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1. Introduction

1.1. Overall purpose of the report

This report is being prepared under the DG REFORM call for tender REFORM/2021/OP/0006 Lot 1 "Integrated policymaking in the area of RDI" project under Deliverable 3 – Vertical industry pilot report on robotisation. This report provides analysis and insights on the Slovak cutting edge robotisation ecosystem including the utilization of quantitative data analysis as the first step for helping select strategic priorities that could fit into a further roadmap building.

For the current version of the report, we present:

- Introduction (Chapter 1)
- Summary of key findings (Chapter 2)
- Megatrends analysis (Chapter 3)
- Analysis of the Slovak robotisation ecosystem (Chapter 4)
- Analysis of Slovak researchers involved in robotisation (Chapter 5)
- Annex 1: Desk research and literature review
- Annex 2: Technology list creation
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1.2. Methodology overview

The methodology overview depicts the first steps of the Roadmap creation such as Industrial performance assessment (baseline), and megatrends analysis necessary for the further identification of strategic priorities. Stakeholder input and validation are crucial to the process, as quantitative methods for assessing industrial baselines are combined with top-down expert knowledge of the country's overarching industrial strategies.

Creation of technology lists. The process of scoping the robotisation industry required **developing a comprehensive list of cutting-edge technologies**. This task was methodologically approached, combining the use of ChatGPT with traditional desk research and literature review. The study team utilised ChatGPT to generate a list of cutting-edge technologies relevant to the robotisation sector (detailed technology lists and keywords can be found in Annex 2).

To develop and validate the comprehensive list of cutting-edge technologies in robotisation, we employed also a **systematic literature review**. This involved sourcing and analysing academic papers, industry reports, and market analyses to identify prevailing trends and innovations within robotics (see Annex 1 for the full list of reviewed reports). Post completion of the desk research, we organized the identified technologies into categories based on their types, such as Robotic Process Automation (RPA), Collaborative Robotics (Cobots) or Humanoid Robotics, and their application areas like medical or agricultural robotics.

Megatrends analysis involves the systematic assessment and evaluation of large-scale, transformative forces that significantly impact societies, economies, industries, and individuals over extended periods, often spanning decades. These megatrends are overarching, pervasive, and have far-reaching consequences, shaping various aspects of human life and the business environment. Recognising the

dynamic nature of the business landscape, megatrends analysis becomes paramount for the identification of emerging trends wherein Slovak companies can not only add value but also position themselves strategically for future opportunities. European Commission officially identifies 14 key megatrends[1]. From which the most important in Slovakia's Robotisation are the Aging population, Urbanization, Shifts in consumer demands and the rise of Industry 4.0 technologies.

Company analysis: After keywords were validated using desk research, they were entered into the Milda.ai database, which produced company lists for each technology. By utilising advanced technologies like Large Language Models (LLMs) and Natural Language Processing (NLP), Milda.ai aggregates and validates information from multiple inputs, including social media (LinkedIn, Facebook, Twitter), company websites, and patent databases (PATSTAT). The system processes these data points to create structured profiles, covering variables such as company name, activities, location, patents, and industry, ensuring comprehensive and reliable insights for users. Local Slovak databases such as the Start-ups register, Slovak company register, CREPC, SKRIS and Registeruzsk were also consulted.

Benchmarking: The analysis of Slovak companies started with benchmarking Slovak companies against other Visegrád region (Poland, Czechia and Hungary) countries companies. The Visegrád region is selected as the benchmark for comparison due to its relevance and similarity to the target area. For the overview of the Visegrád region's cutting-edge robotisation companies, we have analysed a dataset of a total of 1 333 companies. Company analysis included the total number of companies per technology, per country and companies by age, industry, turnover and company size. The benchmarking was used to contextualise Slovak company data but does not provide a basis for full-scale country rankings or market sizing.

Researchers' analysis was implemented collecting all Slovak researchers, affiliated institutions and publications data from the OpenAlex database. In analysing researchers' data, a set of stringent criteria was applied, ensuring that only active researchers with recent publications related to the relevant technologies (matching the selected keywords) are included (with publications from the year 2019 onwards). Further, to narrow down the researchers' analysis, we have applied these filters:

- Focus on the research from applied science universities, hence we analysed mainly researchers from the Technical University of Košice, University of Technology in Bratislava and The University of Žilina. We still kept aggregated data on the Other universities for comparison.
- Researchers must have at least one publication within the last five years (2019 onwards).
- Researchers must have at least five publications related to the specified technological terms.

Overall positioning of Slovak cutting-edge robotics technology ecosystem: assumptions were made regarding the categorization of Slovakia's local performance in specific technology areas as LEADING, GROWING, or LAGGING. The lighthouse principle was selected for the data visualisation. The quantity of Slovak enterprises and the number of Slovak researchers active in these domains. A LEAD designation is ascribed when both indicators are favourable (green), signifying a commanding presence of both commercial and academic strengths within a given technology. Conversely, a LAG classification (red for both criteria) indicates a relative deficiency in both industry engagement and research activity. In scenarios where the indicators are mixed—one red and one green—or uniformly moderate (yellow), the technology is categorised under GROW. This classification denotes a sector with potential: there

[1] https://knowledge4policy.ec.europa.eu/foresight/tool/megatrends-hub_en#explore

may be a robust commercial footprint lacking equivalent research support, or a strong research foundation yet to be fully realised in market presence. These GROW sectors are identified as strategic opportunities for targeted development, indicating areas where either enhancement of commercial activity or bolstering of research initiatives could propel Slovakia towards a better role in the respective cutting-edge technologies.

Data limitations. Acknowledging potential limitations in the dataset, it is recognized that while most of the data sourced from Milda.ai is deemed valid (approximately 90%), there may still be instances of incompleteness or lesser relevance. To mitigate this, various filters are applied during data clean-up, including exclusions based on industry sectors deemed less relevant to the analysis (such as media or broadcasting services, advertising or market research, non-governmental organizations, industry associations or advocacy groups, and educational or research institutions).

After the delivery of the first pilot report, the project team made these improvements and provide **lessons learned**:

- To refine the identification and categorisation of robotics companies, we have undertaken several qualitative revisions of the technology lists. A key focus has been on ensuring a comprehensive capture of companies operating within the robotics ecosystem. Special emphasis was placed on including manufacturers, integrators of robotic technologies, and sub-component suppliers, as they are central to the development and deployment of robotic solutions. Additionally, service providers were incorporated, given that many also develop their own hardware and software solutions, along with distributors who often act as integrators or provide IT solutions essential for robotic technologies.
- In parallel, we carefully filtered out industries such as health and wellness, to exclude companies involved in the usage of medical robotics, rather than its development, and eliminated sales-oriented businesses, such as e-shops or distributors not directly engaged in technological innovation.
- A filtering process was applied, using Milda.ai relevance scores to ensure only companies with a high degree of relevance were included. Specifically, only companies with relevance scores of 80-100% or 50-79% were considered, ensuring precise technology keyword matching.
- We also expanded the analysis to include companies based on their position within the value chain, specifically identifying those involved in R&D activities, a critical element in understanding innovation dynamics within the sector.
- Subsidiary companies were integrated into the general list if they had a Slovak domain, while notable companies without Slovak domains, such as FANUC, were also added to the dataset to provide a more comprehensive overview of robotics companies operating in Slovakia.
- The purpose of benchmarking with Visegrád countries was to provide context for the Slovak data, rather than to deliver precise rankings or establish market positioning. Given the differences in country and technology sizes, the goal was not to claim full coverage but to offer a comparative framework for understanding the data. As such, the results should be interpreted with caution.

2. Summary of key findings

This report provides the findings of the Vertical Industry Pilot on advanced robotisation in Slovakia. A comprehensive methodology was applied, integrating innovative tools such as ChatGPT with conventional desk research and literature review, to deliver a thorough scoping of the sector. The analysis identified key technologies actively present in Slovakia, including Robotic Process Automation (RPA), Collaborative Robotics (Cobots), Aerial Drones, Agricultural Robotics, Medical Robotics, and Humanoid Robotics. Conversely, technologies such as Soft Robotics, Swarm Robotics, Nano Robotics, and Quantum Robotics were excluded due to insufficient evidence of local production.

The assessment encompassed 165 companies across the Slovak robotics sector, complemented by data from 410 researchers affiliated with 29 research institutions. The main findings are summarised below:

- **Concentration of companies**: the highest concentration of companies is in RPA (61), Aerial Drones (60), and Cobots (35), highlighting these as the most developed areas. Conversely, specialised fields such as Medical Robotics (8 companies) and Humanoid Robotics (4 companies) have fewer participants, reflecting the advanced research requirements, regulatory frameworks, and longer commercialisation timelines associated with these technologies.
- **Sector characteristics**: SMEs dominate the sector, with over 95% of firms employing fewer than 250 staff, and a majority (97%) reporting annual turnovers below EUR 50 million. This indicates an established yet fragmented industry, with 65% of firms operating for over a decade. Emerging enterprises account for 11%, suggesting a trend of ongoing innovation but also highlighting potential challenges in scaling due to limited resources.
- **Industry composition**: Slovakia's robotics sector is driven primarily by the Electronics, Machinery, and Automotive industries. There is increasing adoption of robotics within Agriculture and Fisheries, particularly in areas such as automation and precision farming. Integrators and service providers play a significant role, particularly in RPA and Cobots, facilitating the deployment of systems from global brands such as Fanuc, ABB, and Kuka.

When benchmarked against the broader Visegrád region, **Slovakia demonstrates strengths in RPA, Cobots, and Agricultural Robotics**. However, the Slovak market is comparatively less mature, with fewer established companies than in Poland and Czechia. Slovakia shows a higher proportion of newer enterprises, indicating a slightly more dynamic and innovative environment, though scalability remains a challenge.

The benchmarking analysis indicates that **Czech companies covered in the analysis lead in R&D engagement**, with 36% of companies actively investing, particularly in Collaborative Robotics, Agricultural Robotics, and Humanoid Robotics, reflecting a strong focus on advanced automation and human-robot interaction. **Slovak companies show a slightly lower R&D engagement** at 28% yet demonstrate a particular emphasis on Medical Robotics and Agricultural Robotics, suggesting strategic focus areas despite broader challenges. Poland presents a diversified approach, with R&D investment in RPA, Aerial Drones, and Cobots, supported by favourable policies and market size. Hungary maintains balanced engagement across various technologies, notably in RPA and Aerial Drones, highlighting a consistent level of R&D activity across key sectors.

The analysis of **Slovakia's research landscape** indicates increasing engagement in robotisation technologies, with contributions from researchers across various institutions. Collaborative Robotics (Cobots) has the highest level of academic interest, reflecting its relevance in industrial automation. Aerial Drones are also a significant focus, with research covering applications in agriculture, geodetic

measurements, surveillance, and logistics. The Technical University of Košice emerges as a key institution, leading research efforts in areas such as Cobots, Aerial Drones, and Robotic Process Automation (RPA).

The overall positioning of Slovak Robotic technologies

The analysis of cutting-edge robotisation technologies in Slovakia involved the creation of an **Overall Positioning Table**. This table consolidates data on companies and researchers, providing an overview of the country's current standing across various advanced technological domains. It highlights strengths and potential areas for growth, illustrating avenues for future enhancement and investment.

The positioning table assesses Slovakia's status using two primary indicators: the number of enterprises and active researchers in each domain. A LEAD designation (green) indicates strong commercial and academic engagement, while a LAG classification (red) signals deficiencies in both. Technologies falling under GROW (yellow) show mixed indicators or moderate activity, suggesting potential for development. These GROW sectors represent strategic opportunities where enhancing commercial activity or strengthening research could improve Slovakia's position in advanced robotics technologies.

The Overall Positioning Table categorises Slovakia's engagement in cutting-edge robotisation technologies as Lead, Grow, or Lag, based on industry presence and research activity, highlighting strengths and areas for potential growth:

- Notably, **Slovakia demonstrates a strong position (LEAD) in sectors such as Aerial Drones**, highlighting areas where the country has established a more solid foundation of industry presence and research activities.
- However, the analysis also identifies sectors where Slovakia is currently less or not developed (LAG), such as **Medical Robotics**. This area represents a potential field for further development and investment to enhance Slovakia's technological landscape.
- The data analysis indicates growth opportunities (GROW) in several technologies, including **Robotic Process Automation (RPA), Humanoid Robotics, Collaborative Robots (Cobots) and Agricultural Robotics**. These sectors, marked by the presence of either a significant number of companies or researchers, suggest areas where targeted efforts could lead to substantial advancements, enhancing Slovakia's capabilities and positioning in the global technology sector.

TABLE 1. OVERALL POSITIONING OF SLOVAK ECOSYSTEM IN THE CUTTING-EDGE ROBOTISATION TECHNOLOGIES

Cutting-edge technology	No of Slovak companies	No of Slovak researchers	Positioning
Robotic Process Automation	61	14	Grow
Humanoid Robotics	4	65	Grow
Medical Robotics	8	25	Lag
Aerial Drones	60	57	**Lead**
Collaborative Robots (Cobots)	35	70	Grow
Agricultural Robotics	32	7	Grow

Source: compiled by the study team. – is indicated where there are no companies present or the numbers are equal between all countries.

3. Megatrends analysis of cutting-edge technologies of robotisation

The European Commission's strategies on robotisation are central to its updated **industrial policy**, focusing on strengthening the EU's strategic autonomy while ensuring a **green and digital transition**[2]. This involves enhancing the resilience of the single market, reducing dependencies on critical supplies from outside the EU, and fostering innovation and skills development to adapt to technological changes. The Commission emphasizes the importance of international partnerships and the need for Europe to remain competitive and integrated in the face of global and technological shifts[3]. This approach aims at a more crisis-proof and integrated market to support Europe's recovery and long-term sustainability.

These policies are also being shaped by **global megatrends**, such as the a**geing population, urbanization, shifts in consumer demands**, and the rise of **Industry 4.0 technologies**[4]. These trends are prompting the necessity for advanced automation and robotisation within various sectors to ensure continued productivity, meet changing consumer needs, and address sustainability concerns. Specifically, the pronounced ageing population in Europe is urging industries to integrate robotic systems and automation technologies to mitigate the effects of a shrinking workforce and to offer better support in elderly care, thus ensuring operational continuity and adapting to demographic shifts. Urbanization and evolving consumer demands are further catalysing the need for industries to adopt more efficient, flexible, and personalized production processes. As urban areas expand and consumer expectations shift towards customization and rapid service, industries are increasingly turning to automation and robotisation technologies to improve supply chain efficiency, reduce turnaround times, and fulfil the demand for customized products. The advent of Industry 4.0 technologies plays a critical role in this transformation, as it offers innovative solutions to these emerging challenges.

In response to these overarching megatrends, **the future of robotisation** is set to see significant technological advancements. Robotic Process Automation (RPA) and Collaborative robots (cobots) are expected to become central to the next wave of industrial innovation. Cobots, for instance, will help alleviate labour shortages and enhance safety in manufacturing environments by working alongside human employees. Moreover, future developments are anticipated in humanoid robotics, agricultural robotics, and aerial drones, providing adaptable, efficient, and novel solutions to complex manufacturing and service issues. These emerging technologies, supported by European Commission policies and driven by global megatrends, are expected to enable industries to navigate the rapidly evolving landscape effectively, ensuring resilience, competitiveness, and sustainability in the increasingly digital and automated future industrial landscape.

In the table below, we discuss the use of robotisation in the industry focusing on our pre-selected categories and their connection to megatrends.

[2] https://single-market-economy.ec.europa.eu/industry/strategy_en

[3] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en

[4] Empowering supply chains with Industry 4.0 technologies to face megatrends , paper written by Elena Pessot, Andrea Zangiacomi, Irene Marchiori, Rosanna Fornasiero consulted via https://onlinelibrary.wiley.com/doi/10.1111/jbl.12360?af=R

TABLE 2. CUTTING-EDGE ROBOTISATION AND AUTOMATION TECHNOLOGIES MAPPING TO MEGATRENDS

TECHNOLOGY NAME	TECHNOLOGY DESCRIPTION	MEGATRENDS
Robotic Process Automation (RPA)	Simplifies complex data processes and enhances operational efficiency in industries by automating routine tasks. RPA is critical in industrial robotisation as it eliminates manual errors, frees up human workers for more strategic roles, and significantly accelerates data-related processes.	Automation and the Future of Work
Humanoid Robotics	Aligns with European initiatives designed to mimic human actions, addressing labour shortages and improving service delivery. In industrial robotisation, humanoid robots represent a versatile tool capable of performing complex tasks, enhancing operational flexibility and human-robot interaction.	Aging Population, Shifts in Consumer Demands
Medical Robotics	Expands significantly in the EU healthcare sector, performing surgeries, rehabilitation, and logistics. Beyond healthcare, medical robotics principles are being adopted in industrial robotisation for tasks requiring precision and reliability, influencing design and function in other robotic applications.	Aging Population, Healthcare Innovation
Aerial Drones	Utilized for surveillance, agricultural monitoring, and delivery services, enhancing European airspace and agricultural practices' safety and efficiency. Their importance in industrial robotisation extends to inventory management, aerial inspections, and large-scale monitoring, revolutionising logistics and supply chain management.	Growing Urbanization, Climate Change
Collaborative Robots (Cobots)	Enhance productivity while ensuring workers' safety, becoming essential in interactive industrial environments. Cobots are pivotal in industrial robotisation for their ability to work alongside human employees without significant alterations to existing infrastructure, facilitating a seamless integration of robotics into various industries.	Aging Population, Automation and the Future of Work
Agricultural Robotics	Set to revolutionise European farming practices, improving efficiency, yield, and sustainability. In the context of industrial robotisation, agricultural robotics introduces automated solutions for planting, harvesting, and crop management, significantly reducing labour costs and improving precision agriculture techniques.	Climate Change, Depletion of Natural Resources

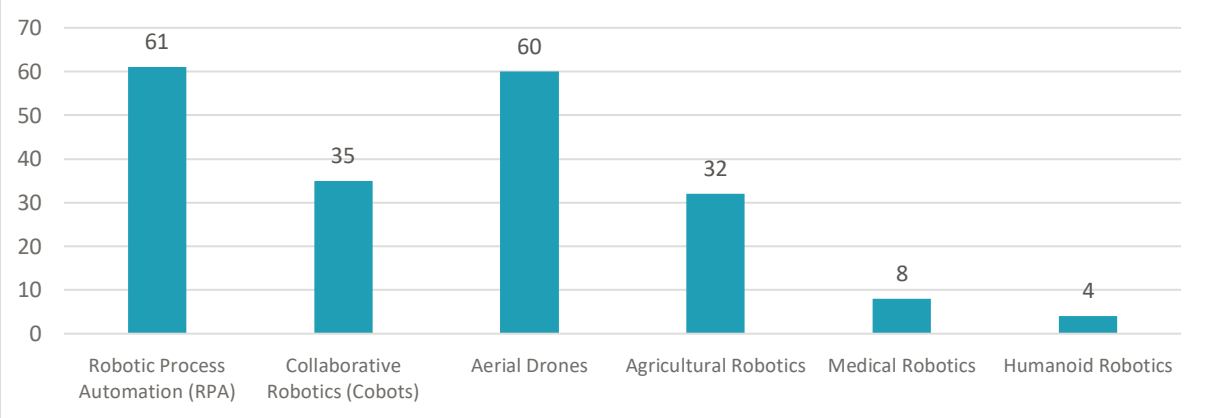
Source: compiled by the study team based on desk research.

4. Analysis of the Slovak automation/robotisation ecosystem

4.1. Overview of Slovak robotisation companies

The cutting-edge robotics report covers **165 companies** operating across various advanced robotic technologies in Slovakia. These companies engage in a range of areas, with significant representation in Robotic Process Automation (RPA), Aerial Drones, and Collaborative Robotics (Cobots). Figure 1 highlights the technologies covered by these companies, with 61 companies involved in RPA, 60 in Aerial Drones, and 35 in Cobots technologies. Fields such as Medical Robotics (8 companies), Humanoid Robotics (4 companies), and Agricultural Robotics (32 companies) have fewer companies involved. This can be attributed to the highly specialised nature of these technologies, which often require advanced research, regulatory approvals, and longer commercialisation timeframes, leading to fewer entrants compared to more established sectors like RPA and Aerial Drones. It is important to note that some of the companies operate in more than one cutting-edge robotic technology[5].

FIGURE 1. ROBOTIC TECHNOLOGIES COVERAGE IN SLOVAKIA BY NUMBER OF COMPANIES (N=165)*

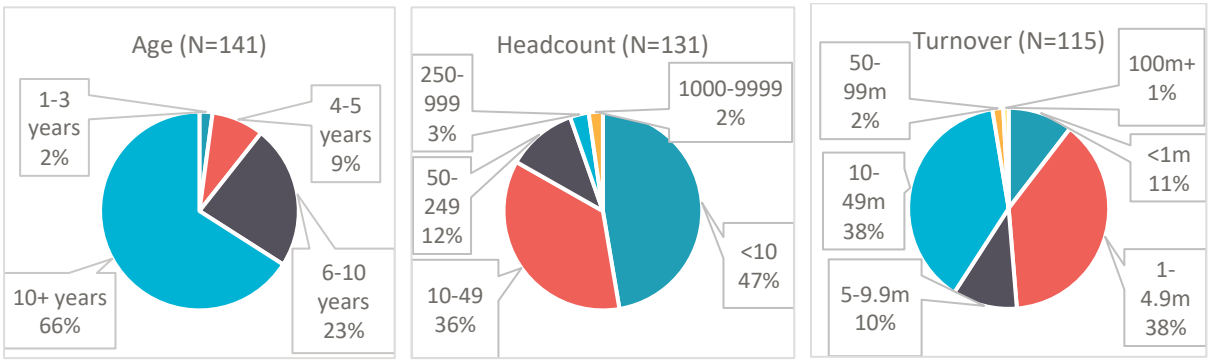


*Source: produced by the study team. *Certain companies can operate more than one technology.*

Regarding **company characteristics**, Figure 2 presents an analysis of company age, headcount, and turnover. A large proportion of the firms (66%) have been in operation for more than 10 years, indicating an established presence in the industry. However, there is also a notable presence of younger companies (11%), potentially startups, (operating for 1-5 years), reflecting ongoing innovation in the sector. Most companies are small to medium-sized enterprises (SMEs), with 95% employing fewer than 250 staff. Although fewer in number, larger entities with headcounts between 250 and 9,999 employees are also present (5%). In terms of financial performance, even 97% of the companies report annual turnovers lower than EUR 50 million, indicating their status as SMEs, while a smaller number report turnovers exceeding €50 million (3%). The prominence of SMEs in the Slovak robotics sector suggests an industry that is adaptable and responsive to market developments and technological changes. This environment supports the growth of niche technologies. However, the market's fragmented nature, with many smaller companies, may present challenges for scaling due to limited resources and access to global markets.

[5] The scope of cutting-edge robotic technologies was reduced removing nanorobotics, quantum robotics, swarm robotics and underwater robotics due to low coverage of such companies in Slovakia.

FIGURE 2. ANALYSED SLOVAK ROBOTICS COMPANIES BY AGE, HEADCOUNT AND TURNOVER

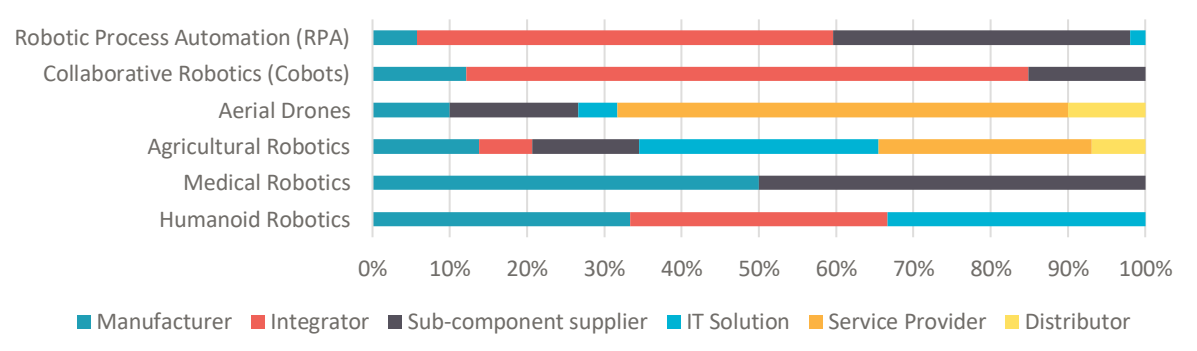


Source: produced by the study team.

Figure 3 provides an **overview of the distribution of companies by operation type** across various robotic technologies, revealing key characteristics of the Slovak robotics sector. The presence of manufacturers remains limited in the largest technologies such as RPA and Cobots, where only a small number of companies are engaged in the production of robotic hardware. For instance, only 3 manufacturers are active in the RPA domain and 4 in the Cobots field, indicating that domestic production capacity in these areas is relatively low. Conversely, there is a stronger representation of sub-component suppliers, particularly in sectors such as Aerial Drones and Agricultural Robotics, where a notable number of companies focus on supplying key components. Integrators constitute a significant portion of the ecosystem, particularly in the RPA (28 companies) and Cobots (24 companies) segments, where they play a vital role in the deployment of international robotic systems, including those provided by global leaders such as Fanuc, ABB, and KUKA. Furthermore, service providers represent the largest group across several technology domains (Aerial Drones or Agricultural Robotics), with many offering not only services but also contributing to the development of hardware and software solutions.

The Slovak robotics industry has limited domestic production but is closely connected to the global robotics landscape through the integration of international systems from major international robotics brands. This interaction allows local companies to gain valuable experience with advanced technologies and develop their solutions. The sector's diversity, with a strong presence of integrators and service providers, enables flexibility and adaptation to technological advancements, supporting the industry's development within the broader robotics ecosystem.

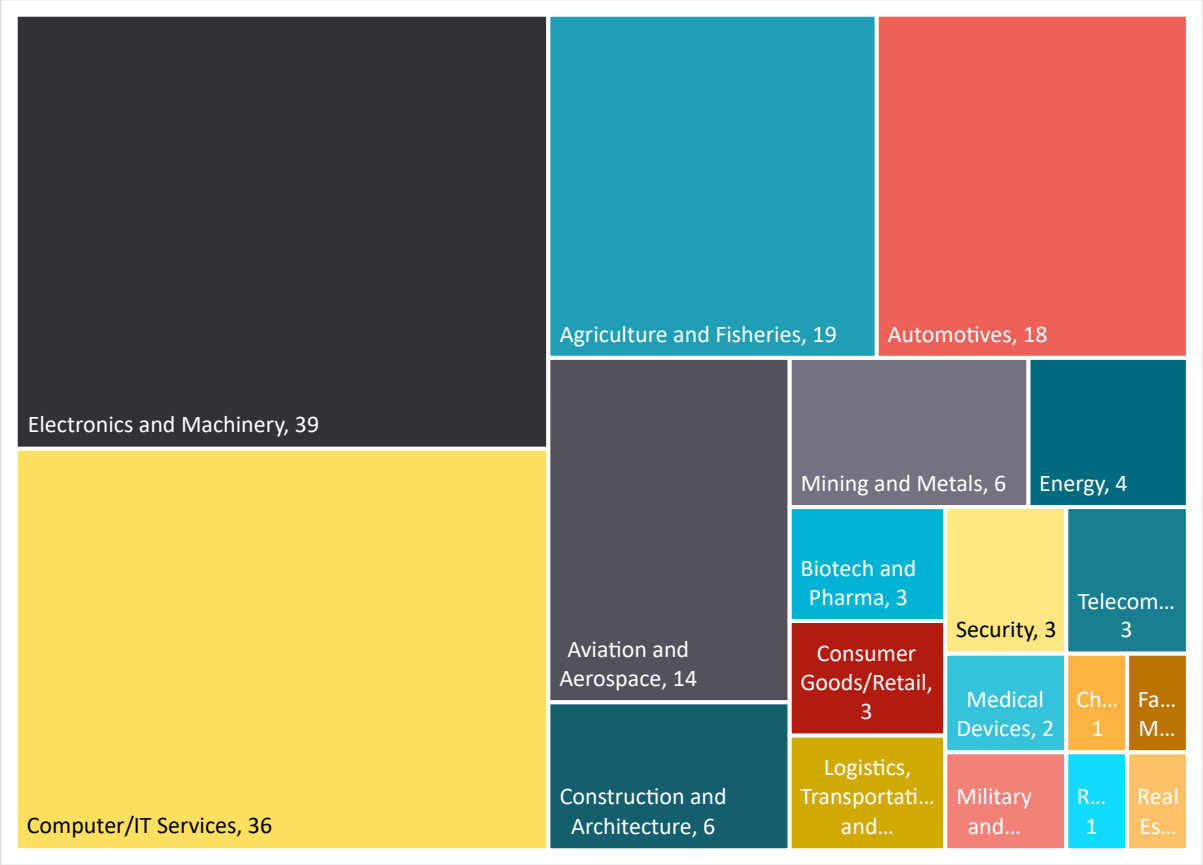
FIGURE 3. COMPANIES BY TYPE PER ROBOTIC TECHNOLOGY IN SLOVAKIA*



*Source: produced by the study team. *Certain companies can operate more than one technology.*

In Slovakia, **the robotics sector is primarily driven by the Electronics and Machinery industries**, which play a critical role in the country's economic and technological landscape. These industries form the backbone of the robotics market, contributing significantly to both innovation and production. Alongside these, the Automotive sector holds a major presence, reflecting Slovakia's strong automotive manufacturing base. Additionally, Agriculture and Fisheries are important industries where robotics technologies are increasingly applied, particularly in areas such as automation and precision agriculture. This sectoral focus highlights Slovakia's reliance on its traditional manufacturing strengths and its gradual adoption of robotics in key economic areas.

FIGURE 4. ANALYSED SLOVAK COMPANIES BY INDUSTRY (ROBOTISATION TECHNOLOGIES)

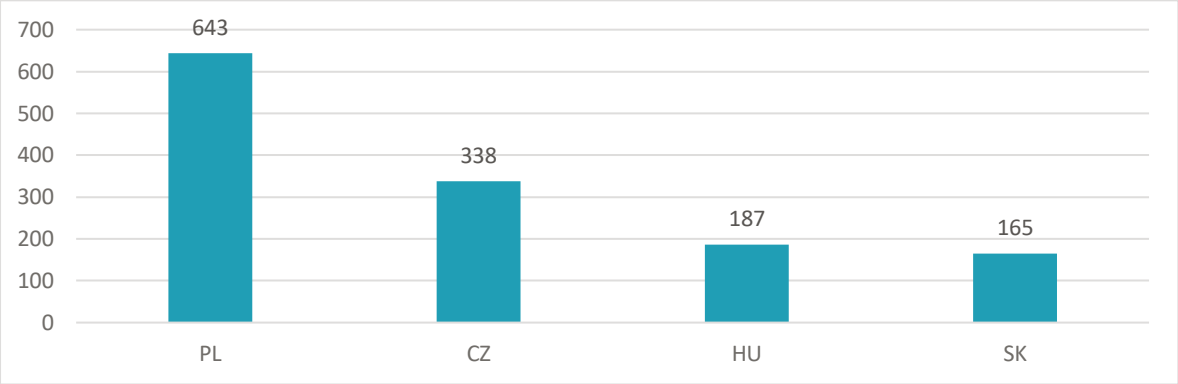


Source: produced by the study team.

4.2. Overview of Visegrád region robotisation companies

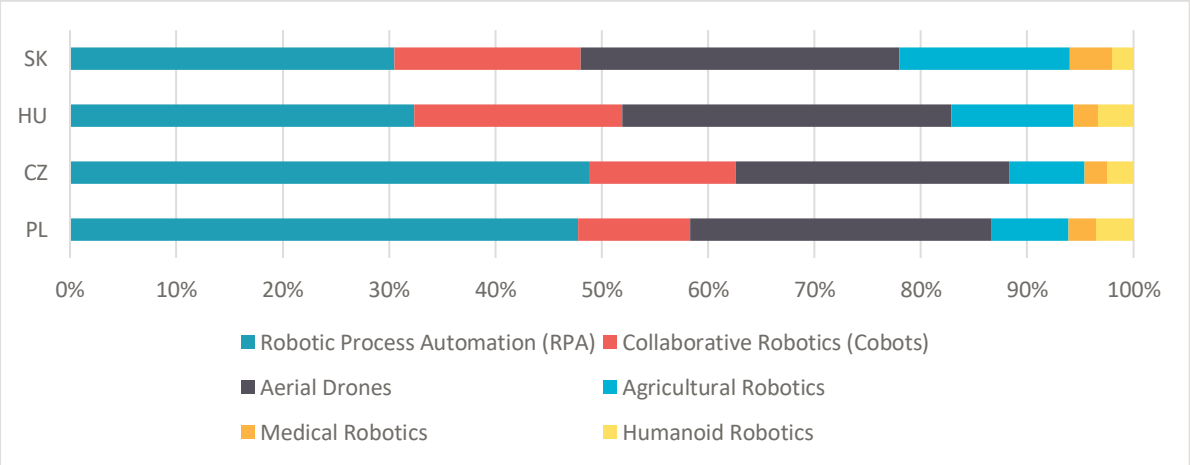
For the overview of the Visegrád region's cutting-edge robotisation companies, we have analysed a dataset of a total of **1,333 companies** in Robotisation. As it can be observed in the Figure 5, Poland matched the highest number of companies with our selected robotisation technologies keywords, with Czechia being the second, Hungary third and Slovakia the fourth. Looking at the companies' coverage of robotic technology (Figure 6) we can see that most of the analysed companies operate in Robotic Process Automation (RPA) technology, Aerial Drones being the second largest technology presented in the analysis and Cobots following the third. It is important to note that the Visegrád region consists of all four countries and is compared to Slovakia alone.

FIGURE 5. NUMBER OF VISEGRÁD REGION COMPANIES IN ROBOTISATION BY COUNTRY*



*Source: produced by the study team. *No double counting of companies*

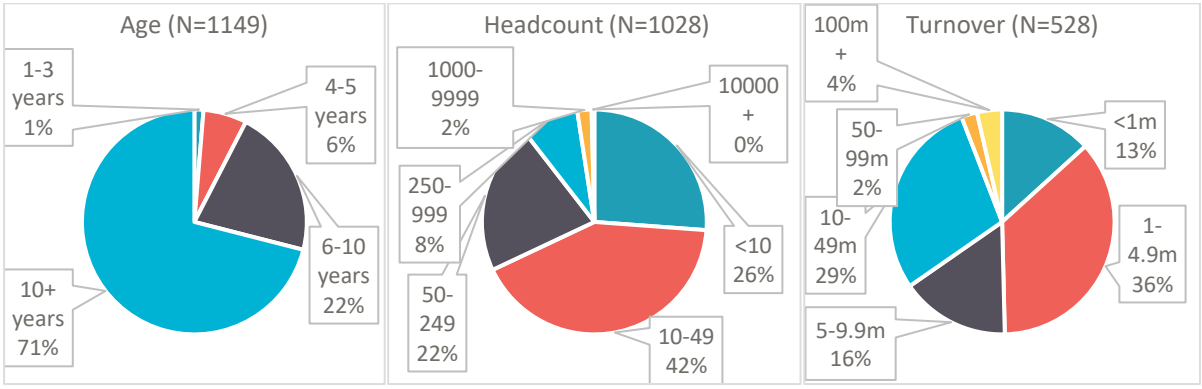
FIGURE 6. % SHARE OF ROBOTIC TECHNOLOGIES PER COUNTRY*



*Source: produced by the study team. *Certain companies can operate more than one technology.*

When comparing Slovakia to the broader Visegrád region, some trends are evident. The majority of Slovak robotics companies (66%) have been **operating for more than 10 years**, which is lower than the Visegrád average of 71%. Young companies which could potentially be startups (1-5 years) account for 11% in Slovakia, compared to the region's 7%. Slovakia's robotics industry shows signs of growth and dynamism, particularly with a stronger presence of newer companies. However, it lags behind the broader region in terms of overall market maturity, and efforts to support the scaling of young firms may be crucial for its future competitiveness within the broader region. In terms of **company size**, SMEs dominate in both Slovakia and the Visegrád region. In Slovakia, 95% of companies employ fewer than 250 employees, closely mirroring the Visegrád average of 90%. Notably, Slovakia has a higher proportion of small companies with fewer than 10 employees (47% vs. 26% in the Visegrád region). This indicates that **Slovakia's robotics sector is highly decentralised**. While this fosters innovation and specialisation, it may present challenges in scaling and accessing resources, potentially limiting the sector's overall growth and competitiveness. Turnover figures reveal a similar financial landscape. In Slovakia, only 3% of companies report annual turnovers higher than EUR 50 million, regional average is higher at 6%. This distribution is consistent with the regional average, although Slovakia shows a higher concentration of companies in the lower turnover brackets. This suggests that while the sector is growing, it remains relatively modest in scale compared to larger markets.

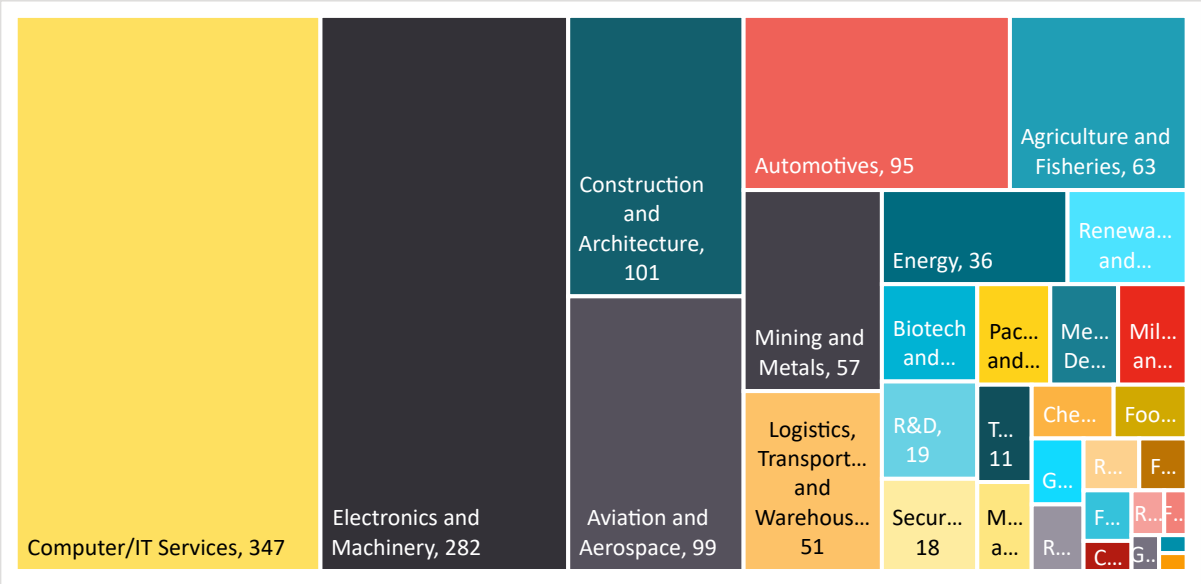
FIGURE 7. VISEGRÁD REGION COMPANIES BY AGE IN ROBOTICS



Source: produced by the study team.

In Slovakia, the **most prominent industries** contributing to the robotics sector are Electronics and Machinery, which represent the core of the country's industrial base. Additionally, there is a significant presence of companies from the Automotive sector. In comparison, the broader Visegrád region shows a slightly different industry composition. The region has a stronger emphasis on sectors such as Computers/IT Services, where robotics solutions are being increasingly integrated, and a more dominant presence in Construction and Architecture. This suggests that while Slovakia remains anchored in traditional manufacturing and automotive, the rest of the Visegrád region is more diversified, particularly in digital and IT-driven industries. This difference highlights Slovakia's reliance on its industrial heritage, while other Visegrád countries may be more oriented towards digital transformation and automation in broader sectors.

FIGURE 8. ANALYSED VISEGRÁD REGION COMPANIES BY INDUSTRY

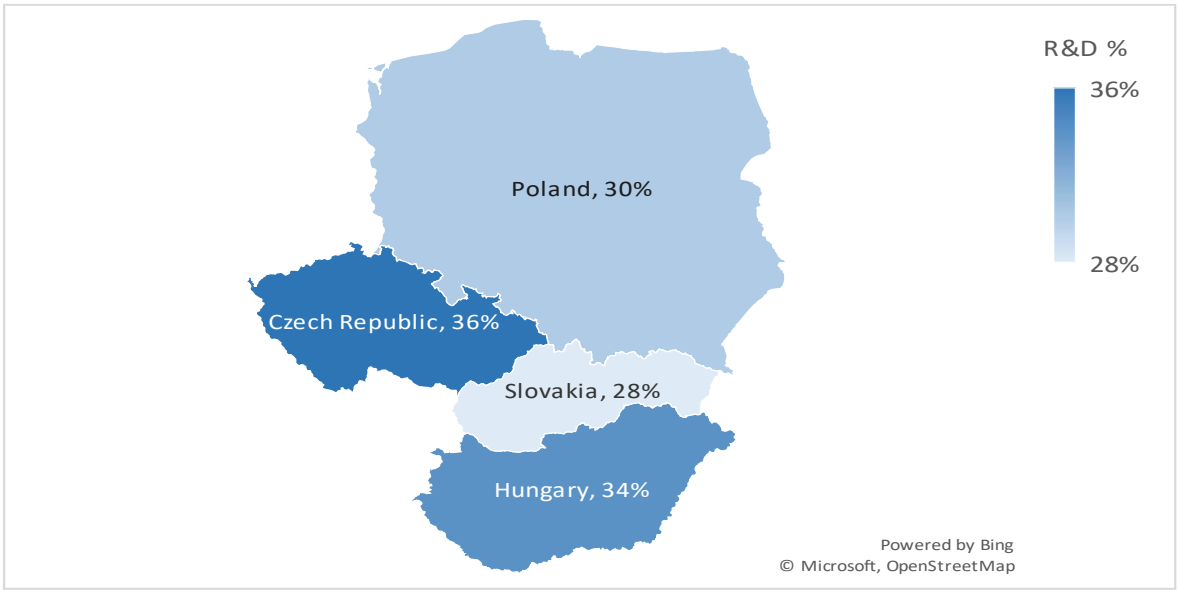


Source: produced by the study team.

The Visegrád countries companies display similar patterns of **R&D investment** across key robotic technologies, with some differences in focus areas. The Czech Republic companies lead overall in R&D activities (Figure 9), particularly focusing on Collaborative Robotics, Agricultural Robotics, and Humanoid Robotics (Figure 10), reflecting a strong commitment to advanced automation and human-

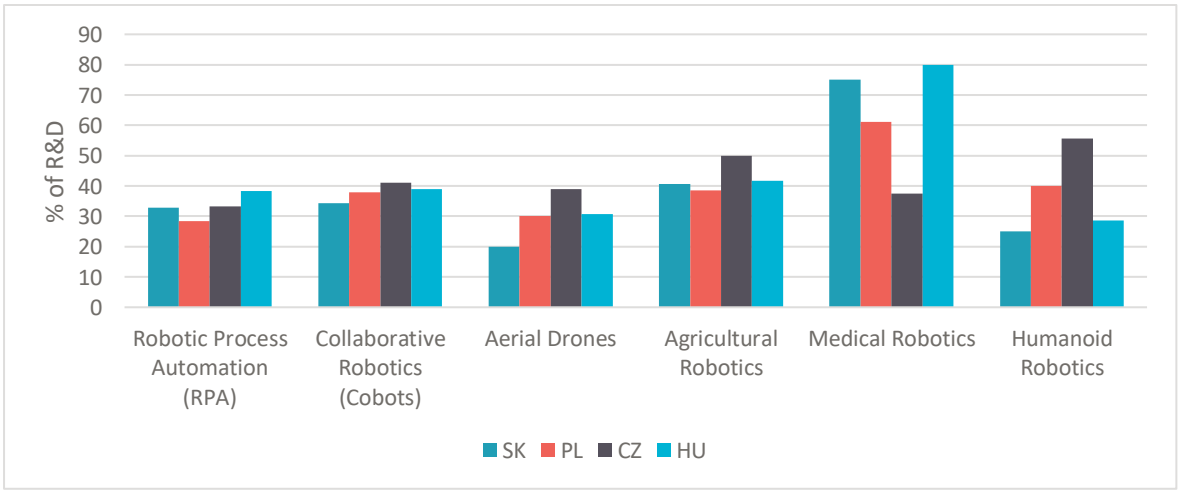
robot interaction. Hungary follows closely, focusing on Robotic Process Automation, Cobots and a particularly strong emphasis on R&D in Medical Robotics. Slovakia, while lagging slightly in overall R&D investment (28%), shows a higher focus on Medical and Agricultural Robotics R&D. Poland demonstrates a balanced approach regarding investments in R&D in most robotic technologies with notable emphasis on Medicinal Robotics as well. Companies working with Medical Robotics invest more in R&D due to the high complexity, regulatory requirements, and demand for advanced, innovative healthcare solutions, making continuous research essential to meet industry standards and maintain competitiveness. Despite these variations, the overall alignment in R&D efforts across the Visegrád countries highlights a shared commitment to advancing robotics technologies to remain competitive in the European and global markets.

FIGURE 9. % OF COMPANIES WITH R&D ACTIVITIES IN ROBOTICS IN THE VISEGRÁD REGION (N=1 333)



Source: produced by the study team.

FIGURE 10. % OF R&D INVESTMENT BY ROBOTIC TECHNOLOGY PER COUNTRY



Source: produced by the study team.

4.3. Cutting-edge Robotisation technologies company examples from Slovakia

Below we provide a list of some robotic technology companies per different cutting-edge robotisation categories such as RPA, Humanoid robotics, Soft robotics, Medical robotics, Aerial drones and Cobots. The examples present a mix of new, agile players and established industry leaders within the Slovakian and broader European robotics market. The Slovak robotics ecosystem features a diverse mix of manufacturers, consulting firms, and IT solutions providers. Companies like MRAZROBOTICS, AICOBOTIX, and FANUC focus on hardware production, integration, and development, with activities ranging from industrial robot development to partnerships for robotics integration. Meanwhile, IT solutions providers like Airvolute integrate software innovations, including drone technology and AI, into robotics, reflecting a trend towards merging hardware with advanced software capabilities.

Examples of Slovak companies in Robotic Process Automation (RPA) technology

spinbotics **SPINBOTICS** is a Slovak company specializing in modular robotics. Founded in 2020, it focuses on providing highly adaptable, modular robotic solutions designed for easy integration and use. Their flagship product, Spinbot, is a modular robotic worker aimed at addressing workforce shortages by automating repetitive tasks. The company emphasizes innovation in robotic automation, with a mission to increase productivity while reducing operational costs. Spinbotics focuses on R&D in modular robotics, with an emphasis on developing customizable robotic systems for various industrial applications. Their R&D efforts target creating flexible, scalable automation solutions that can be easily integrated into production lines.

INNOVATRICS **INNOVATRICS** is a Slovakia-based company specializing in biometric solutions, offering high-performance fingerprint and facial recognition systems. It serves global clients across sectors like government, finance, and enterprise. The company is renowned for its biometric algorithms used in identity management and verification solutions. Innovatrics' R&D activities focus on advancing biometric technology, particularly in contactless systems, liveness detection, and multimodal biometrics. Their research aims to enhance accuracy, security, and scalability for identity verification and fraud prevention applications.

SPINEA BY TIMKEN **SPINEA** is a Slovak company specializing in the development and production of high-precision reduction gears, particularly their signature TwinSpin® and DriveSpin® products. These gears are widely used in robotics, automation, medical devices, and defence industries. Spinea's R&D focuses on innovating cycloidal reduction gears and actuators to enhance precision, durability, and integration. They hold multiple international patents and continuously advance their products to maintain leadership in motion control systems for high-tech applications.

robotec INDUSTRIAL AUTOMATION **ROBOTEK** is a company specializing in the integration of robotic and automation technologies across various sectors of the industry, including but not limited to food, pharmaceuticals, heavy engineering, automotive, and more. Their services span from initial consultancy and technology solutions to programming, implementation, and after-sales service. They also provide warranty and post-warranty services for workstations, automation workplaces, and robots, as well as regular inspections and training for their clients' staff. Robotec's R&D focuses on innovation in automation technologies, utilizing its innovation centre to develop and test new robotic systems. They work on enhancing efficiency, precision, and integration of robotics for industrial applications.

NEOOPS is a consulting company specialized in Robotic Process Automation (RPA) services. Established in 2015, the company has automated hundreds of processes for clients across various sectors, including Business Services, BPOs, Banking, and Utilities. NEOOPS is recognized as a leader in the RPA industry, with multiple awards from Blue Prism for Implementation, Shared Services, and Authorized Training Partner of the Year. The company partners with XpertRule and CloudTrade Technologies Ltd to enhance its intelligent automation offerings. Their R&D efforts aim to enhance automation capabilities by integrating AI-driven technologies into RPA solutions, improving process automation, and developing new intelligent automation tools.

Examples of Slovak companies in Collaborative Robotics (Cobots) technology

AICOBOTIX, a Slovak company, focuses on developing and integrating advanced robotics and artificial intelligence (AI) solutions. They specialize in creating robotic systems that incorporate AI technologies to enhance automation, precision, and efficiency in various industrial processes. Their expertise spans areas such as autonomous systems, robotic process automation (RPA), and AI-driven robotics for both commercial and industrial applications. Their R&D activities are focused on advancing autonomous robotic systems and AI-driven automation. Their research includes the development of self-navigating robots, robotic process automation (RPA) solutions, and AI integration for intelligent decision-making and efficiency improvement. They also focus on sensor technologies for real-time data processing and enhancing human-robot interaction (HRI) for safer, more effective collaboration in shared environments. These efforts aim to innovate and expand the applications of robotics and AI across various industrial sectors.

FANUC Slovakia S.R.O, with headquarters in Nitra, offers industrial robots, CNC control systems and CNC machines as a part of automation for production in Slovakia. Its aim is to supply high-performance and reliable products for factory automation and software of the traditional Japanese brand FANUC, one of the worlds' largest manufacturers of factory automation and industrial robots. Their operations in Slovakia focus on manufacturing and providing solutions for industrial automation, including robotic arms used in assembly lines, material handling, welding, and packaging. They are known for delivering high-precision equipment aimed at enhancing efficiency and productivity across manufacturing sectors such as automotive, electronics, and metalworking. Additionally, FANUC offers services like maintenance, training, and technical support for their automation products in Slovakia.

MTS Slovakia focuses on industrial automation and provides a range of technologies from manual workstations to fully automated robotic systems. They are known for producing components for automation, conveyor systems, collaborative robots, and vision systems. MTS also develops battery storage systems and offers technical training and support. Their clients span industries such as automotive, where they automate production lines for major companies like Mercedes and Foxconn, improving efficiency and output. They emphasize human-friendly industrial environments. Their research includes developing advanced automation technologies, enhancing conveyor systems, and improving vision systems for quality control. They also work on energy storage solutions and continuously develop new methods to optimize automated production lines for industries such as automotive.

Rossum Integrations focuses on designing, manufacturing, and installing robotic workstations and automated production lines. They specialise in both industrial and collaborative robotics, providing custom solutions that match specific client requirements. Their services include consultation, design, testing, programming, installation, training, and maintenance. R&D activities at Rossum Integration involve the development of innovative robotic

systems, particularly in enhancing the efficiency, safety, and adaptability of collaborative robots (cobots) in various industrial settings.

MEPAC SK specialises in precision engineering, production, and automation solutions. The company is involved in collaborative robotics by providing automation systems that enhance manufacturing processes, including the integration of collaborative robots (cobots) for various tasks. These cobots help in workplace automation, enabling efficient and safe human-machine collaboration in production settings. MEPAC offers tailored robotic solutions, emphasizing flexibility and improved productivity for clients.

Examples of Slovak companies in Aerial Drones technology

FIIHAA Engineering is a company specializing in the development and production of autonomous systems, particularly drones, for industrial applications. The company's main product, the BDC-X8, is the world's first drone capable of installing bird detachers on high voltage lines, featuring resistance to high voltage and steady behaviour in electromagnetic fields. Another offering, the BDC-MINI, is a lighter and simplified version of the BDC-X8, designed for increased efficiency and broader use. The company's team consists of experts in electronics, engineering, and automation, with a focus on strategic management, business development, and improving flight characteristics and sensor systems.

Aliter Technologies is a Slovakian company specializing in providing communication solutions for unmanned aerial vehicles (UAVs) and ground-to-air communications. They sponsor seminars on UAV regulations and offer products like the BDC-X8 UAV for installing bird diverters on electrical power lines, which can maneuver under electric voltage, saving time, cost, and preventing damage to vegetation. Aliter Technologies also acts as a reseller for ReconRobotics' tactical micro-robot and personal sensors systems.

UAV SAVE based in Slovakia, specializes in the development, production, and maintenance of unmanned aerial vehicles (UAVs). They offer customizable drones for commercial and scientific applications, including aerial reconnaissance, object detection, and monitoring. Their R&D focuses on advanced drone technologies, such as integrating various sensors, cameras, and autonomous control systems. They also provide comprehensive services like design, production using high-tech materials, and ongoing support for their UAV products.

Airvolute, a Slovakia-based company, specializes in providing comprehensive software solutions for the drone industry. Their primary offering, the Airvolute Motor Control (AMC) Manager, is designed for configuring and testing DroneCore.Power. The company is also involved in collaboration with NVIDIA, a global leader in advanced computing technologies, extending beyond hardware integration. Airvolute's work on drone technology has led to innovative solutions, such as reducing the total weight of UAVs and offering state-of-the-art AI edge processing.

NETSODIS is a technology company specializing in the development and manufacture of advanced sensors and components for unmanned aerial vehicles (UAVs). The company's products include high-resolution cameras with thermal imaging capabilities, as well as gimbals and stabilization systems. NETSODIS also provides software solutions for UAV traffic management and anti-drone technology. With a focus on precision and innovation, the company is at the forefront of the aerial robotics industry and is actively contributing to the advancement of Beyond Visual Line of Sight (BVLOS) technology.

Examples of Slovak companies in Medical Robotics technology

POTRUBNÁ POŠTA is a company specialising in logistics and automation, primarily focusing on the transportation and handling of medical products, including medicines, samples, and blood. They operate an automated storage system, known as Protitube Antivirus, which prepares, stores, and delivers individual medicine packages. Their services also extend to the transportation of transfusion products and cytostatics. The company serves various sections of hospitals, such as laboratories and pharmacies. Their solutions aim to improve efficiency and safety in the delivery of medical supplies.

Novo Technologies is a company specializing in the development of advanced technologies for disinfection and recycling of materials. The company's core focus lies in the creation of contactless plasma disinfection tools for dental applications and the development of intelligent recycling systems for metal waste in wastewater, resulting in the production of metal-based ceramic micropowders. These technologies are financed through projects funded in cooperation with the EU.

ITREND COMPANY is a company specializing in the development and production of specialized tracked machines for defense and military services. They create robotic defense vehicles, including unmanned ground vehicles (UGV), which perform various tasks in dangerous environments worldwide. Their flagship product, the TrackReitar DEF platform, serves as the base for their Modular Autonomous Vehicle (MAV), which can be adapted for reconnaissance, combat operations, ammunition delivery, or wounded evacuation. ITrend caters to military, firefighters, special forces, and other professionals.

Examples of Slovak companies in Agricultural Robotics technology

MRAZ Robotics is a company specializing in the development and deployment of advanced industrial robots. Their flagship product, MRAZ3, is a robust and autonomous robot capable of performing complex tasks in various industries, including georadar measurements, firefighting intervention, fog disinfection, security guarding, agriculture, robot rescue, extraction, and more. The company's goal is to provide more efficient and safer solutions for its clients.

LEOTRONICS is a European developer and manufacturer of mobile robots and solutions based in the Slovak Republic. The company specializes in the creation of portable robots, primarily for firefighting purposes, as demonstrated by their presentation of a fireman robot at the ELMIA Subcontractor 2021 exhibition. They have a close working relationship with the Slovak Republic fire department and firefighters. Over the past two years, their research and development team has partnered with Infoland to develop and manufacture mobile robots, with a focus on utilizing these robots for disaster response and security forces.

BAVENIR, a Slovakian company based in Bratislava, specializes in the development of digital interoperable environments for various industries, with a particular focus on the energy sector and smart grids. The company is known for its work on Shar-Q Storages, a significant component of future smart grids, and the delivery of an interoperable digital environment called Auroral. BAVENIR also develops Spade Multi-purpose physical-cyber agri-forest drone ecosystem for governance and environmental observation. The company was founded to transfer the founders' skills and experience to the market via tangible cutting-edge innovations.

Examples of Slovak companies in Humanoid Robotics technology

TERAIS is an international project led by the Department of Applied Informatics of Comenius University Bratislava, Slovakia. The project aims to establish the department as a workplace of international academic excellence in the field of robotics and artificial intelligence. TERAIS collaborates with experts from the University of Hamburg in Germany and the Italian Institute of Technology in Genoa to achieve this goal. The project participates in conferences and events, such as the European Researchers' Night in Bratislava and the 22nd Conference on Cognition and Artificial Life, to showcase its research and foster international networking.

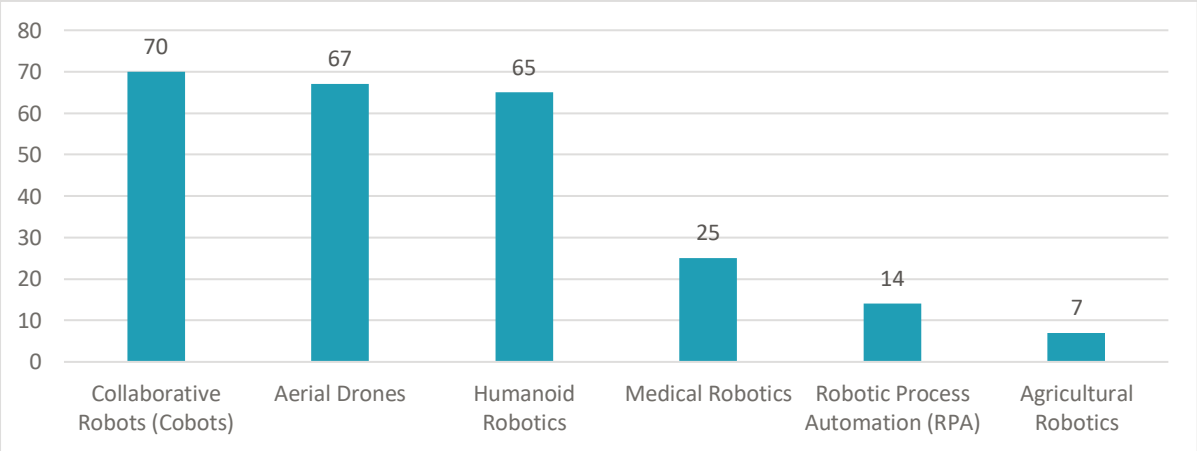
RoboTech Vision is a Slovak company specializing in the development of mobile robots with artificial intelligence (AI) elements. Established in 2013, it has its headquarters in Častá, Slovakia, and a branch in Bratislava. The company focuses on creating autonomous mobile robots designed for various environments and tasks. Its devices can move autonomously and perceive the environment, making them versatile for different use cases. One of its notable accomplishments is receiving the best evaluation at the V4 Armed Forces negotiations with its autonomous robot. Their R&D efforts include designing universal navigation algorithms, AI-powered object recognition systems, and voice-controlled solutions. The company also specializes in customized robotic solutions for various environments and tasks. Their key developments include mobile platforms (Caster, Crawler), advanced navigation algorithms (AON, AVN), and sensor systems (RTV sensor Box) that enable autonomous decision-making in complex environments.

5. Analysis of Slovak researchers involved in robotisation

To analyse the focus of Slovak academia on cutting-edge Robotisation technologies, we assessed the involvement of Slovak researchers and their contributions (publications) post-2019. Our examination utilized a dataset from OpenAlex database that included 410 Slovak researchers from 29 research institutions[6]. This analysis facilitates an understanding of which technologies Slovak institutions and researchers are concentrating on, as well as the productivity of research groups across different technological topics. Moreover, the analysis of researchers and institutions allows us to identify how focused or dispersed specialists are and which technologies are most and least established within specific institutions.

In Slovakia, the landscape of technology-based publications and author contributions highlights significant activity in several key areas of cutting-edge Robotisation technologies. In the area of Robotisation within Slovakia, the data indicates activity across various robotic technologies, showcasing the commitment to exploring and integrating robotics into diverse sectors. **Collaborative Robots (Cobots)** lead with 70 authors, reflecting their critical role in enhancing human-robot collaboration in industrial and healthcare settings, where safety and productivity are paramount. **Aerial Drones,** with 67 researchers, showcase substantial research and development efforts driven by their versatile applications in agriculture, surveillance, and logistics. **Humanoid Robotics**, with 65 researchers, underscores a significant commitment to developing robots that mimic human actions and interactions, essential for tasks requiring human-like dexterity and for applications in service and healthcare industries.

FIGURE 11. RESEARCHERS PER CUTTING-EDGE ROBOTISATION TECHNOLOGY



Source: produced by the study team.

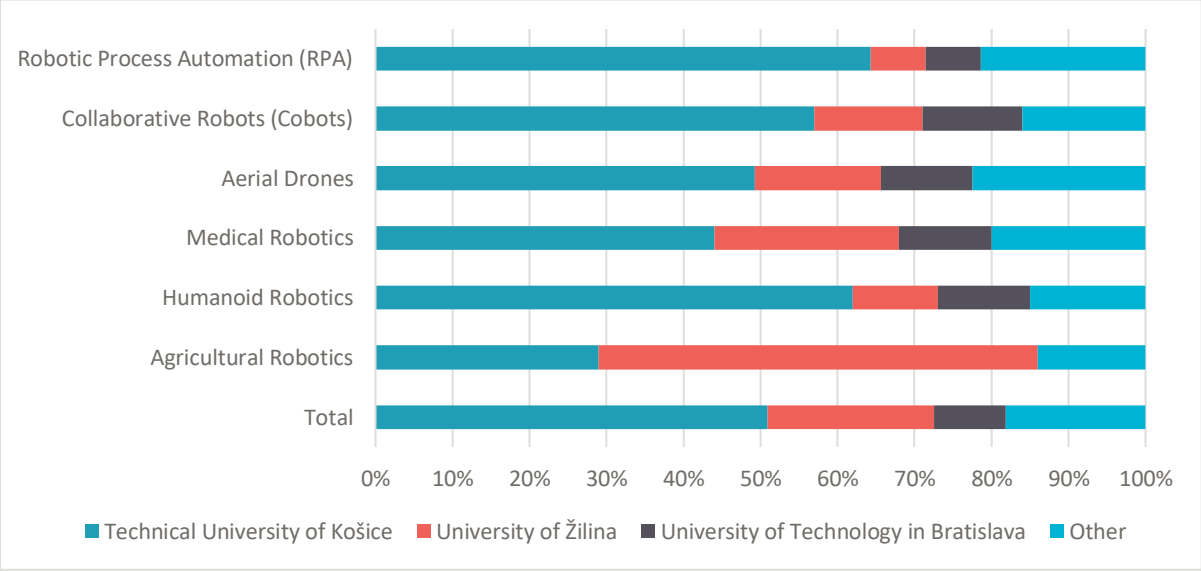
The landscape of Robotisation technology research within Slovak institutions, as depicted in Figure 12, is dominated by several leading universities that significantly contribute to various fields of robotics. Among these, the **Technical University of Košice stands out,** with a substantial 53% share of researchers focusing on cutting-edge robotisation technologies. The university performs well particularly in the areas of Collaborative Robots (Cobots), Aerial Drones, and Humanoid Robotics, with

[6] The initial available sample included 3,198 researchers across 126 institutions. However, several filters have been applied, namely 1) researchers with their last known institution in Slovakia (ensures focus on national research capabilities), 2) researchers with at least one publication since 2019 (assumed to be active researchers), and 3) researchers with at least five term-related publications (to help identify researchers focusing on applied research). After applying these filters, the number of researchers decreased to 410 and the number of research institutions to 29.

respective researcher counts of 40, 33, and 40. Furthermore, in terms of percentage shares, the Technical University of Košice leads the research on Robotic Process Automation (RPA) with 64% and Humanoid Robotics with 62% in Slovakia. This is driven by a strategic focus on emerging technologies and a commitment to fostering an environment that encourages cutting-edge research and development.

The University of Žilina is the second largest contributor to the cutting-edge robotisation research. It leads in Agricultural robotics, although the number of researchers writing on this topic remains low. The University of Žilina makes its mark in Aerial Drones as well with 11 researchers contributing to the topic, further emphasizing its focus on innovative robotic systems that can operate in various environments, from the sky to agricultural fields. Meanwhile, **The Slovak University of Technology in Bratislava** shows substantial research output across Cobots and Humanoid Robotics, with 9 and 8 researchers respectively, indicating a strong commitment to both collaborative robotics and technologies that mimic human actions. Other notable contributions come from various institutions that collectively add to the research landscape, particularly in fields such as Aerial Drones (Comenius University Bratislava, Technical University of Zvolen, Institute of Geography and Armed Forces Academy, to name a few) and RPA (Institute of Informatics and Institute of Electrical Engineering). Despite having a smaller share, these institutions play a critical role in diversifying and enhancing the overall research capabilities in Slovakia.

FIGURE 12. SLOVAK RESEARCHERS BY INSTITUTION (CUTTING-EDGE ROBOTISATION)



Source: produced by the study team.

6. Annex 1: Desk research and literature review

1. Not so disruptive yet? Characteristics, distribution and determinants of robots in Europe[7] JRC report 2020
2. Advanced robotic automation[8], 2023 EU-OSHA report
3. What future for European Robotics[9], 2021 report by JRC
4. Industrial robotics trends for 2024[10], whitepaper by Hokuyo USA
5. AI Watch. AI for enhancing Robotics[11], JRC 2022 report
6. AI Watch. Evolution of the EU market share of robotics: Data and Methodology[12], JRC 2021 report
7. The robots are ready, are you?[13], 2018 report by Deloitte
8. Hamied Nabizada, Marcel Lewke, Moein Azizpour, Raphael Höfer, Luis Miguel Vieira da Silva, Pezhman Pourabdollah, Philip Topalis, Omar Ismail, Alice Kirchheim, Alexander Fay "Current Trends in Robotics Development"[14]
9. Special Issue on Trends and Challenges in Robotic Applications[15] by Luis Gracia and Carlos Perez-Vidal
10. Elena Pessot, Andrea Zangiacomi, Irene Marchiori, Rosanna Fornasiero "Empowering supply chains with Industry 4.0 technologies to face megatrends"[16]
11. Katarina Valaskova, Marek Nagy, Stanislav Zabojnik and George Lăzăroiu "Industry 4.0 Wireless Networks and Cyber-Physical Smart Manufacturing Systems as Accelerators of Value-Added Growth in Slovak Exports"[17]
12. Marek Nagy, George Lăzăroiu, and Katarina Valaskova "Machine Intelligence and Autonomous Robotic Technologies in the Corporate Context of SMEs: Deep Learning and Virtual Simulation Algorithms, Cyber-Physical Production Networks, and Industry 4.0-Based Manufacturing Systems"[18]
13. Sütőová, A., Šooš, Ľ., & Kóča, F. (2020). Learning needs determination for industry 4.0 maturity development in automotive organisations in Slovakia. Quality Innovation Prosperity, 24(3), 122-139[19]
14. Papulová, Z., Gažová, A., & Šufliarský, Ľ. (2022). Implementation of automation technologies of industry 4.0 in automotive manufacturing companies. Procedia Computer Science, 200, 1488-1497[20]
15. Commission staff working document, 2023 Country Report – Slovakia[21]

[7] https://joint-research-centre.ec.europa.eu/system/files/2020-05/jrc120611.pdf
[8] https://op.europa.eu/en/publication-detail/-/publication/ba3df395-1ba5-11ee-806b-01aa75ed71a1/language-en/format-PDF/source-310337626
[9] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC125343/what-future-for-european-robotics.pdf
[10] https://hokuyo-usa.com/application/files/3017/0308/6118/Hokuyo-USA_-_2024_Robotics_Trends_-_WHITEPAPER.pdf
[11] https://ai-watch.ec.europa.eu/document/download/b8f11c0b-8549-4c20-a1e7-fa80c008109e_en
[12] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC124114/jrc124114_01.pdf
[13] https://www2.deloitte.com/us/en/pages/operations/articles/global-robotic-process-automation-report.html
[14] https://www.researchgate.net/publication/366986636_Current_Trends_in_Robotics_Development
[15] https://www.researchgate.net/publication/373084382_Special_Issue_on_Trends_and_Challenges_in_Robotic_Applications
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[17] https://www.mdpi.com/2227-7390/10/14/2452
[18] https://www.mdpi.com/2076-3417/13/3/1681?type=check_update&version=2
[19] https://www.qip-journal.eu/index.php/QIP/article/view/1521
[20] https://www.sciencedirect.com/science/article/pii/S1877050922003593
[21] https://economy-finance.ec.europa.eu/system/files/2023-05/SK_SWD_2023_625_en.pdf

7. Annex 2: Technology lists creation

The process of scoping the robotisation industry required developing a comprehensive list of cutting-edge technologies. This endeavour was methodologically approached, combining the use of ChatGPT with traditional desk research and literature review. The study team utilised ChatGPT to generate: 1) a list of cutting-edge technologies relevant to the robotisation sector; 2) a list of general (not cutting-edge) technologies in robotisation. PPMI consulted with ChatGPT to generate preliminary information on significant technologies, marking a starting point for research and aiding in providing focal points for our study, by producing relevant lists. These lists were subsequently corroborated through desk research and the examination of the most up-to-date sources outlining industrial trends.

To develop and validate the comprehensive list of cutting-edge technologies in robotisation, we employed also the systematic literature review. This involved sourcing and analysing academic papers, industry reports, and market analyses to identify prevailing trends and innovations within robotics (see Annex 1 for the full list of reviewed reports). The diversity and range of sources ensured a well-rounded understanding of the current technological landscape. Post-completion of the desk research, we organized the identified technologies into categories based on their types, such as humanoid, cobots, or RPA, and their application areas like medical or agricultural robotics. This step was followed by the compilation of a detailed list that included brief descriptions of each technology, emphasizing their relevance and potential advantages.

Robotisation technology list creation

As a result of the abovementioned methodological steps – desk research and the Chat GPT search – we have created a list of the most recent and impactful cutting edge technologies in robotisation:

1. ***Robotic Process Automation (RPA):*** *Software technology that makes it easy to build, deploy, and manage software robots that emulate humans' actions interacting with digital systems and software.*
2. ***Humanoid Robotics:*** *Robots with its body shape built to resemble the human body, typically designed to mimic human motion and interaction.*
3. ***Medical Robotics:*** *Robots used in healthcare, including surgery robots, rehabilitation robots, hospital logistics robots, and for performing tasks such as diagnoses and treatment.*
4. ***Aerial Drones:*** *Unmanned aerial vehicles (UAVs) used for various tasks, including surveillance, delivery, agriculture, and photography, capable of flying autonomously or being remotely controlled.*
5. ***Collaborative Robots (Cobots):*** *Robots designed to work alongside human workers, often in a shared workspace and without safety cages, equipped with sensors and systems to ensure safe interaction.*
6. ***Agricultural Robotics:*** *Robots designed for agriculture, used for tasks such as planting, watering, weeding, and harvesting, aimed at increasing efficiency, productivity, and precision in farming operations.*

After keywords validation using desk research, the keywords were entered into Milda.ai, which produced company lists for each technology. Below we provide specific keywords for robotisation technology company search in Milda.ai.

TABLE 3. LIST OF KEYWORDS USED FOR EACH CUTTING-EDGE TECHNOLOGY IN ROBOTISATION SECTOR

TECHNOLOGY TYPE	KEYWORDS
Robotic Process Automation (RPA)	robotic process automation OR autonomous machine control OR industrial robot OR automated manufacturing robots OR robotic workflow optimization OR automated production robotics OR intelligent robot automation
Humanoid Robotics	humanoid robotics OR humanoid robot development OR advanced humanoid robots OR autonomous humanoid OR human like robot design OR bipedal robot innovation OR ai powered humanoid robots
Medical Robotics	medical robotics OR medical robotic OR surgical robot development OR robotic medical devices OR healthcare robotic innovation OR robotic surgical equipment OR medical robotic instruments OR robotic pharmacy OR robotic disinfection
Aerial Drones	aerial drones OR unmanned aerial vehicles OR drone hardware manufacturers OR aerial drone OR uav design developers OR autonomous flying drones OR advanced drone platforms
Collaborative Robots (Cobots)	collaborative robotics OR collaborative robot manufacturers OR human robot collaboration OR cobot development OR safe robot human interaction OR collaborative robotic arms OR robot human workspace integration
Agricultural Robotics	agricultural robotics OR autonomous farm robots OR precision agriculture robots OR automated crop management OR robotic farm automation OR agricultural robot OR automated harvesting robots OR vertical farming

Source: compiled by the study team based on search in Chat GPT and desk research.

8. Annex 3: Company list (excel file)

Please find the excel list with analysed Slovak robotic companies as a separate attachment.

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