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Map of the Polish AI

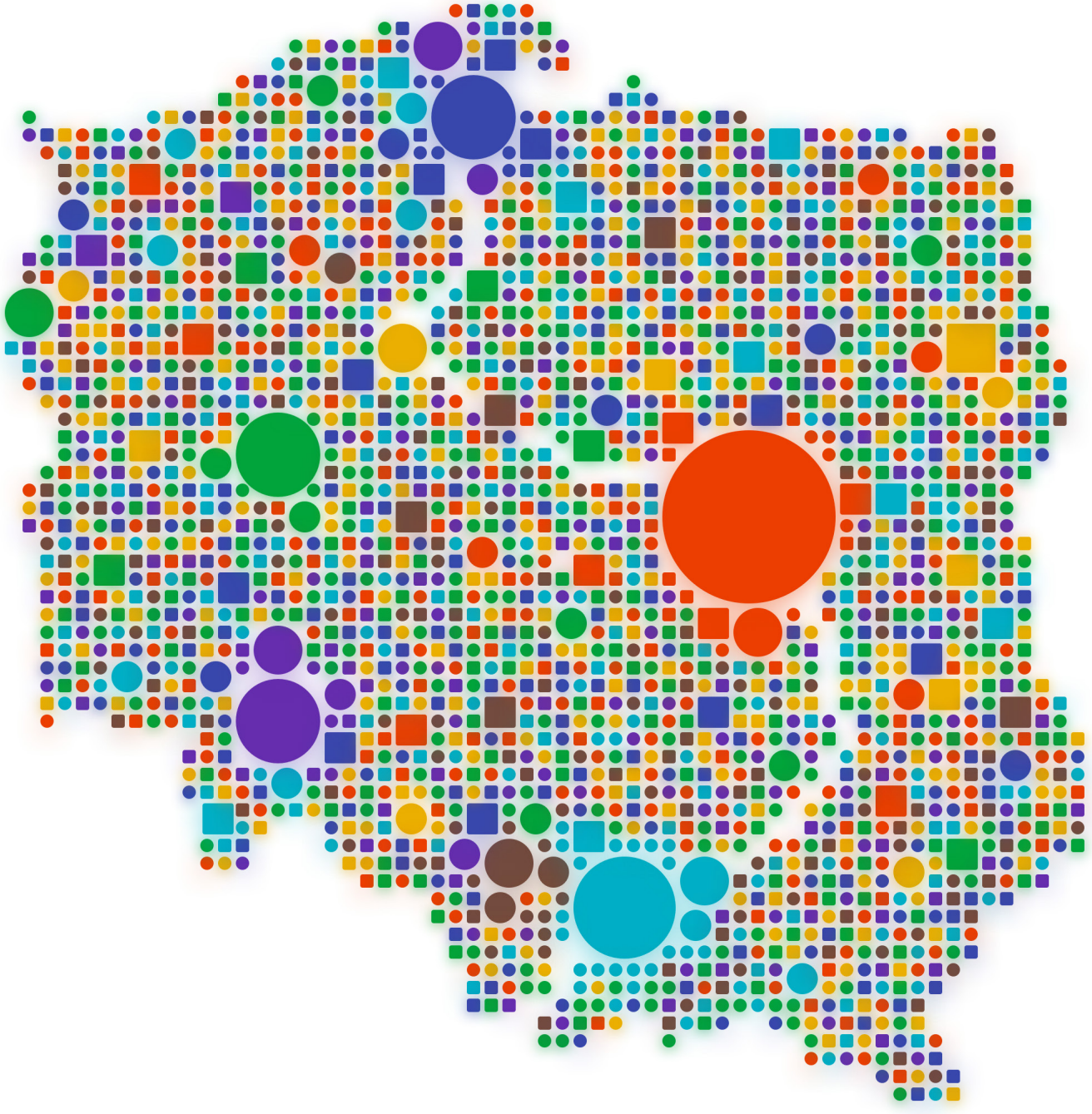

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Table of Contents

Foreword

I'm pleased to present the 2nd report prepared by the Digital Poland Foundation regarding Artificial Intelligence.

Previously, we were focused mostly on the novelties within the AI domain. This time we are exploring the AI ecosystem in Poland to streamline the creation of Polish the AI Strategy, integrate this particularly vibrant ecosystem and present AI capabilities to investors.

As the Polish government is still working on devising the Polish AI strategy, Digital Poland Foundation wants to support this work with this publication. In our opinion without a thorough knowledge of the industry, it is impossible to create a framework which effectively addresses all stakeholders and the needs of companies in Poland.

The map of Polish AI is the most comprehensive undertaking on the Polish market for and about the artificial intelligence industry. It contains information on practically all meaningful companies operating in Poland which offer services or products in the field of modern technologies. We believe this map will be necessary to help both domestic and international investors looking for interesting projects in Poland. The study is the first and, so far, the only one that widely and painstakingly presents national companies using AI.

Although, there are companies which first introduced AI in the 90's, technology was more widely introduced in business only after 2010. Our research shows that in recent years we have been witnessing a genuine AI boom.

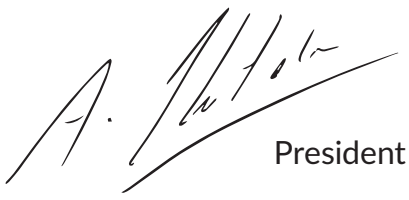
Development of AI in Poland is primarily driven by young companies and very few Polish champions develop AI. What is also interesting, many global corporations established their AI R&D centres in Poland to take advantage of huge pool of tech talents.

Polish AI companies usually operate using rather small AI teams. Only 10% of companies have a team that can be described as big, that is one where over 20 specialists work with AI.

Furthermore, most of them are located in big cities. Warsaw is undoubtedly the capital of the Polish commercial AI sector. Nearly half of the companies providing AI solutions are based there.

Categorically, as experts point out, the main barrier to the development of the Polish AI sector is not the absence of funding or expertise but rather a very limited demand for solutions based on AI. Polish companies working on AI develop their solutions for foreign buyers instead of local companies.

We hope that this document will constitute an indispensable help for both domestic and international investors looking for interesting projects in our country.



Aleksander Kutela

President of Digital Poland Foundation

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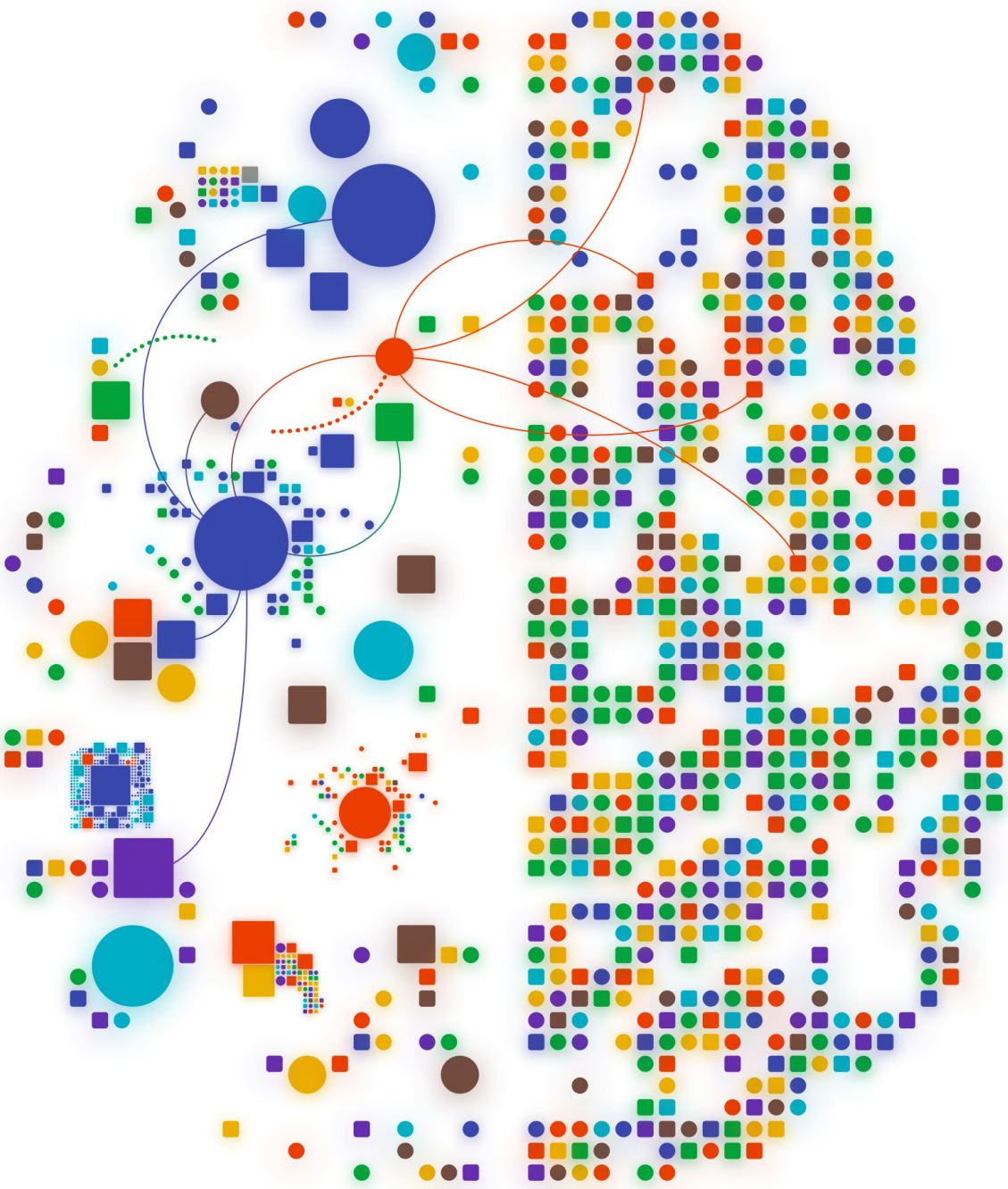
Executive Summary

– main findings from the report



Artificial Intelligence is ready for business, but are Polish businesses ready for AI? Giants like Google, Microsoft, Baidu, Tencent or Amazon invest huge resources in research and development related to the use of AI. However, the possibilities offered by AI are not reserved only for the largest ones. In Poland, more and more companies notice the potential of AI. In fact, the number of companies, which provide AI solutions and services have been growing rapidly year-by-year since 2015. We can, therefore, safely state that the AI boom in Poland is clearly visible.

Main findings from the report are presented below:

Booming number of companies

- There are companies which introduced AI as early as in the late 90's. However, this technology was more **widely introduced in business only after 2010**. In recent years, there has been a clear AI boom – **half of Polish AI companies have introduced the technology over the last two years**.
- AI is clearly the **domain of large metropolitan areas** in Poland. **85% of AI companies** which participated in the survey are located in **six major urban areas**. **Warsaw** accounts for **43% of AI companies**.
- In terms of financing, **two out of three companies** (66%) declare that they **rely fully on their own funds to fuel development,** but **23% have received VC funding**.

Business applications

- The demand for AI services in Poland is limited and this creates a **natural tendency to reach for clients abroad**. 73% of companies receive at least some of their revenue from clients abroad. **33% receive most of their revenue from foreign clients**.
- There are **two main obstacles** faced by companies implementing AI services. **41%** point out that their potential clients **do not understand their own needs** and, in effect, **do not see the potential benefits arising from AI**. **38%** of companies cite **insufficient data as an obstacle**. There is a need to much more educate CEOs and managers about AI.

- There is a need to **raise the awareness of AI** by educating non-experts in order to improve the implementation of the technology.
- **Two services most frequently provided by Polish AI** companies are **analytics, big data and business intelligence (43%),** together with **sales, marketing and advertisement (37%)**.
- Companies often also provide services in areas, such as **financial services and insurance (28%)**, **internet of things** and **industry 4.0 (27%)**. This may reflect the relative competitiveness and **openness to innovations in the Polish financial and industrial sectors**.
- The **major application of AI is image processing and recognition with 62%** of companies using AI in this area. Other popular applications are **data exploration (55%)**, **recommender systems (52%)** and **natural language processing (43%)**.

Human Resources

- Polish companies usually operate using small AI teams. Over half have AI teams consisting of 5 or less employees. Only 15% of companies have a sizeable team of over 20 specialists working with AI.
- Nearly all (85%) companies plan to expand their AI team, but usually want to hire up to 5 people. Only 13% of companies plan a dynamic expansion by recruiting more than 10 AI specialists.
- The experts who were consulted for the report point to a mismatch between the availability of AI specialists and the demand for their skills. This mismatch may be an important bottleneck in the development of the AI sector in Poland. In order to bridge this gap, there should be more education of specialists and non-experts. The latter means training managers to understand AI and being able to identify areas were the technology can be applied.

Technology

- The trends in Poland regarding the technical aspects of AI reflect global trends. The most widely used language is Python, with 87% of companies using it. 38% use R language, but its popularity is low among companies which introduced AI over the last two years.

- AI companies also use other popular languages, such as C/C++ and C# (50%) and Java (30%), which is a sign that many of them build complete solutions around AI capabilities.
- Polish companies use popular frameworks – TensorFlow (69%), Keras (49%) or PyTorch (38%).

Cooperation with the Scientific Community

- Globally, the AI sector has very close ties with academic teams. This is also the case among Polish companies.
- Half of them employ PhDs in their teams and 6% have more than 5 people with a scientific degree on their payroll. Also, 39% of companies publish papers based on their work and 8% have already over 10 publications.
- Overall, 77% cooperate with the scientific community, however, the extent and scope of cooperation varies depending on the size of their AI team. Among companies with a larger team (6 or more specialists), 88% cooperate with academia (versus 63% of companies with up to 5 AI specialists). They most often directly employ academic researchers (73% vs 23%) and cooperate with university research teams (49% vs 20%).
- AI companies usually cooperate with the scientific community in order to engage researchers and students in the day-to-day operations of the company. 48% engage people from the scientific community in the development of their own AI solutions and 31% create internships or classes for students.
- Only 13% of companies are involved in providing courses or studies and 11% engage in student research groups.
- Generally, companies expect that universities will provide them with fresh graduates and expert researchers, but usually do not undertake the effort to help the scientific community grow their teams within the universities. In the long-term perspective, this may be a hindrance in the development of the Polish AI sector, because academic research teams play a central role in the development of AI in the economy.

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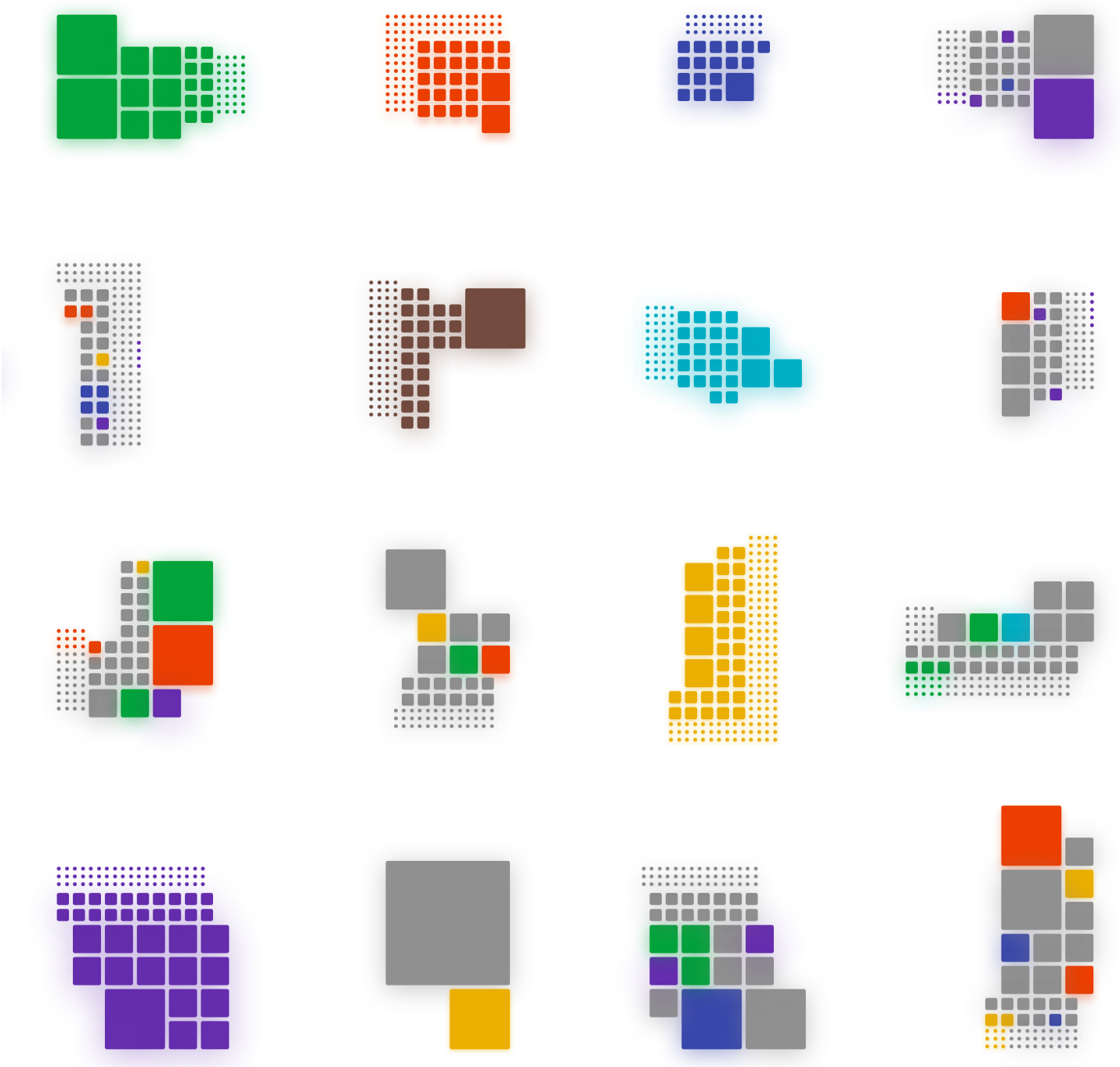
About the report



Economists working on artificial intelligence are largely unanimous that this technology will affect many sectors of the economy, similarly to the case of the internal combustion engine, electricity or the Internet. It is fairly obvious that the development of artificial intelligence will have a huge impact on the competitiveness of the economy. What's more, the possibilities offered by AI are not only reserved for the largest ones.

More than 160 small and large companies completed our survey. Our research shows that there are more than 260 AI development companies operating in Poland. This is the first, but certainly not the last study of that kind in Poland.

Why has the Polish AI Map been created?

In Poland, work has begun on the development of the national AI development strategy under the leadership of the Ministry of Digital Affairs, Entrepreneurship and Technology as well as Science and Higher Education. The Digital Poland Foundation would like to actively support this process and thus decided to create the Map of Polish AI. This kind of map is essential because without thorough knowledge of the industry, it is impossible to plan a strategy that best addresses all stakeholders and the needs of companies in Poland.

What is the purpose of the Map of Polish AI?

The main goal is to support the **creation of the national AI development strategy** and to present a reliable and up-to-date picture of the **state of AI technology in Poland**. The study is the first and so far, the only one that meticulously illustrates national initiatives using AI.

We were also many times **asked by investors about AI companies in Poland,** so we decided to shed some light on this topic. Moreover, we decided to **present associations and main events about AI in Poland** because our colleagues from the CEE region were **interested in attending** those **events** and **engaging with the polish scientific diaspora**.

The Map of Polish AI is the most comprehensive development on the Polish market for and about the artificial intelligence industry. It contains information on almost all companies operating in Poland which offer services in the field of modern technologies. **Moreover, it covers also foreign R&D centers which were opened in Poland by global giants like Google, ByteDance, Samsung, IBM or TCL**.

We hope that this document will constitute an indispenable help for both domestic and international investors looking for interesting projects in our country.

AI in our study

In the survey we utilize definitions of AI presented in the "Review of Strategies for the Development of Artificial Intelligence in the World" report (p.138). Artificial intelligence means devices and software that imitate cognitive functions of the human mind, such as: learning and decision-making, inference, speech recognition and articulation of thoughts, problem solving, object recognition as well as domains of knowledge pertaining to neural networks, fuzzy logic, artificial life and robotics. It is both devices and software that arose as a result of human work, and not as a result of biological evolution itself. Artificial Intelligence is also the machines' unaided ability to solve various problems without using a pre-programmed algorithm of action coded by humans.

We strongly encourage you to familiarize yourselves with the "Map of Polish AI sector" report.

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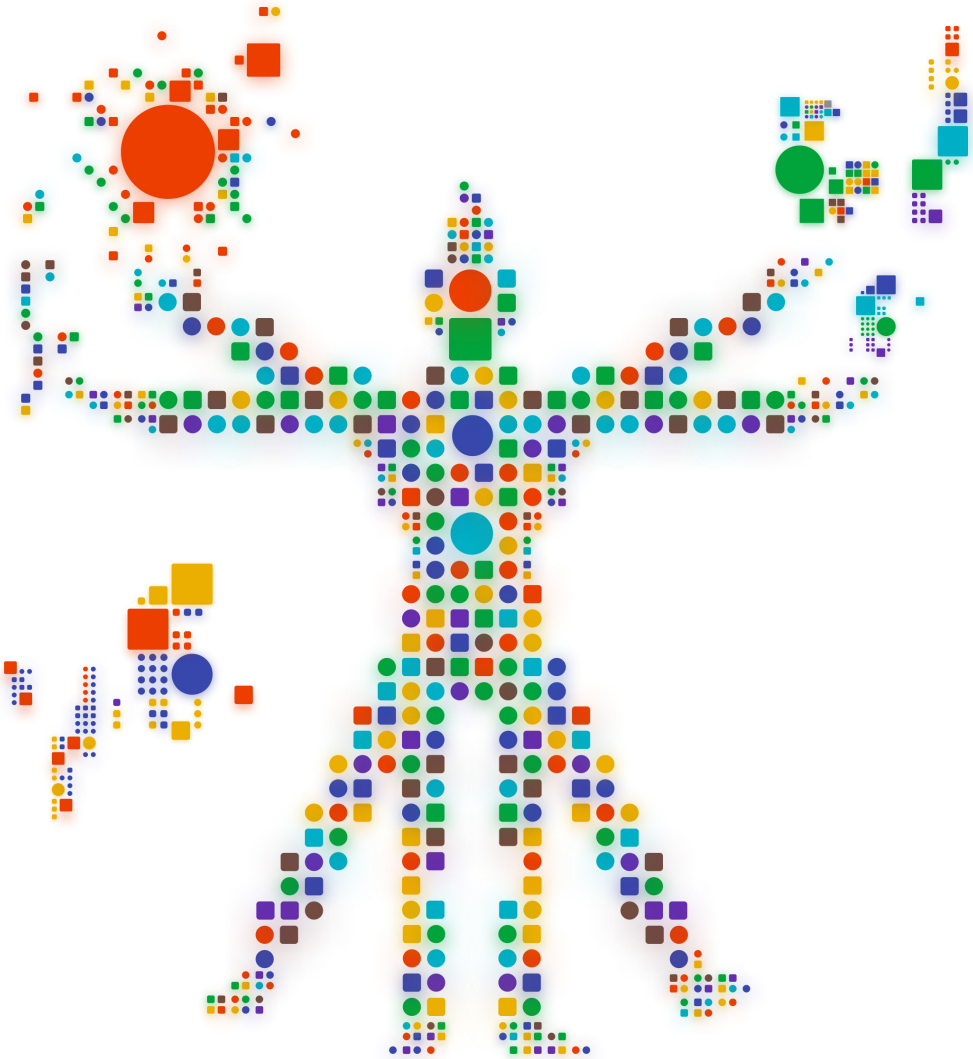
1. The state of AI in Poland – survey

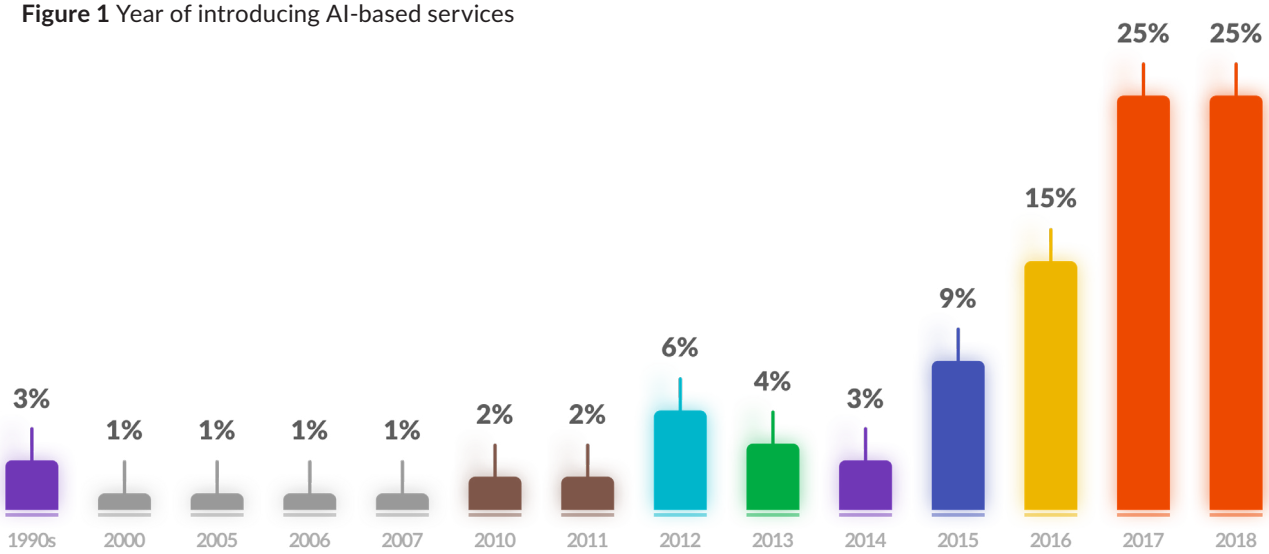


1.1 Polish AI Companies and Start-ups

During recent years there have been significant developments in artificial intelligence. We have also witnessed a rising tide of popularity of AI implementation in businesses all around the world. Tech giants are investing heavily in AI and governments are publishing strategies to promote the research, investment, use and development of AI. This technology is also increasingly recognised in the public debate as a force that will shape the economic and social landscape in the future to come.

This trend can also be seen in the Polish ICT sector. Among companies included in the survey, there are ones that **introduced AI as early as in the late 90's**. However, technology was more widely introduced in business only after 2010. Since then, more and more companies, which provide AI solutions and services, started to pop up. This number has been growing rapidly year-by-year **since 2015, so there is a visible AI boom in Poland**. In particular, **half of AI companies which took part in the survey have introduced AI solutions over the last two years**. Given that, the research was conducted in October 2018, this outcome may underrepresent the number of AI companies which introduced AI in 2018 by omitting some which started their AI journey in the latter part of that year.

Figure 1 Year of introducing AI-based services



Warsaw is undoubtedly the capital of Polish commercial AI sector. Nearly half (43%) of the companies providing AI solutions are based there. Warsaw clearly benefits from a strong academic ecosystem and access to corporate clients, as many large companies, both global and Polish, have their headquarters in the capital of the country.

Commercial AI is clearly the domain of large metropolitan areas in Poland. These include Warsaw, the Tri-city area (Gdańsk, Gdynia and Sopot), Kraków, Poznań, Wrocław and the Katowice urban area. **Six large metropolitan areas**, each with over half a million inhabitants, in total, are home to more than **85% of AI companies which participated in the survey**. The **only exception is** Łódź**,** which despite being the third largest Polish city does **not have a visible representation among AI companies**.

Many AI companies, which have their HQ in Poland or operations, **are active outside of Poland** and have **clients in Europe or Northern America**. For this reason, it should not come as a surprise that **more than a third** (35%) of companies **have an office** or other **type of permanent representation outside of the country**. This could mean that companies that operate in **Poland are not fully ready and open to use AI** in their regular core businesses and **Polish AI companies seek opportunities abroad**. It should be a **clear signal to government** and the biggest polish state-owned companies to **stimulate demand for AI solutions in Poland** to speed the development of an AI ecosystem in Poland and stop brain drain.

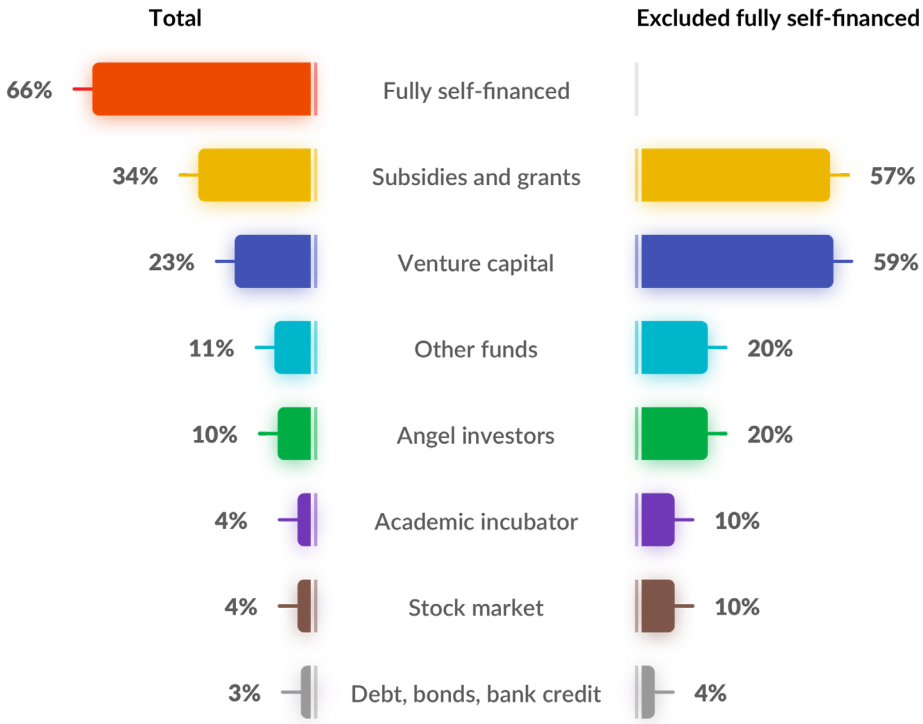
Figure 2 Location of companies which develop or offer AI services or products

In terms of financing, **two out of three companies** (66%) declare that they **rely fully on their own funds to fuel development**. This outcome is somewhat blurred by the fact that 21% of these self-financed companies received subsidies or grants[1]. This should technically not be counted as self-financing. Nonetheless, using available public grants does not usually dilute company equity or change the ownership structure.

1 The question allowed for multiple responses. Companies stating full self-financing declared not only using grants and subsidies, but in some cases, also other forms of financing. For example, 4% of them used venture capital. In a way, such an answer may properly represent a case where a externally funded company creates a subsidiary focused on AI solutions.

Among companies which were funded by external sources, the two **most frequent methods of financing were subsidies and grants** (57%) and **venture capital** (59%). It should be noted that **only 10% of such companies were funded by academic incubators** despite many such programmes being launched in Poland over the last decade. This mean that AI companies are not interested in incubators or current programs do not offer the best option for development. Regardless of the fact, it means that **incubators need to change what they have to offer in Poland**.

Figure 3 Methods of financing



Polish AI companies are often funded by money from outside of the country. One in three (34%) are financed at least partly by foreign capital. This applies not only to companies backed by VCs (48%) but also to those which are fully self-financed (29%). It means that **Polish companies are open to foreign capital**, but also it means that **Poland is a host to more and more R&D centres or AI subsidiaries of global corporations. It could also reflect the fact that many start-ups** were **established by foreigners** in Poland due to e.g. a cheaper labour force so they could offer AI services with bigger margins to clients in their home markets in the UK or US.

In regards to **companies which needed external financing from abroad**, it could mean that the **Polish VC sector** is not willing to take the risk and invest in the latest technologies, so it **prefers to invest in typical eCommerce business**. Bearing in mind that the Polish government recently began offering a lot of new funds for start-ups, **it's not likely that the need for external financing comes from lack of funds in Poland**. Rather it should be a symptom of a smaller pool of high-risk capital in Poland.

The results presented above are also confirmed by **Piotr Pietrzak**, CTO at IBM Poland. According to Piotr:

"Generally, investments in AI can be categorised into three groups: (1) Solutions dedicated to specific sector and use-case, (2) analytical platforms, (3) R&D companies which develop the latest AI technologies for commercialisation in the future. The latter two are the domain of mostly foreign funds which usually operate in USA, Israel or China. It comes from the fact that these two areas are capital intensive and require much more time for commercialisation. In Poland, VC funds invest rather mostly in proven and tested solutions, dedicated to particular sectors or aimed at solving very specific problems. Currently, these investments are usually no more than 3 million PLN. Of course there are cases of bigger transactions when the investment is aimed at widening the product portfolio of an established and well-known company. Such investments, however, are rare on the polish market.

Many AI companies currently find financing outside of capital markets. The leading institution in this regard is NCBiR (National Centre for Research and Development) which offers various programmes for financing R&D activities. Additionally, PFR (Polish Development Fund) has become an active animator on the investment market in Poland. It has created a set of mechanisms aimed at companies in various stages of development and operating across a range of industries. This suggests that in the coming year we may expect increasing competitiveness in the investment process, investment flowing to a larger number of AI projects, but only if more VC would increase their risk appetite".

However, when structuring grants for R&D projects one has to be careful. According to **Dominik Batorski**, PhD, Chief Scientist at Sotrender and Assistant Professor at ICM University of Warsaw, points out that:

"**There is no correlation between receiving a grant and working in a particular domain**. This means that **there are no particular goals in financing R&D**. At t he end of 2018, **NCBiR** (National Centre for Research and Development) **had no explicit policy in terms of supporting specific domains of AI**. It is debatable whether it is the right path. However, given the current early stage of development of AI, it would be difficult to prioritise particular domains.

The research does not allow us to verify the effectiveness of grant policies in terms of developing domestic AI services and products. Undoubtedly, **receiving a grant is linked to a larger AI team and a wider range of AI applications**. But the outcomes show that grants do not necessarily translate into expansion abroad. **Among companies which received a grant only 23% declared receiving at least 30% of revenue from abroad**. This state of affairs can result from a few factors. First of all, grants can be sought after by early stage companies. In addition, it is possible that companies which fare well will want to avoid grants and the bureaucratic burden which comes with them. Finally, it is also possible that projects supported by grants are still in the early stage and did not yet gain traction in the market.

The **results presented in this report show unambiguously that the development of services and products based on AI rely heavily on R&D activities**. The development of the AI sector in Poland requires the establishment of an effective cooperation between companies and scientific institutions. Without strong academic teams in the field of AI, companies will find it hard to recruit new employees. More importantly, they may find it prohibitively hard to operate in more advanced domains of AI. On the other hand, academic teams benefit from cooperation with businesses by having access to training grounds and data that are currently collected on a much larger scale in the corporate sector.

Wojciech Walniczek,
Senior Investment Director at MCI Capital

"It is surprising that so many Polish AI companies fund growth with their own funds. This may either be because these companies are sufficiently profitable or that AI solutions are developed by companies that are already established on the market.

If the former is true then this could mean that founders tend to be wealthy. Maybe they have already built a successful business and now they use their knowledge and capital to launch a new company in an area which seems to offer many opportunities. If true, this would be a good sign. Additionally, the fact that companies derive most of their revenue from AI solutions (see figure 4) would suggest that companies may indeed be able to finance their operations from their current revenue stream.

However, a small share of companies using external funds may also suggest that many Polish AI companies are in fact subsidiaries of more mature companies which have the funds necessary to invests in new ideas. This would mean that while the core products of these companies are indeed AI solutions, they operate within and are backed by a larger corporate structure.

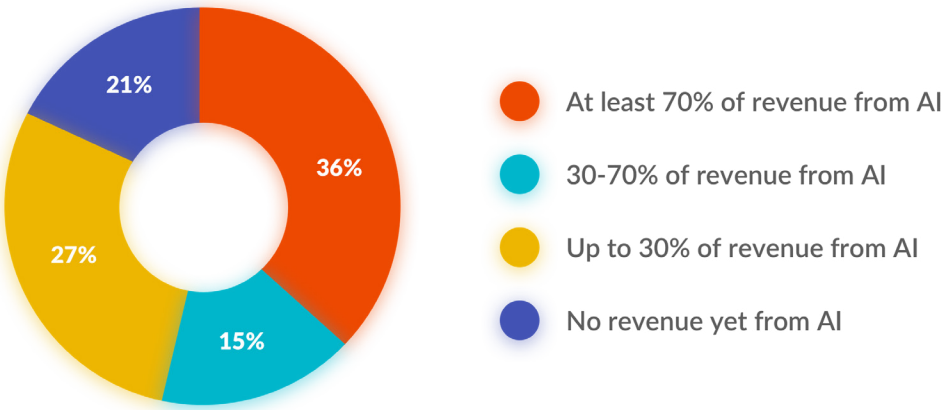
In this context, the relatively low share of external financing from VCs, angel investors or other funds may imply a very preliminary, even "garage" stage of development. I am keenly interested in next editions of the report so as to see trends in financing done by more mature entities. If the share of companies funded by external sources is to rise then this would suggest a rising maturity of AI companies and, potentially, an increasing acceptance of VC financing by the market. This would also mean an increasing availability of high-risk capital whose current deficit may be one of the factors hampering the growth of companies developing AI solutions.

The report is an interesting first step to a better understanding of how local AI companies operate. This area of technology is especially important given the ongoing global race to innovate. I would be particularly interested in a more qualitative study so that one could get a sense of the "blood, sweat and tears" from the front faced by those developing AI solutions in Poland."

1.2 Business Applications

Among companies included in the survey, **over a third (36%) can already be defined as AI-only companies,** as they receive over **70% of their revenues from services or products based on this technology**. However, **many companies offer AI services just as one of their products**. This is especially the case for companies which added AI products or services to their existing portfolio. In effect, **15% of companies obtain about half of their revenue from AI** and about one in four (27%) receive less than 30% of revenue from such services. Additionally, **21% of companies are still not earning any money on AI, which can be understandable, given that half of the companies introduced AI over the last two years**.

Figure 4 Share of AI services or products in the total revenue of the company

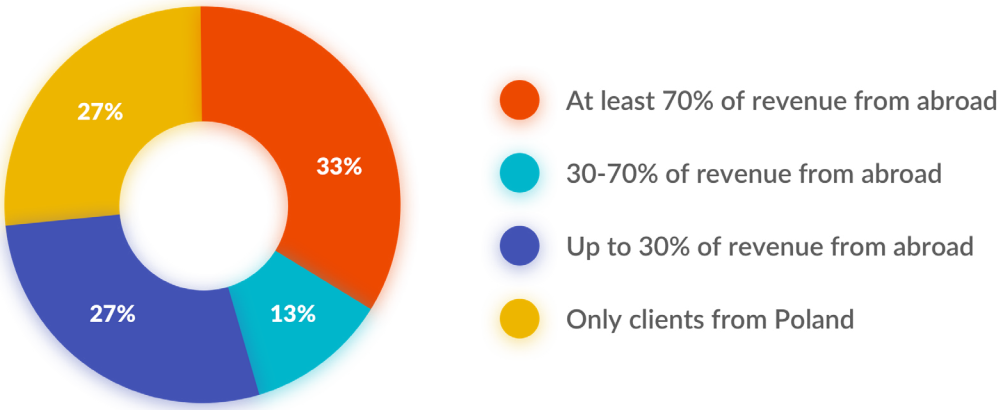


Access to foreign markets plays a crucial role in the development of the Polish commercial AI sector. The **demand for AI-based solutions in Poland is limited by:**

- smaller risk appetite of the biggest state-owned companies for implementation of the newest and untested technologies,
- the overall number of large companies in Poland,
- budgets of large companies in Poland which are relatively smaller than those in Western Europe or other developed countries.

In addition, **AI services, similarly to other digital technologies, offer economies of scale. For these reasons there is a natural tendency to reach for clients abroad**. And indeed, 73% of companies receive at least some of their revenue from clients abroad. Moreover, a third (33%) of companies get most of their revenue (over 70%) from such clients. Only about one in four (27%) companies work solely for local clients.

Figure 5 Share of revenue from abroad in the total revenue from services based on AI

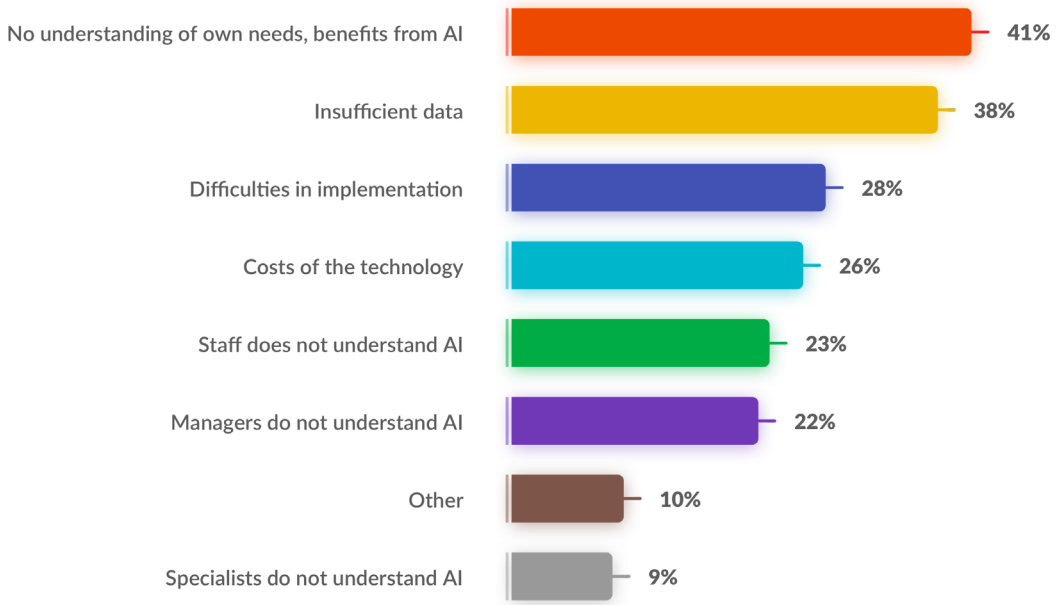


Katarzyna Ludka, AI Director at Ringier Axel Springer Polska, sees the exposure of Polish AI companies to foreign clients as proof of the underdevelopment of the domestic market:

"The outcomes of the survey present a relative immaturity of the Polish market. The number of AI companies is growing but the majority of their revenue come from foreign clients. This may indicate that domestic companies do not understand the benefits which come from introduction of AI solutions. In this context, in my opinion, **the key issue is the education of CEOs, business managers and the market as a whole**. The understanding on the business side of what AI is and what problems it can help solve should be coupled with an effort in educating future AI specialists in Poland."

This view is reflected in the outcomes of the survey. The **biggest obstacle in Poland in the massive implementation of AI solutions**, according to 41% companies surveyed, **is the lack of understanding of the company's own needs, so it cannot see the potential benefit arising from AI**. The overall **lack of understanding of AI is seen as more crucial at the managerial and staff level** (22% and 23% respectively), than specialists (9%). This means that **in Poland there is a strong need for AI education for CEOs and managers**. Another **major issue is the lack of necessary structured data to implement AI solutions** – 38% of companies list this as an obstacle. However, the availability of data is a more broader problem in the digitisation of companies and institutions. **It should be emphasised that costs of technology come only fourth as an obstacle** (26%). This is a sign that implementation of **AI is hampered much more by misunderstanding and lack of data than by pure financial constraints**.

Figure 6 Main obstacles in implementing AI solutions



Lack of AI understanding at the managerial level and **poor general preparedness for implementation of AI solutions are among Polish companies and institutions a recurring theme**. This is also pointed out by experts who commented on the report. **Tomasz Staszelis**, Chief Digital Officer at ZF Polpharma highlights this view:

"The rising number of AI companies is an optimistic trend. However, the number of successful implementations in business and other areas is still low in Poland. One of the reasons for this is **insufficient awareness of how AI can affect the efficiency of business activity**. It is **very important for the AI community to proactively educate the businesses, society and raise the understanding of the technology**."

Paweł Gora, professor at Faculty of Mathematics, Informatics and Mechanics, University of Warsaw, points directly to **low awareness of AI as being responsible for constraining the development of the AI sector in Poland**:

"There is a **problem with a lack of understanding the benefits that the implementation of AI solutions can bring. Many entrepreneurs see this, along with insufficient data, as the main obstacle**. This may suggest that specific actions should be taken, so that the economy can take full advantage of opportunities offered by AI. **One of the key elements is education, including both specialists implementing the**

technology, as well as potential clients and consumers. Larger societal awareness of opportunities (and dangers) that AI brings can facilitate the implementation of solutions, client acquisition, establishment of partnerships (including cooperation between business, academia and the public sector), data acquisition and help in the process of overcoming legal and technical barriers. **Greater awareness should also help in convincing talented individuals in pursuing an education in AI**."

Robert Siudak,
Advocacy and Projects Director at Instytut Kościuszki

"Definitively, the **main barrier to the development of the Polish AI sector is not the absence of funding or expertise but still a very limited demand for solutions based on AI**. This applies especially to the **domestic market**. There are several reasons why this is the case and these include, among others, a **B2B market dominated by state-owned enterprises which function in a conservative, quasi-market logic**, and on the other hand, the sector of **small and medium-sized enterprises still lag in the process of digital transformation**.

AI is not an exception. **Research conducted by us in the cybersecurity sector confirm that the largest barrier is limited demand for innovative solutions**. This is usually a consequence of little understanding for own needs and potential benefits on the business side. In effect, entering global markets, especially in Western Europe and the USA, becomes a natural step for many companies offering high-tech products."

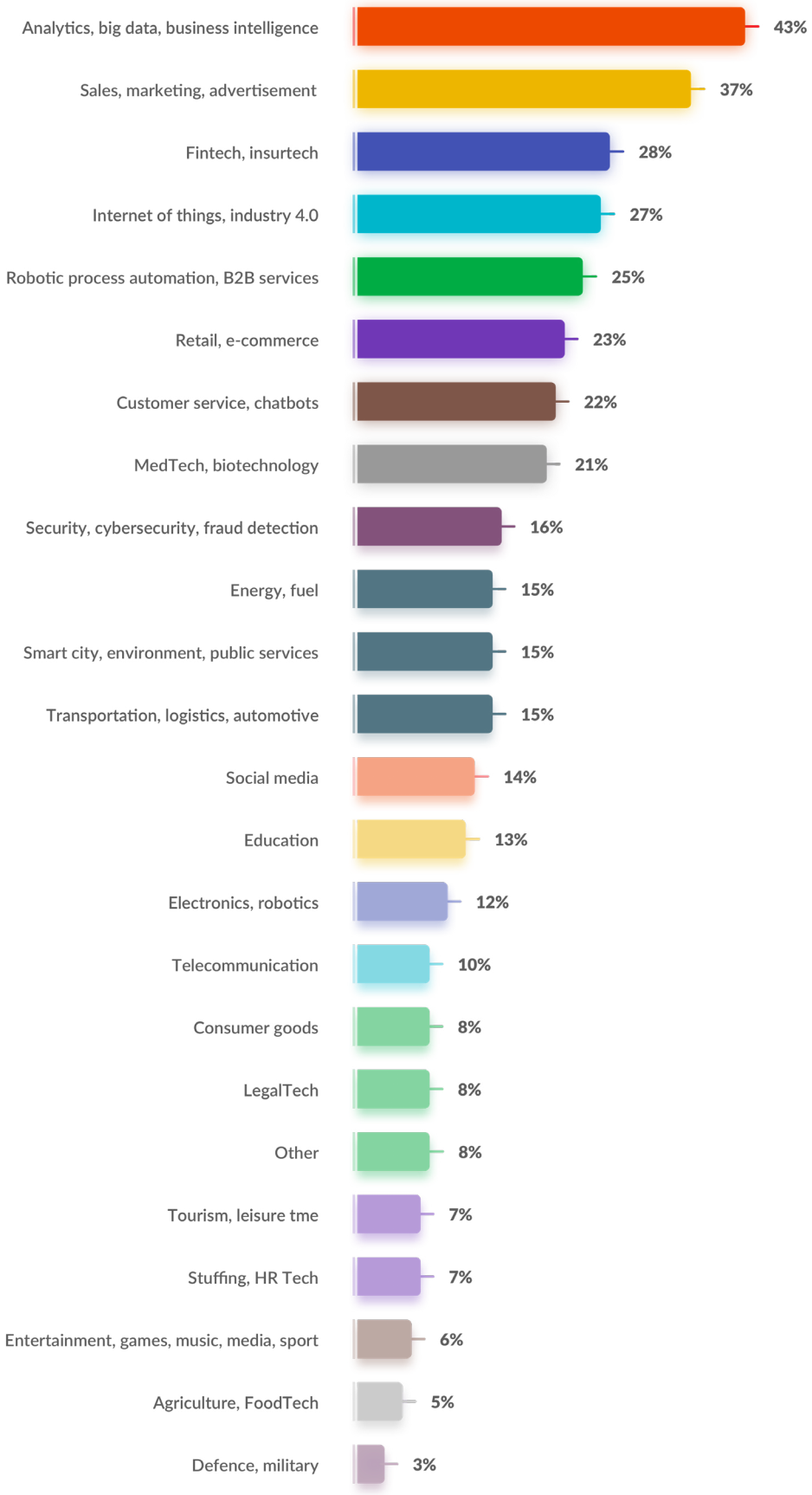
The two sectors of the economy, in which Polish AI companies offer services the most frequently, are analytics, big data and business intelligence (43%) **together with sales, marketing, and advertising** (37%). It should be noted that the **third most popular sector is finance and insurance** (28%). This reflects the fact that the Polish financial sector is modern and, as such, offers more opportunities for companies in this area. This view is supported by **Hubert Rachwalski**, CEO of Nethone, a company offering anti-fraud solutions:

"The introduction of EU directive PSD2 was a ground-breaking moment for our industry. We have noticed an increasing interest in AI among financial institutions in Poland. A large number of high-tech projects appeared, so AI companies started to fight to acquire new clients. Additionally, in the last year, there was a substantial shift in the way large finance companies approach small tech providers. This was the first sign that innovations such as AI will be introduced on a larger scale."

AI companies also often work in the area of internet of things and industry 4.0 (27%). It is a good sign. Manufacturing plays an important role in the Polish economy and makes up 20% of Polish GDP. Bearing this in mind, AI adoption in this area may suggest that the local manufacturing base will be prepared for global competition and better integration with the German industrial base. Definitely, **implementation of AI in Industry 4.0 is on horizon of interest for Polish AI companies since Europe is strong in B2B markets and industry in general**. The same cannot be said about B2C market in Europe since we are missing big tech players like Amazon, Google or Facebook from the US market or Tencent, Baidu, ByteDance from China.

There are some services which are noticeably absent. **Only 6% of companies offer services in the area of entertainment, games, music, media and sport, which is surprising given the number of game development teams in Poland**. **More importantly, despite the strength of Polish agriculture, only 5% of companies offer services in the area of agriculture** and foodtech. This may suggest that local producers may be reliant on foreign suppliers of technology, lower openness of the agriculture sector to the adoption of new technologies like drones and AI or lack of scale of the agriculture sector in Poland. It could also raises questions about the long-term competitiveness of this sector within Europe. Similarly, **only 3% of companies work in the area of defence and military**. This **raises serious concern given the scale of the Ministry of Defence's budget and the importance of AI in modern military technology**. There is a huge risk that in future the Polish army will have to rely on foreign-developed AI solutions with all the security concerns that come along.

Figure 7 Economic sectors in which Polish AI companies provide their services

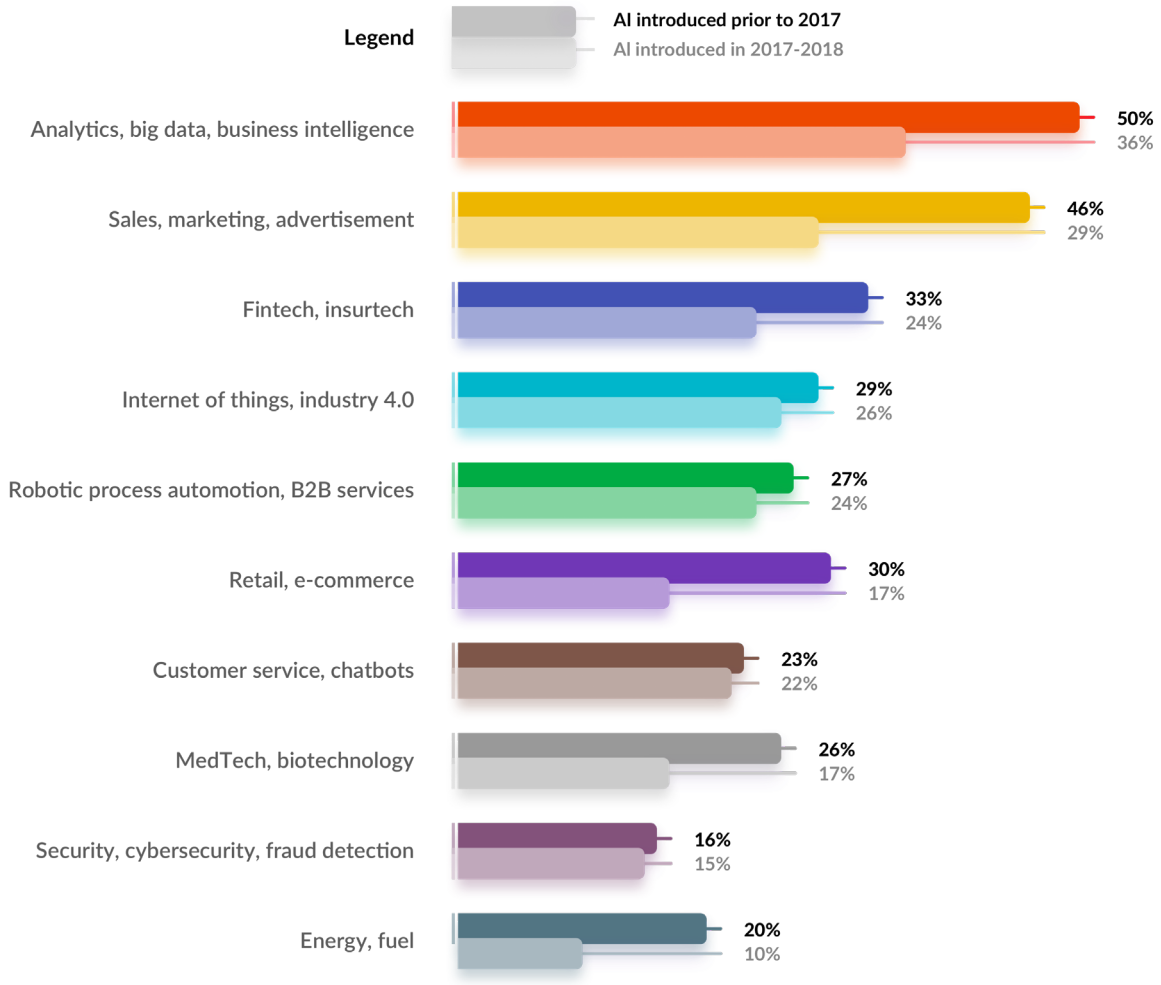


Tomasz Wesołowski, CEO of Edward.ai, points out that regardless of the specific type of service, companies need to clearly communicate the business value of the technology in order to convince potential clients:

"The outcomes presented in this report clearly show that AI companies build their product portfolio based on big data coupled with analytics and along with services for sales and marketing. **This overlaps with our observations of clients' needs – their marketing and sales departments that are most ready to spend money on innovative technology**. In the future, we will definitely see an increasing dynamic in the area of digital assistants (currently in chatbot and RPA categories). The technology can be applied actually in any area involving supporting business processes, but is currently hindered by the barriers in understanding the Polish language. However, this state of affairs is changing rapidly and already today we are capable of applying AI to local languages. We just need our clients to believe in this. This leads to a **major obstacle which is a low understanding of the current state of AI technology**. While most clients gladly discuss AI, they are willing to invest only in projects with a clear business value, proven concept with many references from other clients. For this reason, in our communication we focus on particular benefits. Clients do not want to pay for technology, but for real solutions for their business challenges."

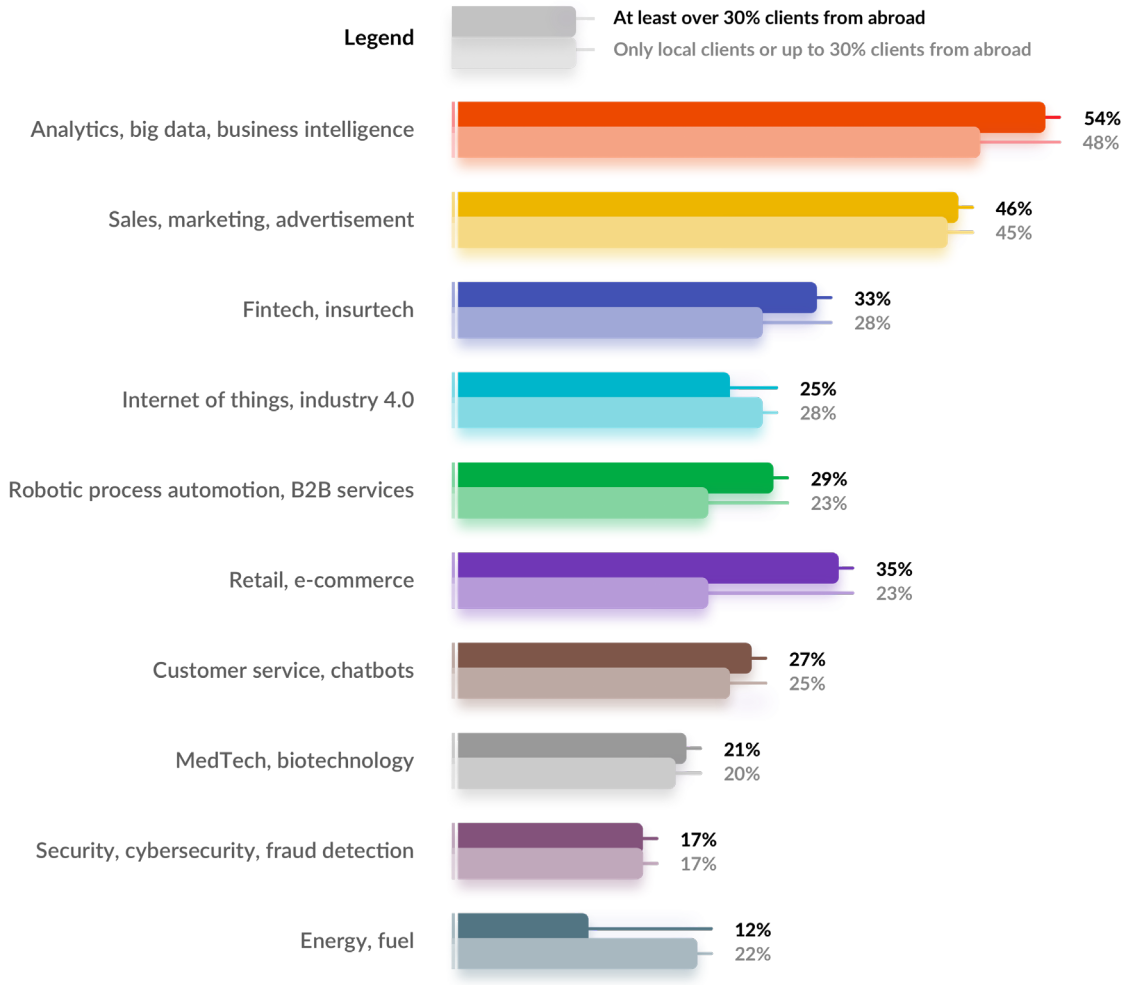
Comparing companies that have introduced AI over the last two years with those that applied the technology prior to 2017, one can notice some interesting differences. **New entrants focus less on traditional AI applications such as analytics, big data and business intelligence** (36% among new entrants vs., 50% for established companies) **or sales, marketing and advertisement** (29% vs. 46%). **Where they seem relatively more focused** (or as focused as the established companies) **is internet of things and industry 4.0** (26%), robotic process automation (24%) or **customer service and chatbots** (22%).

Figure 8 Economic sectors in which Polish AI companies provide their services – Top 10 by date of AI introduction



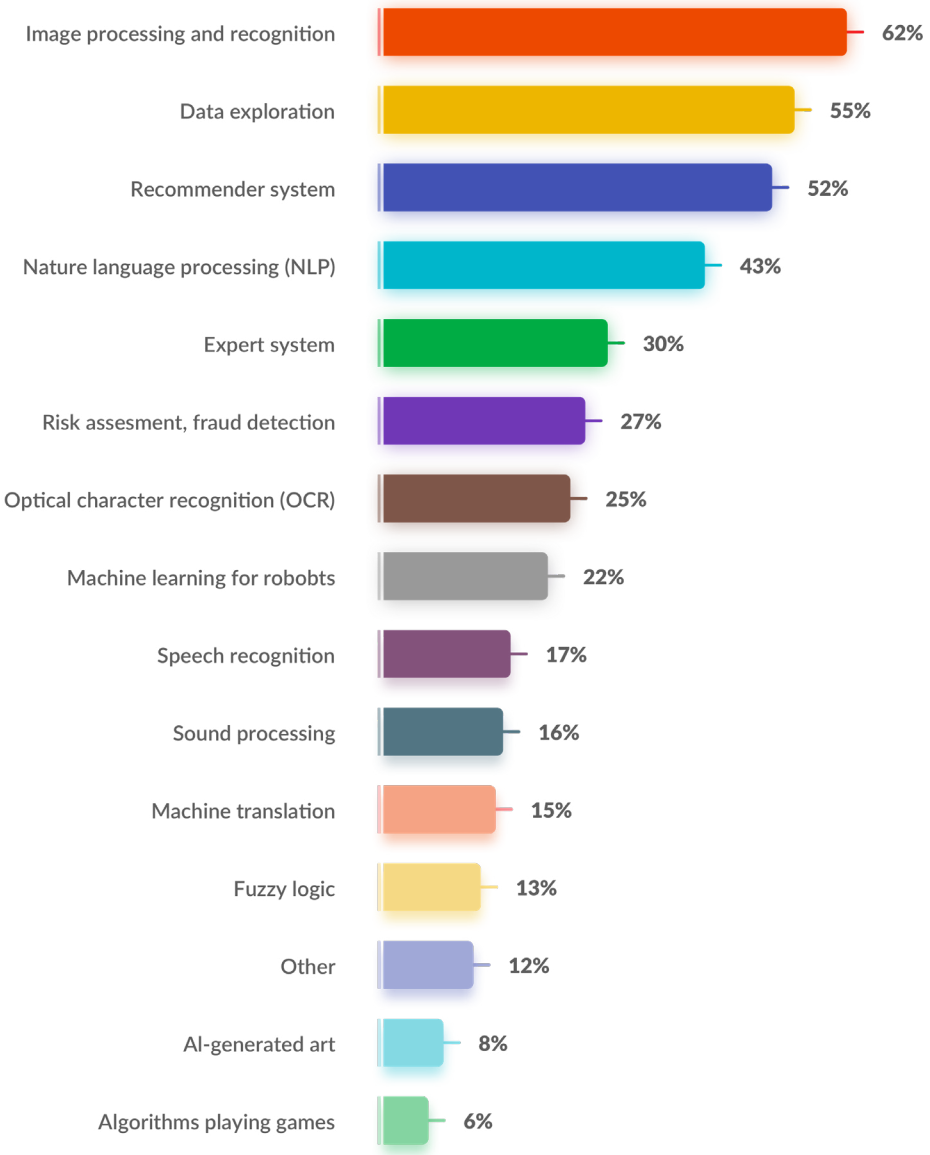
There are also some differences in the portfolio of services provided by companies operating mostly locally (with revenue solely from Polish clients and revenue of up to 30% from foreign clients) **and those that are active mostly on foreign markets** (all revenue comes from foreign markets or at least 30% of revenue from foreign clients). The **latter work more often in the area of retail and e-commerce** (35% vs. 23% among locally operating companies). On the other hand, **companies relying more on local clients more often provide services in industrial area**. 22% of them work in energy and fuel (12% among companies operating mostly on foreign markets).

Figure 9 Economic sectors in which Polish AI companies provide their services – Top 10 by structure of clients



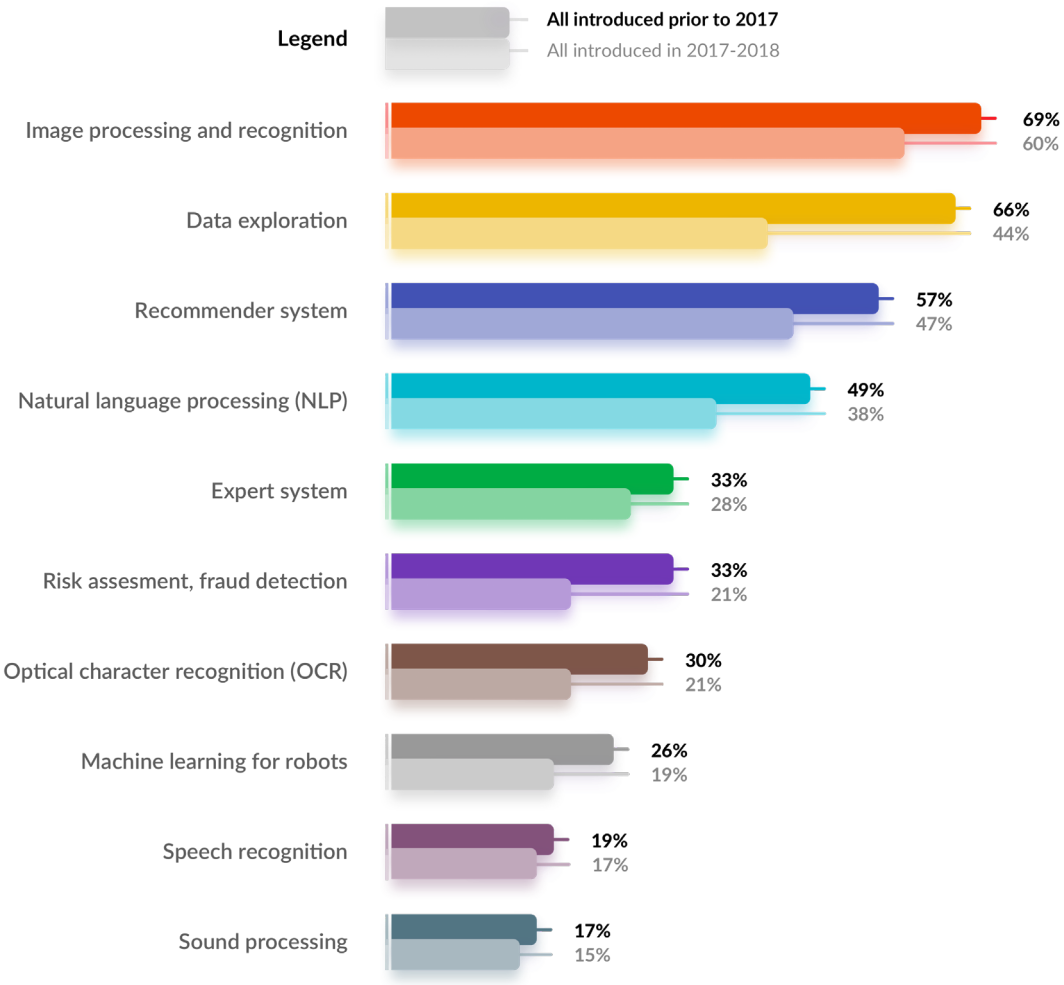
When it comes to particular applications of AI, **the major one is image processing and recognition. 62% of companies use AI in this area**. Other **popular applications are data exploration** (55%), **recommender systems** (52%) **and natural language processing** (43%). This should come as no surprise, given the strength of deep learning algorithms in understanding visual content or language used by humans.

Figure 10 AI applications in services



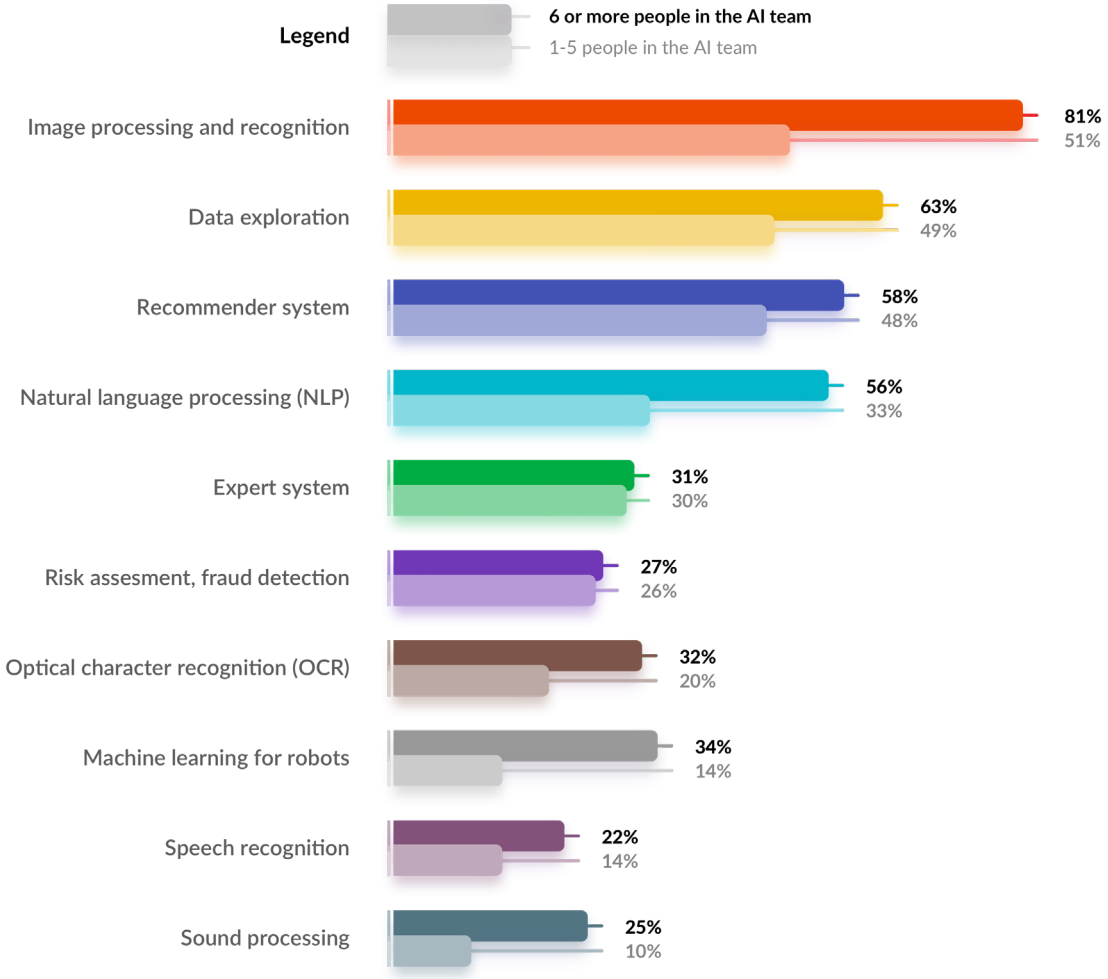
Companies which introduced AI solutions over the last two years tend to apply the technology to a lesser extent in such areas as data exploration (44% vs. 66% among established companies) **or risk assessment and fraud detection** (21% vs. 30%). This can be explained by the fact that **these areas can be relatively well addressed with traditional machine learning techniques**. New entrants will naturally **tend to rely more on newer algorithms** and on one of the most important methods - deep learning. This hierarchical learning is particularly suitable for applications such as image processing and recognition, speech recognition, sound processing and increasingly, natural language processing. It is in this area where new companies will rather seek opportunities.

Figure 11 AI applications in services – Top 10 by date of AI introduction



The size of the AI team impacts the choice of applications. Companies with **larger teams** (6 or more people) much more often **work in the areas where deep learning is the main AI method**. 81% of the companies do image processing and recognition (51% among companies having up to 5 AI specialists). They more often do natural language processing (56% vs. 33%), OCR (32% vs. 20%), machine learning for robotics (34% vs. 14%) or sound processing (25% vs. 10%).

Figure 12 AI applications in services – Top 10 by date of AI introduction



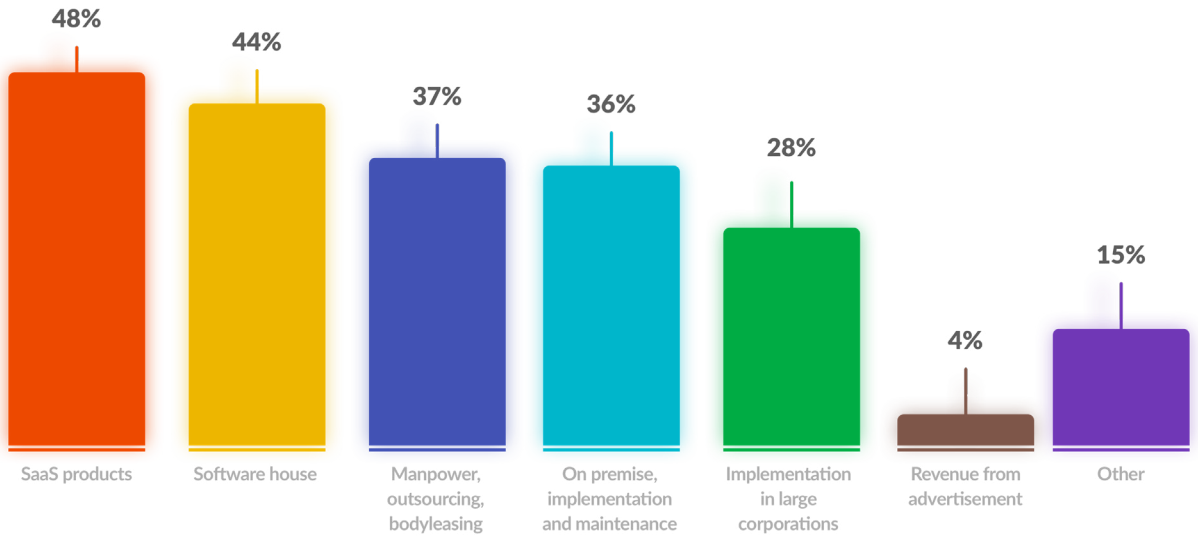
One should notice, **however, that from the client's perspective the specific method is often not so relevant**. The clients seek ways to grow their own client base, increase operational excellence, reduce costs and increase profit margin. Such a view is shared by **Tomasz Kopera**, Senior Head of the International Services Development at T-Mobile Polska:

"It should be remembered that at the current stage of development, **AI will not replace human labour or solve the majority of business problems**. For this reason it should be treated more as **support for business operations rather than a goal in itself**. Contrary to most companies investing in AI, T-Mobile Polska is concentrated on developing solutions aimed at increasing the operational efficiency and lowering corporate costs. We are closely watching the maturity of available AI products, talking with a wide

variety of providers, cooperating with academia and testing the applicability of solutions in various areas like chatbots or categorization of incoming correspondence via traditional mail and redirecting it automatically to a specific department after doing OCR. The end goal for us is to **provide services with the highest quality for customers thanks to AI**."

Polish AI companies usually **offer SaaS products** (48%) or **operate as a software house** (44%). Very **few of them generate revenue based on advertising** (4%). **This topic is highly relevant since almost half of AI companies in Poland are missing specific products and offer only brain power for many foreign companies.** It could mean that we are missing good product managers in Poland or we are missing demand for products from the biggest Polish stated-owned companies.

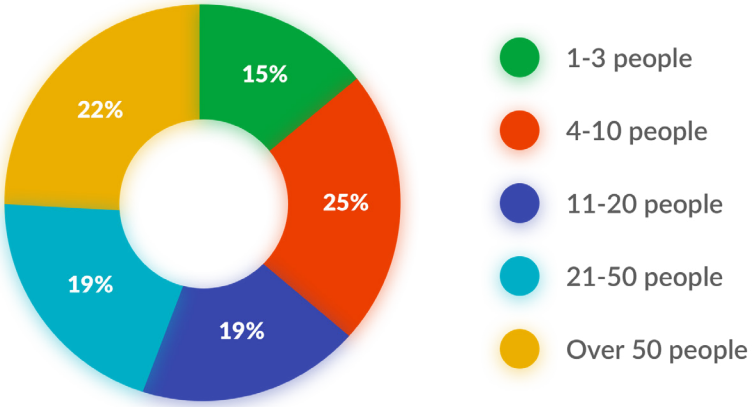
Figure 13 Business models of AI companies operating in Poland



1.3 Human Resources

The companies which participated in the survey differ in regards to their size. **22% of them have a total headcount of more than 50 employees** which would mean that they are well established on the market. On the other hand, **40% are still in an earlier stage of development with a headcount of 10 employees or less**. The fact that companies of varying sizes participated in the survey suggests that the **findings of report are well balanced and accurately capture the state of the Polish AI sector**.

Figure 14 Overall number of employees in the AI company



Regardless of the company size, **the true measure of AI capability is the size of the team working with the technology**. Among companies surveyed in Poland, these **tech teams tend to be fairly small**. Over **half of the companies which participated in the survey have AI teams consisting of 5 or less employees** – 27% have one or two people and 31% have 3-5 people. **Only 15% of companies have a sizeable team of over 20 specialists working with AI.**

This can be seen in two ways. There definitely exists a vibrant sector with many small teams, working on their own ideas (we should remember that 50% of companies introduced AI in the last two years). On the other hand, the number of companies with a strong AI muscle potentially capable of competing globally are fairly limited. The latter view is shared by **Piotr Surma**, CEO of Applica.ai:

"**It is concerning that Polish AI companies are focused on the domestic market**. Only a third of them receive over 70% of revenue from abroad (see figure 5). It is especially disturbing in the context of an ongoing market consolidation and a **relative shallowness of the do-**

mestic market. Another concerning fact is the **limited scale of operation among domestic AI research** teams. Only 10% of them consist of over 20 specialists. **Foreign companies often have much larger research teams**. It raises a risk that products developed by Polish companies will be less competitive than those offered by foreign ones."

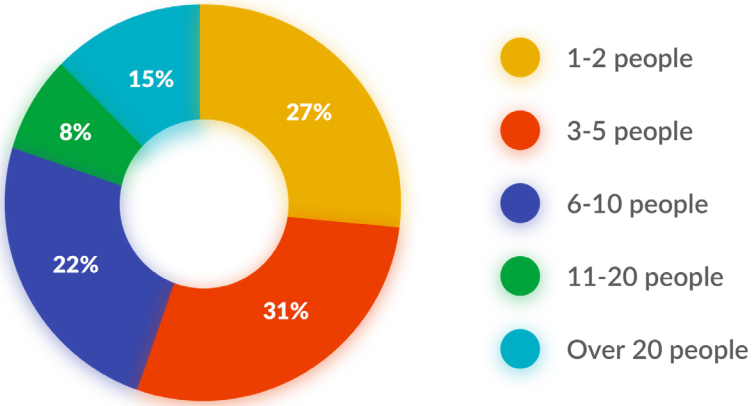


Figure 15 Size of the AI team

The **good news is that nearly all (85%) companies intend to expand their AI teams**. Still, two in three (64%) plan to hire no more than 5 people. It is to be debated whether growth at this pace is sufficient to keep up with foreign competition. **However, only 13% of companies plan to expand rapidly by hiring over 10 specialists**.

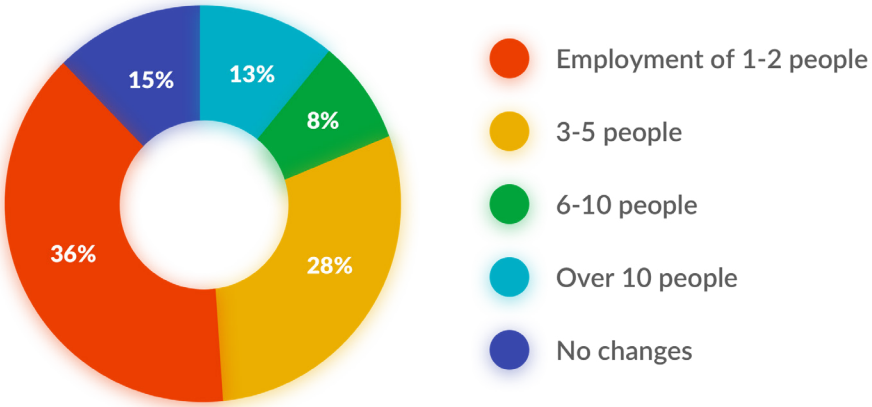


Figure 16 Planned change in the size of the AI team

Recruitment plans by Polish companies coupled with their rapidly rising number (see figure 1) clearly shows that **there is a rising demand for properly trained employees**. Given the fact that even recently AI and machine learning was a niche, **there are few highly**

trained and experienced specialists on the market. Obviously, **companies turn to hiring fresh graduates from a growing number of programmes offered by universities**. These graduates, however, lack technical experience and soft skills and it will take some time for them to mature as AI experts. In this context, the **lack of human capital may be a major constraint in the growth of the Polish AI sector** in the long run.

The importance of educating AI specialists but also end-users was highlighted by **Piotr Marczuk**, Corporate Affairs Director at Microsoft Poland:

"**The barrier to development of AI in Poland is not financing**. In fact, before we begin to dream about a thriving Polish AI sector, **we should focus on education**. Even today, just when we step through the threshold of AI applications, the first thing we encounter are **significant skilled personnel shortages**. There is an insufficient number of people well-versed in big data, analytics and advanced statistics with experience in big projects. **If universities, entrepreneurs or the government will not do something about it then these dreams will remain unfulfilled**. It is the same with end-users. Today we are amazed by innumerable amounts of data. **The ability to tame this flood of data, structure it, categorize and use it effectively is highly valuable. It is also in this area that we should direct our attention**. This should already be done on the level of primary and secondary education. There are areas which we do not readily link with AI, such as agriculture or healthcare. The application of AI in these domains will result in a revolutionary increase in economic productivity and quality of life. However, without education, it may all halt on the stage of planning in Poland. That's why **we should really focus on education.**"

Dorota Pietrzak, Head of Training Services for Business Clients at INTRA, also **emphasises the need to educate non-experts in understanding AI** and its potential benefits:

"An extremely important aspect of cooperation between business and academic communities, but also in business ecosystem itself, is the **development of mutual understanding of needs in the area of AI**. In the report 41% of companies pointed out the lack of understanding of their own needs and benefits in terms of AI and 22%-23% stated a lack of understanding among managers and staff (see figure 6). On the one hand, this may be due to the lack of education among non-experts regarding AI, its

mechanisms and potential services. On the other hand, it may also mean insufficient communication flowing between AI teams. In this context, **it is crucial to raise awareness regarding AI services coupled with developing communication skills. Focusing on these two areas will considerably increase the effectiveness of AI implementation**."

Krzysztof Nowakowski,
Managing Director & Country Head at Korn Ferry

Personnel is one of the key challenges when it comes to AI. From the point of view of specialists in areas such as ERP, CRM or mobile applications, the learning curve is actually pretty steep and switching to AI and machine learning is not a matter of days but rather months or even years. For this reason, in most cases recruitment is usually the only option to bridge the gap in data science, the area most commonly associated with AI. However, **few real experts in the field are available on the market, they are expensive and it is often hard to motivate them to switch their workplace**.

When it comes to talent management in the area of AI **it is absolutely critical to train people and mix teams so that new employees, especially recent graduates, have a chance to work with people who are more experienced. Mentoring can be a very effective way of reducing the deficit in data science** capability because AI involves many issues which one cannot learn from a textbook. Another tested method is "technology rental" which means replacing recruitment with the usage of SaaS platforms in cases when these platforms can actually provide the necessary functionalities. Apart from saving on recruitment, this solution has an additional advantage as it allows to develop skills – the employee using AI, works with solutions which are ready-made, but can also try out his or her own ideas.

It is without any doubt that along with the development of AI and the increasing number of practical applications, the career interest in this field will increase really fast. It was already mentioned in the US that **data scientists could be one of the sexiest jobs on the planet**. There will definitely be more specialists available in the coming years, but the gap between supply and demand is not likely to disappear soon. In this context, **it is crucial to remain agile and follow a diversified talent strategy**.

1.4 Technology

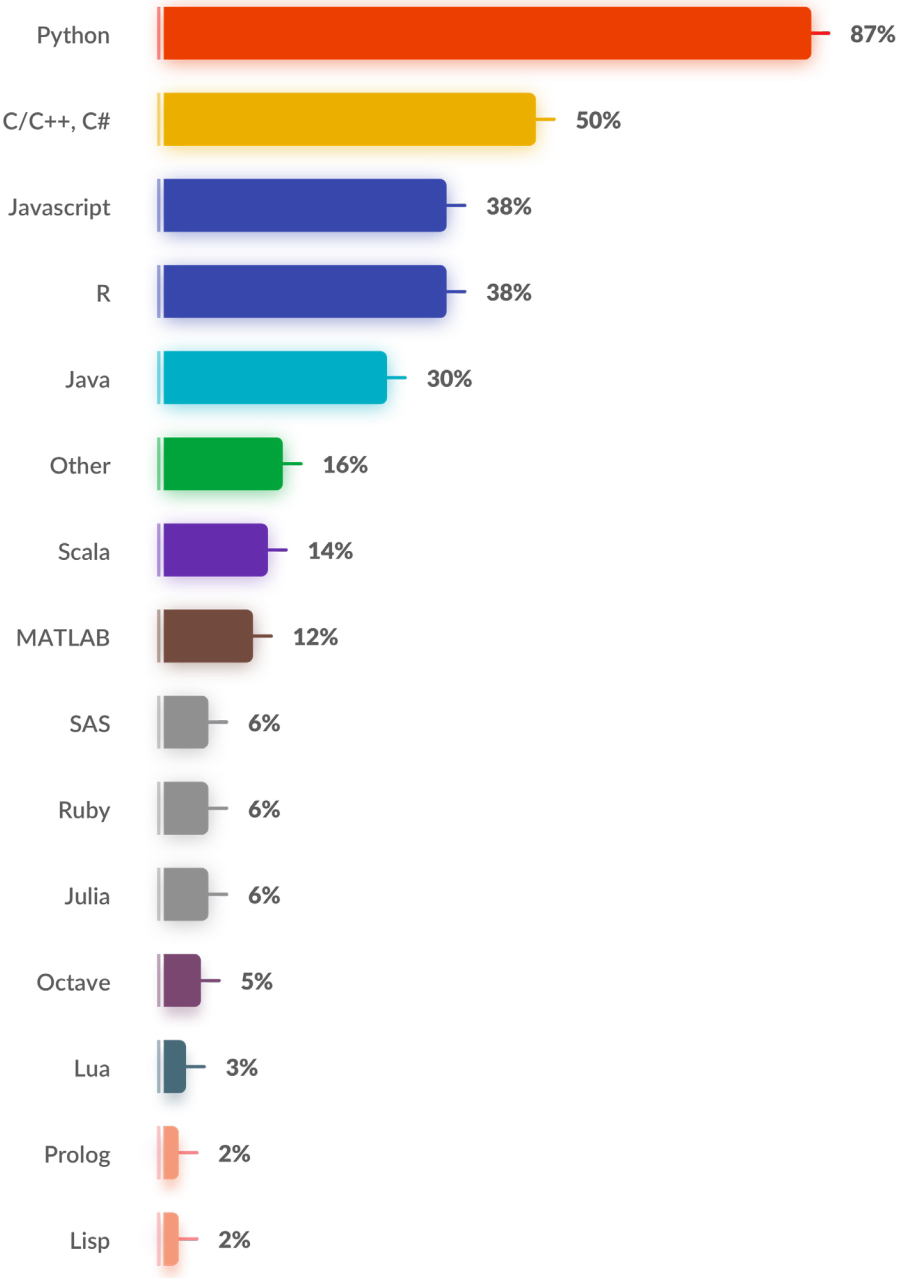
Python is the **programming language of choice among AI specialists worldwide** and it is reflected in the outcome of the discussed survey. **87% of companies use Python to build their AI solutions**. The popularity of the language comes from the fact that it is relatively easy to work with, while at the same time it offers significant capabilities and functionalities.

Another popular language used for data science and AI is **R, with 38% of companies applying it in their services**. **Scala and Julia** are less popular, with respectively, **14% and 6%** of companies using them.

A different category is **commercial software,** dedicated for data science, AI and computation, these include **MATLAB** and **SAS**. **The former is used by the academic community** and the **latter has been used for ages by corporations to handle and analyse large amounts of data**. However, **they are not popular among Polish AI companies** – MATLAB is used by **12%** and **SAS by 6% of them**.

Companies also use popular programming languages which **usually are not used to build AI solutions,** but rather to develop complete solutions on top of what AI can provide. These include **C/C++ and C# (50%) and Java (30%)** which are used to build complete applications, develop back-end and low-level firmware. **Javascript is used by 38%** and is applied to build user interfaces.

Figure 17 Technologies used to develop AI services



Vladimir Alekseichenko, CEO of Data Workshop and Biznes Myśli, shared his view on the programming language toolkit of a data scientist:

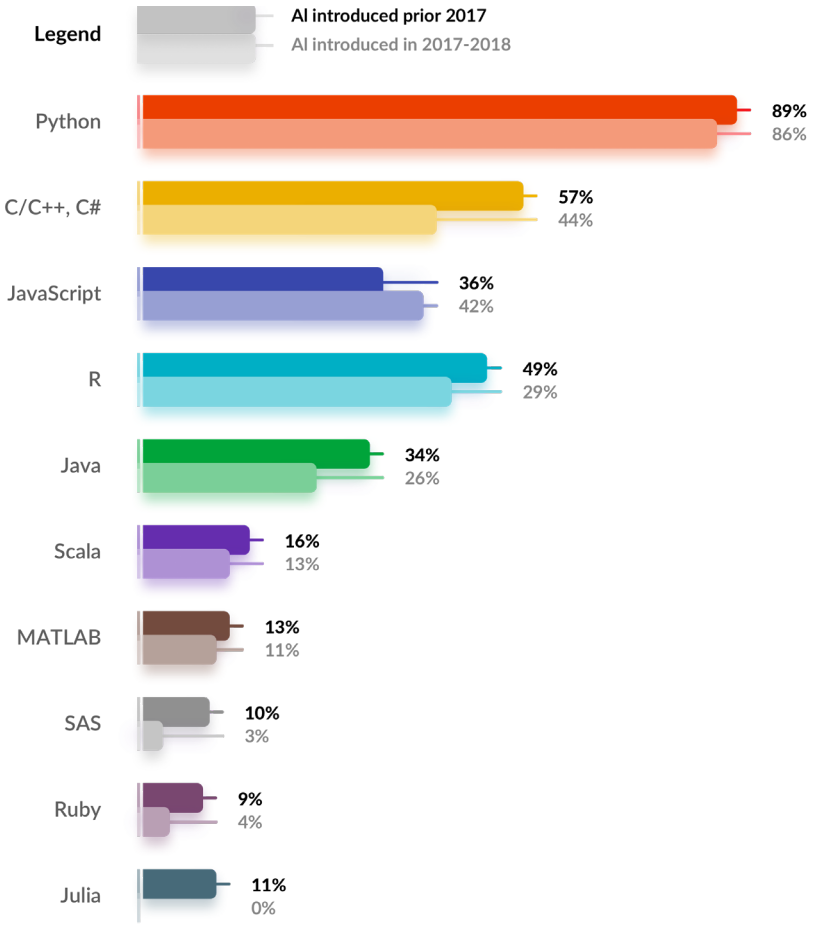
"**Python and R are languages used both to prototype and implement the AI solution**. **Python is simple**, it allows users to build a functionality with a few lines of code and, in effect, **makes it possible to focus on the actual business case**. This is why businesses like this particular language. **Big players such as Google, Facebook or Uber** have developed a community around it and for this reason **it is easy to start the machine learning journey with Python**. **R language** has its advantages and many fans, but it also

poses some challenges which include the standardisation of code. Additionally, it may be **hard to implement deep learning in R** and there are **few good libraries** (and no one is truly working on solving this issue). From the perspective of a data scientist, one works with Python or R and if there is need for more efficiency then **only some parts of the code are rewritten in C/C++ or Java**. Other languages are not really important."

A comparison between **companies which introduced AI over the last two years and those that did it prior to 2017** shows some important differences. First of all, the **former use C/C++ and C#** (44% vs. 57% among established companies) and Java (26% vs. 34%) to a lesser extent. This probably **reflects the fact that these companies are often in an earlier stage of their company's life-cycle** and a smaller share of them deliver complete solutions to their clients.

However, when it comes to **pure AI technologies**, one can notice that **new entrants use less R language** (29% vs. 49%), **SAS** (3% vs. 10%) **and none use Julia** (11% among established companies). This shows the **evolution of data science toolkits and increasing dominance of Python**.

Figure 18 Technologies used to develop AI services – Top 10 by date of AI introduction



The declining importance of R language is an evident trend in the data science community and it is highlighted by **Tomasz Kułakowski**, CEO at deepsense.ai:

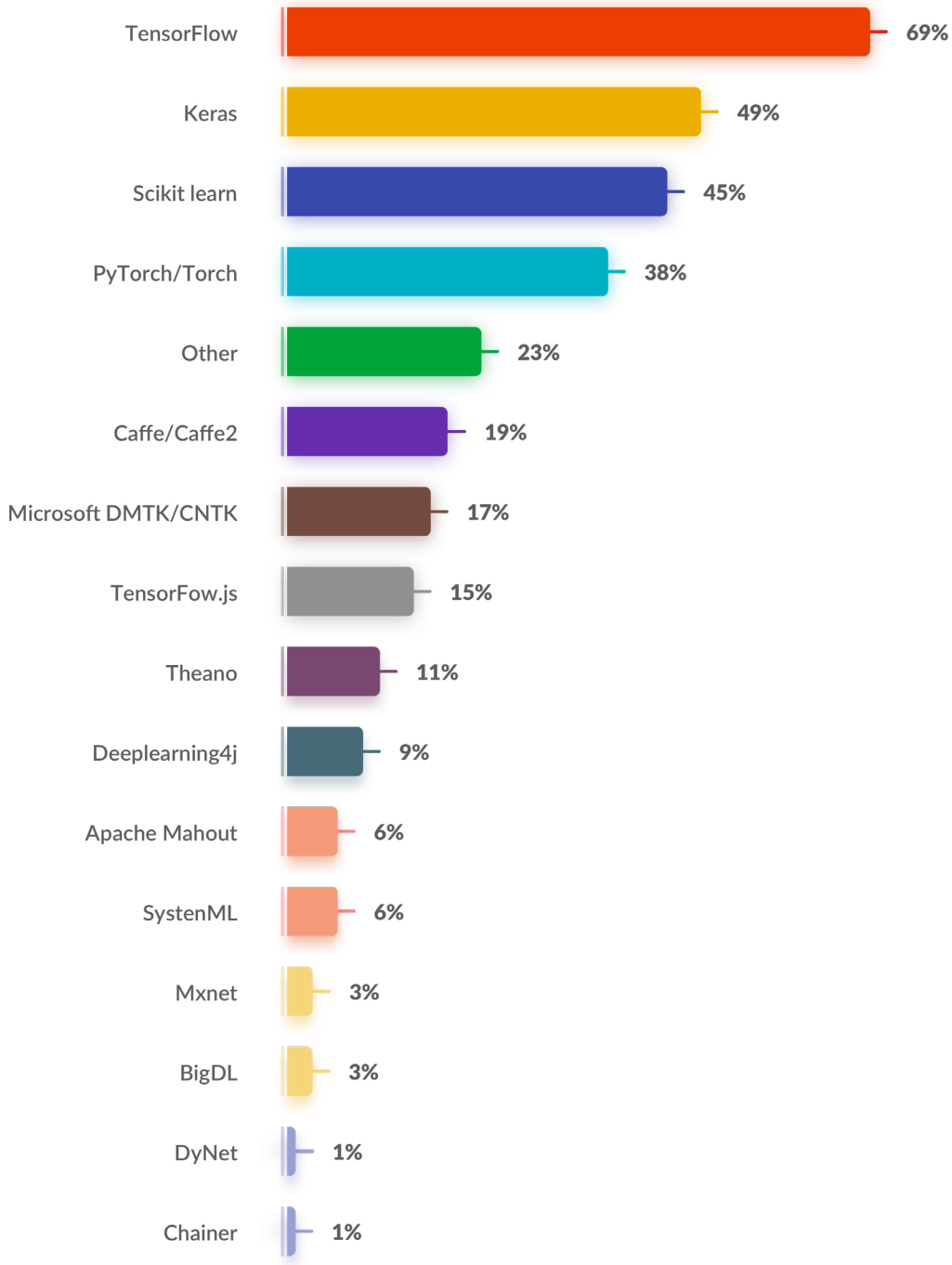
„**Python remains the king of contemporary data science**. Among companies which are longer on the market there is a clear tendency to use **R language which until recently was the main tool of data science**. It is likely that programmers made a deliberate choice to switch to Python which can be used to solve a wider range of problems. It seems that **newcomers on the market offer a different set of competence**, suited for different problems and, eventually, aimed at other types of clients. This would be good news, because it would mean more access and a democratisation of AI solutions for a wider range of clients."

Definitely, **the most popular framework for building deep neural nets is TensorFlow, provided by Google, with over two in three companies (69%) using it**. **Tensorflow is the go-to end-to-end solution** allowing users to deploy trained models to production environments. The **second most frequently used framework is Keras** (49%). Its popularity stems from the fact that it provides an easy way to build models on top of TensorFlow and Theano, and therefore **lowers the threshold of starting the journey with deep learning models**.

PyTorch, developed by Facebook, is used by 38% of companies but its use should increase. This is due to the fact that its libraries are based on Python, so it is accessible to data scientists, most of whom use the language. Additionally, it gives access to particular steps of the computation and thus makes it easier to modify the model and have a better control over its functioning.

The **scikit-learn library**, available in Python, is **used by 45% of companies,** but it is a set of instructions more suitable for data analysis and traditional machine learning.

Figure 19 Frameworks used to develop AI services



One should note that **each tech giant supports its own popular deep learning framework, available as an open-source. Tensorflow** (used by 69% of companies) is supported by **Google**, **PyTorch** (38%) by **Facebook** and **DMTK/CNTK** by **Microsoft** (17%).

Marek Zieliński, Data Science Engineer at 10 Senses, points at recent trends in the development of deep learning frameworks and their meaning for business applications:

"Looking at the example of Tensorflow and PyTorch, **two trends** are apparent in the development of frameworks. One is for the **framework to be a full end-to-end solution**. This allows fast prototyping coupled with capability to deploy to production on various hardware (also mobile and edge devices). Here it is worth mentioning **TensorRT from Nvidia**, a **platform designed to optimise and run trained networks directly on GPU platforms** including edge devices. TensorRT is capable of working with all major frameworks. **One can also observe a constant improvement of the cloud infrastructure specifically tailored for AI**. These recent developments lead to **unprecedented levels of scalability and precise cost control** – factors which are crucial for companies implementing AI solutions.

The **second trend** is the **increasing capability to inspect and tinker with the inner workings of a model**. This introduces a **better explanation of, what till now, was mostly a black box**. Such capability could **prove beneficial for cross-functional AI teams** where both technical and domain knowledge can be mixed together. Careful fine-tuning of the models might be required to solve real-life problems of the local markets."

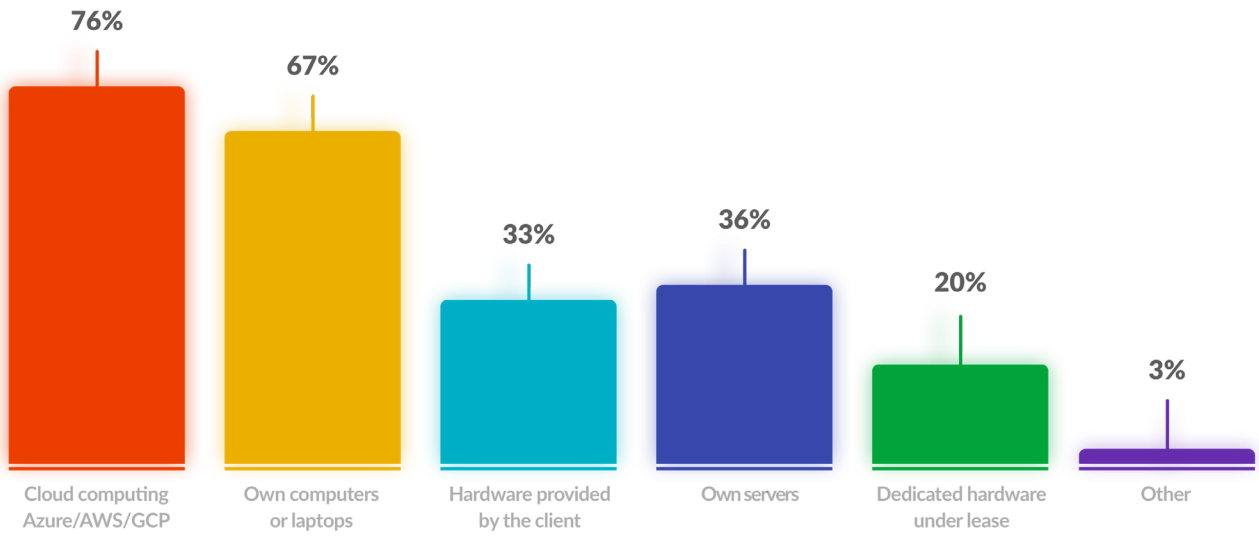
Piotr Migdał,
PhD, Independent Data Science Consultant,

Currently, **the most popular technologies are open-source, both when it comes to languages and particular libraries**. This can be easily **explained by the rapid pace of evolution** in the world of machine learning and deep neural networks. Solutions that are most agile and offer the most options prevail. Nonetheless, the **most popular neural network frameworks couple open access with a direct support of a tech giant**. TensorFlow, Keras and TensorFlow.js are supported by Google; PyTorch – by Facebook. **Python** remains the main tool due to its popularity, an abundant ecosystem for data analysis and, contrary to R language, the **versatility, and ease of integration with other IT systems**.

Among new tools, JavaScript, the language of web pages, becomes increasingly popular in data science. It is happening despite the fact that it was not created for this purpose. Web browsers offer a flexible interaction with data on the client side regardless of the device or operating system and without the need to install any software. Most probably, **we will see the development of TensorFlow.js** which will allow users to apply GPU-supported neural networks in the browser. This would further increase the interest in this language among data analysts.

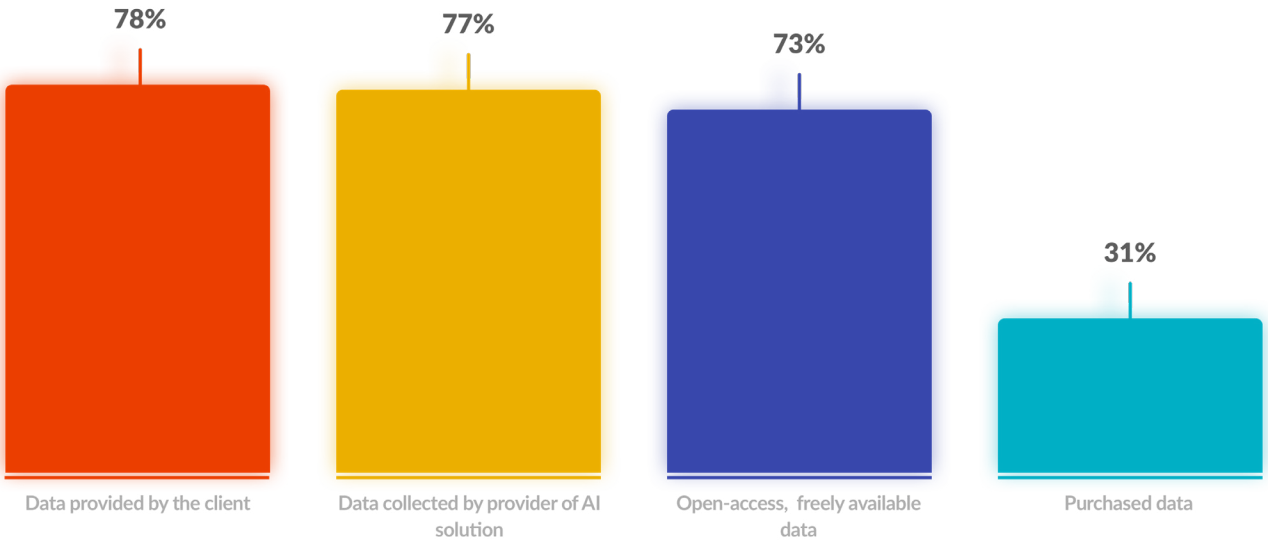
Most companies provide their services using cloud computing services such as Azure, AWS or GCP (76%) or using their own computers (67%). In addition, one in three companies use hardware provided by the client (33%) or their own servers (32%). Using cloud computing so broadly in Poland for AI purpose clearly means that there isn't a problem with the computing power for AI companies. Higher usage also of their own computers underline the thriving ecosystem of start-ups which tend to test their solutions on their own hardware.

Figure 20 Usage of computing power by AI companies



When it comes to data, **AI companies generally use various sources or, maybe more accurately, whatever is available and serves the business case well. 78% use client data, 77% collect their own data** and **73% use open-access**, free of charge data sets. However, only 31% of companies purchase data. This question in the survey offered multiple choices and the results underline that **AI companies use data from every source they have.**

Figure 21 Type of data used

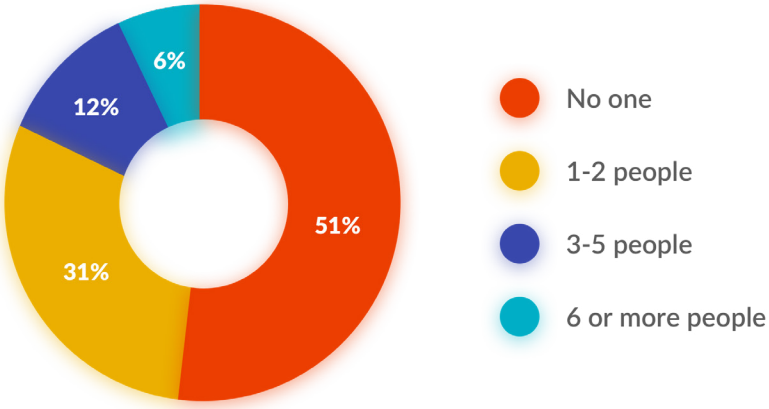


1.5 Cooperation with the Scientific Community

The academic community is at the root of a vibrant AI ecosystem and its importance cannot be overstated. The **success of places such as Toronto, London or Paris stems directly from the achievements of scientific teams operating in these cities decades prior to the AI boom**. There are few sectors of the economy that are so closely tied to academia as AI is.

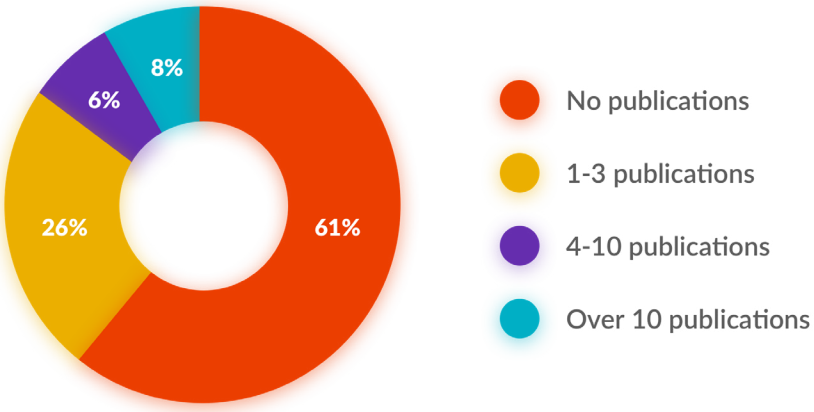
Not surprisingly, **half (49%) of AI companies in Poland employ PhDs which is a very good news**. Among these companies, **most (31%) employ one or two people with a scientific degree.** However, only 6% have a larger number of people with a scientific background, with 6 or more PhDs.

Figure 22 Number of PhDs in the AI team – companies hiring people with a scientific degree



The AI community works very openly. There is a **large number of blogs and platforms, such as Kaggle which allows access to state-of-the-art algorithms and techniques**. Leading **research groups also publish their findings** and these **can often be read free of charge on arXiv as preprints**. Thus it should not be surprising that **Polish AI companies participate in the research community. 26% of them take part in Kaggle competitions** and **20% publish their projects in an open source standard**, mostly on github. Maybe more importantly, **39% of companies have published articles in research journals**. A small group is very active in this area – 8% of companies have over 10 publications. These outcomes **clearly show how important the scientific community is in the development of the Polish AI sector**.

Figure 23 Number of papers published as a result of work in the area of AI



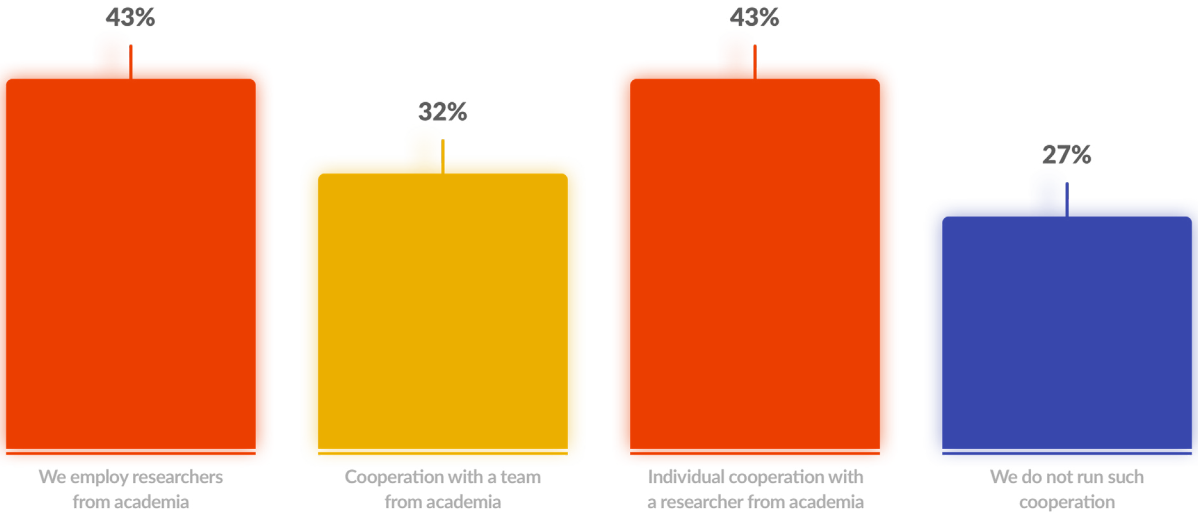
The role of the academic ecosystem is highlighted by **Michał Staśkiewicz**, CEO of Alphamoon.ai:

"It is pretty clear that an **experienced team disproportionately increases work efficiency and reduces the probability of project failure.** In the area of artificial intelligence and machine learning it is even more important because projects are often complicated, have a scientific side, require good handling of mathematics and statistics and top-notch analytic skills. **In effect, the entrance barrier is significantly higher than in other domains of IT**. It also requires proper academic training. In a way, **never before was there a domain which would to such an extent fuse business and science**.

The publications are open access publications and, increasingly, there is a **practice of source code sharing**. This results in rapid implementation of new ideas in the industry. Open publishing becomes a natural way of promoting skills. All this results in **PhDs in machine learning and AI being more and more sought after by companies**. These specialists have the skills necessary to apply cutting-edge technologies and present the results in a concise way. **Currently, all major teams have at least a few PhDs among their ranks**."

Among Polish companies **only one in four (27%) do not run any cooperation with the scientific community, which is an important development**. Those that do, have chosen various ways of incorporating people from academia: 43% directly employ researchers, 32% have formed a cooperation with an academic team and 43% cooperate with a single researcher.

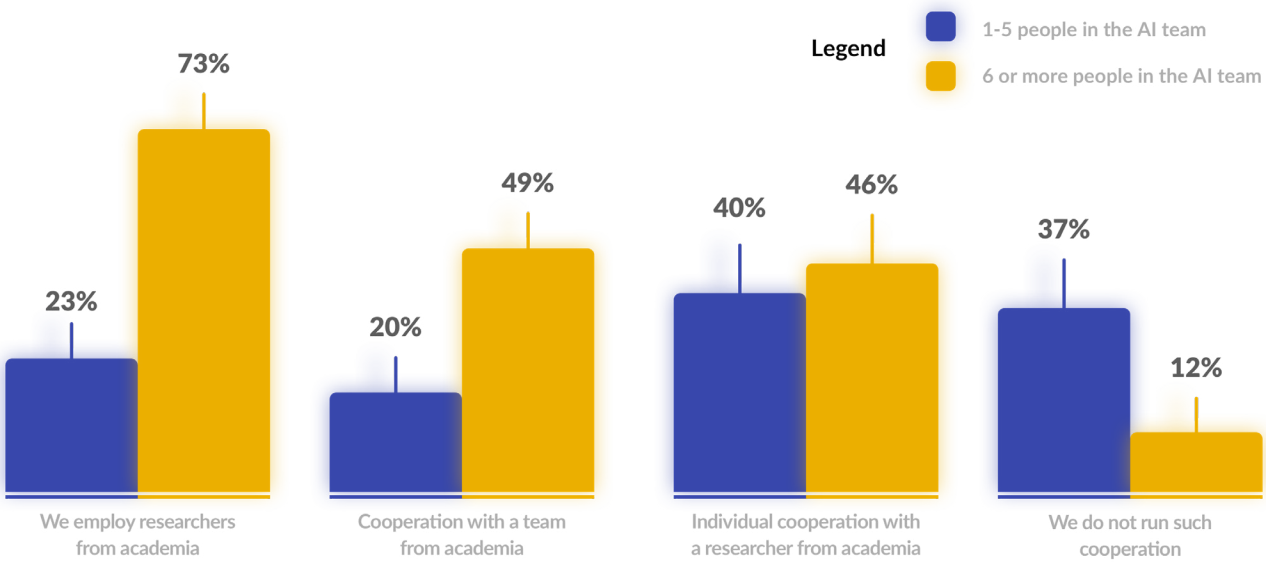
Figure 24 Cooperation with the scientific AI community



The nature of cooperation with the scientific AI community varies significantly depending on the size of the AI team. **37% of companies with smaller teams** (1-5 doing people doing AI) **do not run any cooperation**. However, when they do, **they usually cooperate with a single researcher (40%)**. Only about one in four directly employ researchers from academia (23%) or cooperate with an academic team (20%).

This is, however, **starkly different among companies with larger AI teams** (having 6 or more people doing AI). **Only 12% of them do not run any cooperation with the scientific community**. Actually, the **majority (73%) directly employ people from academia**. Also, 49% cooperate with a scientific team and 46% do so with an individual researcher.
These outcomes clearly show that **companies which chose to develop particular strengths in the area of AI relied heavily on the scientific AI community**. It also reiterates the notion that academia plays a key role in the development of AI sector.

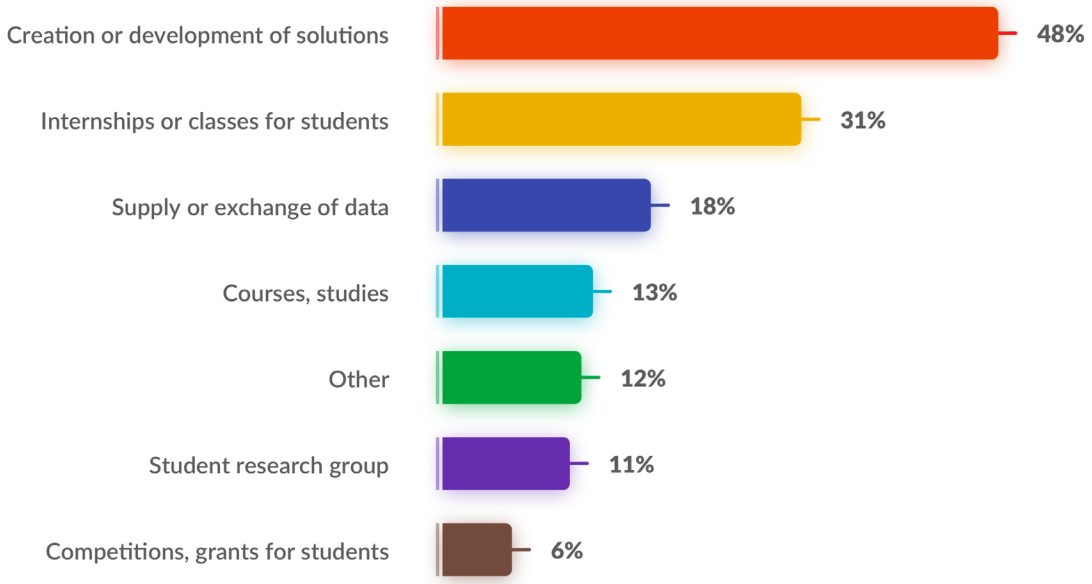
Figure 25 Cooperation with scientific community – by size of the AI team



Given the importance of the scientific community for the AI sector, it is sensible to describe in more detail how companies cooperate in this area. Usually, it boils down to engaging academic researchers or students in the day-to-day operations of the company. **Nearly half (48%) of the companies cooperate with the scientific community with the goal of developing their own solutions**. **One in three (31%) offer internships and organise classes for students**.

Unfortunately, only a relatively small number of companies engage in activities aimed at building teams and capability at the universities. 13% are involved in university courses, 11% in the workings of student research groups and 6% organise competitions or grants for students. Clearly, there is room for improvement. **AI companies which offer courses or more closely cooperate with universities underline that this method of cooperation is also good for their recruitment processes**.

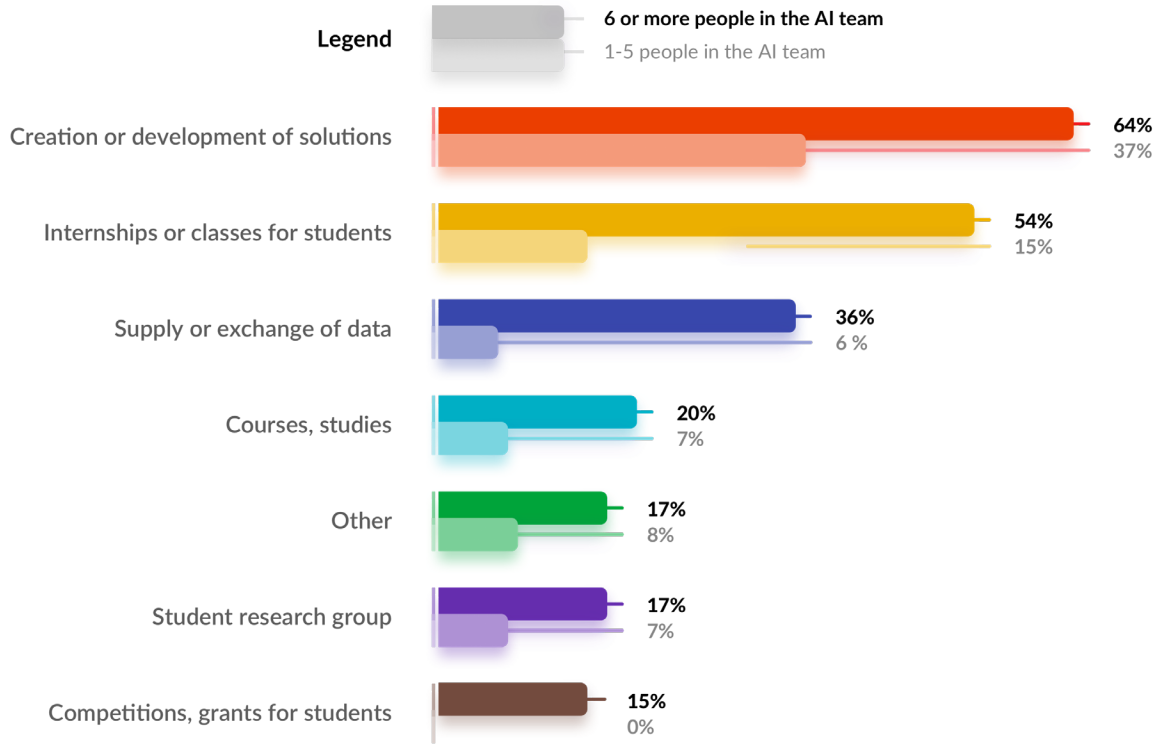
Figure 26 Type of cooperation with the scientific community



Companies with larger AI teams (6 or more people) tend to be much more involved in cooperation with the scientific community. 64% of them engage people from academia in the development of their solutions (compared to 37% of companies with smaller AI teams). They also more often organise internships and classes for students (54% vs. 15%) and supply or exchange data (36% vs. 6%). In addition, a larger share of these companies organise courses (20% vs. 7%) or students research groups (17%).

It would be hard, however, to argue that along with the growth of AI teams, companies switch to cooperating with scientific community in a more reciprocal fashion. They simply cooperate more because they need more graduates, more brainpower and skills. The key reason is to develop their own services and hire people – it's the same logic as with companies which have smaller AI teams.

Figure 27 Type of cooperation with the scientific AI community



These outcomes show a worrying trend. Namely, **the companies expect academia to provide them with fresh graduates and expert researchers**. But **they do not usually undertake the effort to help the scientific community grow their teams within the universities**. In the long-term perspective, this may be a hindrance in the development of the Polish AI sector because academic research teams play a central role in the development of AI in the economy.

Tomasz Trzciński, PhD, Chief Scientist at Tooploox and Assistant Professor at Warsaw University of Technology,

The research community does not only provide businesses with employees but **gives them inspiration** to create new services and products. The relationship with academia, as showcased in the report, is in **line** with international trends. Globally, **many AI companies grow directly out of strong academic institutions,** such as University of Toronto or University of Oxford. Unfortunately, **due to the one-sided nature of this relationship, focused on hiring researchers instead of participating in the academic life, this situation can lead to the depletion of properly trained personnel**. It should be noted that this problem is **apparent also in technologically advanced countries like Great Britain and Canada**. In Poland, it is further exacerbated by the relatively weak global standing of local universities which **to large extent, is the result of a low number of breakthrough papers presented at top-tier events**.

For this reason **it is a good sign that Polish AI companies are interested in publishing the results of their work**. Unfortunately, these **companies do not usually know where to publish,** to improve the competitiveness of the Polish scientific community. As a result, there were **only a few papers with Polish affiliations accepted at the main-track NeurIPS 2018 conference** - the most prominent scientific event in AI. Among over one thousand published papers, there were **only four presented by researchers affiliated with Polish universities**. And only one out of these four was affiliated with a Polish AI company.

It is particularly important to be noticed, as the long-term development of Polish science would certainly lead to tangible financial gains resulting from the commercialization of tech products developed domestically and spun out of research labs. It would also increase the attractiveness of studying in Poland and, in effect, increase the supply of AI specialists in the country.

Dominik Batorski, PhD, Chief Scientist at Sotrender and Assistant Professor at ICM University of Warsaw,

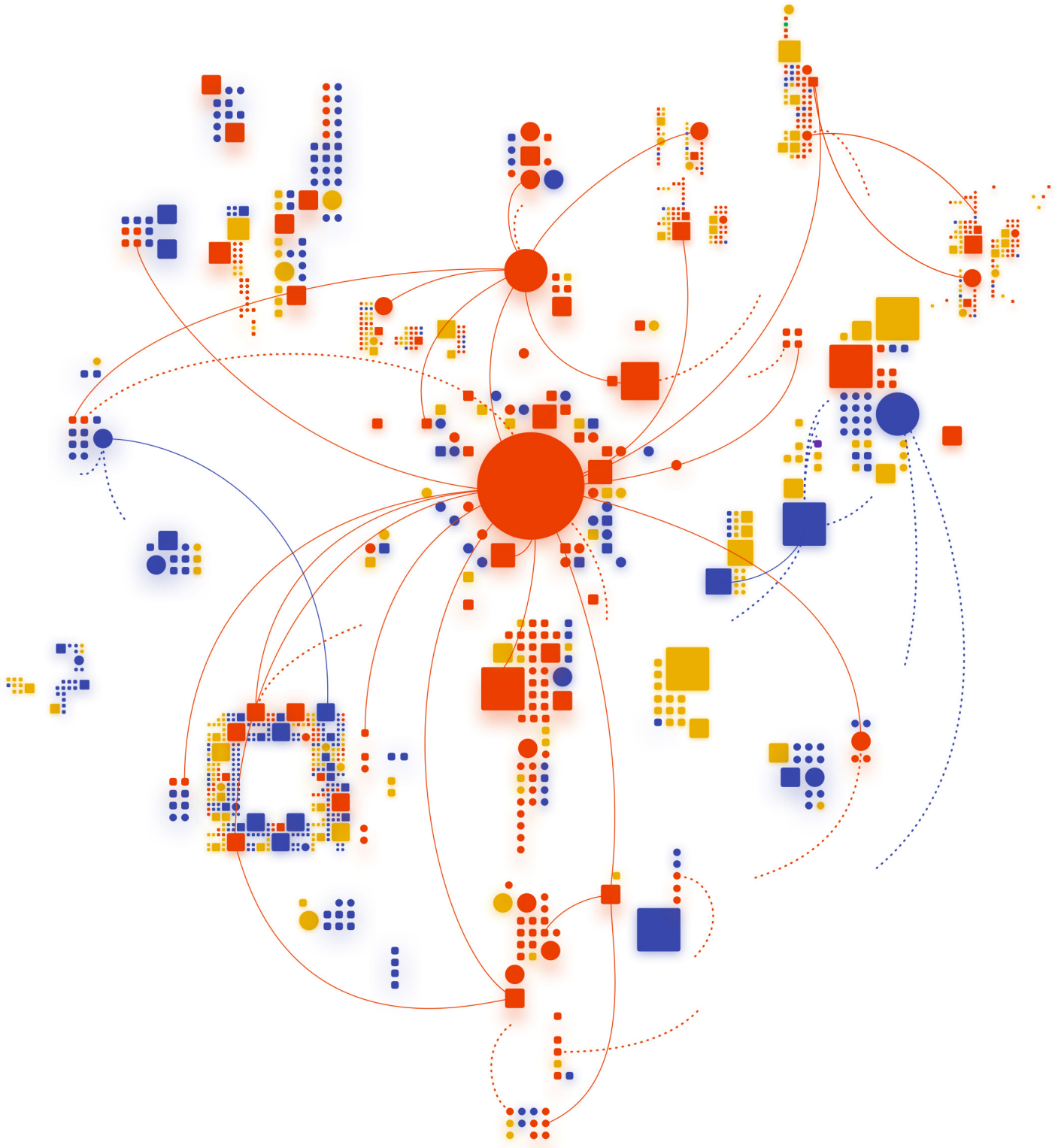
Currently, there isn't any other industry so much linked with the scientific sector as AI is. **One in three companies cooperate with academic teams, even more collaborate with individual researchers and 43% employ academics**. AI teams within companies are usually small and only 18% employ 3 or more PhDs. However, if one includes all people developing AI then these teams are much larger. 31% employ 6-20 AI specialists and 10% over 20 people.

The larger the team, the more likely it is to cooperate with the scientific community. 82% of the companies which do not cooperate with academia have AI teams of up to 5 people. On the other hand, about two in three companies cooperating with universities or employing academic researchers consist of 6 or more AI specialists. Larger teams, PhD on the payroll and cooperation with universities translate into higher versatility in terms of AI applications. For example, **machine learning for robotics is the domain of 41% of companies which do cooperate with academia** and only 5% of companies try to implement machine learning for robotics on their own without such a cooperation. In speech recognition these numbers are 26% and 11% respectively.

The **size of AI teams plays a key role in the nature of cooperation with the scientific AI community**. Internships are organised by companies regardless of the size, but competitions and challenges, courses and data sharing is rather the domain of companies with more sizeable AI teams. These activities are aimed at recruiting talented graduates. It is also apparent that **companies which received grants have visibly larger AI teams**. Based on the data, it is hard to tell whether these larger teams are the effect of financial backing from a grant or rather a factor that makes it easier to receive the grant in the first place..

digitalpoland

2. Map of the Polish ecosystem



2.1 Scientific Societies

There are a number of scientific societies in Poland which focus their attention on data science, artificial intelligence and machine learning. Some have already been operating for some time. For example, Polish Neural Network Society was founded in 1995. The societies are located not only in Warsaw, but in other cities as well. They are run by people from different academic institutions which suggests that a range of universities have a representation in the community.

In order to coordinate the effort of developing the AI sector, **five major societies have formed a new structure – Polish Initiative for the Advancement of Artificial Intelligence (PP-RAI, Polskie Porozumienie na Rzecz Rozwoju Sztucznej Inteligencji)**. The first conference of PP-RAI took place in October 2018.

Organisation	Foundation	President
Polish Initiative for the Advancement of Artificial Intelligence (PP-RAI: Polskie Porozumienie na Rzecz Rozwoju Sztucznej Inteligencji)	2018	Coordination committee consists of 9 members who represent each of 5 founding societies
5 PP-RAI societies:		
Polish Artificial Intelligence Society (Polskie Stowarzyszenie Sztucznej Inteligencji)	2009	Grzegorz J. Nalepa, AGH University of Science and Technology
Polish Neural Network Society (Polskie Towarzystwo Sieci Neuronowych)	1995	Leszek Rutkowski, Częstochowa University of Technology
Polish Special Interest Group on Machine Learning (Polska Grupa Systemów Uczących się PL SIGML)	2013	Jacek Koronacki, Polish Academy of Sciences; Jerzy Stefanowski, Poznań University of Technology; Michał Woźniak, Wrocław University of Science and Technology
Polish Chapter of the IEEE Systems, Man, and Cybernetics Society		Piotr Jędrzejowicz, Gdynia Maritime University
Poland Section of IEEE Computational Intelligence Society		Joanna Kołodziej, Warsaw University of Technology
Other societies:		
IEEE Robotics and Automation Society Polish Section		Krzysztof Kozłowski, Poznań University of Technology
Association for Image Processing (Polish Member Society of the IAPR logo International Association for Pattern Recognition)	1998	Leszek Chmielewski, Warsaw University of Life Sciences
Network Science Society (Polish Chapter)		Przemysław Kazienko, Wroclaw University of Technology
Poland Chapter of IEEE Signal Processing Society		Piotr Samczyński, Warsaw University of Technology
International Neuroinformatics Coordinating Facility Node of Poland	2007	Tomasz Piotrowski, Nicolaus Copernicus University

2.2 Leading conferences and meet-ups

Major conferences

There are many conferences covering topics such as artificial intelligence, machine learning, data science and big data. They differ regarding the profile of target audience (specialists vs. non-experts), the stage of career (students vs. professionals) and the topic of the conference (research vs. business applications). Most major conferences are organised in Warsaw.

PyData

Largest data science conference focused on users of Python language. Held annually for two days. Aimed at specialists.

Why R?

Conference focused on applications of R language. Held annually for two days. Aimed at specialists.

PI in ML: Polish View of Machine Learning

Largest Polish research conference focused on research and applications of deep learning. Held annually for four days. Aimed at researchers.

Data Science Summit

Conference on various data science topics, including machine learning, big data and visualisation. Held annually, lasts one day. Aimed at specialists and students.

Artificial Intelligence & BIG DATA

Conference focused on business aspects of big data and artificial intelligence. Held annually for two days. Aimed at non-experts.

Business Analytics Summit

Conference focused on business aspects of big data and artificial intelligence. Held annually for two days. Aimed at non-experts.

ML@Enterprise

Conference focused on business aspects of big data and artificial intelligence. Held annually for two days. Aimed at specialists.

InfoShare

Largest tech conference mainly for developers in the CEE region. Includes an AI roadshow which takes place in 6 Polish cities. Held annually for two days, aimed at integrating the IT community and sharing programming experience.

Big Data Technology Summit

Large conference focused on big data analysis, scalability, storage and search. Held annually, lasts one day. Aimed at both specialists and non-experts.

Artifical intelligence and robotisation in the financial sector (Puls Biznesu)

The conference focuses on business aspects in the financial sector which is one of the sectors dynamically implementing new technologies. The conference is held annually for two days.

TFML

The conference on Theoretical Foundations of Machine Learning Conference is organized by Department of Machine Learning, Institute of Computer Science and Computational Mathematics, Faculty of Mathematics and Computer Science, Jagiellonian University.

Meet-ups

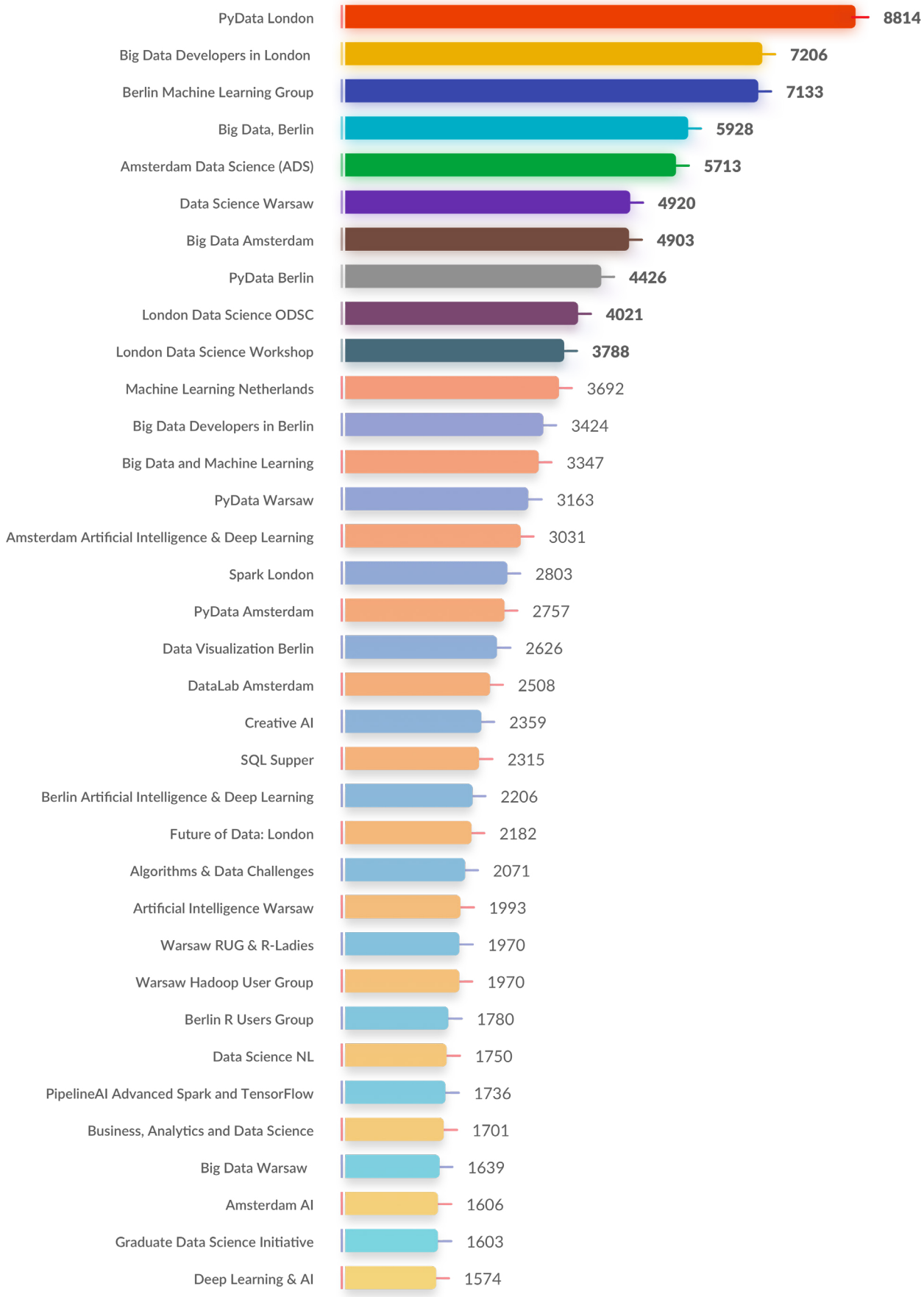
In Poland, there is a vibrant ecosystem of meet-ups and events. In each agglomeration there are communities organised around major topics or technologies. Usually, these meetups are sponsored by companies operating in particular cities.

- **PyData**. Cyclical events focused on applications of Python, data science and machine learning. PyData meet-ups are organised in cities such as Warsaw, Tricity area, Wrocław, Kraków and Łódź.
- **R language**. The community or R users is vibrant and long-standing. There are various R Users Groups meet-ups in most big cities of Poland.
- **Hadoop**. The most prominent meet-up is Warsaw Hadoop User Group. However, there are meetups focused on Hadoop in other cities also.
- **Data Science**. The largest event is Data Science Warsaw. Similar meet-ups under the "Data Science" idea are already organised in other cities such as Wrocław, Poznań, Tricity, Lublin, Łódź or Kraków.
- **AI**. AI meet-ups have been organised recently in cities such as Warsaw, Poznań, Kraków
- **Self-Driving Cars**. The meet-up group held in Warsaw aimed at building a community around the technology of self-driving cars.

There are also many other meet-ups organised by corporations such as Samsung, Accenture, Roche, T-Mobile and others.

A comparison between meet-ups held in Warsaw and other major European cities shows that the local community is a vibrant one. The number of participants in Warsaw meet-ups is similar to that in Amsterdam. It is somewhat smaller than in London or Berlin, but these are much larger agglomerations and two major tech centres in Europe.

Figure 28 Number of meet-up participants in Warsaw and other major European cities. Data delivered by Dominik Batorski.



The rising interest in topics such as data science, machine learning and artificial intelligence led to a rapid increase of people interested in the AI community in Poland. A good example would be a comparison of two editions of PyData conference, held in 2017 and 2018. It can be easily seen that PyData is evolving from a local meeting of AI experts into an increasingly transnational event attracting a wider audience. In 2017, 415 people took part in the conference and in 2018 audience increased to 435 participants. However, in 2017 19% of conference participant who took part in the conference came from abroad. This number rose last year to 31%. Similarly, in 2017 only 13% of participants were women but this number rose to 21% in 2018. These are positive trends. They show that the Polish AI community is increasingly integrated in the global exchange of ideas and that the career in this field is becoming more attractive to a diverse range of candidates.

Figure 29 Residence of people participating in PyData conference. Data delivered by Piotr Migdał.

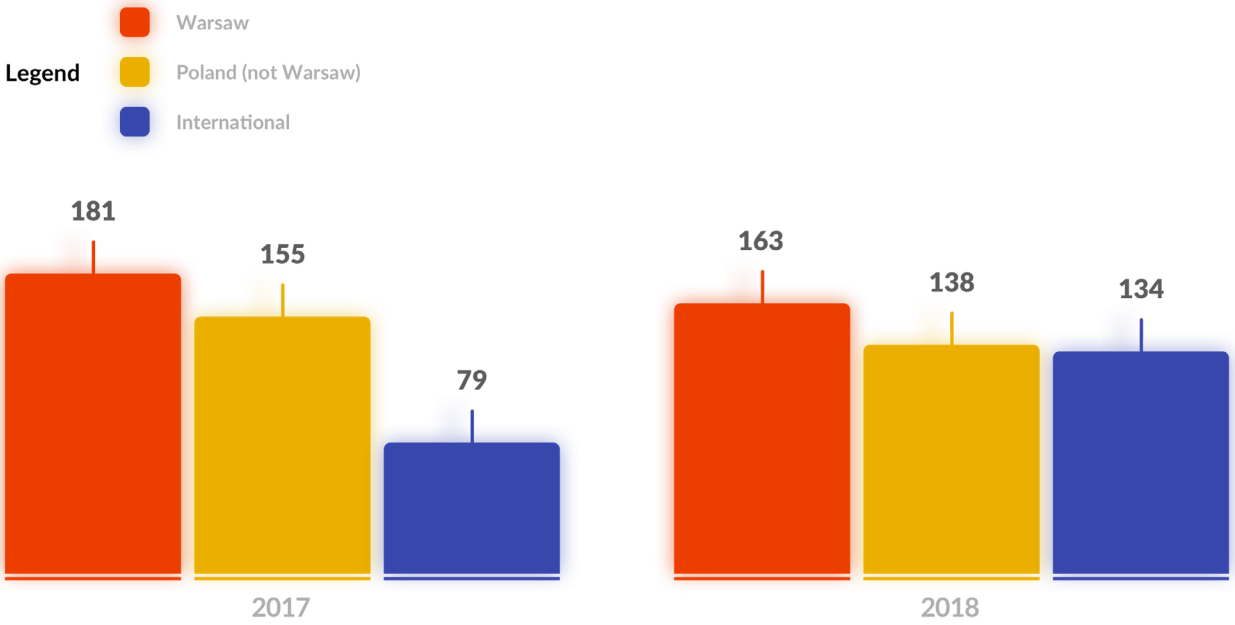
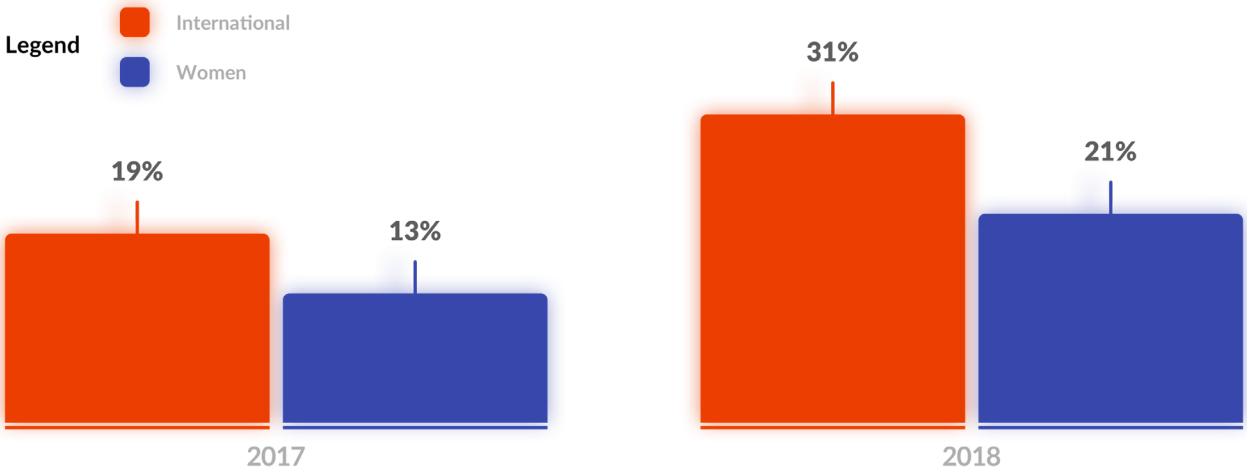


Figure 30 Share of women and international guests among participants of PyData conference. Data delivered by Piotr Migdał.



2.3 Map of Polish AI Companies and Start-ups

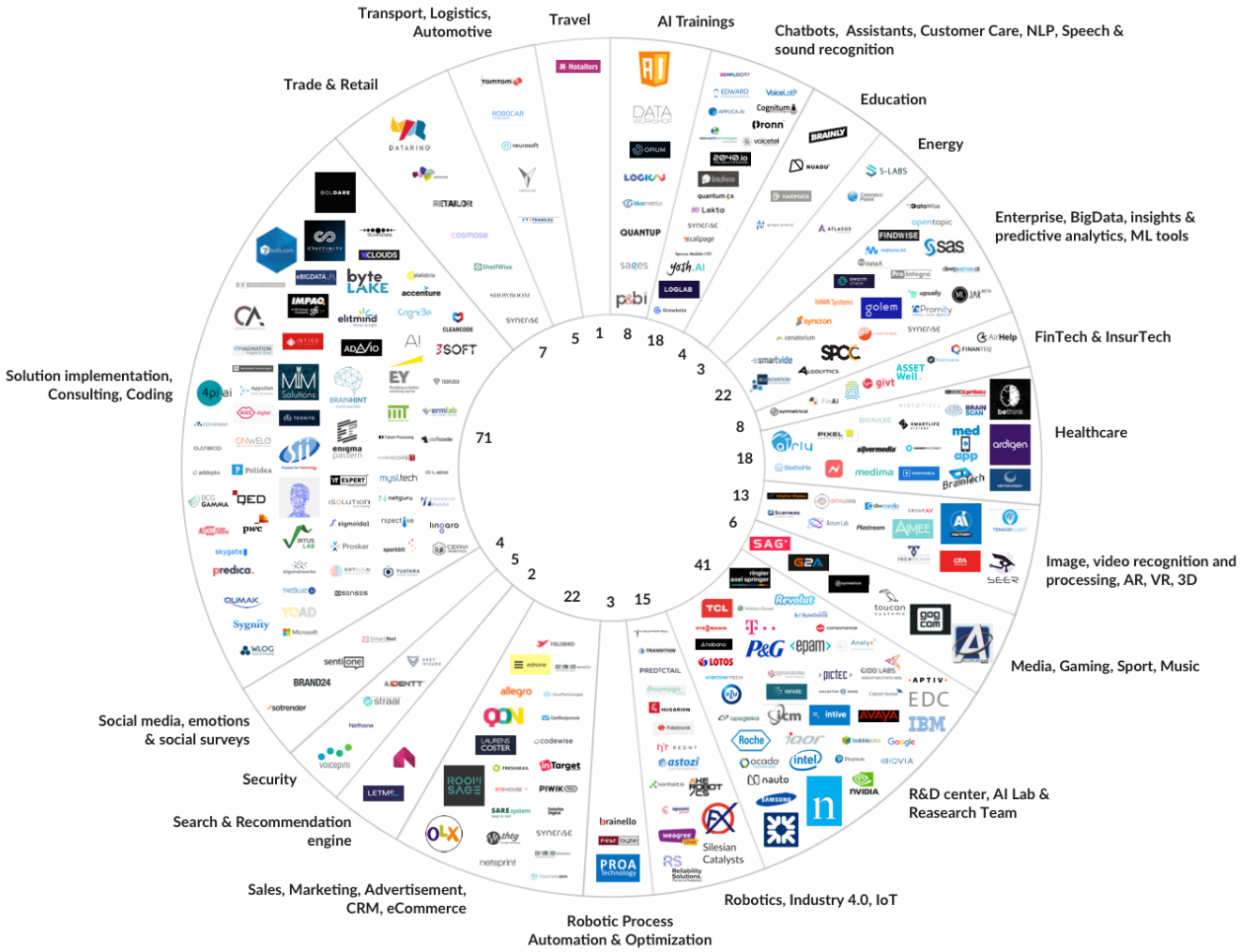
In this chapter we listed companies which develop AI in Poland. We categorise them based on end-services and clients. In order to present the whole AI ecosystem we also put on the map R&D centres and AI labs of global corporations.

If your company is not listed in this report **please fill-in the online survey** available here: bit.ly/MapOfPolishAISurvey

We would love to add your company competences!

In the meantime, **the whole list is available here**: bit.ly/MapOfThePolishAIEcosystem

Please do **pay attention to the size of letters** in the www address



AI Trainings

OPIUM

LOGICAI

QUANTUP

sages

p&bi

bluemetrica

DATA WORKSHOP

Chatbots, Assistants, Customer Care, NLP, Speech & sound recognition

Dronn

EDWARD AI POWERED SALES ASSISTANT

EMPLOCITY

Growbots

Lekta

VoiceLab

APPLICA.AI

yosh.AI

quantum.cx

Spruce Mobile LTD

stanuschtechnologies a thinking software

InteliWISE

LOGLAB

2040.io INTELLIGENCE FOR BUSINESS

callpage

Cognitum Artificial Intelligence

voicetel COMMUNICATIONS S.A.

SYNERISE

Education

NUADU

BRAINLY

grupa pracuj

HARIMATA

Energy

ATLASUS improving the future

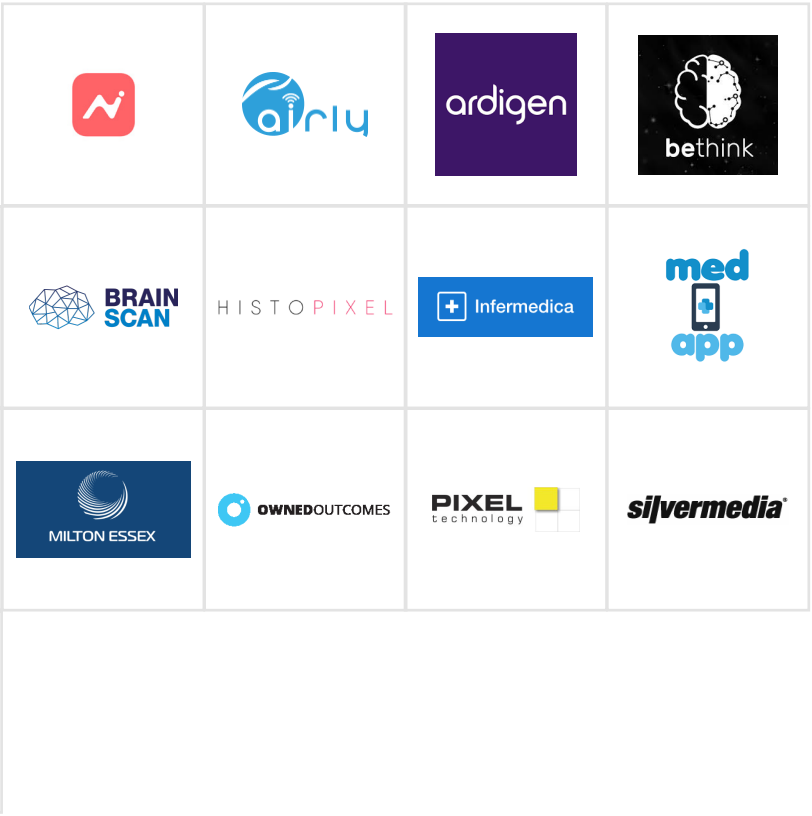
Connect Point

S-LABS

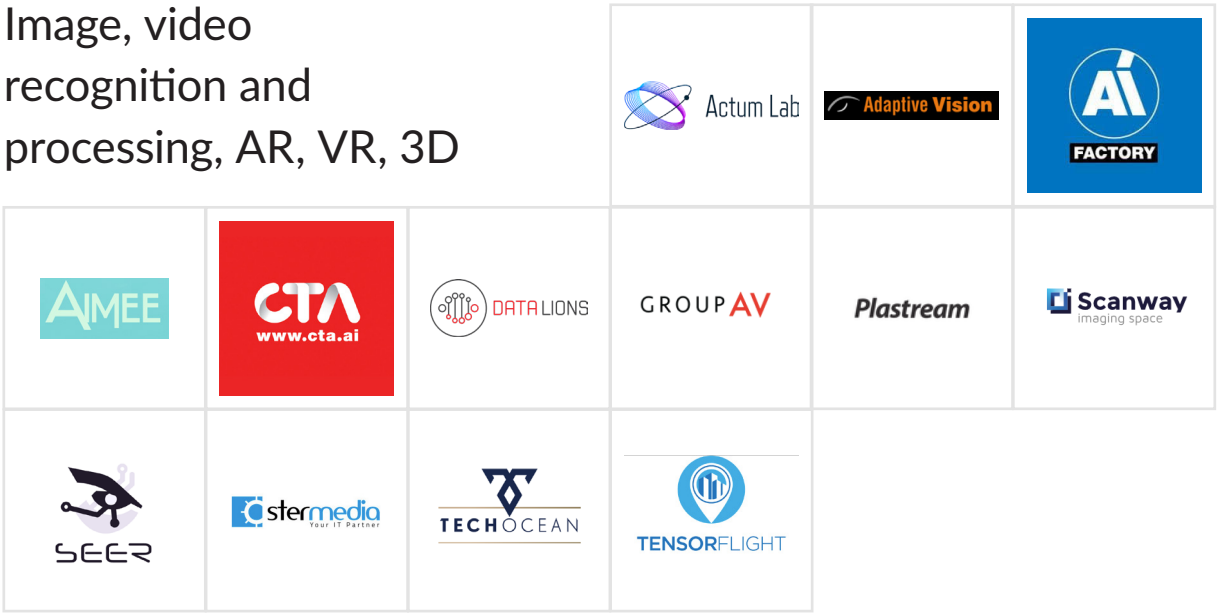
Enterprise, BigData, insights & predictive analytics, ML tools

FinTech & InsurTech


Healthcare



Image, video recognition and processing, AR, VR, 3D



Media, Gaming, Sport, Music

R&D center, AI Lab & Reasearch Team

habana | intel

Robotics, Industry 4.0, IoT

AKE ROBOTICS | apzumi spatial | astozi trust the experience

Fideltronik | FX | HUSARION | kontakt.io | nomagic just AI | PREDICTAIL

REDNT | Reliability Solutions. The Art of Prediction | Silesian Catalysts | THAUMATEC | TRANSITION TECHNOLOGIES | weagree ONE

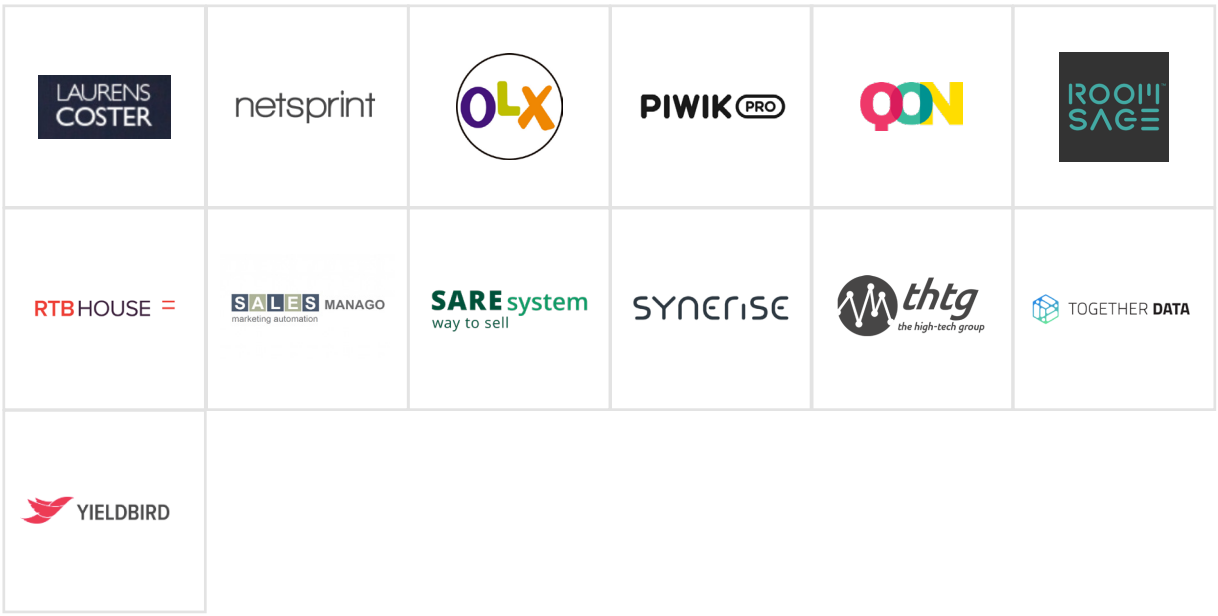
Robotic Process Automation & Optimization

brainello | First byte | PROA Technology

Sales, Marketing, Advertisement, CRM, eCommerce

inTarget | allegro | SALES MANAGO marketing automation

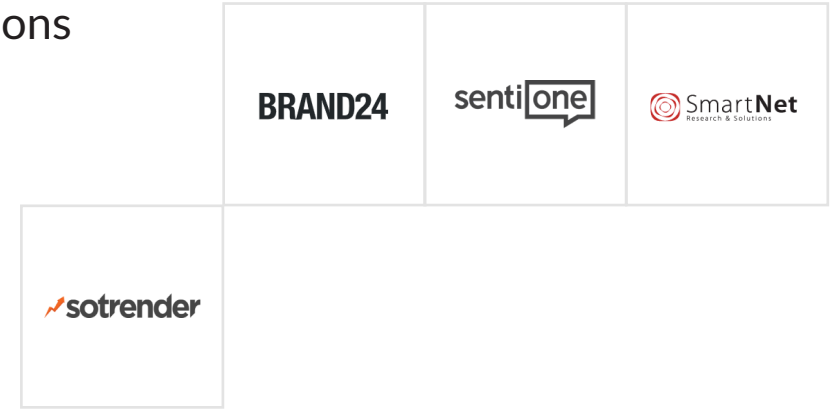
CloudTechnologies | codewise | Deloitte. Digital | edrone | FRESHMAIL | GetResponse



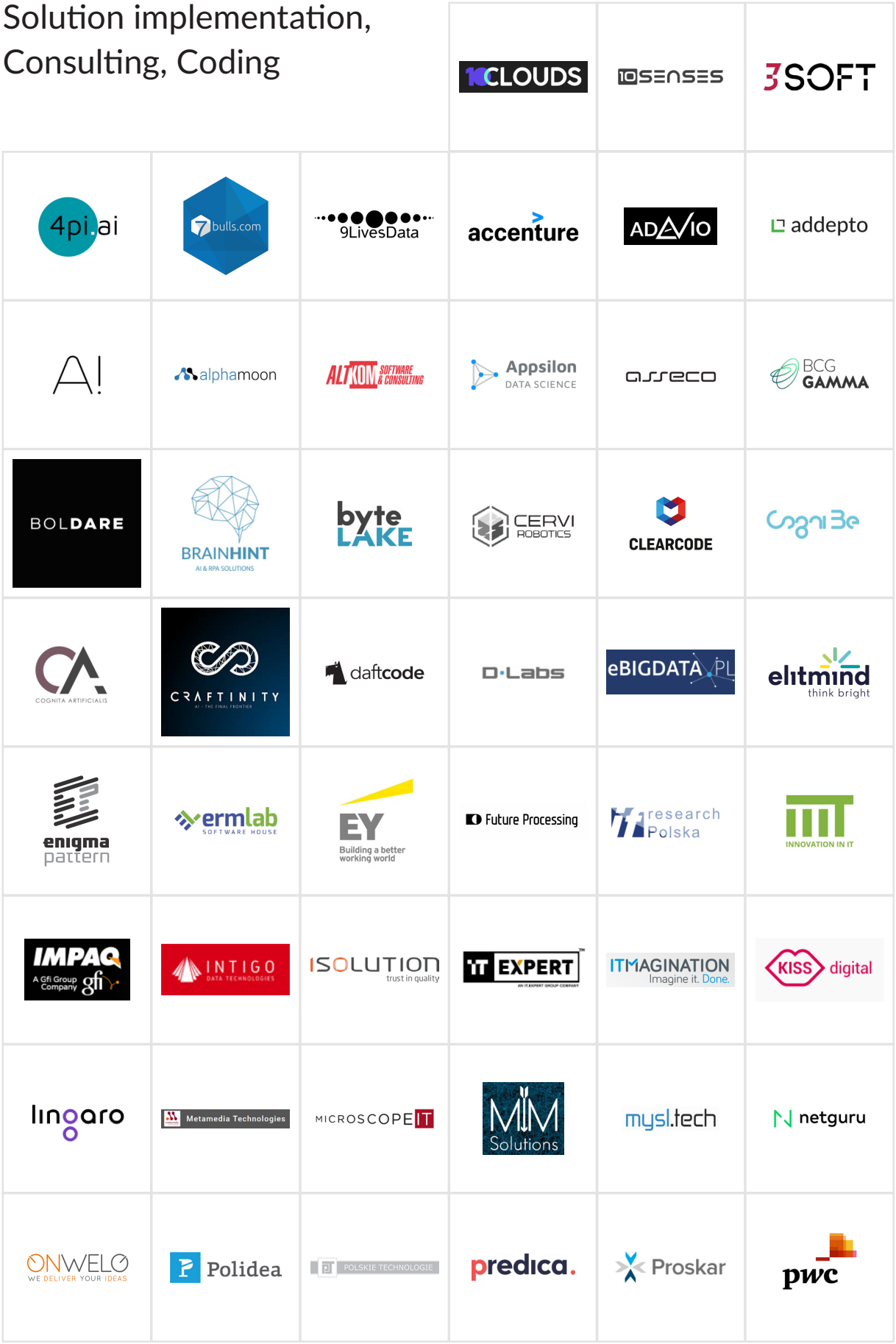
Search & Recommendation engine

Security

Social media, emotions & social surveys

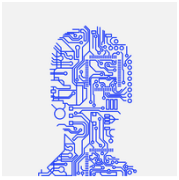


Solution implementation, Consulting, Coding



QED | QUMAK | rspective | sigmoidal | Passion for Technology | SOFTPLUS.AI DEEP LEARNING EXPERTS

sparkbit | statistrix | Sygnity | TEONITE | THEBLUE AI | TOOPLOOX

TUATARA business solutions |  | IRTUS LAB | WLOG SOLUTIONS | YOAD | Algonetworks

skygate | Microsoft

Trade & Retail

cosmose | DATARINO | estimote | RETAILOR

ShelfWise | SHOWROOM | SYNERISE

Transport, Logistics, Automotive

ROBOCAR TECHNOLOGIES | TOMTOM

Travel

Hotailors | TRANS.EU ROAD TRANSPORT PLATFORM | veturai | neurosoft

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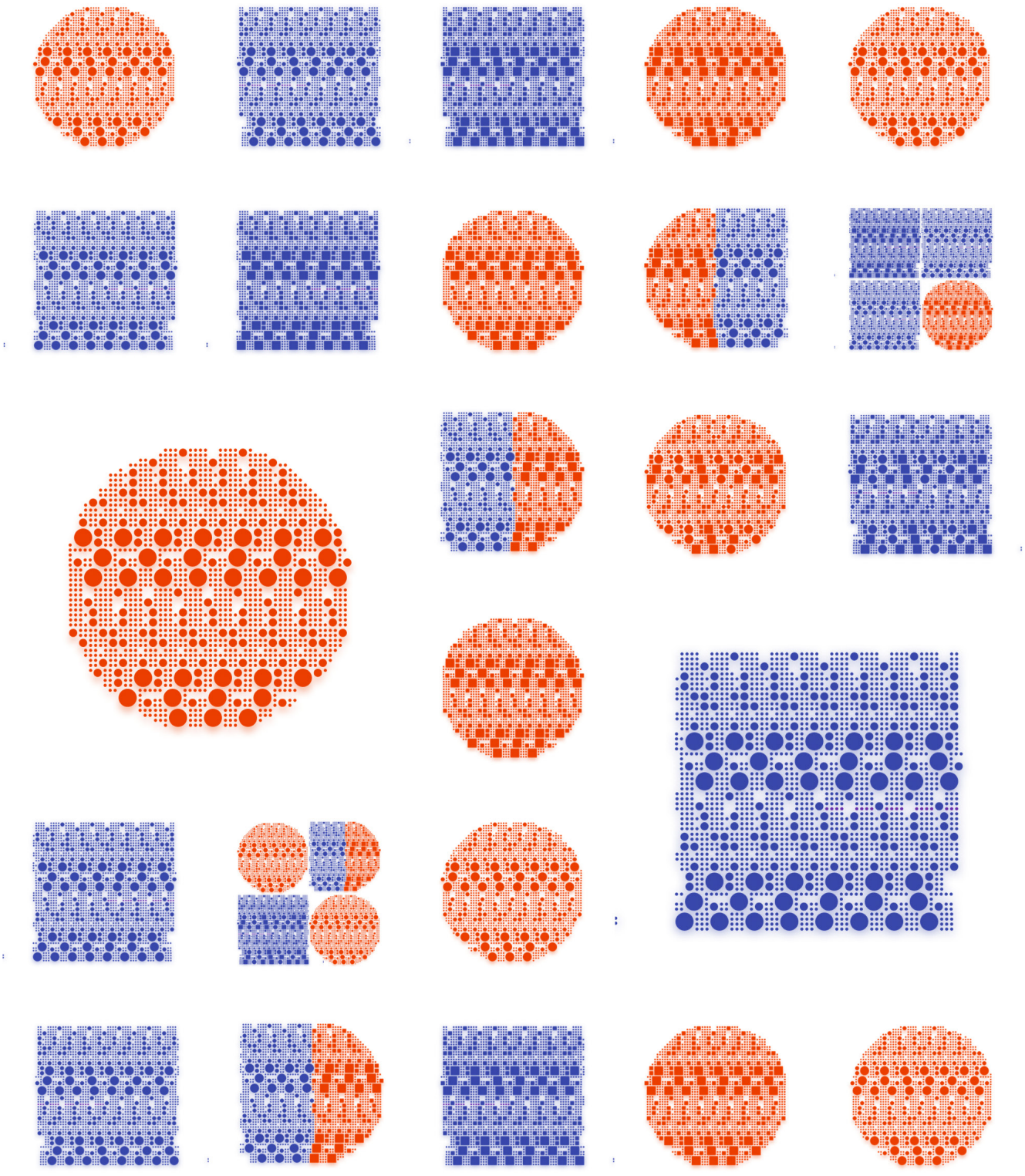

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Piotr Mieczkowski is an experienced professional with a demonstrated history of working in the consulting, telecommunications, IT, media and energy industry. He has hands-on experience in implementation of IT & network systems, business analysis, business development, business strategy, valuation, digital transformation, M&A. Piotr advised policy-makers in CEE region, investment funds, and CEOs helping them formulate successful strategy. He is familiar with latest business & technological trends including AI, RPA, big data, cloud, blockchain, IoT and 5G. Prior to joining Digital Poland Foundation, Piotr worked for NCBiR, EY, Cyfrowy Polsat, Polkomtel, Orange Polska, Shell Polska. He is a graduate of the Faculty of Management at the University of Warsaw (MA) and Electronics and Information Technology of the Warsaw University of Technology (MSc).

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About the Digital Poland Foundation

The Digital Poland Foundation turns **digital challenges into opportunities for the Polish economy**. We position Poland as a **leading digital innovation hub** by promoting cross-industry nationwide initiatives, combining forces, connecting topics and projects, creating networks of digital leaders.

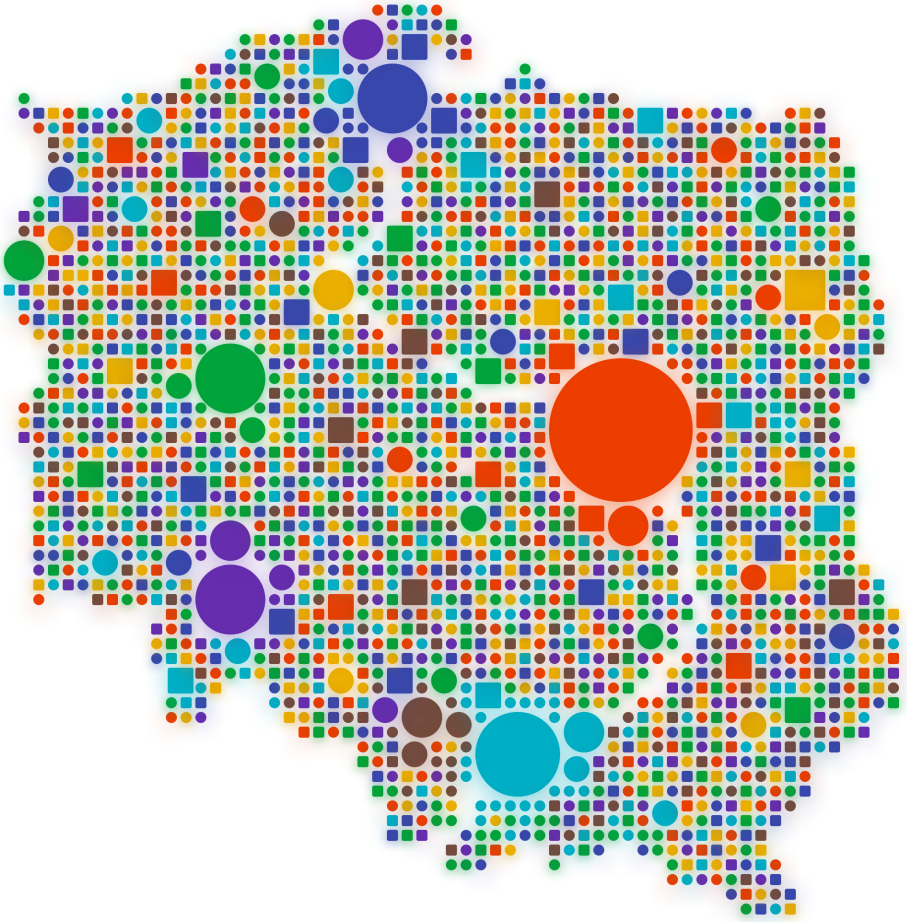
How do we want to achieve it?

- **Strengthening the Polish digital system** by supporting synergies among digital leaders, companies and initiatives
- **Merging with leading global digital hubs** by connecting Polish leaders and companies with global digital leaders
- **Promoting locally and internationally** by presenting chances of digitalisation in Poland & communicating our advantages as digital hub

Among **Strategic Founders & Strategic Partners** you may find companies like: Baker McKenzie, Daftcode, Ghelamco, MCI Capital, Microsoft, Polpharma, Ringier Axel Springer, T-mobile, UPC, Visa, Żabka.

Furthermore, **we are part of a bigger European initiative**. The Digital Poland Foundation was created on the model and **in cooperation with the Swiss initiative called Digital Switzerland**, founded in 2015. Now, more than 250 companies around Europe cooperate together to reach one goal – Let's digitalise Europe!

Map of the Polish AI



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