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# Summary

There is no escape. Artificial intelligence (AI) will be part of all services tomorrow, but also of all products, as part of an evolution that some compare with the rise of electricity. Just as everything became 'electrical' in the past, everything now becomes 'smart'. If we want to continue offering relevant and competitive services and products tomorrow, we will have to take AI into account.

AI is a very broad term. That is why strategy development and prioritization present us with real challenges. What we do know, is that every technology needs an 'ecosystem', a substrate, to develop. The strength of AI lies in its ability to support the entire ecosystem, from hardware to end-user.

This ecosystem will initially create a partnership between companies, government and education. With the necessary coordination and governance, efforts are made to promote the use of AI in industry and to valorise the research results of Flemish universities. Such an ecosystem offers Flanders, our small region in the big world, opportunities, but it also forces us to make choices.

AI refers to systems that display intelligent behavior in order to achieve specific goals (European Commission, 2018). Disciplines within the AI domain include machine learning and deep learning, natural language processing, semantic intelligence, collaborative systems and image processing.

AI is currently in full development because the cost price of the required hardware (mainly due to cloud solutions) and software is decreasing very fast.

This study has three objectives:

- to map the current developments in Flanders in the field of AI;
- to compare the position of Flanders with a number of countries, both within and outside Europe;
- to formulate recommendations as a basis for the elaboration of policy initiatives and government interventions to further support developments in the field of AI in Flanders.

We have examined various indicators based on desk research and interviews with subject-matter experts.

Where applicable, we zoom in on a number of important sectors and applications for Flanders, such as Industry 4.0, trade and healthcare, without wanting to pursue completeness.

We discuss these objectives for each component of the AI ecosystem:

- education;
- research;
- scale-ups, start-ups and spin-offs and the challenge of financing;
- business;
- promotion;
- collaboration;
- policy initiatives.

## Education

AI is about everything, AI is multidisciplinary, and cross-pollination can only take place if the use is known. Everyone will have to deal with it. For education, this means that AI will not only be relevant for STEM programs, but that knowledge of AI must have a place in just about every program.

Today AI is present in the curriculum of Flemish bachelor's and master's programs. KU Leuven is the only one that offers an English Master-after-Master program that is entirely dedicated to AI.

AI is also omnipresent in the training offers of other countries. There are several masters that focus on AI, as well as AI-related subjects within various programs (computer sciences, language and communication technologies, human sciences, etc.).

Flemish universities underline the need to adapt their programs more quickly to AI. Greater flexibility gives universities the opportunity to respond to the economic and social needs of Flanders. Why do we not offer a new AI master or even an interuniversity AI master? To date, and our academic respondents agree, this is a difficult process that is only slowly unfolding.

In order to meet the increasing needs, it is necessary to integrate more AI specializations and AI-related subjects into programs such as computer science, informatics and statistics. At the same time, it is important to take into account the multidisciplinary aspect of AI and also to promote this in programs outside of IT, such as psychology, communication and medicine. Moreover, there is a need for shorter trainings, re-trainings and on-the-job trainings, for people in the business world as well.

## Research

The United States and China are the global leaders in AI research, even though Flemish expertise should not be underestimated. The research on AI disciplines is well represented in Flanders in the main strategic research centers and in the many laboratories. However, it is advisable to conduct multidisciplinary research between AI and other scientific disciplines. Examples of this can be found in medicine, biology, law and political sciences.

In addition, research on AI in combination with other emerging technologies, such as cybersecurity, Internet of Things (IoT), and augmented reality (AR) and virtual reality (VR), should also be encouraged and supported. All our respondents therefore point to the need for coordination of AI research in Flanders.

Worldwide we see a steady increase in AI-related publications since 2005.

With regard to patent applications, many AI technologies are made available as 'open source'. Most patent applications for AI are a combination of hardware and software since pure software patents are less common. Compared to other emerging technologies, AI has the second highest patent growth rate.

With regard to the funding of AI research and AI development in Flanders, the Research Foundation of Flanders has financed several AI scholarships for PhDs, postdocs and research projects in recent years. A specific AI committee within the FWO can strengthen the funding procedures.

In Europe, research is funded with initiatives such as the 'Horizon 2020' program. For example, natural language processing and speech recognition belong for the Flemish language to Horizon 2020. This contributes to the European language network. The advantages offered for many applications, including language applications in care for the elderly, are unmistakable.

Public-private cooperation arrangements are often invaluable for realizing technological breakthroughs. In Flanders there are several public-private partnerships in the context of smart cities. In addition, Flanders Make and imec offer public-private cooperation arrangements through their icon projects. The Flemish Supercomputer Center, on the other hand, provides the necessary computing power for AI.

## Scale-ups, start-ups and spin-offs and the challenge of financing

Most AI companies and AI start-ups are located in the United States, Europe and China, respectively. The largest AI hub is located in Silicon Valley, followed by New York, Beijing, London, Shenzhen and Seoul.

On a sample of about 4.200 companies in Europe in 2018, nearly 600 are considered AI scale-ups. More than three-quarters of European AI scale-ups are B2B-oriented. The United Kingdom, France and Belgium lead in the share of AI scale-ups.

The startup landscape has a rapid evolution. Worldwide there are approximately 3.500 AI start-ups that produce goods and services using machine learning, deep learning, image recognition, natural language processing or other AI disciplines. These startups are mainly active in the communication, sales and marketing, healthcare and financial services sectors.

In addition, there are several AI spin-offs at the Flemish universities. KU Leuven, UAntwerp and UGhent are among the 10 most active spin-off institutes in Europe.

Given the current and potential impact of spin-offs, start-ups and scale-ups on AI, it is recommended to provide sufficient support in areas such as administrative simplification, marketing, communication and financing.

In the area of AI financing in the private sector, the United States is clearly the leader. With € 15 to 23 billion, the United States offers the largest sum of funding for AI, followed by Asia with € 8 to 12 billion and Europe with just € 3 to 4 billion. China, however, has been investing more and more in AI in recent years and is catching up, as the equity financing figures show for startups.

In terms of risk capital, AI represents 17% of all European venture capital transactions, with data analysis (9%) and IoT (8%) in second and third place. Flanders has with imec.istart an important 'accelerator' at home.

## Business

The Flemish companies are only just discovering what AI can do for them. Flanders should not, however, remain stationary. AI is in the transition phase of 'early adopters' to a generally broader use. The growing demand for AI talent is not expected to be matched by the supply. There is an increased need to train more talent with multidisciplinary backgrounds to meet the increasing demand. We recommend providing the necessary financial resources and training programs for retraining and relocating the workforce.

The use of AI in companies is still in its infancy, although it is certain that AI will have an impact on many sectors, including trade, health care, the automotive sector and the financial sector. Healthcare and surgical robotics are one of the most promising new markets. Given the existing basis of the pharmaceutical market in Belgium, there is a need for targeted stimuli for AI in healthcare and health tech.

## Promotion

Despite the fact that Flanders is known as a knowledge society, contemporary AI talent often leaves for large companies and AI hubs worldwide. Permanent appointments and chairs in higher education can form an incentive scheme for our best talents to stay. The Flemish government and organizations must jointly ensure that the AI talent in Flanders is maintained and that the necessary support is available for people whose job will be replaced by AI.

In order to attract talent and partners from abroad, we must also be able to give our performance a more global appearance. This way we strengthen the knowledge and expertise in Flanders. Promotion and support are of course recommended.

## **Collaborating with others: in Belgium, in Europe and beyond**

Coordination with European initiatives is crucial for maintaining good cooperation with the European member states and regions, and for generating mutual benefits. In April 2018, 25 European countries, including Belgium, signed a declaration to work together on AI. Europe wants to focus on the inclusion of AI in the entire economy, the preparation for socio-economic changes as a result of AI, and the organization of an appropriate ethical and legal framework.

AI is a concept that has a countless number of possible applications. The Flemish government must further implement AI within all its powers as an example for industry and business. It is up to the government to promote FAIR data management\* and facilitate the reuse of data models and data between organizations and disciplines.

## **Policy initiatives**

The Flemish government is currently drawing up an AI plan. In 2017, the Royal Flemish Academy of Belgium for Science and Arts examined the opportunities, risks and challenges of AI in the field of research, education and industry. The resulting report contains recommendations for accelerating AI developments in Flanders, so that Flanders and Belgium can keep pace with the international competition.

The other countries studied in the context of this study are making significant public investments in AI and have a national AI strategic plan that highlights the priorities. Such initiatives can serve as a guide for Flanders.

## **'Bringing it all together': Coordination between the elements of the AI ecosystem**

A good alignment between the elements mentioned above is necessary to shape the AI ecosystem. Coordination around AI brings all players from the sector around the table. A strong Flemish AI network, embedded in the larger European landscape, with an open view of the world, is the ideal to be pursued. After all, AI does not stop at the Flemish or even European borders.

Also of critical importance is the close involvement of all stakeholders (such as companies, academics, research centers and laboratories). Good coordination can ensure participation in strategic research priorities for Flanders on the basis of national, regional and European agendas. This approach may be conducive to more far-reaching cooperation and better access to shared resources. A leverage effect can also be expected for the available talent and the already accumulated expertise. Initiatives such as the Digital Innovation Hubs of the European Commission and the European Lab for Learning and Intelligent Systems (ELLIS) and the Confederation of Laboratories for Artificial Intelligence Research in Europe (CLAIRE) already provide a basis for sharing knowledge and supporting companies on an international level.

Given the Flemish cluster policy, it is appropriate to include AI in the 'priority' clusters. However, since AI crosses all sectors and is an innovation tool rather than the innovation itself, it is important that all existing clusters can draw on the AI knowledge that is available in Flanders.

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\* Findable, Accessible, Interoperable, Reusable –  
Vindbaar, toegankelijk, interoperabel, herbruikbaar