. Digitization and circular economy are the key challenges in the years that lie ahead, and these two elements will fundamentally alter our R&D, production and business models.

What is the current level of implementation of Industry 4.0 in the chemistry, plastics and life sciences sector in Flanders? What barriers prevent our companies of adopting Industry 4.0 technologies? And how do we stimulate further transition towards Chemistry 4.0?

That is the central starting point for this research report from Catalisti, Centexbel and sirris 'Route towards a digitized chemical and plastics sector in Flanders'.

It is not easy to separate myths from real opportunities, take appropriate actions, and gain a competitive advantage. With this study, we want to offer sector companies insight into the opportunities and risks that accompany Industry 4.0.

We give special thanks to the many experts, particularly from the companies, who took part in numerous interviews and workshops and contributed to this study.

The study results in an action plan. A guideline and suggested actions for supporting organizations like Catalisti, essenscia, sirris, Centexbel and many others to take and boost Industry 4.0 implementation in chemical and plastics companies. This report is therefore not an end point, but the start of a collaboration process in which Catalisti will take an important role in the coming years.

FLANDERS INNOVATION & ENTREPRENEURSHIP

CATALISTI

Clusters for Growth

EXECUTIVE SUMMARY

In 2017 Catalisti, the cluster for chemistry and plastics in Flanders, has initiated a study, DIGICHEM, to obtain an overview of the level of implementation of Industry 4.0 in the chemical and plastics sector in Flanders, the related challenges, and required collective actions that must be taken to increase the level of implementation to maintain competitiveness of the sector in Flanders on a European (and worldwide) level.

The DIGICHEM study was executed by Centexbel, sirris and Catalisti in a joint effort in the period February 2018 – January 2019. Within the study, Catalisti, Centexbel and sirris interviewed more than 40 individual companies, analyzed the relevant pre-existing studies and collected information from more than 70 different organizations through collective workshops.

The DIGICHEM study confirmed the importance and great potential impact on following overarching key-features:

- An increased operational excellence, productivity and flexibility within production, supported by a vertical integration within a smart and digitized factory;
- A horizontal integration, leading to the development of new products and associated services from collaboration in a digitized supply chain.

Depending on their size, their position in the value chain or the products they produce, the route towards Industry 4.0 is different for every business. Adoption barriers are related to building a vision and strategy, digitization of all resources, the coupling with information systems, the organization structure and culture.

Understanding the challenges and the barriers allows the development of a dedicated action plan for the Flemish chemical and plastics industry, focusing on the (collective) actions and trajectories that are needed to put more companies on the I4.0 road.

The actions in the action plan will be carried out in the coming years through collaboration of all triple helix partners in Flanders: government, research institutions and industry.

The action plan exists of 4 major action lines: 'Technology scouting and watch', 'Experimentation labs', 'Learning network' and 'Skills, education and legal framework'. The action plan describes both actions to be taken over the coming years and actions that are already ongoing in Flanders.

Catalisti will take the necessary steps and coordinate with all relevant stakeholders in Flanders to implement the various action lines of the plan through strong collaborations.

INTRODUCTION

The chemical and plastics industry is confronted with a new type of industrialization: Industry 4.0. In essence, Industry 4.0 (I4.0) stands for the arrival of the internet on the production floor. It involves the integration of digital technologies and automation into production and logistics and the use of Industrial Internet of Things (IIoT), data analytics and digitized services in industrial processes. Smart, digitized production facilities and networked value chains already have - and will have - profound implications on value creation, business models, downstream services and organization in the chemical industry.

By the name alone, it can be understood that Industry 4.0 is the fourth industrial revolution which is an ongoing transformation in the industrial sector. To understand the difference between Industry 3.0 and Industry 4.0, it is essential to understand what changes were introduced in each of the revolutions which the industry underwent previously:

1. **Industry 1.0**: Industry 1.0 refers to the mechanization of work (by the introduction of steam) which our ancestors used to perform manually by hand.
2. **Industry 2.0**: Industry 2.0 is the transformation which was brought about by the introduction of electricity in the various processes, allowing mass production. The first electric assembly line was built in 1870.
3. **Industry 3.0**: Industry 3.0 was a huge leap ahead wherein the advent of computer and automation ruled the industrial scene. It was during this period of transformation that more and more robots were used in to the processes to perform the tasks which were performed by humans. Industry 3.0 introduced more automated systems onto the assembly line to perform human tasks, i.e. using Programmable Logic Controllers (PLC). Although automated systems were in place, they still relied on human input and intervention.
4. **Industry 4.0**: Industry 4.0 fosters what has been called a "smart factory". Within modular structured smart factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world and make decentralized decisions. Over the Internet of Things, cyber-physical systems communicate and cooperate with each other and with humans in real-time both internally and across organizational services offered and used by participants of the value chain.

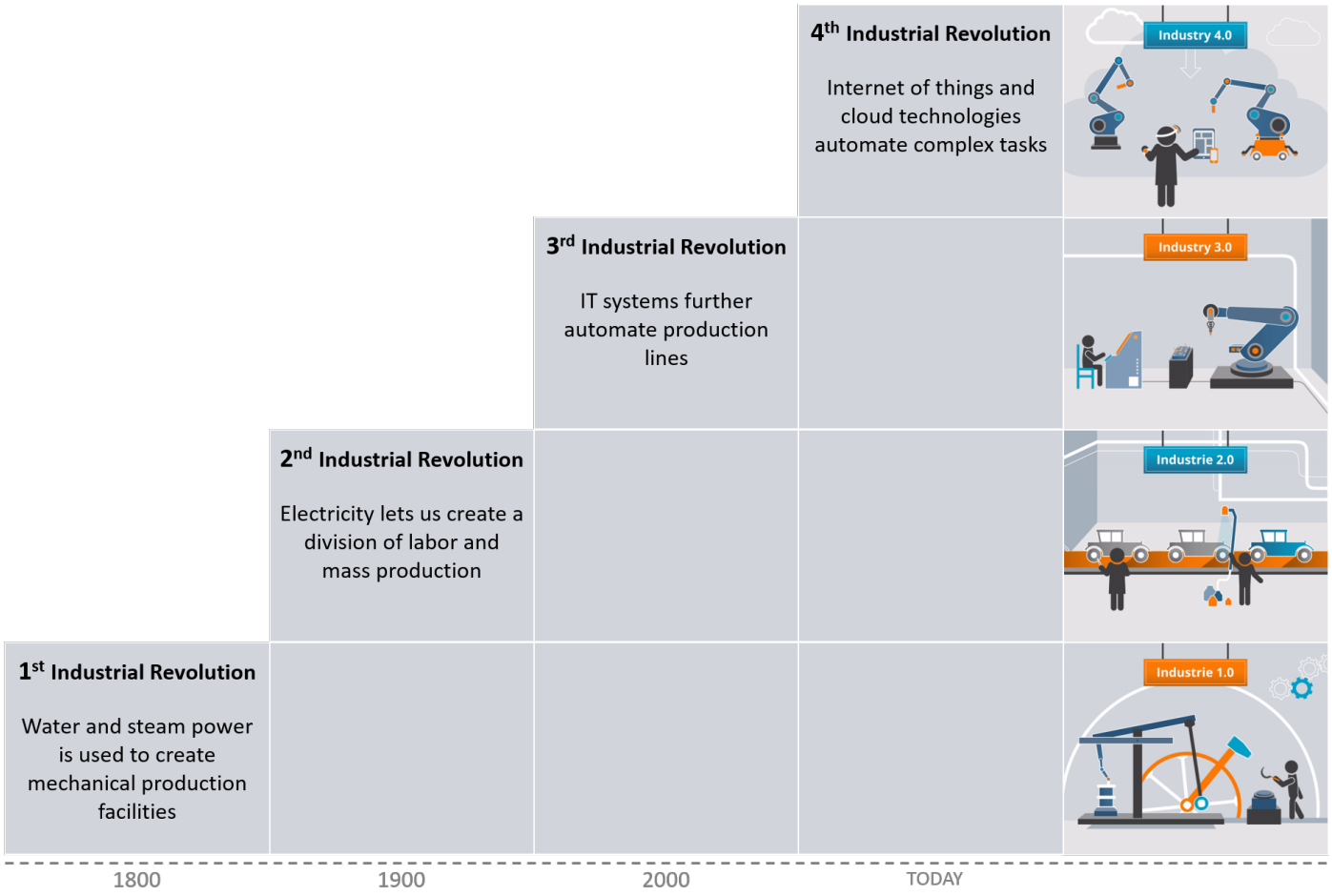

Fig 1. Industrial revolution timeline (Source: Daxue Consulting)

The following paragraphs describe the findings of the DIGICHEM study: the interest of our sector in Industry 4.0, the barriers that prevent implementation and the action plan to stimulate the use of Industry 4.0 technologies in chemical and plastics companies.

DIGICHEM: ROUTE TOWARDS A DIGITIZED CHEMICAL SECTOR IN FLANDERS

CHEMICAL INDUSTRY IN FLANDERS

The chemical and plastics industry (for ease also referred to in this study as the "chemical" industry or sector) transforms a wide range of raw materials – predominantly fossil oil, natural gas, coal and increasingly renewable bio-based feedstock – into a number of primary building blocks such as syngas, methanol, ethylene, propylene, benzene, toluene, xylene, ethanol and glucose. These primary building blocks in turn are transformed by a series of chemical transformations into a wide range of industrial basic and intermediate chemicals, which in their turn are used to manufacture products and finished goods. The chemical sector is thus a highly integrated and diversified industry: products of one chemical plant are used as starting materials for the processes of another one. Such highly integrated production is not only very efficient from an economical and environmental perspective, it also contributes to a vibrant downstream chemical industry such as pharmaceuticals and biotechnological products, detergents and cosmetics, plastics and rubber processing, inks and varnishes, products for crop protection, textiles and feed & food ingredients.

The chemicals, plastics and life sciences industry has evolved over the past four decades to become one of the most important industrial sectors in Belgium and Flanders, and it has been very successful from an economic point of view. The Flemish chemical industry has some attractive features, such as first-class availability of raw materials thanks to the central location in the Western European pipeline network, a high level of integration and diversity across the value chain, a highly-skilled labor force which ensures world-class technical expertise and operational excellence, and the presence of lead plants and R&D centers in Belgium/Flanders with focus on sustainable innovation. Today, Flanders is recognized as hosting one of the highest concentrations of the chemical industry not only in Europe but in the World, the "Antwerp-Rotterdam Area (ARA)" cluster being the third largest in the world in terms of production capacity. Today, Flanders is a worldwide key player in chemistry and there is no doubt about the economic importance of this sector for the welfare of Flanders.

The sector is at the forefront of innovation with 2 billion euro spent on R&D in 2017, which represents almost half of the total industrial R&D spending in Flanders. With a turnover of almost 43 billion euro, the chemical and life sciences industry in the Flemish region represents approximately 67% of total turnover of the chemical and life sciences sector in Belgium. These industries also account for 22% of the regional industrial contribution and for almost one third (30%) of the export, and they employ directly and indirectly approximately 160 000 people. The chemical sector accomplished an added value of 12,5 billion euro in Flanders (key figure of 2016). As such, the sector accounts for more than 30% of the added value that was achieved in total by the manufacturing industry in Flanders. More than 3.500 companies, ranging from large multinationals to a multitude of SMEs, rely on chemistry and life sciences for their businesses, making the sector of the chemical industry and life sciences the second largest industry in Flanders.

The interplay between large, medium and small enterprises, whether or not research intensive in nature, along the entire chemical value chain is one of the key strengths of the Flemish chemical industry. These companies can be divided according to their nature and their research intensity:

- **Large enterprises with no research activities in Flanders ("LEs focused on production")**: First, these are the multinational enterprises, such as BASF, Covestro, DuPont, Shell, Dow Chemical, ExxonMobil, Total, INEOS, Evonik, Air Liquide, that have been located here for many decades due to the "openness" of the Belgian and Flemish economy. These are predominantly enterprises whose R&D activities are located abroad (in the country of their origin), and that mainly operate production facilities in Flanders (with hardly any associated research activities). Apart from that, there is also a relatively small group of (by origin) regional enterprises such as Solvay and Tessenderlo Chemie. These "national" enterprises are now also part of large, international groups, and most of their R&D activities are performed abroad. As a consequence, these companies mainly have production facilities in Flanders.
- **Large enterprises with research activities in Flanders ("LEs with R&D")**: There is also a vast number of large enterprises, although being part of a multinational group, which have research facilities in Flanders such as Eastman, 3M, Janssen, Agfa, Beaulieu, and Samsonite. Large enterprises in the chemical sector are often vertically integrated in business units. As a consequence, these units often have a large degree of autonomy, especially with regard to their daily operations. The business activities of these different units can be quite different, so that an important part of the R&D activities is executed at the level of the different business units and not at a company level. For a Flemish branch office of a multinational company, it is of the utmost importance to expand and to anchor its R&D activities locally in order to strengthen its position relative to external competitors as well as to other business units of the same multinational group. Often, the same types of business units are located in different countries, and in this case a business unit with an own R&D department takes a stronger position in the entire multinational company as compared to a comparable business unit without own R&D facilities. For these "de facto SMEs", there is "external" as well as "internal" market competition.
- **SME innovation pushers (or "early adopters")**: These are small- and medium-sized enterprises that have own R&D resources to develop innovative solutions for their problems and to bring these developments to the market. These are SMEs that are technology oriented and that offer their services to the commercial market as technology providers (like Eco Treasures, ChemStream and Emulco), or these are SMEs that develop and market their own products (like Devan Chemicals, AvoRe/InOpSys and Conwed Plastics).
- **SME innovation followers**: These are small- and medium-sized enterprises that are not actively involved in innovation and that do not develop own products or processes, but that implement developments of others, like for example Vitalo and Anziplast. From an economic point of view, these companies form a relatively large and important group. These enterprises need to be made aware of the importance of innovation and need to be convinced that implementation of innovation is useful, if not vital, for their businesses.

It is, hence, important to take into account this synergistic interplay (along with the differences in nature and research intensity) between chemical companies when analyzing the challenges and needed collective actions with regard to I4.0.

DIGICHEM PROJECT

Industry 4.0 offers interesting opportunities to better respond to customer requirements through automation, digitization and interconnectedness between products, value chains and business models.

Although there is no doubt about the opportunities that I4.0 offers for the chemical and plastics sector, there is still a rather "wait-and-see" attitude in many chemical sector companies. Indeed, for many companies, I4.0 is a major challenge with many hurdles and unanswered questions. Catalisti organized in March 2017 a preliminary workshop with various companies in the chemical and plastics sector in order to 1) capture an initial set of those questions and 2) define needs and interests of Catalisti members regarding I4.0. After this inquiry, it was clear that setting up a dedicated study on I4.0 was strongly supported by Catalisti members. This resulted in the DIGICHEM study, initiated by Catalisti.

The concrete goal of the DIGICHEM study was to develop a collective innovation plan as one of the first steps in the transformation of the Flemish sector of chemistry and plastics towards Industry 4.0. It was envisioned that this innovation plan should outline a number of things:

- The scope and meaning of I4.0 for the Flemish chemical and plastics sector;
- The specific needs and challenges for the Flemish chemical and plastics sector with regard to I4.0;
- The barriers/hurdles as encountered by the companies, blocking their digital transformation;
- A concrete innovation plan with collective priorities, relevant actors and most suitable instruments..

A dedicated project approach was chosen, based on a number of pillars:

- Individual company visits and inquiries, and thorough analysis thereof: about 40 companies provided in-depth insight into their I4.0 challenges;
- The collective needs arising from these individual company visits (and their presented cases) were challenged during dedicated workshops, focusing on business, product, process and barriers. Over 70 companies participated in these sessions;
- All inputs and findings were consolidated and translated into a set of collective actions (innovation plan) for the Flemish chemical sector.

INDUSTRY 4.0 FOR THE FLEMISH CHEMICAL SECTOR

INTERNATIONAL FRAMEWORK

A number of recent international studies on Industry 4.0 within the chemical sector are available[1] [2] [3] [4] [5]. All these studies highlight the importance of Industry 4.0 for the (competitive position of the) chemical industry. Advanced technologies (e.g. Industrial Internet of Things (IIoT), advanced materials, additive manufacturing, advanced analytics, artificial intelligence and robotics) have reached a level of cost and performance that enables widespread applications within the chemical industry. All studies highlight the importance to start the transformation process right now to not miss the opportunities at hand. However, they all stress that the barriers that prevent this transformation should be taken down. Next listing summarizes the main observations:

- **From talk to action**: chemical companies plan to invest 5% of annual revenue in digital operations solutions in the next five years. It is estimated that about a third of all chemical companies will reach an advanced level of digitization and integration in five years' time. Now is really the time to start the roll-out of the transformation process.
- **Data analytics core building block**: the rapidly growing number of sensors, embedded systems and connected devices results in a huge continuous data flow. Expert and effective data analytics is essential to create value with this data. Many chemical manufacturers have already invested in IT systems and infrastructure to generate data. However, many companies fail to take advantage of this data and the potential intelligence. Cheaper computational power and better advanced-analytics tools are, however, mature enough to be applied to optimize plant operations.
- **Focus on people and culture to drive transformation**: Industry 4.0 has a significant impact on how a company chooses to organize itself and to develop the required capabilities. Companies will need to make sure staff understands how the company is changing and how they can be a part of it. The biggest challenges revolve around internal issues such as culture, organization, leadership capabilities and the speed of transformation. The absence of a digital culture and capabilities was identified as the single biggest challenge by chemical companies. For many companies, the digital culture is closely linked with the need to have a clear vision from top management about the digital transformation roadmap.

1 Industry 4.0 and the chemicals industry: Catalyzing transformation through operations improvement and business growth, Deloitte University Press, 2016
2 Digitization in Chemical Industry, European Chemical Industry Council, 2016
3 Industry 4.0 for the chemical industry, Covestro 2017
4 Using advanced analytics to boost productivity and profitability in chemical manufacturing, Mc Kinsey, 2018
5 Industry 4.0: Building the digital enterprise: Chemicals key findings, PWC, 2016

- **Need for more transparency across the entire value-chain** from procurement via manufacturing to distribution. Increased real-time visibility is needed to improve forecasting and planning of operations. This is a real challenge for many companies since often they don't have transparency about the inventory, location and movement of products upstream and downstream of operations or actual demand directly from customers.
- **Closer customer interaction and development of new services**: clients and customers will be at the center of the changes with respect to value chains, products and services. Many companies are expecting to strengthen their digital offerings to customers, either by digitizing existing products or by developing new digital services. The chemical sector expects additional significant revenue growth to flow from their new digital business models, new sales approaches and integration initiatives.
- **Predictive maintenance** is seen as one of the applications with the biggest potential. Indeed, the operating time of critical assets can be increased by using the analysis of big data to find ways to anticipate their failure. Studies indicate that predictive maintenance typically reduces machine downtime by 30 to 50 percent and increases machine life time by 20 to 40 percent..

Summarizing, based on the findings of different studies, the different topics, challenges and issues can be linked to two main drivers for the chemical industry to start the transformation process towards Industry 4.0:

- **Operating the business**: so-called smart manufacturing allows to optimally produce smaller series of customized products (mass customization). Smart manufacturing combines information technology (IT; e.g. IIoT, artificial intelligence, advanced analytics) with operational technologies (OT; e.g. additive manufacturing, advanced materials, robotics). Different I4.0 technologies and applications are market ready to be integrated in existing chemical production systems.
- **Growing the business**: digital horizontal integration with suppliers and customers allows to share data, improve cooperation and improve order fulfillment and service levels. New products and services can be offered, allowing growth of the business.

Within the framework of the DIGICHEM study, focus was put on Industry 4.0 for the Flemish chemical and plastics sector. The identified topics of interest, challenges and barriers were compared and mapped to the findings from international studies on I4.0 for the chemical and plastics sector. As explained in the next sections, the topics of interest and barriers for the Flemish chemical and plastics sector are to a large extent in line with the findings from the international studies referred to above.

INQUIRY OF THE FLEMISH CHEMICAL SECTOR: TOPICS OF INTEREST

Through individual interviews and collective sessions (and analysis thereof), a number of specific opportunities, needs and challenges have been identified for the Flemish chemical and plastics sector. As a guide for the interviews, the sirris-Agoria Masterplan Innovation framework of "Factory of the Future", "Product of the Future", and "Business of the Future" was used (**https://www.sirris.be/masterplan-innovation-framework-future-technology-industry**). During the collective sessions, over 80 people representative for the chemical and plastics sector in Flanders participated to identify the different topics of interest within the field of Industry 4.0. The individual and group discussions resulted in the identification of about 18 relevant topics of interest.

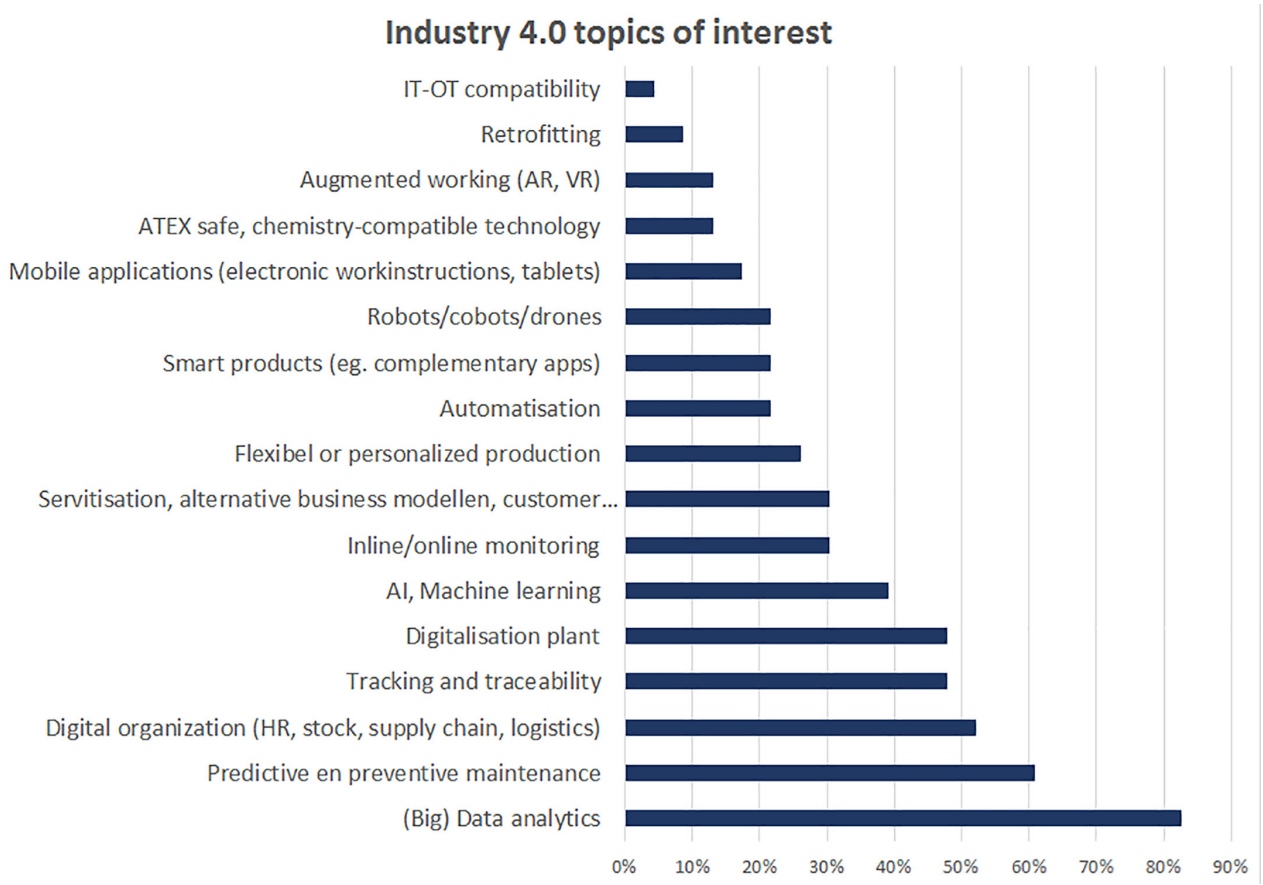

Fig 2. I4.0 topics of interest as defined by the Flemish chemical sector

The different topics can be clustered in two main themes:

- Vertical integration for an increased operational excellence, productivity and flexibility;
- Horizontal integration for collaboration along the entire value chain.

These themes are in line with the international trends (as referred to above). In next paragraphs, the two themes are briefly explained and linked to the topics of interest as raised by the Flemish chemical and plastics sector (see figure above). Where relevant, industrial use-cases and/or statements from the target group are included.

Vertical integration for increased operational excellence, productivity and flexibility

Introduction

Industry 4.0 requires interoperability between machines, devices and people (interconnectedness). The challenge is to vertically integrate all relevant digital assets on the different levels of the enterprise in a flexible way (from "edge"-devices to "cloud"-applications: sensors, actuators, PLC's, SCADA systems, MES, ERP,…). Once the entities are connected, data should be extracted and analyzed to be used for optimization of processes and evolving towards smart production, making best use of all available resources. The next figure illustrates this vertical integration and the topics of interest.

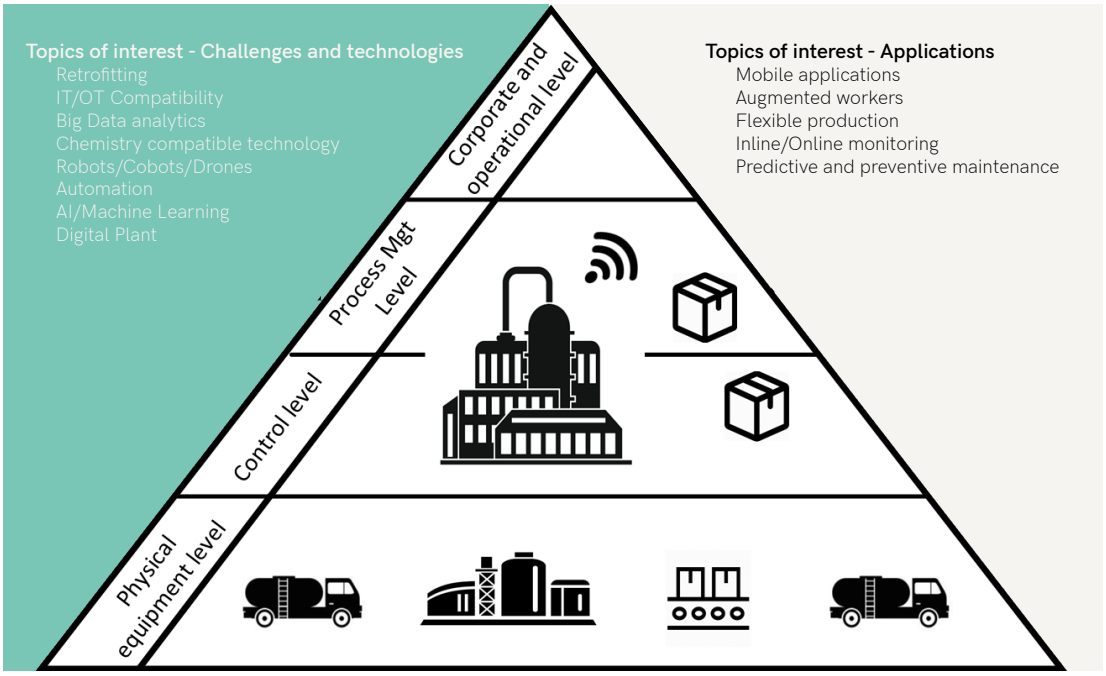

Fig 3. Vertical integration – challenges and applications

Selected challenges raised by the companies

- **Tremendous technology stack:** The I4.0 vision comes with a huge technology stack. For most chemical companies, it is not always that clear which technologies have the biggest potential for their specific challenges. There is a clear need for technology scouting and inspiring examples with practical application. Currently, I4.0 is often seen as a technology push. Additionally, if not managed correctly the introduction of digital technology can be perceived as a threat (such as employability) for a number of people. It is important to start with small pilot projects focusing on the added value of those technologies (for example applying digital technologies for supporting the operators).
- **Creating a digital plant requires connecting equipment and applications:** There is still a big challenge in setting up a good interface between all existing equipment and systems. Not all equipment can be easily connected (e.g. some legacy machines need to be equipped with smart sensors to be able to connect them with other entities: cyberizing legacy equipment). Additionally, different IT applications need to be integrated in such a way that optimized data exchange can be done. This interconnectivity is a basic requirement to start with I4.0.

- **Big data analytics requires data collection and data valorization:** Data will be available in different data formats and sources. This data should be put in a uniform format to allow data analytics. It is important to first master the basics and then start with data analytics. Getting started with advanced data analytics doesn't make sense when the basics of process control and maintenance are not in place. Many companies do not even have their essential engineering data in order (e.g. they do not know when certain pumps have changed). After relevant data is collected and aggregated, this data should be valorized. Indeed, creating digital data is one thing, turning this into useful and reliable information requires a lot of effort and domain-specific knowledge. There are many companies in Flanders (including startups and scale-ups) that can offer expertise in data analysis. It is, however, important to include domain-specific expertise (e.g. chemistry knowledge), and not only the knowledge to process data (e.g. mathematical algorithms).

Some potential applications

- **Inline/online monitoring for process intensification:** I4.0 creates opportunities for process intensification, making better use of the available resources (energy, materials, water, etc.). This allows to take decisions regarding material and energy consumption reduction, by monitoring the processes and analyzing the generated data.
- **Predictive maintenance:** For the chemical industry, predictive maintenance is one of the most promising application fields for advanced data analytics. Data analytics brings opportunities for cost savings, better asset utilization and better prediction of problems. In a context of predictive maintenance, having relevant, accurate and reliable data is a main challenge.
- **Augmented workers:** Augmented reality (AR) and virtual reality (VR) applications offer opportunities in operator training. Virtual reality is ideally suited for safety training. It brings a much richer and realistic experience to the trainee with higher impact than traditional ways of training. Augmented reality can be applied for process monitoring and maintenance. The task of the operator will therefore evolve more towards a higher level of process supervision and control.
- **Flexible production with collaborative robots (cobots) to reduce the physical load:** Unlike industrial robots, collaborative robots allow to combine human dexterity and versatility with machine precision, speed and consistency. The robot takes care of the "dirty, dull and dangerous" operations, while the human operator can focus on the tasks that require human insight and problem-solving capabilities.

Beaulieu International Group (Digital plant)

Gradually, the control systems of our production equipment are being revamped in order to have interface capabilities that support data collection. Our aim is to have all equipment and infrastructure connected so that the plant is digitized. However, this is a step-by-step process, because one has to switch from old module control systems to future-proof ones. There are too few skilled people to carry out this conversion. If a switchover has taken place, the profits are enormous – efficiency increases by 25% are possible. There is also a long-term vision: augmented reality, adapted workwear, digitalization of the factory, scheduling maintenance at "energy cost-peak moments", etc. there is a clear vision on digitization, but the implementation takes a lot of time due to the lack of technically skilled people (who are currently being sought after).

InOpSys (Big data analysis)

InOpSys is a young, innovative enterprise that develops flexible and modular units for processing waste streams. As they deliver and operate on-site solutions for their customers, remote control of their installations is very important. By having one control room that centralizes all information on resource consumption, installation availability, process diagnostics, etc., InOpSys can reduce operation costs and increase their efficiency and sustainability.

BASF (Big data analysis)

At BASF, using digital technologies and data, we are creating additional value for our customers and are increasing the efficiency and effectiveness of our processes. For example, to calculate the most promising polymer structure from thousands of possibilities, you need a high-performance computer with above-average computing power – just a supercomputer like our Quriosity. With Quriosity, much more complex models are possible, in which significantly more parameters can be varied. This could not only result in substantially reduced development times, but also previously unknown relationships can be recognized and used to advance completely new research approaches.

https://www.basf.com/global/en/who-we-are/innovation/our-way-to-innovations/supercomputer.html

BOREALIS (Predictive maintenance)

In May 2018, Borealis started up a Digital Studio at Brussels Airport. The Studio is designed to be a creative and agile enabler for developing smart solutions for customers and employees, always in cooperation with the business.

The first result of the Digital Studio was related to predictive and preventive maintenance. Searching from historical data patterns and linking them to specific failures, future failures can be predicted one month in advance. This project also helped to create awareness on data quality and establishing a disciplined data collection system for all relevant maintenance processes.

Indaver (Smart Production)

Indaver continually innovates and invests in smart processing and digitization to facilitate the management of large volumes of increasingly complex waste streams and improve our service towards customers.

Beaulieu International Group (Smart production)

Implementations have taken place around individualization and the creation of small series for flooring products. The products have also been 'digitized', whereby the final look of a product can be predicted digitally based on the custom combination of the raw materials. We see more and more need for this kind of customization.

Sioen (Augmented worker)

We've installed a COQLBOX in our premises. This is a central information HUB where all the production-relevant information (and organizational information) is available for everybody. When the shift changes, all the operators of the starting shift and ending shift come together in the COQLBOX to discuss what has happened and what needs to be done.

Niko (Augmented worker)

The start of digitization projects is always a problem faced by the operator. The main application of technology is to support teams by increasing autonomy and self-regulation. This created a lot of buy in and eliminates the fear for newly-introduced technologies.

Horizontal integration for collaboration along the entire value chain

Introduction

Horizontal integration refers to a digital integration of all actors within the value chain. These value networks are optimized networks that integrate suppliers and the processes, information flows and IT systems in the product development and production stage to logistics, distribution and ultimately the customer. The creation of those networks generates opportunities for new services. Next figure displays the horizontal integration and the topics of interest.

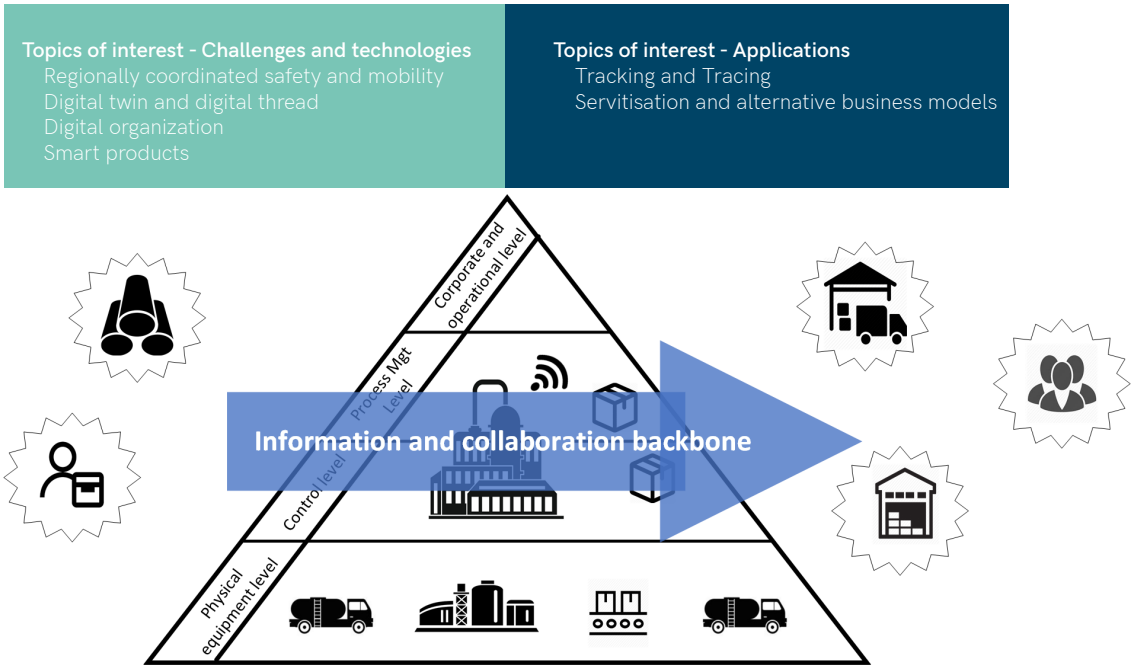

Fig 4. Horizontal integration – challenges and applications

Selected challenges as raised by the companies

- **Creating a digital twin and digital thread:** The notion of "digital twin" is an important aspect of I4.0. This means that physical "things" (assets, products, etc.) in the real world have a virtual counterpart in virtual space. These two are exchanging information through a data connection. By building a "digital thread" between departments (sales, purchasing, design, engineering, logistics, HR, etc.) and external partners (suppliers, customers), complete end-to-end processes within the factory and across the supply chain can be digitized. As a result of this, richer and more performant "systems of engagement" with external partners and internal employees can be built:
  - Setting up a digital value chain is both resource and time consuming and requires intensive collaboration and trust between all partners involved;
  - Digitally linking entities in the supply chain and exchanging data, requires dedicated industrial standards. These standards are missing today. Industrial Data Space (IDS) is an initiative (by Fraunhofer, Germany) that focuses on creating a secure data space that supports companies from different industries and different sizes in the autonomous management of data.
- **Identifying 'smart products' for the chemical industry:** Within industry, tremendous attention is given to smart products and the potential to create new services. However, smart products within the chemical sector are not always that straightforward. For example, for basic chemicals it is not easy to define smart products. Moreover, the added value (and who it will capture) is quite often unclear and should be carefully balanced against the cost.

Potential applications

- **Tracking and tracing of raw materials and products**: The availability of large amounts of data creates possibilities for "tracking and tracing" in the entire value chain. Tracking and tracing of raw materials and products is a main application domain for the chemical industry. Products can be traced not only in the plant during the production process, but also through the whole value chain and during the whole product life cycle (linked to horizontal integration).
- **Localization of assets**: during shutdown and maintenance, localization of all critical assets can be very valuable. During dismantling large installations for maintenance, it is important to know where all parts are located. E.g. during revision, expensive valves can be localized and identified of using GPS and RFID technology. For spare parts repair, the product data can also contain information about the repair steps that have been executed and are still to be executed.
- **Richer customer experience**: Augmenting physical products with complementary digital services offers opportunities for a richer customer experience and improved customer engagement. Recording digital touchpoint data (i.e., data with regard to any interaction that a company has with its prospects or customers) leads to a better understanding of customer needs and product usage. When the performance of a product is unsatisfactory, specific feedback can be provided to the production facility. Products are connected to the internet to follow customer habits and to create custom business models based on this information.
- **Additional services**: For example, valorization of services and software (plastics/chemicals as a service) or managing waste streams and recycling. Although there are many additional services that can be developed by digitizing the value chain and making products smart, it is not always that easy to earn money with these new services. It is difficult to evaluate the ROI and assess the willingness of the customer to pay for the extra value provided.
- **Collaboration platforms**: The digital integration of different entities in the supply chain enables the creation of collaboration platforms. Those platforms can be open (e.g. sharing research information, etc.) but also closed (e.g. for technical services by maintenance companies).

INEOS/Agilians (Digital organization)

Together with INEOS, Agilians has built a new Management of Change system based entirely on the latest agile methods and internet technologies. The objective was to find an optimal fit between quality and operability for an extensive process. The only option was to design a digital process model from INEOS' unique way of working, for which an exact copy was developed. This provided INEOS specialists with an easy-to-use application that does exactly what is needed. After this first success, a custom project management application was also built. INEOS is now reaping the benefits of an investment in modern web technologies, making them work consistently and flexibly. In short, a good example of innovative collaboration between companies from different sectors that bundle their knowledge.

Ajinomoto Bio Pharma Services (Digital organization)

At Ajinomoto Bio Pharma Services, we digitized our organization by combining technologies like SAP, Sharepoint, linked software and in-house developments. We created digital workflows, team portals and user dashboards that enhance cooperation and boost productivity.

Govi (Digital twin)

All products receive unique codes and are traceable, according to the raw materials used and, in the future, to all production parameters. All products are quality controlled, a Certificate of Analysis (COA) is generated, send to the customers on shipment time. In case of sporadic complaints from the customers, the specific root cause can be determined.

AGFA (Smart Products)

AGFA provides its customers with high end printing and ink solutions. But they also offer additional products like software to print invisible patterns that can be used for track and trace or encrypted codes and patterns to prevent counterfeiting.

B4Plastics (Smart Products)

B4Plastics is a Flemish start-up that develops, designs and distributes eco-plastics. Their COMPOST3D® 3D-filament is not made from natural resources and 100% compostable, it also comes with specific software and an app that allows the user to calculate the composting time even before printing the actual object.

INQUIRY OF THE FLEMISH CHEMICAL SECTOR: BARRIERS THAT PREVENT ACTION

During the individual company visits/discussions and the collective sessions, the barriers, preventing companies from starting their I4.0 transformation process, were identified. The figure below summarizes the different issues raised by the chemical and plastics sector.

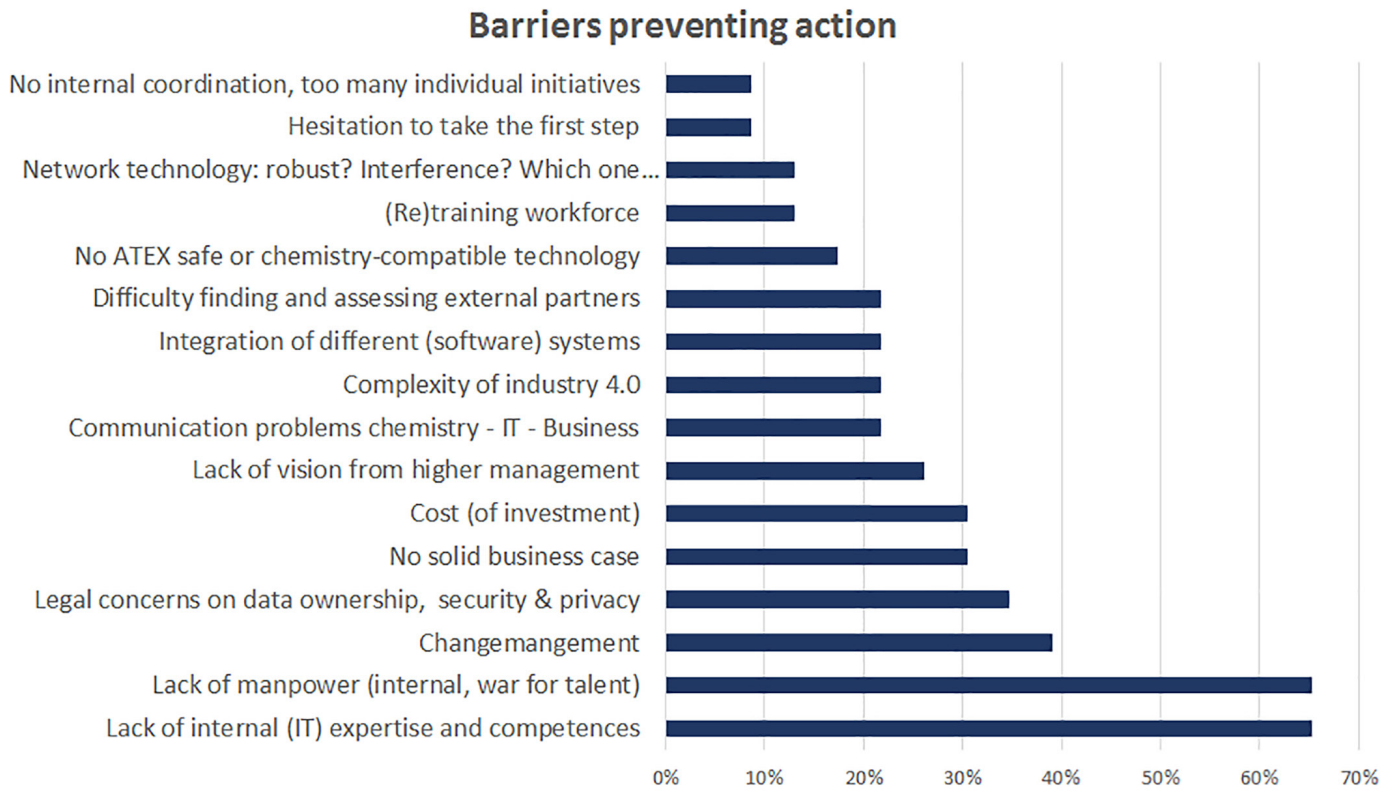

Fig 5. Barriers preventing actions

As can be seen from the above figure, the barriers do not only concern technological issues. Indeed, to assure successful transformation towards I4.0, it is not enough to address the developments associated with the fourth industrial revolution from just a technological perspective. Companies also need to transform their organization and culture. In fact, successful transformation projects address issues within four key areas (based on the Acatech I4.0 Maturity index[1]):

- **Resources** include a company's workforce (human resources), machinery and equipment, tools, materials and products. Employees should have broad-based IT skills and technological resources should have data processing capabilities to control the connected sensors and actuators and generate feedback data. All resources interact to aggregate data and create a digital shadow. Human-human, machine-machine and human-machine communication should allow real-time exchange of data and information.
- **Information systems** allow data and information transfer between the different entities. Therefore, different applications need to be integrated. A horizontal and vertical integration and standard interfaces are combined to create highly flexible information systems.

1 Industrie 4.0 Maturity Index - Managing the Digital Transformation of Companies, Acatech, 2017

- **Organizational structure** refers to both a company's internal organization (structure and operational processes) and its position within their value network. The organizational structure establishes mandatory rules that organize collaboration both within the company and externally.
- **Culture** refers to the mentality of its employees with regard to the agility to change. Companies will be unable to achieve the desired agility if they simply introduce digital technologies without addressing their corporate culture. Instead, they must begin by deciding how they want their company to do things in the future and which skills their employees will require.

It can be observed that, in addition to the four key areas from the Acatech I4.0 Maturity Index, also **issues/barriers with regard to the company vision and strategy were raised (fifth key area)**. The following figure shows the mapping of the different barriers raised by the Flemish companies to the five key areas:

In next sections, the different barriers are explained in more detail.

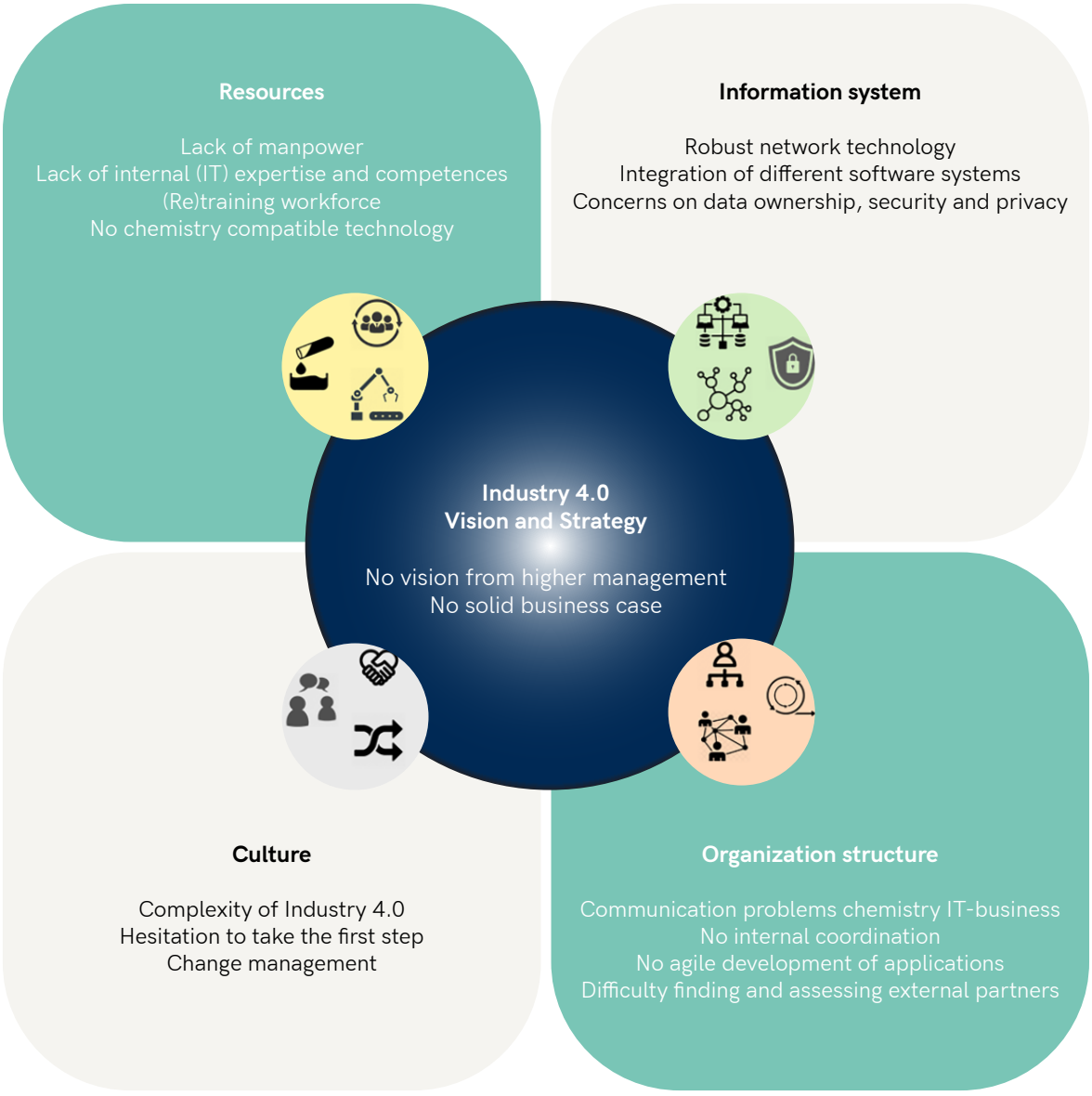

Fig 6. Clustered barriers preventing actions

Vision and strategy: towards a clear I4.0 transformation plan

During the interactions with the companies, following challenges were discussed:

- **Need for a clear company I4.0 vision**: Management should design a top down vision with regard to Industry 4.0 for their company. Ideally, this vision is linked to a bottom-up implementation (see further).
    - Currently, many companies have no clear I4.0 vision. As a result, there is a lot of uncertainty resulting in a lack of management, no coherent organization, too many uncoordinated individual initiatives, etc.
    - When developing this vision, careful attention should be given on putting the "WHY" before the "HOW": business results and/or safety improvements should be the main driver before technology integration.
    - Once this vision and the according roll-out strategy is developed, this should be communicated to all employees. Industry 4.0 comes with a lot of change and questions, and it is the role of the management to counter these issues by communicating openly on the coming transformation process and the impact on the company and its employees.
- **Need for a solid business case**: The Industry 4.0 vision should be translated in a business case.
    - Many companies are having a hard time defining a I4.0 business case, both quantifying costs and returns of investments and efforts. The added value of a digital transformation can currently not be easily assessed.
    - When rolling out this business case, the complexity needs to be reduced (you cannot tackle everything at the same time). Relevant subprojects need to be defined. It is important to create momentum and buy-in through pilot projects. A bottom-up approach with involvement of employees (and stimulating them to formulate ideas and solutions) is preferred.

3M

"In large, multinational companies, sometimes visions differ per site or even per department. Innovations can be impeded by internal red tape."

Janssen Pharmaceutica

"Business cases are often not straightforward. Sharing experiences and learning from others could speed up further projects and implementation."

Beaulieu International Group

"Beaulieu has a total vision regarding Industry 4.0. This vision is based on customer-relation strategy and technological developments."

Ajinomoto Bio Pharma Services

"We apply lean manufacturing principles in I4.0. We start simple and work our way to smart through continuous improvement."

Resources: looking for dedicated expertise, skills and compatible technologies

During the interactions with the companies, following challenges were discussed:

- **Missing expertise and competencies**: The shift towards Industry 4.0 means that not only core technological expertise/ competencies are required but also expertise on mastering digital technologies. Quite often this expertise is missing. There are different options to acquire the necessary expertise/competencies: internal training, attracting new people or working with external expert partners.
    - If there are internal people with the right skills or the potential to acquire those skills, they should be "freed" so that they can build and apply this expertise (should be incorporated in the organization's culture and structure).
    - Hiring new employees requires significant manpower and time (which is often missing). There is a war on talent going on (e.g. limited supply of data scientists).
    - Also retention management is very important: employees are given extensive (and costly) training but necessary actions need to be taken to assure that those people stay within the company.
    - Questions are raised on the expertise of graduates. Are graduates sufficiently trained? The basic level is too low, so it is important to pay sufficient attention to this in the training. Curricula are often too old and not adapted to industrial reality. Life-time learning is becoming more and more important.
- **Another issue concerns technological barriers**: I4.0 is all about connecting entities, but not all entities are ready to be connected.
    - Legacy equipment needs to be upgraded (cyberized). The already installed base is a barrier to implementing new (more sustainable) things. There is currently also a large installed base of 'older' machines, so it will take a relatively long time before a completely new way of working (supported by I4.0 technologies) will be implemented.
    - Additionally, there is a need for 'chemistry-compatible' technology. Innovative technologies emerge (e.g. sensors, cobots, etc.), but in most cases they are not at all ATEX-safe or chemical resistant.
    - It is also noted that life cycles of technology are shortening. How can this be managed?

Janssen Pharmaceutica

"We need to adapt and strengthen some cross-functional interactions and related competencies. e.g. IT and chemical engineering."

Beaulieu International Group

"Beaulieu has started with an automation task force wherein engineering works closely together with IT."

BASF

"How do you manage digital solutions that consist of multiple technologies, given their short technological life cycles? Especially in the context of production installations that have been designed with a lifetime of 30 to 40 years, and which can run for 5 consecutive years or more, without interruption or shutdown."

Information system: need for integrated and secure systems

During the interactions with the companies, following challenges were discussed:

- **Need for robust and secure network technology**: When different entities will be connected (in the company and the supply chain), a robust network is needed. Security plays an important role within the chemical sector (e.g. cyberattacks to an installation). The security of a digital network is as strong as its weakest link, and this is usually the human being. Cybersecurity is a point of attention: customers ask this on a regular basis because they do not want to use the possibilities of interconnectedness without security being guaranteed. This can block the digital interconnection and collaboration between entities in the supply chain.
- **Need for integrating different software systems**: Within a company, departments quite often work as islands. Those islands use their dedicated software systems, based on the application (e.g. product development software, simulation software, planning software, etc.). Within the I4.0 framework, these applications should be integrated in a smooth way to allow optimized use exchange and use of data and information. This is a difficult challenge. Industrial standards for this integration are (being) developed, but the practical applicability is limited. This blocks the integration process.
- **Big data - legal and security concerns**: Large amounts of data will become available. Who owns this data, e.g. product data of the customer? The same goes for supplier data: if you receive data from your supplier and do something with it, who owns it? You do not want to expose everything between customer/supplier because then you are less strong in the commercial negotiations. How to convince the customer of the importance of data exchange? Also in the context of open innovation and co-creation, these issues appear. Safe and trusted global data platforms, portals and digital collaboration tools create opportunities for co-creation with partners.

Ajinomoto Bio Pharma Services

"At Ajinomoto Bio Pharma Services we believe in open innovation and co-creation. We work with transfer portals to improve interaction with external partners. But how do you combine open innovation with IP protection and secure exchange of data?"

Organization structure: enabling collaboration in and outside the company

With regard to the organization structure, following issues and remarks were raised:

- **The organizational structure should facilitate and stimulate internal initiatives and collaboration**: There should be enough room for 'bottom up' contributions. The operators themselves should (by virtue of their operational responsibility on the shop floor) be able to indicate what can be improved. In other words, space and time can (must) also be given to the operators to come up with their own proposals. As an organization, you have to be able to handle this idea generation. This requires a system to select ideas, and a system that also allows ownership and idea stimulation by operators. Senior management is sometimes too concerned about its own objectives, which often means that it focuses too much on the short-term objectives and less on the long-term objectives.
- **Interdisciplinary teamwork and communication should be improved**: Within I4.0, IT and OT will meet. Questions are raised on how to align IT employees with OT employees (operations, engineering, automation). It is important to form teams with people who have relevant knowledge, both downwards and upwards. It is important to have both 'all-rounders' and people with specific knowledge around the table (interdisciplinary), who approach the problem with an open mind (no box thinking). The development of a 'common language' is also very important. The organizational structure should facilitate this interdisciplinary collaboration.
- **Collaboration with external partners is necessary**: Often it is much more economical to work with external parties than to do everything yourself. However, it is difficult to find, evaluate and select the right external partners for collaboration. Cooperation with external partners as a catalyst for digital innovation will be unavoidable due to the ever-increasing speed of change. There are questions on how to set up these partnerships and alliances to create added value within the company. E.g. for large companies connecting with a small start-up can give great added value. Web platforms for collaboration in the field of chemistry already exist. These are typically websites on which challenges are posted, and on which startups and scaleups can offer solutions/services. From these offered solutions, the organizer can select the best solution. This type of collaboration and matchmaking should be stimulated.

Niko

"Evaluating different external parties is difficult in the selection phase. Many solution providers have offerings in the domain of "digitalization" and have their own specialization. It takes a lot of effort to find out who is the most suited partner for a specific project."

Recticel

"Since 3 months, an Industry 4.0 engineer has been recruited. The first assignment of this engineer is to make the foaming production line of Wetteren Industry 4.0 proof. All data has to be readable, to be linked to input, production parameters, ERP, etc. Recticel will probably have this partly done by an external company. Here, they sometimes run into difficulties, especially in the search for relevant suppliers."

3M

"Just try it. Start with a small team, a specific goal and take the first steps."

Organization culture: willingness to change

With regard to the organization culture, following issues and remarks were raised:

- **Supporting the change process (organizational transformation)**: In addition to technological competencies, change management skills are equally important. 'Digital transformation' and 'organizational transformation' must go hand in hand. This change management should not be underestimated: there is a wave of new technologies coming and people have difficulties in assessing the impact on their job. Careful attention should be spent on informing all employees on Industry 4.0 (what does it mean) and definitely on the impact of I4.0 on the company and its operations. Often the (older) operators think that they will lose their job due to digitization. Hence the importance of communicating about the change process and the actions that will be taken to support this process, cannot be neglected.
- **Keeping everybody on board**: Careful attention should be spent on inspiring and retraining employees to continuously learn and ensure that they stay motivated to work in an ever-changing environment. It is noted that specific action should be taken for the "experienced" employees: their expertise should be exploited to the maximum, while assuring that they stay on board in the change process. It is noted that often younger people have less difficulties with the changing environment. Learning teams can be set up were young and old employees (inexperienced and experienced) work together to learn from one another. In any way, the aim is to create a culture where employees, young and old, are proud of their environment.

BASF

"Change involves people, process and technology, and digital transformation adds data as a fourth element. The current technological change is arguably not driven by the chemical industry. Then again, we do not necessarily feel that there is a lack of technology to make the change. The biggest challenge will be how to manage the additional complexity, understand dependencies in what we do, and how to deal with traditional domain boundaries. We are therefore putting emphasis on the skills of our people, both those who use and who develop and support the technology, as well as rethinking the way we work."

ACTION PLAN FOR THE FLEMISH CHEMICAL SECTOR

A STEPWISE APPROACH TOWARDS IMPLEMENTATION

The introduction of Industry 4.0 involves upgrading digital competencies and capabilities and entails changes across large parts of the organization. Given that this transformation is very complex and time-consuming, a stepwise approach is needed to ensure positive impacts during the different stages. A number of typical steps can be identified; each step building on the previous one and requiring additional capabilities. For successful implementation, it is up to each company to decide which development stage represents the best balance between costs and benefits for its own particular challenges. Following steps can be identified (based on the Acatech Model):

- **Computerization**: All entities within the company are modified such that they can be connected (e.g. legacy machines, but also software applications).
- **Connectivity**: The different entities are connected in a digital chain using standard internet protocols for data exchange.
- **Visibility**: Data of the different processes is collected and made visible. This makes it possible to keep an up-to-date digital model of the factory (digital twin). This digital twin can help to show what is happening in the company at any given moment, so that management decisions can be based on real data.
- **Transparency**: The next step is to understand why something is happening and use this understanding to produce knowledge by means of root cause analyses. This requires engineering knowledge and advanced big data analytics to be combined.
- **Predictive capacity**: The company is able to simulate different future scenarios and identify the most likely ones.
- **Adaptability**: Predictive capacity is a fundamental requirement for automated actions and automated decision making. Continuous adaptation allows a company to delegate certain decisions to IT systems, so that it can adapt to a changing business environment as quickly as possible.

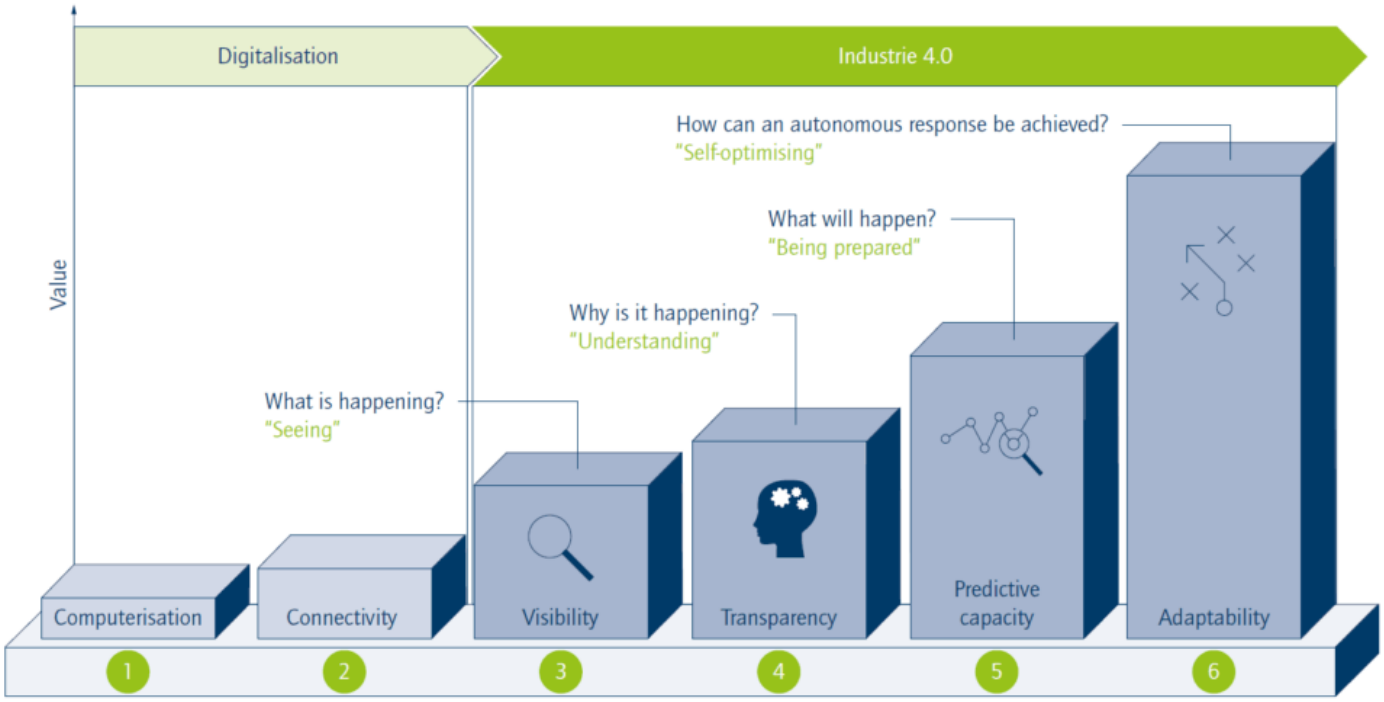

Fig 7. Stages in the I4.0 development path (Source – Acatech I4.0 Maturity Index)

To assure a successful transformation of the chemical and plastics sector towards Industry 4.0, companies that want to start their transformation need to be coached and supported during this process. Four dedicated actions are defined for this purpose.

FOUR ACTION LINES

Based on the different topics of interest and the barriers raised by the chemical industry, an action plan to support the Flemish chemical sector with their transformation towards Industry 4.0, was developed.

The action plan contains four action lines:

1. Learning network
2. Experimentation labs
3. Technology scouting and watch
4. Skills, education and legal framework

Learning network

Companies are looking to learn from others. They want to see successful examples and learn what approach was used, what worked and what did not, what errors should be avoided, how did they get started?

Inspiration and examples can be shared across different sectors. For several I4.0 topics the challenges are similar regardless of the sector in which the company is active.

Concrete actions that were suggested are:

- Find and share testimonials from innovation leaders to inspire other companies to take actions.
- Organize company visits to showcase successful implementations, both regional and international.
- Connect chemical companies who could learn from one another and also connect the chemical/plastics sector and the technology sector to exchange experiences.
- Organize dedicated work sessions to learn from others (focus on specific challenges).

Actions already ongoing in Flanders

Sirris organizes different workshops and masterclasses. For example on Design for Advanced Manufacturing

https://www.sirris.be/nl/agenda/masterclass-design-additive-manufacturing-dag-1-2-2)

https://www.sirris.be/nl/agenda/meet-cobots

https://www.sirris.be/nl/agenda

IBN Digitizing Manufacturing

https://www.sirris.be/nl/ibn-digitising-manufacturing

Within Centexbel, two working groups are installed 'technical textiles' and 'industry 4.0', in which Industry 4.0 topics are included and make part of the targets and goals of these working groups. We inspire the companies through testimonials, visits, state-of-the-art tooling and presentations.

Flanders Make organizes events to bring companies together to learn from each other: seminar, symposium, specific events, masterclasses. A lot of knowledge is available that can be used and shared across different sectors.

https://www.flandersmake.be/nl/events

co-creation sessions and support services by imec

https://www.imec-int.com/en/livinglabs

Experimentation labs

Most of the Industry 4.0 technologies are new to the companies. Often the purchase of technologies, installations or machines requires high investments, which are difficult to justify in an early phase of technology exploration and experimentation. Making test labs available and accessible, where companies can explore and experiment with new technologies can remove this barrier.

Suggested actions and experimentation environments:

- Inspiring demonstrators to show the potential in an industrial-relevant lab with open access to all interested stakeholders. The demonstrators are driven by collective challenges (industrial steering) and are developed in close collaboration with technology/solution providers.
- Hands-on masterclasses and workshops where participants get deeper insights and can experiment themselves with new technologies and applications. Also paying attention to human aspects and change management.
- Application environment for feasibility studies: individual challenges can be tackled during a feasibility study to assess both the economic and technological feasibility of certain technologies/applications for company specific use-cases.

Actions already ongoing in Flanders

Sirris has different application labs for experimenting and testing

https://www.sirris.be/nl/service/hoogtechnologische-infrastructuur-en-industrieel-partnernetwerk

focus on smart and digital assembly

https://www.youtube.com/watch?v=MMwJzqIALQc

https://www.youtube.com/watch?v=pIE2AagmtDk&t=28s

focus on integration of innovative technologies in production systems

https://www.youtube.com/watch?v=tSYhgtfSDqQ&t=161s

Flanders Make Operator 4.0 support lab and Make Lab

https://www.flandersmake.be/en/our-services/testing-and-validation/production

There already are 17 industrial living labs in Flanders

COLLABORATIVE WORKCELL 4.0

What if your new colleague is a robot? This living lab demonstrates this, using a mobile work bench that combines a cobot, digital work instructions and light projections, with measurements of the physical and mental workload experienced by the employee.

Partners: Flanders Make and imec

https://www.industrie40vlaanderen.be/proeftuinen/collaboratieve-werkcel-40

SMART CONNECTIVITY

Location and production data are must in factories with cobots, AGVs and other mobile units. Learn how to obtain reliable data and localisation solutions in challenging situations, such as a factory hall with obstacles and personnel.

Partners: imec, Flanders Make and EUKA

https://www.industrie40vlaanderen.be/proeftuinen/smart-connectivity

LIVING LAB 4.0 AGROFOOD

Food companies can optimise their processes with sensor technology and hyper-spectral cameras. They thereby improve the quality of their products and their position on the market.

Partners: Flanders' FOOD and ILVO

https://www.industrie40vlaanderen.be/proeftuinen/living-lab-40-agrofood

SMART MAINTENANCE

Affordable sensors facilitate the shift from periodic to conditional maintenance, which saves industrial companies a lot of money. This living lab shows how to lower maintenance costs and how to increase productivity.

Partners: Flanders Make and imec

https://www.industrie40vlaanderen.be/proeftuinen/smart-maintenance

OPERATOR SUPPORT 4.0

Assembly processes are becoming extremely complex. Fortunately there are numerous solutions for maximum production flexibility without pushing employees to their limits. The fastest way to 'lot size 1'!

Partner: Sirris

https://www.industrie40vlaanderen.be/proeftuinen/operatorondersteuning

CONDITION-BASED & PREDICTIVE MAINTENANCE

Production machines are home to a wealth of information. IoT sensors and cloud solutions pave the way for optimal maintenance and further digitization.

Partner: LSEC/3IF.be

https://www.industrie40vlaanderen.be/proeftuinen/conditioneel-en-predictief-onderhoud-industrial-data-space

DIGITAL SERVITISATION

How do you quickly assess the feasibility of a new, smart product with an associated digital earning model? This living lab provides the building blocks (sensors, connectivity, data-analyses, dashboards) you need!

Partner: Sirris

https://www.industrie40vlaanderen.be/proeftuinen/digitale-servitisatie

CSITE VISION

Virtual and augmented reality offer unprecedented possibilities for the construction industry. This living lab serves a range of tangible business ideas via demonstrations and inspiration sessions.

Partners: WTCB, Howest, Sirris

https://www.industrie40vlaanderen.be/proeftuinen/csite-vision

MACHINE UPGRADING 4.0

By upgrading existing installations with sensors, actuators and computing power you give a new life to old machines.

Partners: KULeuven Campus Bruges, Flanders Make, UGent

https://www.industrie40vlaanderen.be/proeftuinen/machine-upgrading-40

DRONES IN AGRICULTURAL & CONSTRUCTION INDUSTRY

From inspections and thermographic scans of roofs to autonomous spraying of crops: drones are revolutionising both construction and agriculture. At DronePort, the heart of the Flemish drone community, all the building blocks for an innovative drone project are within reach.

Partners: EUKA, Confederatie Bouw Limburg, WTCB, Proefcentrum Fruitteelt

https://www.industrie40vlaanderen.be/proeftuinen/drones-de-bouw-en-landbouw

SMART FARMING 4.0

Spectral image sensors allow the use of drones for screening crops for diseases. Two practical cases demonstrate the possibilities.

Partners: ILVO, imec, Flanders Make, KULeuven, VITO, Proefcentrum Fruitteelt

https://www.industrie40vlaanderen.be/proeftuinen/smart-farming-40

AR/VR IN LAB AND PROCESS ENVIRONMENTS

In lab and process environments, you can support your employees with digital work instructions, augmented reality and digital twins. In this way, you can formulate

Partners: UHasselt, Flanders Make, Howest, Flanders' FOOD, Bioville

https://www.industrie40vlaanderen.be/proeftuinen/armr-labo-en-procesomgevingen

T2 FOR INDUSTRY 4.0

The brand new, high tech T2 Campus assists companies and their employees with the necessary competence development for the transition to Industry 4.0. For example, in the field of the Industrial Internet of Things, cobots, cloud applications and the link between production processes and web applications.

Partners: VDAB, Syntra, Flanders Make, Sirris, UC Leuven-Limburg

https://www.industrie40vlaanderen.be/proeftuinen/t2-voor-industrie-40

EDUCATE 4.0

Innovative digital learning methods help companies find and retain employees with the right competences and skills.

Partners: Catalisti, ACTA, imec, KdG

https://www.industrie40vlaanderen.be/proeftuinen/opleiden-40

CYBERSECURITY 4.0

The tsunami of data causes risks at production level. This living lab offers an overview of solutions in the area of cyber security and helps putting them into practice.

Partners: Howest, UGent

https://www.industrie40vlaanderen.be/proeftuinen/ici-40

MES4SME

SMEs need reliable and easily configurable Manufacturing Execution Software. Experts show the best solutions in this test environment.

Partners: UGent, Flanders Make, VUB

https://www.industrie40vlaanderen.be/proeftuinen/mes4sme

AMPLITUDE

Within twenty years, half of the manufacturing companies will be using 3D printing. Discover the possibilities for your company with the help of practical cases and independent matchmaking.

Partner: SIM-Flanders/Flam3D

https://www.industrie40vlaanderen.be/proeftuinen/amplitude

Technology scouting and watch

The field of Industry 4.0 and the state of technology is evolving rapidly. It is hard for companies to keep up with the latest changes, the state-of-the art and to keep track of new and interesting start-ups. The action line of 'Technology scouting and watch' addresses these challenges.

One aspect that was mentioned over and over again, is the difficulty of finding the right (external) partners. Most companies do not have all necessary expertise and skills in house, so a lot of innovations and implementations are done together with partners. To find the right partners, with the best expertise, relevant experience and established track record is not easy. There is a great need of a cross sectoral supply-demand matchmaking platform that enables companies to find the right partners.

- Supply-Demand matchmaking platform: cross sectoral, one central platform that unites all current stand-alone initiatives.
- State-of-the-art on I4.0 for chemistry: access to research results, studies, research projects, start-ups, scale-ups, etc., but in such a way that companies can find their way through the technology jungle.
- Coaching companies to define their Industry 4.0 Technology Roadmap.
- Dedicated technology sheets: describing a technology, potential applications, potential impact, technological and economic feasibility, successful implementations, do's and don'ts, etc.

Actions already ongoing in Flanders

Industry 4.0 technology watch by essenscia (2019): This provides an insight into the most recent developments concerning Industry 4.0 within the chemical industry. With focus on "Big data" and how this can be an opportunity for your company.

http://www.essenscia.be/nl/technologiewacht

Overview on research projects, technologies and inspiring examples can be found on Sirris blog, Sirris webpage and Sirris Techniline (members only)

https://www.sirris.be/blog

https://www.sirris.be/expertise

http://techniline.sirris.be/WO.wsc/olContent3?FAction=HOME&TopicID=5972&FActionSource=olTopics

WTCB "C-Watch", where innovative ideas and products are published as a source of inspiration in a first step in the innovation process of construction companies.

https://www.wtcb.be/homepage/index.cfm?cat=projects&sub=c-watch

Centexbel uses its information channels to spread inspiring examples from successful implementations. This is done by for instance the monthly electronic publication 'Centexbel INFO'.

Skills, education and legal framework

There are a lot of non-technological barriers or challenges that complicate the implementation of industry 4.0. In the coming years, as technology evolves, it is important that legislations evolves as well to make sure that the use of new technological possibilities are not impeded by old regulations or legislations.

As indicated in the section 'barriers', the lack of manpower, expertise and competences is the main hurdle companies face at the moment. The availability of well-trained technical staff has been a difficulty for the chemical and plastics sector for many years. Industry 4.0 will only increase the demand for technical profiles and will require additional, specific skills. A major effort is needed to increase the availability of these needed profiles on the labor market.

There is a high need for:

- Actions towards education to assure that graduates meet the industrial requirements. Increasing the link between education and industry.
- Actions to improve training of employees to acquire new digital skills.
- Actions with regard to life-long learning.

Actions already ongoing in Flanders

'The future of jobs in chemistry and life sciences' study.

Commissioned by essenscia vlaanderen, professor Ans De Vos and senior researcher Tim Gielens of the Antwerp Management School have conducted a sector-specific study on "The future of jobs in chemistry & life sciences". The research report examines the possible implications of digitization, automation and robotization on employment and production processes in the chemical, plastics and life sciences.

http://www.essenscia.be/nl/studie_impact_industrie_4.0_op_jobs_in_chemie_en_l

BIMportal.be: Belgian referential portal on BIM and ICT in the construction sector

The 2019 Centexbel 'Ontbijtsessies' (Breakfast Sessions) focus on Industry 4.0 related topics, linked to the relevance and implementation possibilities in the textile and plastic converting industries – blockchain, predictive maintenance…

https://www.centexbel.be/en/agenda

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Authors

Luc Van Ginneken, Catalisti, lvanginneken@catalisti.be

Leentje Croes, Catalisti, lcroes@catalisti.be

Sander De Vrieze, Centexbel, sander.devrieze@centexbel.be

Rik Vanhevel, sirris, rik.vanhevel@sirris.be

Bart Verlinden, sirris, bart.verlinden@sirris.be

Walter Auwers, sirris, walter.auwers@sirris.be

Layout

eline.robin@centexbel.be

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www.catalisti.be

Twitter: @CATALISTIvzw

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