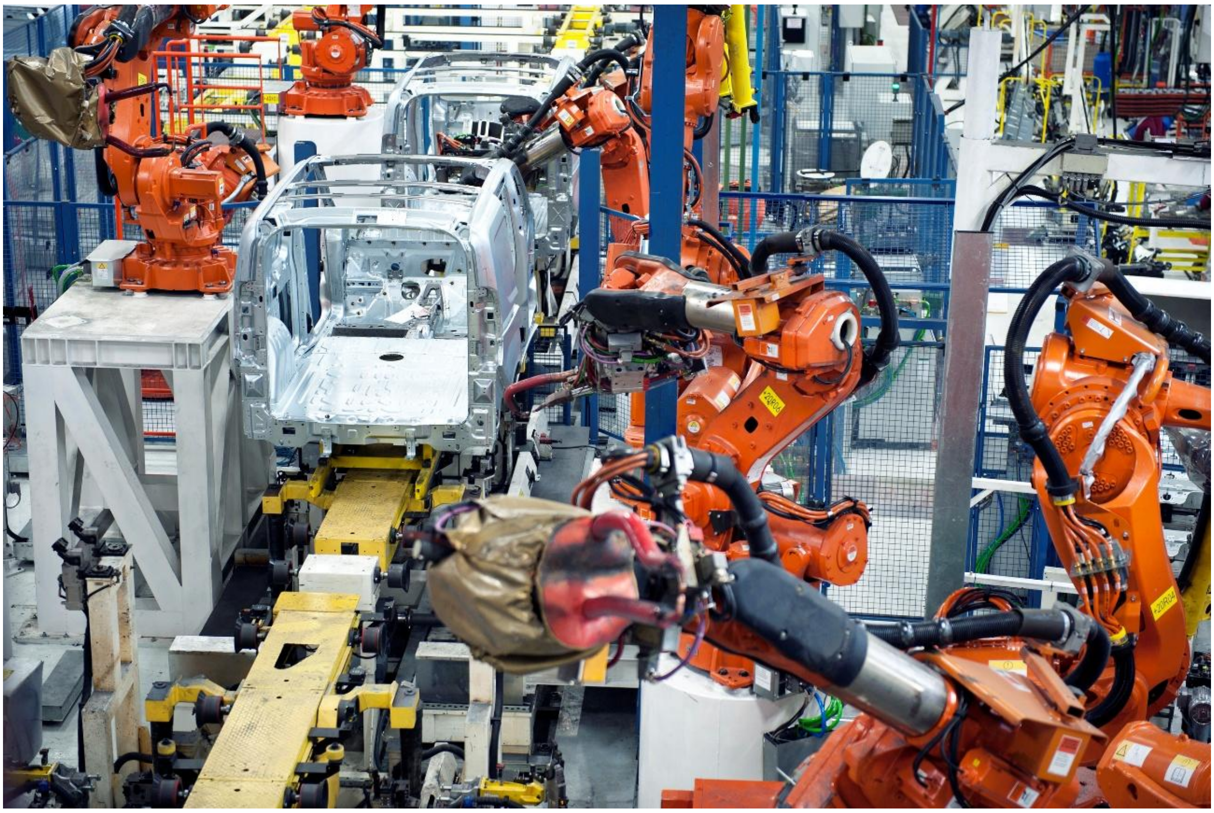
Study

Demands and Opportunities for (AI-based) Robotics in the Industrial City of Berlin

On behalf of the Senate Department for Economic Affairs, Energy and Public Enterprises, State of Berlin

Contact Paul Möhlmann (Prognos AG)

Location, Date Berlin, 19 June 2025



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Demands and Opportunities for (AI-based) Robotics in the Industrial City of Berlin

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Date
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Executive Summary

The development, marketing and implementation of (AI-based) robotics is highly dynamic and offers great potential for innovation and value creation: whether for supplier and development companies thanks to significant growth opportunities in existing and new sales markets, or for industrial users in manufacturing. For the latter, (AI-based) robotics promises greater efficiency, productivity and competitiveness at the economic level. But it can also relieve employees of repetitive and physically demanding tasks and provide flexibility in the face of a shortage of skilled workers. In particular, the integration of artificial intelligence (AI) into robot systems opens up new possibilities for automating increasingly complex tasks, learning independently, working more seamlessly with humans and operating in unstructured spaces not specifically designed for them [1]. This study has examined the structures, demands and opportunities for the development and industrial application of (AI-based) robotics in the state of Berlin through literature and data analyses as well as interviews, and provides recommendations for the further development of this field of technology and innovation in the region. It provides an analytical overview of the ecosystem of actors and examines the diverse opportunities and obstacles as well as the framework conditions and success factors for the development and application of (AI-based) robotics.

The analysis identified 85 industrial companies in the Berlin metropolitan region[2] that use (AI-based) robots in their production. Of these, 72 are located in the state of Berlin and 13 in Brandenburg.[3] The identified Berlin user companies with more than 20 employees (64) account for just under 9% of all industrial companies with more than 20 employees in Berlin. With approximately 46,000 employees, they employ almost half of the workforce in Berlin's industrial sector and generate an estimated €11 billion, or at least 30% of their annual turnover. It is mainly medium-sized and large companies with over 51 employees that use (AI-based) robots. Smaller companies are more inhibited in their integration by high implementation costs, complex regulations and, in some cases, corporate cultural barriers. However, challenges such as the shortage of skilled workers and rising personnel costs are still driving demand for automation solutions, while robotics solutions are becoming increasingly affordable and easier to use. Robots are already performing a wide range of tasks in Berlin's industrial companies, with material processing and handling (36% of companies) and machine feeding (32%) being the most common areas of application. However, the use of AI in robotics has so far only been demonstrated in a small minority of companies using robotics (8%), where AI is used in particular for image processing and robot perception.

In terms of numbers, the metalworking (27%) and mechanical and plant engineering (16%) sectors are the most strongly represented among the Berlin user companies identified. However, if the prevalence of (AI-based) robotics in various sectors in Berlin is measured in terms of the number of employees, it becomes apparent that the two sectors mentioned above are still significantly surpassed by the highly automated automotive industry. In contrast, (AI-based) robots are still relatively unintegrated in the electrical engineering, optical and chemical industries, as well as in the paper industry. Overall, however, with the exception of the automotive industry, the diffusion of

[1] Andreu-Perez et al. (2017)
[2] The study distinguishes between the state of Berlin and the broader Berlin metropolitan region, which in this study is defined as an area with a radius of approximately 130 km from the centre of Berlin, thus including parts of Brandenburg but not the entire state. Unless otherwise specified, the figures and graphics refer to the state of Berlin.
[3] All figures, data and facts in the Executive Summary refer to companies in the state of Berlin.

(AI-based) robotics is not particularly high in any industry, which means that there is potential to drive it forward more strongly.

An analysis of suppliers and developers along the robotics value chain identified a total of 149 companies in the Berlin metropolitan region, 140 of which are based in Berlin and nine in Brandenburg, providing or developing products and services in the field of (AI-based) robotics. These predominantly small companies and start-ups – half of which have fewer than 10 employees – employ a total of around 6,000 people. Their estimated turnover exceeds €700 million per year. The companies are active in all areas of the robotics value chain, with 56% of them in the software sector. They are followed by developers and suppliers of hardware components (41%), system integrators (29%) and robot manufacturers (29%). Around 45% of supplier and developer companies already integrate AI into their products or services. 77% of companies target industrial application markets with their solutions. An analysis of robot types shows that 36% of companies focus on industrial robots and collaborative robots. 35% cannot be assigned to a specific robot type based on their input. 12% focus on driverless transport systems (or automated guided vehicles - AGVs) and 6% each on drones and mobile service robots. In terms of the targeted industrial applications of the solutions, the supplier and developer ecosystem is broadly diversified and serves fields such as material transport and (intra)logistics (7%), maintenance and repair (6%), image processing and machine vision (6%), quality control, testing and inspection (5%) and other fields such as assembly, material processing and finishing, packaging and machine loading.

The potential and strengths of the supplier and developer ecosystem lie, among other things, in its strong expertise in software and AI components and in highly innovative customised solutions for industry. However, many innovations are still in the early stages of development, or there is still a lack of widely available, scalable solutions that are ready for series production. With almost 150 companies located in the region, the results demonstrate a critical mass and high level of value creation. Due to the business structure, which is dominated by micro-enterprises, there is a lack of resources for larger market initiatives, access to industrial markets and robotics promoters such as a large robotics OEM in the region.

Berlin plays an important role in research and development in the field of (AI-based) robotics in Germany and Europe. This is particularly evident in scientific publications, the diversity of research institutions and the number of funded R&D projects in this field. There is potential for improvement in knowledge transfer, the diffusion of existing technologies and in terms of a lower industrial orientation of R&D activities than in Munich, Stuttgart or Saxony, for example. There is also a need for the robotics ecosystem to strategically network stakeholders internally and externally, to bundle and raise the profile of activities, and to establish access to industrial markets and regions.

The study results show that the further development and strengthening of this technology field offers considerable growth and value creation opportunities for supplier and user companies as well as for research at the location. The study therefore identified a need for action and support in networking the innovation ecosystem and transfer, in strategic development and improving visibility, in creating investment incentives, in strengthening the application orientation of R&D funding, in building up skills and co-determination, and in designing innovation- and application-friendly regulations.

1 Background

In the current geopolitical and global economic situation, the competitiveness of industry in Germany and Europe depends largely on technological sovereignty and innovative strength. Compared to Germany, competing industrial locations benefit from low wages and energy costs, as well as enormous subsidies in some cases. In order to compete with these countries on international and national markets, industry needs key technologies such as (AI-based) robotics [4], which not only create new sales markets but also contribute to efficiency, relief and productivity at the location. In robotics, innovations and technological advances are increasing the interaction possibilities of these systems with their environment and increasing the precision with which these interactions can be carried out. In artificial intelligence (AI), current and foreseeable advances are enabling, for example, improvements in the perception and decision-making capabilities of autonomous systems. The synergy arising from these developments in AI and robotics is giving rise to systems that can take on increasingly complex tasks in industry and the economy, learn independently, work more seamlessly with humans and operate in unstructured spaces not specifically designed for them.[5] (AI-based) robotics will play an increasingly important role in almost all areas of the economy. This applies to industry, where it is used to automate manufacturing processes, and to social and health services, e.g. in the automation of medicine and care. AI-based robotics in particular is often ranked alongside technologies such as the steam engine, electricity and computers, which created new economic paradigms in their time, due to its diverse potential for expanding the capabilities and adaptability of robots.[6]

Accordingly, many industries have great potential to achieve efficiency and quality gains and bring new products and services to market through the integration of (AI-based) robotics. How quickly and successfully this integration can be achieved in practice depends on a number of internal and external factors.[7] In any case, the market for (AI-based) robotics will grow in the coming years and decades, opening up opportunities for expansion and innovation for suppliers in this market. This applies to research, development and manufacturing of hardware and software components, robot manufacturing (OEM) and robotics services. Experts predict that the global robotics market could grow to as much as $260 billion by 2030, which would represent growth of approximately 550% compared to 2023.[8]

With 28,355 industrial robots installed in 2023, Germany will be the largest robotics market in Europe and will have the fourth highest robot density worldwide with 429 robots per 10,000 employees.[9] If Germany wants to defend these positions and remain competitive, investment and innovation in (AI-based) robotics are essential. The industrial density and diversity in Germany and the associated mass of industrial data offer ideal conditions and opportunities for the high data requirements involved in the development and implementation of AI solutions in industrial robotics – especially since a large proportion of the available industrial data has not yet been used.[10]

[4] When the term "AI-based" appears in brackets in this study, it means that the statement applies equally to AI-based robotics and robotics in general. When the term AI-based robotics appears without brackets, it refers specifically to robotics that incorporates AI.
[5] Andreu-Perez et al. (2017)
[6] Mir et al. (2020)
[7] Kutz et al. (2022)
[8] Lässig et al. (2021)
[9] IFR (2024)
[10] Asenkerschbaumer et al. (2023), Nishar (2023)

With **149 companies** [11], providing or developing robotics (components) and numerous research activities in the technology field, the Berlin metropolitan region is an important centre for robotics.[12] With around 40,000 business registrations and around 500 start-ups per year, the state of Berlin is Germany's start-up capital, attracting €2.2 billion, or almost 31% of the risk capital invested in Germany, and forming the two most popular start-up hubs in Europe alongside London.[13] In combination with excellent universities and research institutions, above-average economic growth of +1.6% nationwide and its expertise in deep tech and artificial intelligence, Berlin has great synergy potential as a location.[14] The city and region offer developers and providers of (AI-based) robotics a vibrant innovation ecosystem and access to cutting-edge research, talent, funding and networks with potential users from industry and other sectors. However, this great potential is also accompanied by obstacles that need to be overcome, such as high acquisition and implementation costs for robotics solutions, complex liability, labour and data protection regulations, technological challenges and transfer deficits. These risks are particularly inhibiting for small and medium-sized enterprises (SMEs) with limited resources when it comes to developing and applying (AI-based) robotics. In addition, Berlin's vibrant AI ecosystem needs to be networked more closely with the robotics scene, and potential for cooperation and transfer between science and industry needs to be leveraged.

The state is addressing these opportunities and challenges with the **Masterplan Industriestadt Berlin 2022-2026 (MPI)**, the cross-state **Innovationsstrategie Berlin-Brandenburg (InnoBB 2025)** and other measures. The strategies aim to leverage the location's specialisations and strengths for the digital transformation and to develop and establish new and sustainable value chains. In the area of support measures within the MPI, for example, the Berlin Robotics Network was created as an initial platform for networking and cooperation between actors from different stages of the value chain in industry and science.

This study aims to provide a **demands and opportunities analysis for the development and application of (AI-based) robotics in Berlin's industry**. It provides a systematic overview of the local ecosystem and examines the diverse industrial opportunities and obstacles as well as the framework conditions and success factors for this technology field in Berlin. The study will result in well-founded recommendations for action on support measures and various funding instruments for (AI-based) robotics in Berlin. The focus here is on industrial applications on the user side.

[11] Of these, 140 companies are located in Berlin and 9 in the neighbouring metropolitan region of Brandenburg.
[12] The number of robotics companies in the Berlin metropolitan region was determined in this study by analysing several data sources (including Orbis, the federal government's funding catalogue and web research). For the purposes of this study, the term 'Berlin capital region' refers to an area with a radius of approximately 130 kilometres from the centre of Berlin, thus also including parts of Brandenburg. In this study, the metropolitan region is thus conceptually and spatially distinct from the 'State of Berlin' (also referred to as 'Berlin' in the study), which only comprises the area within Berlin's state borders and forms the focus of the study.
[13] Berlin Partner (n. d. b)
[14] Berlin.de (2024)

2 Research Design

The study design is based on an integrated methodology that combines quantitative and qualitative surveys. This ensures a differentiated analysis of the issues and enables a valid assessment of the strengths, weaknesses, opportunities and risks in the context of (AI-based) robotics in Berlin. The study examines the following overarching questions:

Table 1: Key questions of the study

Status quo analysis of the AI robotics ecosystem in Berlin	
Who is shaping the development of (AI-based) robotics in Berlin?	■ Which players are active in the development, marketing and industrial application of (AI-based) robotics in the Berlin ecosystem? ■ How are the roles of different value creation levels in (AI-based) robotics distributed within the location? ■ In which industrial fields and sectors do industrial companies use (AI-based) robotics, and in which sectors are they active? ■ What are the obstacles and success factors with regard to the framework conditions for the development and implementation of (AI-based) robotics?
Opportunities, obstacles and demands	
Where are the greatest location potentials, obstacles and needs for (AI-based) robotics in Berlin?	■ Where are the greatest scientific, economic and technological potential and needs for the development and industrial implementation of (AI-based) robotics in Berlin? ■ What location-specific scientific, economic, technological and application-related strengths and weaknesses as well as opportunities and risks can be identified in the development and industrial implementation of (AI-based) robotics? ■ What are the impacts and needs resulting from the implementation of (AI-based) robotics in the world of work in terms of social justice, ethics and sustainability? ■ What are the implications of the growth of (AI-based) robotics for the education and training of skilled workers?
Future strategies and recommendations for action	
What measures and strategies are appropriate to support the development and implementation of (AI-based) robotics at the location?	■ What support formats, funding instruments and further training programmes can be implemented to provide targeted support for the robotics ecosystem and the development, marketing and industrial implementation of (AI-based) robotics at the location? ■ How can politics and public administration provide conceptual and regulatory support to the players at the location in order to promote the development and implementation of robotics in Berlin?

Own representation.

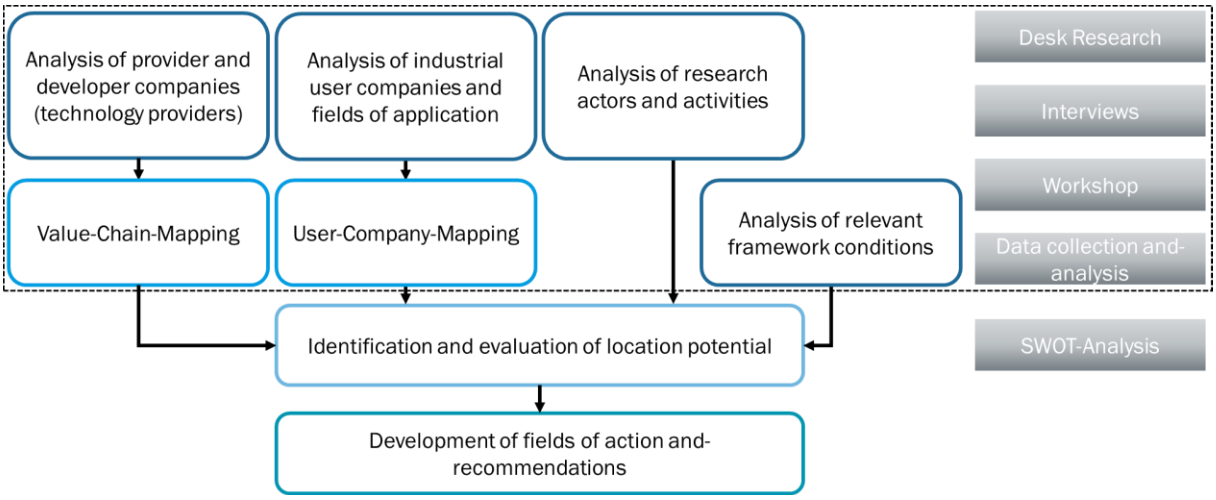
A comprehensive **analysis of relevant literature and (web) publications** will provide a fundamental overview of the technology field, value creation and market structures, as well as general and Berlin-specific framework conditions and strategies. The qualitative analysis will be supplemented by a **workshop and expert interviews**, which will integrate the knowledge of regional stakeholders from the field of (AI-based) robotics into the study. The dialogue formats serve to obtain expert assessments of general and location-specific obstacles and success factors, as well as strengths and weaknesses in the technology field, and to identify potential for development and application.

Through **quantitative and qualitative data analysis** using a big data approach, providers and developers as well as industrial fields of application and user companies at the location are systematically identified and evaluated, and R&D priorities and exemplary collaborations at the location are identified. Various data sources are taken into account and qualitatively verified for indicator-based measurement and big data analysis: patent data, publication data, funding data, company data, other economic data, as well as web-based information and sources. These are used to derive potential, strengths and weaknesses for the location.

The collected data and evaluations are also classified in a location-specific **value chain** of providers and an analytical mapping of **users** in order to create a detailed overview of the competence landscape of (AI-based) robotics in Berlin and to present the focal points in a structured manner.

The results are consolidated through a systematic **SWOT analysis** to create a sound basis for the development of targeted **recommendations for action** that will promote the successful development and application of (AI-based) robotics in Berlin.

Figure 1: Study design



Own representation. © Prognos AG 2025

3 Robotics and AI-based robotics – definitions, fields of application and value chain

3.1 Definition of (AI-based) robotics

The definition of (AI-based) robotics is fundamental to analysing potential applications and technological developments. In the practical development and future-oriented consideration of robotics, the topics of AI and robotics can hardly be separated from one another against the backdrop of the continuous improvement and expansion of robot technologies and the increasing integration of artificial intelligence into various fields of technology. This study will therefore take a broad look at the topic of robotics in Berlin and highlight the use and possibilities of AI in this context.

For the sake of clarity and precision, the terms robotics, AI and AI-based robotics are defined below. These definitions are based on general usage, but do not claim to be exhaustive or based on a comprehensive conceptual analysis. Instead, the definitions are pragmatic and designed to reflect the aim of the study, which is to illustrate the economic, scientific and technological potential of robotics. In this sense, the terms are broadly defined to avoid excluding promising areas of application for definitional reasons.

Robotics refers in this study to the scientific field and economic sector dealing with robotic systems. Robotic systems are mobile machines that can interact with the physical world based on information processing. Robots differ from other forms of automation in that they are programmable, i.e. they offer a certain degree of flexibility in terms of their use and have a higher degree of freedom in their movements. However, the boundaries are not always clear-cut.

This study defines **AI** as machine learning. This refers to the use of statistical algorithms to learn from data and generalise. Models are trained on the basis of large amounts of data, which can then exhibit an impressive level of complexity and flexibility. The most high-profile example of this are large language models (LLMs), on which well-known AI applications such as ChatGPT and Claude are based. However, more relevant to the field of robotics are machine learning models that process images, sound and other data (e.g. LIDAR) rather than text in order to draw an accurate, three-dimensional picture of their environment in real time and enable improved manipulation, analysis and navigation of this environment. LLMs in the narrower sense are currently used in robotics, for example in the field of communication, to make operation simpler and more intuitive. The German manufacturer Autorobotics, based in Münster, is already active in this area. However, the technology is still in a very early stage of development.[15]

In this study, **AI-based robotics** refers to the integration of AI or machine learning into robotic systems. This does not necessarily mean that the robotic system itself is capable of learning. It can also be limited to the use of AI models, which in turn are the result of algorithmic learning processes.

The combination of AI and robotics enables a significant expansion of the capabilities of robotic systems and harbours great potential for innovation, productivity and value creation. Unlike conventional robots, which are limited to predefined tasks in clearly defined spaces, these advanced

[15] Autorobotics (n. d.)

robots can perform more demanding tasks in dynamic and unstructured environments. A clear example of this is autonomous driving or autonomous mobility. Autonomous transport vehicles, but also complex mobile robots in industry, use AI to navigate independently and without human assistance in a complex, unstructured and changing world. AI-based robots can be used in industry, for example, for the detection, handling, storage and transport of production parts and tools. Through machine learning, robots can navigate more complex situations in many fields, make more intelligent decisions and increasingly act as interactive partners in industrial work processes. In the future, their adaptability and autonomy will continue to increase. The use of AI in robotic systems can thus increase their functionality, interactivity and autonomy. Based on Asenkerschbaumer et al. (2023), robots can be divided into the following categories, which are not entirely distinct:

- **Mobile service robots,** which are used for tasks such as cleaning and construction work or for monitoring and analysing large-scale infrastructure due to their mobility.
- **Stationary service robots,** which are used, for example, in medicine or agriculture, where they relieve humans of monotonous or dangerous work or perform stationary precision tasks.
- **Driverless transport systems (AGVs) and drones (UAVs),** which are mainly used in logistics within company premises (intralogistics) and outside such premises to transport goods efficiently and inspect objects and terrain.
- **Industrial robots,** which perform tasks in industrial manufacturing, such as assembly line work, operate in structured environments and are separated from the human work area by safety precautions.
- **Cobots or collaborative robots** are special industrial robots that directly support humans in certain work steps. Thanks to their increasing intelligence and precision, cobots can work safely with humans without protective devices, thus significantly influencing the nature of the future working environment.

The types of robots listed above can be further subdivided and classified in various ways. Industrial robots, for example, fall into two categories: those with **serial kinematics** and those with **parallel kinematics**. The former are further divided into articulated arm robots (e.g. 4-7-axis robots, SCARA and palletising robots) and gantry robots. Even more detailed subdivisions are based, among other things, on the number and position of the axes of rotation. Portal robots are large industrial robots that process workpieces in production lines and closed systems, for example. Robots with parallel kinematics, on the other hand, include delta robots, which are shaped like a hanging pyramid with three arms underneath and can work very quickly, for example to pack and wrap smaller goods at high speed.

Industrial robots now exist in an enormous variety and are adapted to a wide range of tasks thanks to their respective specifications. (AI-based) robotics is an interdisciplinary cross-sectional technology, as it requires technology and knowledge from computer science and, in particular, the field of AI, electrical engineering, mechanical engineering and many other specialist disciplines.

(AI-based) robotics offers considerable benefits for almost all sectors and industries, whether in primary production, manufacturing, the service sector, administration or the public sector.

This study examines the entire value creation network of (AI-based) robotics in Berlin. In addition to the direct development and manufacture of robotic systems with AI components, this network also includes the development and manufacture or provision of intermediate products and services for such systems. From this perspective, non-AI-based robotic systems are the central intermediate product for AI-based robotic systems. Beyond the integration of AI, robotics is also a future-oriented technology and, as such, is analysed extensively in the present study in the context of Berlin. This is in line with the definition provided by the German Federal Government in its AI strategy[16] and takes into account the limitation that it is difficult to measure and predict the extent to which AI integration is present, planned or likely to occur in the future in individual technologies. When the term "AI-based" is placed in brackets in this study, it means that the statement applies equally to *AI-based robotics* and *robotics in general*. When the term AI-based robotics appears without brackets, it refers specifically to robotics that incorporates AI. The survey and analysis of the landscape of providers and developers (technology providers) of (AI-based) robotics will be conducted on a broad level. The survey and analysis of application companies and application potential, on the other hand, primarily highlight **industrial application and fields of use for (AI-based) robotics.**

3.2 Industrial fields of application for (AI-based) robotics

(AI-based) robotics in industry can be viewed from two perspectives. Products of (AI-based) robotics (including preliminary products and intermediate services) can be viewed as the output of companies and industry, i.e. from the perspective of the suppliers, developers and manufacturers of such systems. Or (AI-based) robotics can be viewed as a technological investment from the perspective of user companies or customers who use (AI-based) robotic systems in their processes.[17] From a global perspective, the largest customers for robots in industry are currently the electronics and automotive industries, which account for almost half of the total global industrial robot market.[18] Thanks to further development and innovation, including the integration of artificial intelligence, robots are increasingly gaining new functions and increasing their reliability, flexibility, effectiveness and efficiency. The use of AI in robotic systems improves their capabilities, particularly with regard to:

- Perception and recognition (machine vision),
- Localisation and mapping,
- Planning,
- Motor skills (motor skill learning),
- Motion control and regulation (motion learning) as well as
- Human-robot interaction and collaboration.

As robotic systems keep getting better, especially with AI being added, we're seeing totally new ways to use them in industry, and existing uses are getting better too.[19] Robotic systems can be used in different industrial areas. Table 2 gives an overview of these with examples of how AI integration can help. These contributions can be gradual or fundamental. Of course, it is not only AI integration processes that contribute to all the areas of application listed, but also further developments in other areas. In practice, it is often the interaction of further developments in different areas that enables leaps in automation.

The integration of AI into robotic systems is still in its infancy in many areas and faces many practical, economic and regulatory risks. Voices from Berlin's industry confirm that the low level of technological maturity of AI-based robotics to date means that the integration of such systems is still associated with high costs and a wide range of economic, regulatory and technical uncertainties for companies in many cases (e.g. data requirements and protection, liability rules and

[16] The Federal Government (2018)
[17] IGBCE (2021)
[18] Asenkerschbaumer et al. (2023)
[19] Asenkerschbaumer et al. (2023), Shinde (2024)

implementation costs). However, both of these issues will develop in a positive direction as the technology matures.

Table 2: Areas of application for (AI-based) robotics in industry

Industrial applications of robotics	Industrial applications of robotics
Assembly	■ Improved flexibility to better handle variance in the assembly process, e.g. with components ■ Greater safety, enabling robots to work alongside humans
Machine loading, unloading and handling (machine feeding)	■ Improved flexibility to handle variance in goods, pallets, etc. ■ Greater safety, enabling robots to work alongside humans
Quality control and inspection	■ Improved processing of visual and other data for more accurate detection of defects, especially atypical defects
Material transport and logistics	■ Improved navigation, even in unstructured environments, for the automation of logistics processes using automated guided vehicels
Processing and finishing	■ Improved processing of visual and other data to enable more precise machining of materials and components, especially those that are difficult to detect, such as reflective and unstructured parts ■ Increased safety, enabling robots to work alongside humans
Packaging and unpacking, filling and palletising	■ Improved flexibility to deal with variance in the packaging process, e.g. with irregular and dissimilar goods ■ Greater safety, enabling robots and humans to work together
Research and development	■ Improved flexibility to deal with variance, e.g. in the experimentation process (e.g. in laboratories in the pharmaceutical industry)
Maintenance and repair	■ Improved processing of visual and other data for defect detection ■ Improved decision-making for defect rectification ■ AI use for predictive maintenance

Own representation.

(AI-based) robotics offers a wide range of opportunities to increase both total factor productivity and capital investment in a single company or an entire economy, thereby boosting productivity and value creation. In view of constant technological developments and economic adaptation progress in the field of (AI-based) robotics, it will also be essential to intensify the use of these technologies for reasons of competitiveness. In addition, in view of demographic change and the increasing shortage of skilled workers, as well as industrial cost structures in Germany, (AI-based) robotics offers the opportunity to maintain productivity, secure production sites and increase international competitiveness with innovative solutions, among other things. These factors in turn mean that the development and production of (AI-based) robotic systems are both a promising future market and a core future technology.[20]

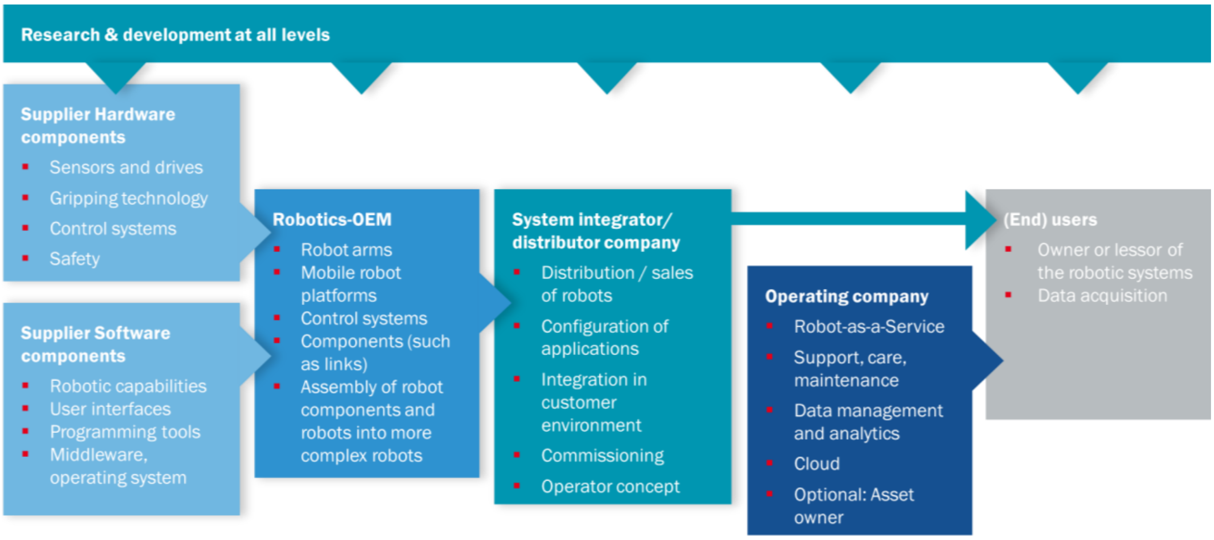
[20] BEAM (2024)

3.3 Value chain of (AI-based) robotics

In order to systematically identify players in (AI-based) robotics in the study, an in-depth understanding of the value chain in this area is necessary. In the course of cross-sectional technological developments (such as the integration of AI), both these value chains and their perception have become more complex. The straightforward and simplistic image of robot manufacturers, system integrators and end users has evolved into one that reflects non-linear value creation networks or value creation ecosystems. Following Asenkerschbaumer et al. (2023), the following simplified structure can be used as a basis for depicting the value creation ecosystem of (AI-based) robotics:

- Suppliers, service providers and manufacturers of software (components)
- Suppliers, service providers and manufacturers of hardware (components)
- Robotics OEMs (in this study, broadly defined as all players who develop and manufacture more complex robots, some of which are made from robots)
- System integrators
- Operators
- (End) users

Figure 2: Value creation ecosystem of (AI-based) robotics



Own representation based on Asenkerschbaumer et al. (2023), according to Robert Bosch GmbH (2022) © Prognos AG 2025

In order to also include actors from research and science, it is important to supplement and consider the value creation level **Research & Development** for a holistic view of the ecosystem. This level can play a role in every value creation step and includes both applied and basic research as well as test infrastructures. This system serves as the basis for operationalising the research design and classifying the actors in the Berlin robotics ecosystem (see Figure 2).

4 Ecosystem for (AI-based) robotics in Berlin

Berlin has developed into an important location for robotics. Many companies that offer and develop products and services in the robotics value chain have their headquarters or a branch in Berlin. In addition, there are numerous scientific institutions dealing with topics related to AI and robotics. The entire robotics ecosystem comprises established small and medium-sized enterprises, innovative start-ups, academic partners and networks. The target markets of these players are mostly in industrial applications, and there are also numerous industrial companies in Berlin that use robotics in various innovative and functional designs to automate their processes. Supplier companies serve a supraregional, often primarily European market, so that local business relationships between the supplying and user companies in Berlin play a subordinate role, according to expert discussions. User companies also source their robots from outside the region, mainly from Germany and Europe, and in some cases from outside Europe. The use of industrial robotics is often standard practice in large and medium-sized industrial companies, but many smaller companies in Berlin are also increasingly turning to robot technologies to counteract the shortage of skilled workers through automation, relieve the burden on employees and increase efficiency and productivity. Overall, however, the analyses and expert discussions show that most users have not yet tapped into the vast potential of robotics and that its use is often limited to individual applications.

The robotics ecosystem in Berlin is examined below in three areas:

- Industrial user companies
- Supplier and technology provider companies
- Science, research and development

A distinction is made between Berlin, which is defined by the boundaries of the **state of Berlin**, and the broader **Berlin metropolitan region**, which in this study is defined as an area with a radius of approximately 130 km from the centre of Berlin, thus also including parts of Brandenburg. Unless otherwise specified, the figures and graphics refer exclusively to the state of Berlin.

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Methodological approach to data collection and analysis of user and provider companies in Berlin

The following evaluations for user companies and provider companies are based on a database created in a two-stage process. In the first step, various sources and databases (e.g. ORBIS, FÖKAT, PATSTAT, company websites) were evaluated using an AI-based big data approach. In the second step, the database was checked, validated and supplemented by means of qualitative individual research. This combination of different survey instruments allows reliable statements to be made about the robotics ecosystem in Berlin. However, it should be noted that larger companies are easier to find than smaller ones due to their larger footprint on the internet and in databases. We attempted to compensate for this by combining the various identification instruments and an iterative, quality-based supplementation process.

For the companies identified, quality-based classifications were made with regard to various categories, such as industry affiliation, and estimates were made regarding employee numbers and turnover, using internal reference values, publicly available information and AI.

The following observations are based on the number of companies as well as employee and turnover figures in order to provide as comprehensive a picture as possible of the corporate structure. The number of companies provides an indication of the breadth and dynamism of the respective field, while the employee and turnover figures indicate the economic and social significance of the companies in the field under review.

4.1 Industrial application of (AI-based) robotics in Berlin

Robotics (based on AI) is relevant as a cross-sectional technology for all industrial sectors. Although micro-enterprises can also benefit from innovative robotics applications such as cobots, industrial robotics is particularly important for larger industrial companies due to its cost-benefit ratio and implementation effort, among other factors: In Berlin (excluding neighbouring districts), there are 752 industrial companies with more than 20 employees (2023).[21] In 2023, these companies generated a turnover of around €37 billion and employed approximately 103,300 people. Gross value added amounted to €11.4 billion, which corresponds to 6.5% of Berlin's economic output.[22] Looking at companies of all sizes in the manufacturing sector in Berlin, the Berlin-Brandenburg Statistics Office reported 4,903 companies with 104,650 employees and a turnover of just under €38 billion in 2023.[23]

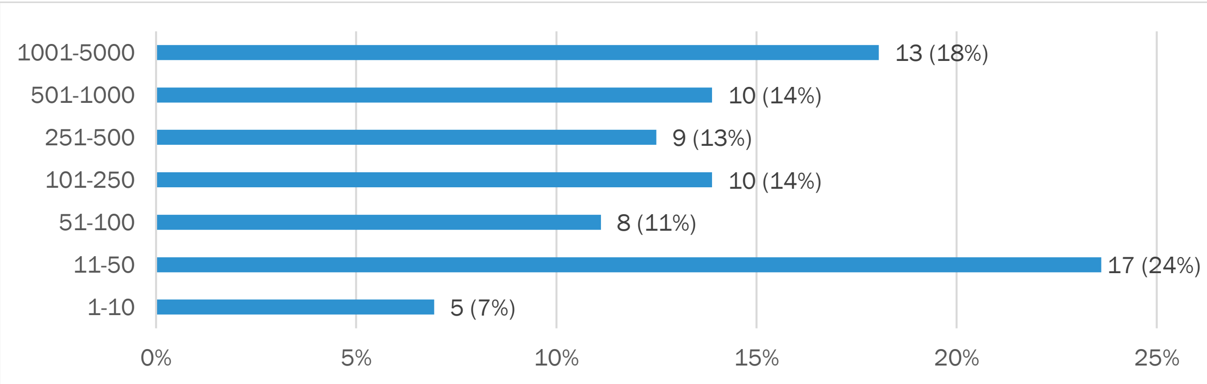
The pharmaceutical industry was Berlin's strongest industrial sector in terms of turnover, generating approximately €7.4 billion (approximately 20% of industrial turnover). This was followed by the manufacture of data processing equipment, electronic and optical products with approximately €3.5 billion (approximately 1% of industrial turnover). In addition to the export-oriented pharmaceutical and electrical industries, other key industrial sectors in the state include the food industry, metal processing, mechanical and plant engineering, the chemical industry and the automotive and vehicle industry. Exports accounted for 47.8% of turnover, with the pharmaceutical and electrical industries having significantly higher export ratios than the average for the sectors at 78.8% and 62.4% respectively.[24]

[21] Manufacturing companies with 20 or more employees; Statistical Office Berlin-Brandenburg, 2024.
[22] Working group on „Volkswirtschaftliche Gesamtrechnungen der Länder“, Statistical Office Berlin-Brandenburg, Federal Statistical Office, Federal Employment Agency
[23] Statistical Office Berlin-Brandenburg 2024b; Note: A comparison with statistics for industrial companies with more than 20 employees shows that the total number of employees and turnover vary slightly. Since the statistics for industrial companies with more than 20 employees also provide a more detailed breakdown into industry categories, comparisons and ratios are calculated using these statistics. This means that only companies with more than 20 employees are considered in direct comparisons.
[24] Working group on „Volkswirtschaftliche Gesamtrechnungen der Länder“, Statistical Office Berlin-Brandenburg, Federal Statistical Office, Federal Employment Agency

Industrial application companies (AI-based) robotics at the location

The analysis identified a total of **72 companies** [25] of all sizes (1.5% of the 4,903 companies in the manufacturing sector) in Berlin that have implemented robots in various fields of application, mostly along their production chains. 64 of these companies employ more than 20 people. Measured against the total of 752 manufacturing companies with over 20 employees in Berlin (2023), these account for just under 9%.[26] A further 13 companies that use robots were identified in the wider Berlin metropolitan region. The survey shows that the industrial companies in Berlin in question employ a total of around **45,000 to 47,000 people** at their sites, which means that almost half of the employees in Berlin's industrial companies who use robots work at these sites. If we narrow the focus to companies with at least 20 employees, this figure does not decrease significantly. A further 15,000 employees work in the identified companies in Brandenburg, resulting in a significantly larger average company size compared to robotics users in Berlin. This difference is driven by large plants such as Tesla's in Grünheide. Figure 3: Relative shares of the 72 robotics user companies in Berlin by number of employees shows the employment structure in the user companies. It can be seen that over **two-thirds of users** are **medium-sized and large companies** with at least 51 employees. This distinguishes the population of robotics users from the overall population of Berlin companies, which is dominated by micro and small enterprises. This is to be expected because robots are capital-intensive and pay for themselves more quickly with higher production scales. However, the use of both industrial robots and collaborative robots is growing steadily worldwide, opening up more opportunities for smaller companies.[27] This is due in part to falling robot costs and lower requirements for handling them. Both factors lower the barriers to entry for the use of robotics in companies.

Figure 3: Relative shares of the 72 robotics user companies in Berlin by number of employees



Source: Own representation based on own surveys. © Prognos AG 2025
The absolute figure is given behind each bar, with the corresponding share of the total in brackets.

Since only a small proportion of the identified companies report their location-based turnover in the available databases, the majority of the turnover of these industrial companies was estimated and extrapolated on an industry-specific basis using the number of employees at the location. The **turnover** of industrial companies using robotics in Berlin is therefore estimated to be in the rough range of approximately **11 to 18 billion euros**. Brandenburg companies in the Berlin metropolitan region contribute an additional €4 to €6 billion, which again reflects the relative size of these 13

[25] This corresponds to just under 1.5% of all companies in the manufacturing sector in 2023.
[26] Senate Department for Economic Affairs, Energy and Public Services, Economic Affairs Division (2024)
[27] ReTraSON (2024)

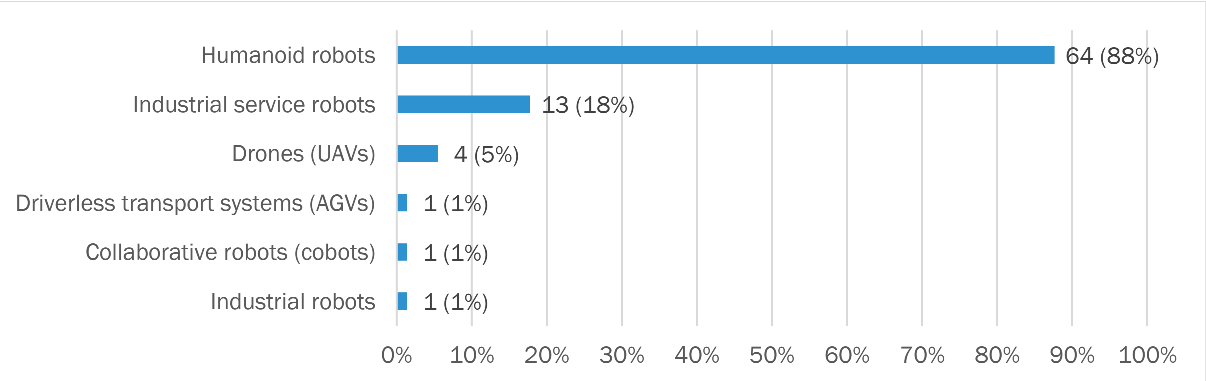
companies. These figures do not change when only companies with at least 20 employees are considered. The turnover of Berlin-based industrial companies with at least 20 employees can be used to put these figures into context. In 2023, this amounted to approximately €37 billion.[28] The Berlin-based industrial companies identified as user companies in this study therefore already account for a significant proportion of the total turnover of Berlin's industry.

As described at the beginning, there is a slight data-related uncertainty in the analysis, particularly for smaller companies. It can therefore be assumed that other, particularly smaller industrial companies in Berlin also use robots. Nevertheless, thanks to its methodological foundation, the analysis provides at least an approximately representative view of industrial robotics applications in Berlin. This is particularly true because, as already mentioned, smaller companies face particular hurdles when introducing robots. This assumption has been further validated by expert discussions.

Industrial applications and types of robotics implemented in Berlin

The type of robots used shows that **88%** of the 72 users employ **industrial robots** in structured and protected environments along the production process. In most cases, these are various articulated arm robots (such as 4- or 6-axis robots), which are frequently used for machine feeding, processing, assembly and palletising. In addition, SCARA robots, gantry robots and flexible delta robots are also used in some cases, the latter mostly for high-speed packaging of smaller products (e.g. in the pharmaceutical industry). Around **18%** of users also use **collaborative robots (cobots)** exclusively or in combination with other robots. According to the survey, the use of driverless transport vehicles (also autonomous guided vehicles – AGVs) is relatively rare and mainly occurs in intralogistics in large-scale industry and in large distribution centres in logistics. Based on expert discussions and the lower density of information and transparency regarding logistics centres on the web, it can be assumed that some applications at the location were not recorded. A slightly higher proportion can therefore be assumed. Even rarer is the use of humanoid robots (initial trials at Mercedes-Benz and, according to announcements, also at Tesla in the future), industrial service robots and drones.

Figure 4: Types of robots used by the 72 industrial user companies in Berlin (multiple assignments)

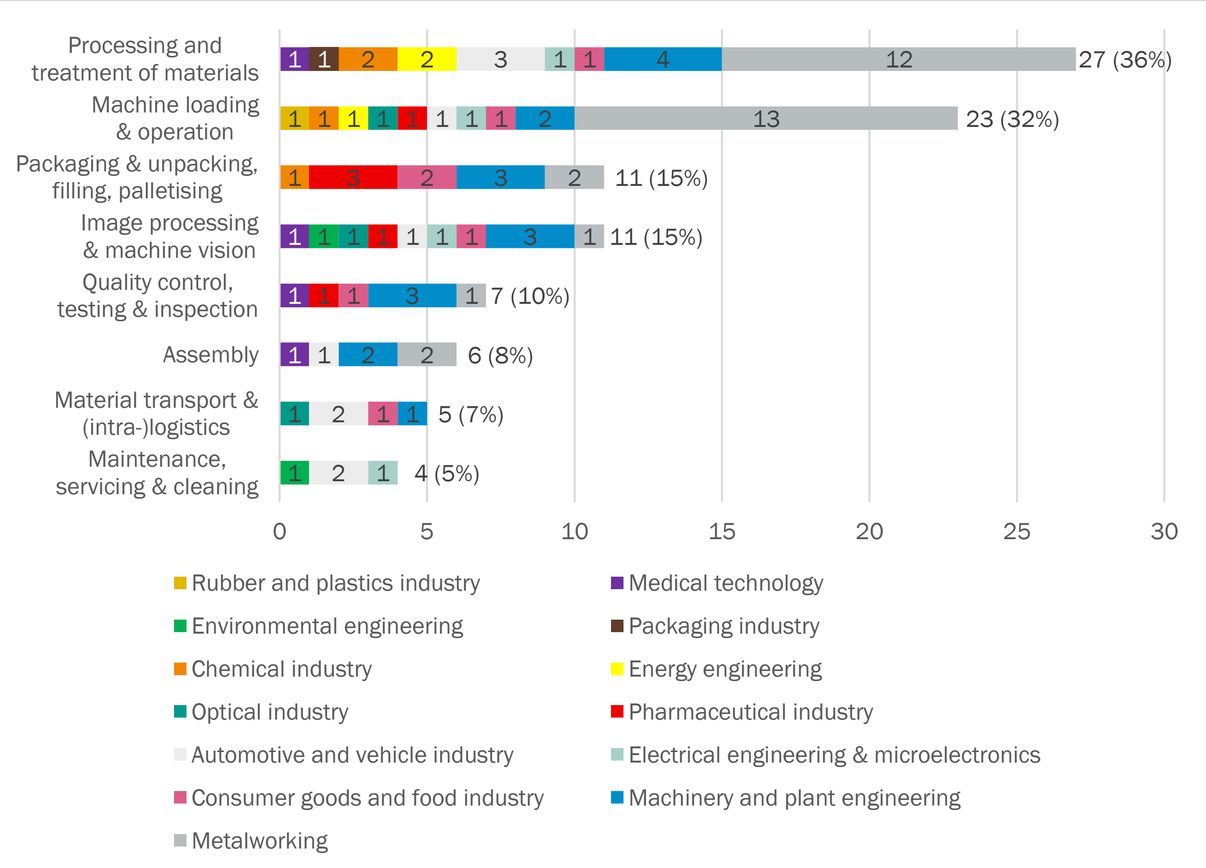


Source: Own representation based on own surveys. © Prognos AG 2025
Behind each bar, the absolute number is given and the corresponding share of the total is shown in brackets.

[28] Statistical Office Berlin-Brandenburg (2024)

Industrial users in Berlin employ their robots in a variety of applications along the entire production chain, from intralogistics, machine feeding and material processing to quality control, packaging, palletising and maintenance (see Figure 5). The analysis shows that **36% of the 72 users**, and thus the most common, use robots for the **processing and treatment of materials** (e.g. welding, milling, painting), followed by **machine loading and operation** with **32%**. These two areas of application are particularly common in metalworking and mechanical and plant engineering. In contrast to metalworking, robots are also used in many other fields in mechanical and plant engineering. In around **15%** of companies, robots are used for **packing, unpacking, filling and palletising.** This corresponds to the large proportion of industrial robots in user companies, as the fields of application are mostly monotonous tasks with frequent repetitions. A special cross-sectional field in the use of robotics is image processing and so-called "machine vision",[29] which is covered in all areas, e.g. via cameras or sensors, and can correspond to innovative applications with AI-based evaluation of image data. The surveys found indications of the use of image recognition and processing in **15%** of user companies.

Figure 5: Distribution across fields of application in robotics at the 72 user companies identified (multiple assignments)



Own representation based on own surveys.
The absolute figure is given behind each bar, with the corresponding share of the total in brackets.

[29] "Machine vision" refers to the field that enables machines to perceive their environment. Optical signals, but also radar and lidar, for example, can be used for this purpose.

Use of artificial intelligence in robotics by industrial users in Berlin

When analysing user companies to determine whether they use AI in conjunction with robotics – as AI-based robotics – a number of good practices became apparent, although in some cases a qualitative estimate of the probability of AI use had to be made. The expert discussions and evaluations showed that AI is mostly used in the processing and analysis of image and sensor data and thus in the orientation and perception of robots, for example in the interpretation of situation images or in quality control. The evaluations show that artificial intelligence is demonstrably used in only **8%** of the 72 user companies identified. In the other companies, it cannot be determined with certainty. It can be assumed that a substantial proportion, but ultimately a clear minority, of users employ AI-based robotics. By far the largest area of application for AI in robotics among user companies is image processing and machine vision. This is evident from the data collected as well as from literature research and expert discussions. In principle, it is to be expected that more and more robotics applications will be able to be used in conjunction with AI in the future, and that they will indeed be used. However, this depends on the specific application. The more complex and unpredictable the environment in which robotics is used, the more likely it is that AI algorithms can offer a cost-efficient and fast solution (also in comparison to human labour). AI can currently be used for tasks that are too complex or versatile for conventional automation, but not so complex or versatile that only a human being is capable of performing them. One example of a potential area of application could be in wholesale, where goods of very different shapes, weights and fragility are handled. Conventional robots cannot cope with such diversity, but AI-based robotics can.

Most of the robots currently used in industry are permanently installed and perform rather monotonous, repetitive tasks. The contribution of AI to optimisation in this specific area still needs to be explored further. Overall, use cases for AI-based robotics are not yet widespread in industry. New possibilities for using AI-based robotics in production are still in development. As a result, demand for self-learning and AI-based robots is not yet very high across the board. In addition, a number of expert discussions revealed that AI trials and developments in the production environment are cost- and resource-intensive, which is why standard solutions in robotics often still come out on top in terms of cost-benefit analysis, especially in smaller companies.

Industry structure of industrial users of (AI-based) robotics

An analysis of the industry distribution reveals a number of focal points for the industrial application of (AI-based) robotics. More than half of the user companies are active in metal processing, mechanical and plant engineering, and the consumer goods and food industries (see Figure 6). The strongest representation is found among **metalworking companies**, with **20** identified companies, accounting for just under a third of the 72 industrial user companies identified. Official statistics for 2023 show a total of 87 companies with more than 20 employees in Berlin that either manufacture metal products or are active in metal production and processing.[30] Of the 20 metalworking user companies, 17 have more than 20 employees.[31] The user companies identified in this analysis thus represent about one-fifth of the 87 companies in Berlin.

[30] Statistical Office Berlin-Brandenburg (2024)
[31] In some cases, the number of employees was estimated due to a lack of data.

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AI-based robotics in metal processing

HWL Löttechnik is a small, owner-managed company based in Berlin that has been active in the field of heat treatment for metal components for decades. Before this treatment, the components must be cleaned. The company uses AI-based robots to transport the workpieces between these steps. Due to the high variability of these workpieces, AI is necessary to implement a customised approach for each one.[32]

In total, there are **eleven small industrial companies** with fewer than **51 employees** in the metalworking sector, so it can be assumed that robotics already plays a role in this SME-dominated industry, even in smaller companies.

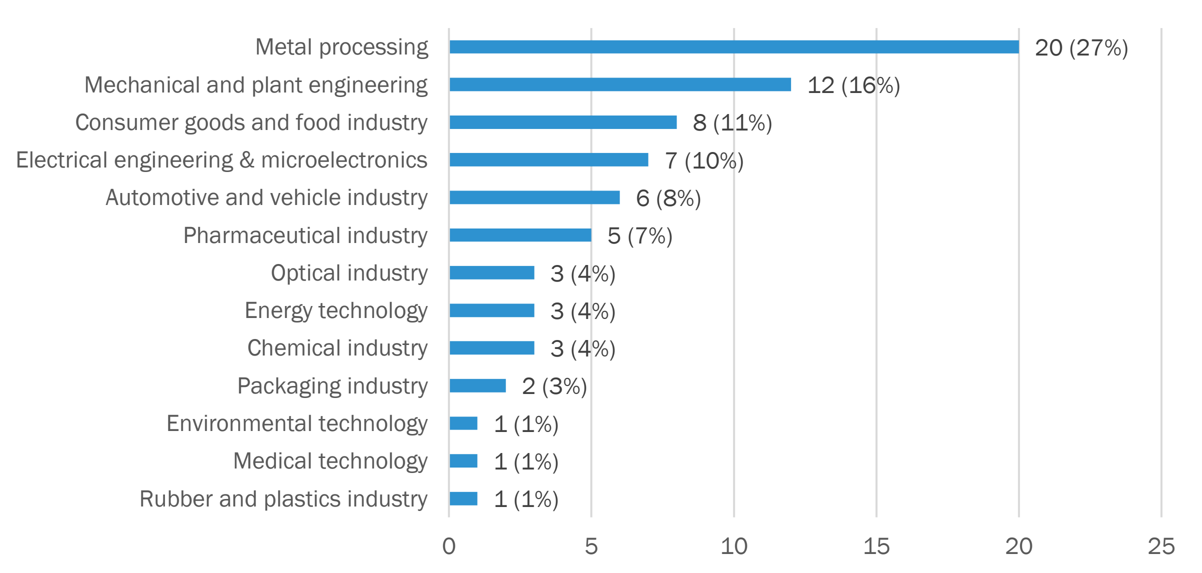
The widespread use of robotics in metalworking, despite the small-scale structure of the companies, is partly due to the fact that labour-intensive work, a shortage of skilled workers and standardised processes with uniform products make the use of robots particularly attractive in this industry.

Robots are often used for isolated tasks. Fully automated production chains or more complex task sequences using robots are still relatively rare. For this reason, the degree of robotics-based automation in the metalworking companies identified is often not yet very high in relation to the overall work process. This outlines the potential for integrating robots even more deeply and broadly into production processes, whereby the specific task profiles and the available robotic solutions must of course be matched.

Robots in the metalworking sector are particularly used for welding, milling, turning, forming, cutting and other mechanical and thermal processing tasks. The expert discussions show that the shortage of skilled workers in these professions and the relief from monotonous tasks are key drivers for the use of robotics in this industry. User companies in this area include **FSM Stamping** (AI-based welding robots), **HWL Löttechnik** (AI-based cobots) and **Geyer Umformtechnik** (cobots for machine loading and welding robots).

[32] Automationspraxis (2023)

Figure 6: Number of 72 industrial user companies in Berlin by industry



Own representation based on own surveys.
The absolute figure is given behind each bar, with the corresponding share of the total in brackets.

Robots are also used in **12** companies in the **mechanical and plant engineering** sector. On the one hand, they are used in the manufacture of machines, e.g. for welding, painting and coating parts, and on the other hand, they are also integrated into the machines offered. This means that some user companies in the mechanical and plant engineering sector are also suppliers and developers of (AI-based) robotics. Examples of users in mechanical and plant engineering include **BORSIG Process Heat Exchanger** and **Hans Hoffmann Trocken- und Lackierofenfabrik**. Nine of the 12 companies identified in the mechanical and plant engineering sector have more than 20 employees. The state of Berlin is home to a total of 56 industrial companies in the mechanical and plant engineering sector with more than 20 employees, which generated a turnover of around €2.3 billion in 2023. This means that around one sixth of the industrial companies in the mechanical and plant engineering sector use robots – a relatively high figure. Berlin-based mechanical and plant engineering companies also have a significantly higher level of innovation than the national average.[33] Taken together, this demonstrates the high affinity of mechanical engineering for innovative robotics in Berlin. This is also due to the fact that robots can be considered part of the industry's own product portfolio.

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MAG-welding robotics in mechanical and plant engineering

The industrial company **BORSIG** manufactures large pressure vessels and heat exchangers in Berlin and uses welding robotics for MAG welding technology. The company has several hundred employees in Berlin and generates an estimated turnover of 90-150 million euros.

[33] Statistical Office Berlin-Brandenburg (2024)

In addition, the **consumer goods and food industry** is also very important in the region. The food industry employs almost 10% of the total workforce in the manufacturing sector in Berlin in the confectionery and bakery products (e.g. **August Storck**), coffee, fruit and vegetable processing, beverage industry and meat processing sectors. In 2023, there were a total of 113 industrial companies with more than 20 employees in food and beverage production in Berlin, generating a turnover of €3.7 billion.[34] **Eight mostly very large industrial companies** have been identified for the industrial application of robotics. In addition to the examples mentioned above, these include **Stollwerck, Bahlsen Werk Berlin** and **Freiberger Lebensmittel**. In the consumer goods and food industry, packaging and palletising robots are used, but there are also other applications such as cobots in quality assurance.

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Cooperation between P&G Gillette and Gestalt Automation (formerly Gestalt Robotics) for mobile AI-based cobots for quality control and inspection

P&G Gillette is cooperating with a number of Berlin-based start-ups to develop innovations in manufacturing. Among other things, mobile cobots for AI-based industrial inspection are being used in cooperation with **Gestalt Robotics**. A robot cell has also been developed that can autonomously grip blades and is used in the production process at the Berlin plant. The high degree of automation allows the plant to integrate an autonomous night shift, thereby relieving employees of night work.[35]

Beyond the industries described above, various (AI-based) robots are used in other industries. For example, **seven user companies** in the field of **electrical engineering and microelectronics** were identified that use robotics primarily for assembly, maintenance and repair (including image recognition), including Kurt Oelsch, BSH Hausgeräte (Nauen plant) and **LAT Funkanlagen-Service** (mobile robot dog for maintenance and repair of railway tunnels). In the **automotive and vehicle industry, six** large industrial companies were identified as users who employ the entire range of robots in their applications, including **BMW** Group Berlin (welding robotics), **Mercedes-Benz** Berlin, **Hasse & Wrede** (Knorr-Bremse), **Stadler** Germany and **Walter Automobiltechnik**. In addition, there are several large and medium-sized users in the **pharmaceutical industry (5), optical industry (3), chemical industry (3)** and **energy technology** (including **Siemens** gas turbine plant and electrolyser plant) **(3).**

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User companies in the context of Berlin's industrial structure

If the number of employees at the identified user companies (AI-based) robotics is compared to the total number of employees in the respective industries (based on companies with at least 20 employees), the following picture emerges:

[34] Statistical Office Berlin-Brandenburg (2024)
[35] Tagesspiegel (2020), Ad Hoc News (2025)

A **high diffusion** of robotics (66% to 100% of employees work in companies that use robotics) can only be observed in vehicle manufacturing. A **medium diffusion** of robotics (33% to 65% of employees work in companies that use robotics) applies to the food industry and the metal industry. Mechanical and plant engineering falls just below the threshold. A **low diffusion** (0% to 32%) can still be observed in the following sectors: electrical engineering, optical industry, chemical industry, and printing and paper. Renewable energies were not recorded separately and therefore cannot be compared. The above estimates do not take into account the respective intensity of robot use and are affected by the methodological limitations outlined at the beginning. However, as these limitations affect all sectors to approximately the same extent, it can be assumed that the analysis nevertheless provides a good impression of the relative prevalence of robotics in Berlin's various industrial sectors. This picture is also consistent with qualitative assessments.[36]

Compared to their overall economic importance in the state of Berlin and their number of companies and employees, the pharmaceutical industry, chemical industry and optical industry (with user companies such as **Swissbit**) are particularly underrepresented, although these sectors place special demands on robotics (e.g. for work in clean rooms). The expert discussions also revealed that there is a great deal of untapped industrial application potential for (AI-based) robotics in Berlin, particularly in the medium-sized chemical and pharmaceutical industries, in various fields of application – whether in laboratory automation, manufacturing, quality assurance or filling and packaging.

Barriers to the diffusion and implementation of (AI-based) robotics

Berlin attracts many people as a livable and attractive city. Nevertheless, it is also affected by a shortage of skilled workers. According to forecasts, the Berlin economy will face a shortage of approximately 377,000 skilled workers by 2035.[37] Industry is particularly affected by this. Regardless of their location, companies are finding it increasingly difficult to find qualified skilled workers in key STEM fields, as well as in industrial mechanics, electrical engineering, metal construction and other professions. Against this backdrop, expert discussions confirm that the decision to implement (AI-based) robotics is driven on the one hand by a lack of skilled workers, but also by the need to relieve employees of monotonous and physically demanding tasks and by the need to shift to other tasks. Cobots are also becoming increasingly relevant in industrial companies, for example to take over machine feeding during the night shift in the same environment as the human day shift.

Industrial sectors are also facing an acute shortage of skilled workers in the operation and programming of robots, particularly in the key areas of artificial intelligence and robotics. However, more and more robotics applications, including those in Berlin, are being programmed with low-

[36] Statistical Office Berlin-Brandenburg (2024), Senate Department for Economic Affairs, Energy and Public Services, Economic Affairs Division (n. d.)
[37] IHK Berlin (2023)

code or no-code applications, so that, according to interviews, training now only takes one or a few days in some cases and the robots are becoming increasingly easy to operate.

The experts noted that the benefits of technologies in the field of (AI-based) robotics are often not clearly apparent to users, especially in smaller industrial companies. To counter this, it is important for providers and developers of (AI-based) robotics to create tools and knowledge to better understand the Berlin industrial landscape and identify its needs. There is also a considerable need for support in raising awareness, particularly among employees and SMEs. In some of the interviews, it was emphasised that, depending on their field of application, robots are often perceived as competition for employees rather than helpful assistants. To change this perception, companies could increase acceptance among their workforce through appropriate communication strategies, workshops and awareness-raising measures. The implementation of pilot projects in which employees work directly with robots was considered particularly valuable, as this can alleviate concerns and promote practical understanding. Some companies also rely on internal ambassadors to build trust and acceptance and offer training programmes so that employees can not only use the technology but also actively help shape it. This aspect also relates to the issue of change management in companies and touches on the technological and technical hurdles to the introduction of robotics. According to industry voices, this requires not only a willingness to introduce the technology, but also more targeted training and further education formats and greater use of existing offerings, such as those provided by integrators of (AI-based) robotics, chambers of industry, universities and technical colleges, service providers such as TÜV Rheinland and the VDI Knowledge Forum.

The interviews show that financial hurdles are a key challenge in implementing robotics solutions for companies. In particular, the high initial investment costs for purchasing robots are perceived as significant. Many companies are reluctant to invest in new technologies as long as the potential savings and efficiency gains are unclear. Numerous medium-sized industrial companies are also reluctant to invest resources in applications for financial support, as these are often not tailored to their specific needs (e.g. support for higher technology maturity levels) and are perceived as lengthy and bureaucratic. Long waiting times are necessary before financial support is actually available. These delays contrast with the quick decisions that companies have to make in order to remain competitive. In addition, many funding programmes are geared towards R&D and solutions that have yet to be developed and do not offer enough support for hardware and software investments in existing solutions, which further complicates the implementation of robotics solutions. Companies are therefore often looking for more flexible, timely financial solutions that are specifically tailored to their requirements and the costs of materials and training. They tend to invest in robotics solutions only when the economic efficiency and benefits have been clearly demonstrated. One low-threshold option for such proof is the dissemination of best practice examples. This assessment means that many companies are waiting to see concrete successes and positive experiences from other companies with the implementation of robotics solutions before taking the plunge themselves. This highlights the relevance of concrete and transferable best practices, especially in smaller industrial companies and sectors, which make up a significant proportion of companies in Berlin (e.g. metalworking, electrical engineering, mechanical engineering).

Another critical aspect is the high investment costs for hardware, which influence companies' willingness to invest. The costs for safety systems account for up to a third of the total costs of a robotics application and thus represent a significant financial obstacle. These challenges require not only technological solutions, but also a reform of regulatory requirements so that companies are able to implement the necessary security infrastructure effectively and cost-efficiently. In addition, the interviews emphasise the need to develop standardised norms that enable these challenges to be addressed on a broad basis and provide companies with a solid foundation for the use of robotics solutions.

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Interim conclusion: user companies in the field of robotics in Berlin

In summary, it can be said that the robotics ecosystem in Berlin is characterised on the user side by:

- larger companies in relation to Berlin's economic structure,
- a large number of industrial robots and a now substantial share of cobots,
- a focus on the metalworking, mechanical engineering and automotive industries
- a classic portfolio of robot application areas, such as material processing and handling, machine operation and packaging, but also a certain focus on image processing and quality control, and
- a low level of secure AI use

Barriers to the further diffusion and implementation of (AI-based) robotics exist primarily in the following areas:

- availability of skilled workers,
- corporate culture and
- financing

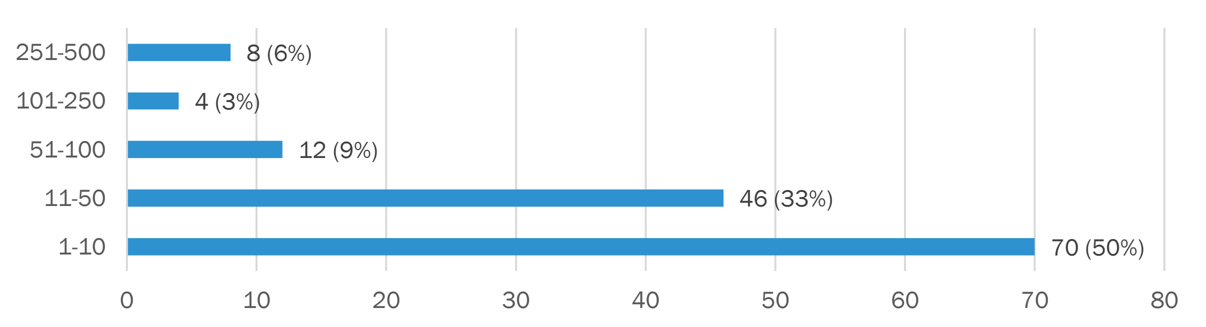
4.2 Companies providing and developing (AI-based) robotics in Berlin

A total of **149 companies (140 in Berlin and 9 in the metropolitan region of Brandenburg)** were identified that **offer or develop goods and services in the field of (AI-based) robotics**. The demarcation of the technology sector within the entire robotics value chain is somewhat blurred, particularly in the case of manufacturers and providers of components and software services, which are often used in many different products and are often not specific to robots. This makes it difficult to clearly determine the value added by companies in the robotics sector. However, all identified companies have a direct link to (AI-based) robotics and are therefore classified as **suppliers and developers of robotics** in Berlin.

The companies employ around **6,200 people, of whom just under 6,000 are in Berlin and just under 200 in the wider metropolitan area**. Of the 6,000 employees in Berlin, around 5,500 work for companies with at least 20 employees. In 2024, a total of around 140,000 people were employed in the manufacturing sector (excluding construction) in the state of Berlin.[38] The number of employees is an estimate that combines various data sources and qualitative assessments, as exact figures are not available in all cases. Nevertheless, it can be said that a significant proportion of employees in Berlin work for companies that offer goods or services in the field of robotics.

[38] Statistical Office Berlin-Brandenburg (2025). Applies to companies of all sizes (including those with fewer than 20 employees).

Figure 7: Distribution of the 140 providers by number of employees



Own representation based on own surveys.
The absolute number is given behind each bar and the corresponding share of the total is shown in brackets.

As the figure above shows, most companies in the field of (AI-based) robotics in Berlin are **small and micro enterprises**. Many of these are **start-ups**. Some of these companies are still in the product development and funding phase.[39] These small companies often work on highly innovative developments in the field of robotics, such as AI-based image processing and object recognition in industry, automated construction machines that can build walls, or exoskeletons for sick, injured or disabled people. The many start-ups face the usual risks that all start-ups and new entrants to a market face, but they also have great growth potential. The **twelve larger providers** with over 100 employees, on the other hand, can be considered established and cover a wide range of activities from mechanical engineering to providers in the field of autonomous driving and AI software development. However, it should also be noted that these larger providers often only have part of their core business and value creation in the field of robotics. Their role in the ecosystem for (AI-based) robotics is therefore smaller than their size implies. On the provider side, the ecosystem is therefore essentially dominated by small companies.

Based on the number of employees, an estimate of the total annual turnover of the identified companies was made using an estimate of the per capita turnover in the various sectors. In Berlin, this amounts to approximately **€701 million to €1,327 million** (€669 million to €1,259 million of which is in companies with at least 20 employees). In the wider metropolitan region, a further €13 million to €31 million is added. As with the number of employees, it cannot be assumed that this turnover can be attributed one-to-one to the value added by (AI-based) robotics.

Classification of Berlin-based robotics companies in a nationwide comparison

The definitions and distinctions between robotics companies are not clearly defined in various data sources and literature and are only comparable to a limited extent with the data collected here. This limits the significance of direct comparisons in the field of robotics between Berlin and other locations as well as other industry data.

Often, the distinctions are not clearly comprehensible or recognisable, nor is it clear how strictly the criteria are applied. Most manufacturing companies in a robotics ecosystem are not robot manufacturers in the strict sense (OEMs), but rather manufacturers of components or providers of services that enter the robot value chain. It is not clear how focused such a company must be

[39] Companies or start-ups in the product development and funding phase have not yet launched their product on the market and are looking for investors to enable them to invest in product development, among other things.

on the field of robotics in order to belong to a relevant association or to appear in relevant statistics. The boundaries are fluid. The comparative figures listed below are therefore only intended to provide a rough classification of Berlin as a location for (AI-based) robotics.

According to the VDMA, a total of approximately 70,000 people work in the field of robotics in Germany, generating an annual turnover of €16.2 billion.[40] The VDMA's Robotics and Automation Association has 415 member companies.[41] It should be noted that many industries that supply robot manufacturers, e.g. in the software sector, are generally not included in the VDMA, and start-ups and micro-enterprises often do not belong to such associations. The companies in the field of (AI-based) robotics identified in this study for Berlin address the entire value chain and are therefore more broadly defined. An analogous approach in Germany would identify significantly more companies than those listed by the VDMA.

The distribution of suppliers in the robotics sector within Germany presents a complex picture. In Saxony, for example, a robotics cluster has formed with 342 companies, according to its own figures, although it is not specified which companies on the supply and application side are included in this figure.[42] According to the Saxony Ministry of Economic Affairs, around 35,000 people were employed in robotics in Saxony in 2022, many of whom are likely to work in the electronics and semiconductor sectors, where preliminary products for robot manufacturing are produced.[43] In contrast, this study does not cover all companies that manufacture a product that could enter the value chain of (AI-based) robotics, but only those for which a clear link to robotics can be demonstrated.

In addition to Saxony, the regions in and around Munich and Stuttgart are particularly well known in Germany for their companies, industries and expertise in the field of robotics. These regions are roughly the same size as the state of Berlin, although they have very different structures.[44] A study by Meyer Industry Research on the top 50 robot manufacturers in Germany in 2025 shows that these top 50 suppliers are heavily concentrated in the industrial and mechanical engineering states of Bavaria, Baden-Württemberg and North Rhine-Westphalia, while eastern Germany, including Berlin, has only one of the top suppliers, namely **Metra Labs** in Thuringia.[45] Although there are many companies in Berlin that can be classified as part of the robotics ecosystem, there are relatively few robot manufacturers in the narrower sense, and none of these robot manufacturers make it into the top 50 in Germany according to the study mentioned above. This top 50 also includes companies with fewer than 100 employees and less than €10 million in annual revenue, so it is by no means exclusively made up of large companies.

If we broaden our view to include the largest robotics clusters in Europe, we find figures for the Danish robotics and drone cluster Odense Robotics, which, according to its own information, comprises over 300 companies in the fields of automation, drones and robots with a total of approximately 8,500 employees and a total annual turnover of €4.6 billion.[46] In the Netherlands, on the other hand, the Hightech NL cluster counts 350 robotics and automation providers.[47] The two clusters mentioned above have a slightly different and overall narrower focus than that applied in this study because they include certain robotics-related but more general inputs, particularly in

[40] VDMA (2023), p.20
[41] VDMA (n. d.)
[42] Robot Valley Sachsen (n. d.)
[43] Hoffmann, Julian (2022)
[44] Depending on data availability, NUTS regions were considered in this study as follows in comparison to Berlin: Stuttgart region (DE11), Munich region (DE212, DE21H), Saxony (DED).
[45] Meyer Industry Research (2025)
[46] Odense Robotics (n. d. a)
[47] High Tech NL Robotics (2023)

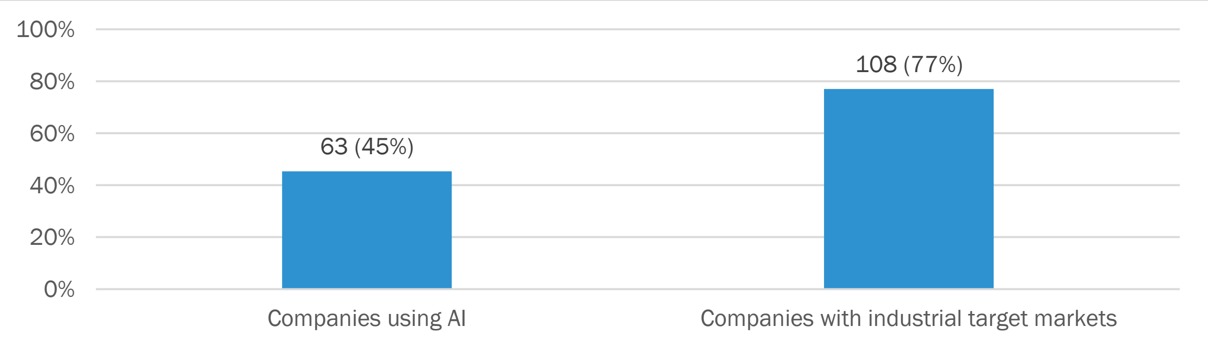
the software sector. On the other hand, they each span a country rather than just a city. Against this backdrop, the 149 companies identified in the Berlin metropolitan region in the field of (AI-based) robotics, with approximately 6,000 employees, show that Berlin is well positioned as a robotics location in a European comparison.

AI use and target market among providers of (AI-based) robotics in Berlin

Berlin has established itself **as a leading location for tech start-ups in Europe**, particularly in the fields of AI, automation and robotics.[48] The reasons for this lie, on the one hand, in the excellent conditions for education and research in the AI and robotics sector, which attract many spin-offs. Added to this is access to specialised local venture capital providers in this field, such as **Global Founders Capital, Join Capital** and **UVC Partners**. According to the EY Startup Barometer, Berlin accounted for almost a third of all nationwide investments in start-ups in 2024.[49] This means that Berlin's start-up landscape offers particularly good conditions for founding companies in the field of (AI-based) robotics, even compared to other regions. Such start-ups, in turn, can drive the integration of (AI-based) robotics in various sectors of the economy if new and tailor-made solutions are developed. These can go beyond the industrial sector and find application in logistics, healthcare or construction, for example. In addition, some interviewees emphasise that, alongside industrial users, public companies such as **Berliner Stadtreinigung** (BSR) and **Berliner Verkehrsbetriebe** (BVG) offer great potential for innovative cooperation in the field of (AI-based) robotics and could promote its application in Berlin through targeted procurement support, e.g. in the areas of inspection, maintenance and cleaning.

The presence of Berlin's AI and start-up ecosystem is also reflected in the structure of provider and developer companies in (AI-based) robotics. Of the 140 Berlin-based companies identified, **almost half (45%) say they integrate artificial intelligence** into the services or products they offer in the field of robotics.

Figure 8: Percentage of the 140 Berlin-based providers that use AI and whose target markets include industry



Source: Own representation based on own surveys.
Each bar shows the absolute number and the corresponding share of the total in brackets.

Only providers whose use of AI was evident from sources such as their company website, articles and social media posts were counted, so the actual number may be higher. There is no significant

[48] Berlin Partner (n. d. a), Berlin Senate Administration (2024)
[49] Confluence (n. d.), Unternehmertum (n. d.), Berlin Partner (n. d. d)

difference between smaller and larger companies in terms of AI use. As expected, AI is more prevalent in software-focused companies than in hardware-focused ones. AI is mainly used in the area of robot orientation and perception.

i

Data Spree GmbH

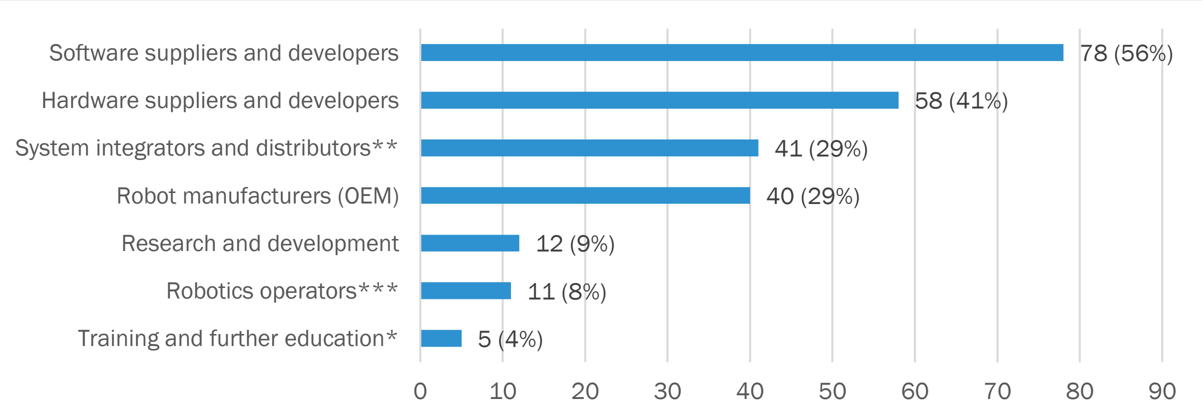
This small Berlin-based company offers AI-based optical systems for the intelligent guidance and control of robots in production and logistics. It is working on automating visual quality inspections using AI. Neural networks are to be trained to accurately detect in real time when products do not meet quality standards. This makes it possible, for example, to sort them out immediately. The company is one of a number of companies that use AI in this way.

Over **three quarters (77%) of companies count industry among their target markets**. This does not mean that industry is the main target market in every case. Nevertheless, it can be said that industrial applications are the focus of many Berlin-based providers and developers in the field of (AI-based) robotics. Providers that focus purely on non-industrial applications, such as the healthcare market, represent a minority.

Structure of Berlin-based suppliers and developers of (AI-based) robotics along the value chain

The following figure shows how many companies can be assigned to the various links in the value chain. In the area of research and development, only companies with a clearly recognisable focus in this area that goes far beyond normal R&D activities were counted, i.e. companies for which research and development services are a main activity, e.g. the development of prototypes for a customer. As a result of this definition, only a few companies fall into this category. Nevertheless, research and, in particular, development of proprietary products play a major role for companies in the field of (AI-based) robotics. **20** of the 140 supplier companies identified in Berlin also fell into the category of **user companies**, i.e. they themselves use robots on a large scale for the manufacture of products or for integration into these.

Figure 9: Distribution of activities of the 140 providers in the field of (AI-based) robotics in Berlin across value creation stages (multiple assignments)



Source: Own representation based on own surveys. © Prognos AG 2025
*The category of training and further education only includes those who offer this for external parties in the field of (AI-based) robotics and not exclusively as part of customer support.
**System integrators & distributors refer to companies that integrate robotic systems into higher-level systems, e.g. in production facilities, or that operate platforms on which robotic systems and components are sold. Software providers who integrate their software into customer systems are not included in this category.
Robotics operators are companies that operate their own robots externally, e.g. in the field of service robotics.
The absolute number is given behind each bar and the corresponding share of the total is shown in brackets.

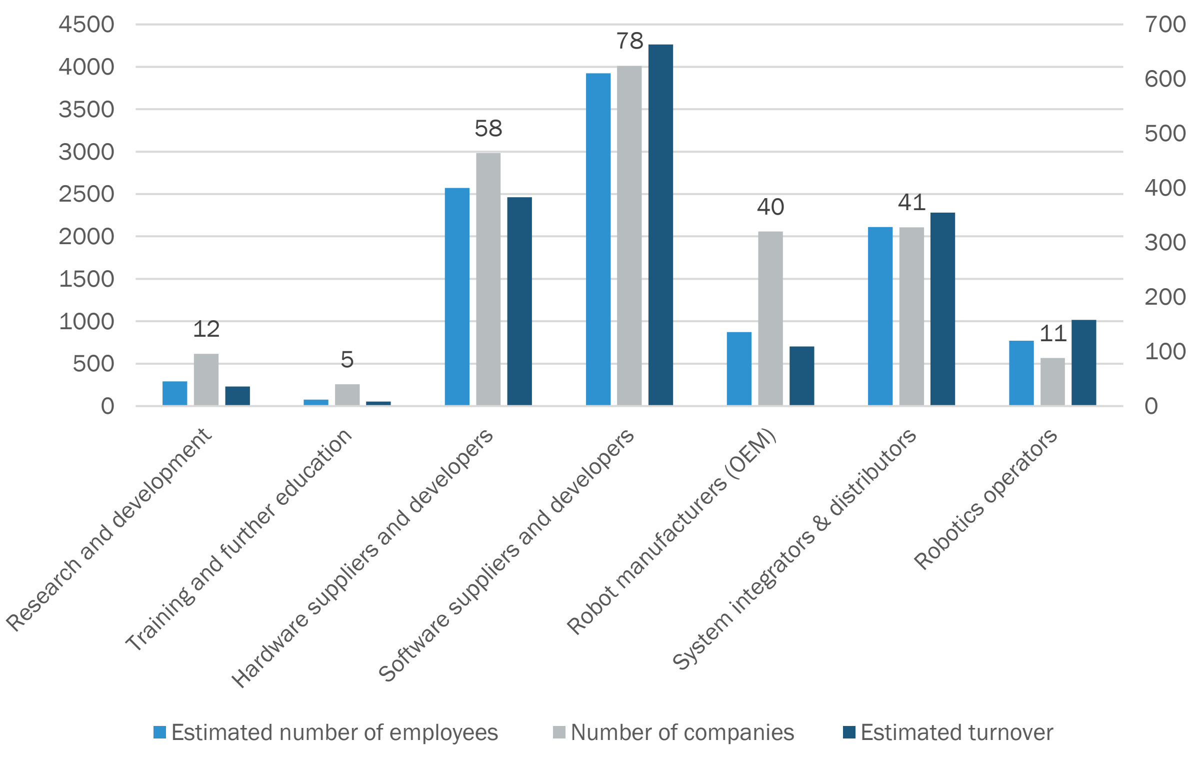
Overall, it can be said that the software sector is the strongest in Berlin. More than half (56% of providers) of all identified companies are active in the **software sector (78)**. And more than half of these **(44)** are **pure software companies** that do not manufacture or develop any hardware. In this sector and among distributors, there are also a number of companies that develop and supply e-commerce platforms for robots and components, such as **CNC24, Generation Robots, DRB77** and **Robotics Industries**. Several players in this sector are concentrated in Berlin as an e-commerce hub.

The **41 distributors and integrators** (29% of providers) also include companies such as **KleRo, Wilhelm Dreusicke, Adolf Neuendorf** and several mechanical and plant engineering companies. In addition, there are around **58 hardware suppliers and developers** (41% of providers), including **Cybertron** (kinematic systems for laboratory automation) and **Robovis** (machine vision hardware) in Wildau. A total of **40 robotics manufacturers and developers** (29% of suppliers) were also identified in Berlin, such as **pi4_robotics** (various robots), **Continuum Innovation** (continuous flexible robot arm), **N Robotics** (mobile robots with image processing), **Gestalt Robotics** (including the development and integration of mobile AI-based cobots for industrial inspection) and **ConBotics** (mobile platform for the construction industry).

The **nine companies identified in the Berlin area** are slightly less software-oriented than those in Berlin itself.[50] Four out of nine can be classified as software companies, but only two of these are pure software companies. In contrast, three companies are hardware suppliers or robot manufacturers (OEMs).

[50] Brandenburg: Hardware suppliers and developers (3), software suppliers and developers (4), robot manufacturers (OEM) (3), system integrators and distributors (3), research and development (2).

Figure 10: Estimated number of employees (left axis), estimated turnover in €1,000,000 (right axis) and number of companies (labels, middle bar) of Berlin-based providers at various stages of the value chain (multi-ple assignments)



Source: Own representation based on own surveys.

When **turnover** and **employees** are included in the analysis, it becomes apparent that **software development and services in the field of robotics** are even more dominant in Berlin than the number of companies would suggest. It is also clear that **robot manufacturers** in Berlin are **mainly very small companies** and that their importance is not accurately reflected by the relatively large number of companies. This is in line with the assessment of experts interviewed, who consider Berlin to have a strength in the software sector and the number of robot manufacturers to be rather small. In addition, there are also many companies and employees in Berlin in the areas of “hardware suppliers and developers” and “system integrators & distributors”.

i

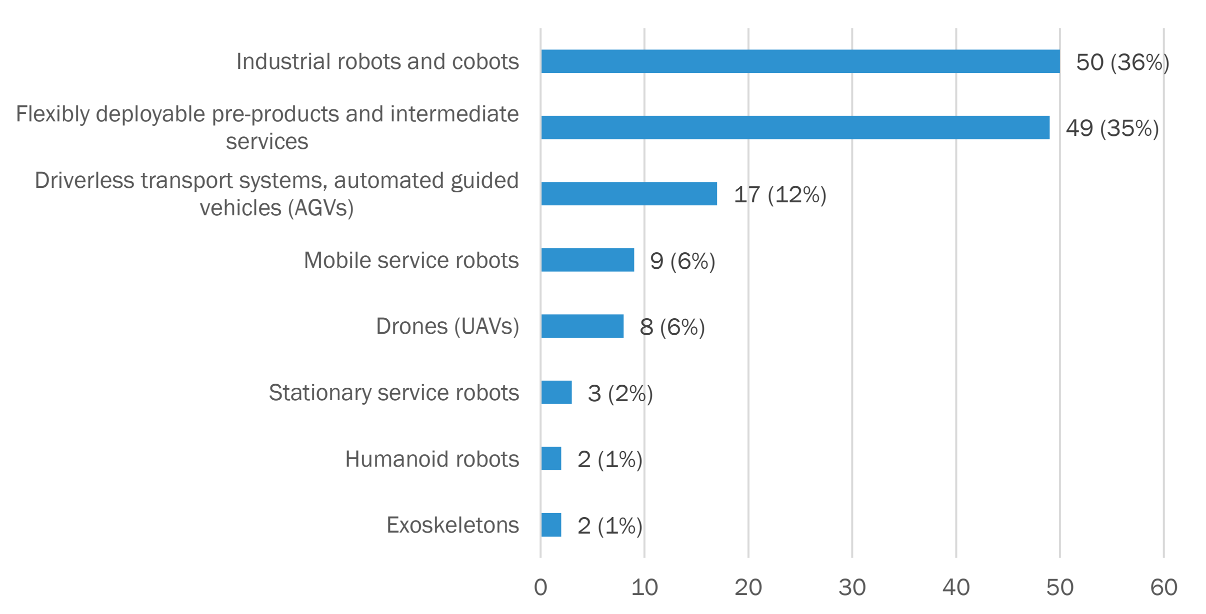
Wilhelm Dreusicke GmbH & Co. KG

This medium-sized company from Berlin is one of the players in the robotics sector that is both a user and a supplier. As a user, **Dreusicke** uses robots to manufacture its core product: rubber rollers and cylinders. As a supplier, it is primarily an integrator and distributor. As a certified system integrator for Universal Robots, it advises, designs, constructs and installs robot cells for various industrial applications, including drawer systems for machine feeding.

Suppliers and developers in Berlin by robotics type and application areas of their solutions

As Figure 11: Distribution of the 140 providers by type of robotics shows, many supplier companies in Berlin cannot be clearly assigned to a specific type of robot (49 companies – 35%). This is primarily due to the fact that they offer preliminary products (hardware components or software services) that can be used in many types of robots, reflecting the relatively high degree of versatility and, in some cases, the lower level of specialisation among the players. However, it is also clear that **robots used in industry are by far the largest sector** (50 companies – 36%), especially when the size of the companies is taken into account. This is an indication that the supplier companies in Berlin develop products that address the needs of industry. This impression is confirmed by existing local partnerships, such as those between **Wilhelm Dreusicke** and **Alfred Rexroth**. The gap that Berlin-based supplier companies can fill, especially for local user companies, is also clear: tailor-made solutions that require close cooperation and coordination.[51]

Figure 11: Distribution of the 140 providers by type of robotics



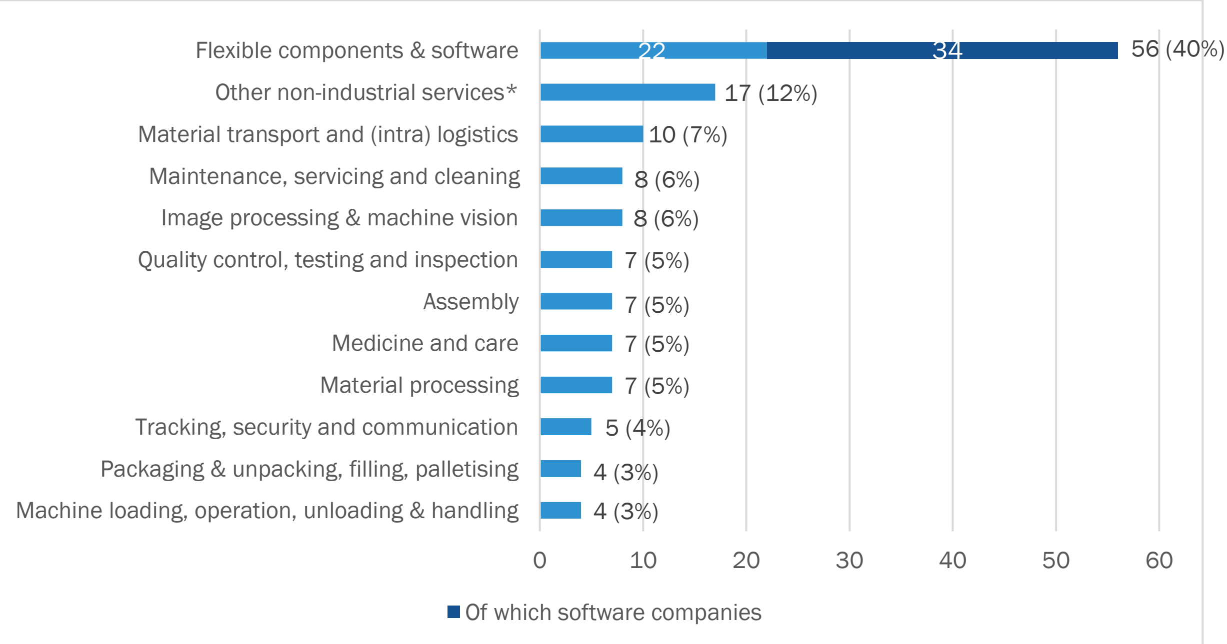
Source: Own representation based on own surveys.
The absolute number is given behind each bar and the corresponding share of the total is shown in brackets.

Industrial applications are followed at a considerable distance by other types of robots, with driverless transport systems (also automated guided vehicles – AGVs) accounting for the largest share (17 companies – 12%). Service robots, drones and humanoid robots currently represent a small minority. Driverless transport systems are also of great interest to industry, specifically in the field of intralogistics. Although many of the companies in this sector do not target industry as their target market, some do, such as **Easymile**, based in Berlin, which offers autonomous load transporters, among other things. However, such technical solutions are not aimed at smaller companies, for which intralogistics generally plays a subordinate role.

[51] Rexroth, Alfred (2024)

Figure 12 breaks down how provider companies are divided with regard to the various fields of application for which the robots, components or products they manufacture are developed or offered on the market. The analysis of the fields of application for robotics shows once again that many providers cannot be assigned to specific fields of application because they operate in upstream stages of the value chain. They account for the largest share **(40%) (flexible components and software)**. The majority of companies in this category (61%) are active in the software sector – an area in which companies can rarely be assigned to a specific field of application for robotics. Apart from that, this category includes many supplier and development companies that cover fields of application along the entire production chain, from intralogistics, machine feeding and material processing to packaging and palletising. Many machine and plant manufacturers also act as developers and system integrators, such as **Boschen-Oetting Automatisierungs-Bau** and **PNS Sondermaschinen. PNS** supplies machines for hose production and manufactures and maintains so-called banding robots, which are used in coil production. Berlin-based providers in the field of robotics work in many different areas of application. Among the specific industrial applications, none stands out strongly from the others.

Figure 12: Distribution of the 140 providers in Berlin across the fields of application for robotics



Source: Own representation based on own surveys.

*Other non-industrial services include, for example, robots for cleaning and passenger transport.

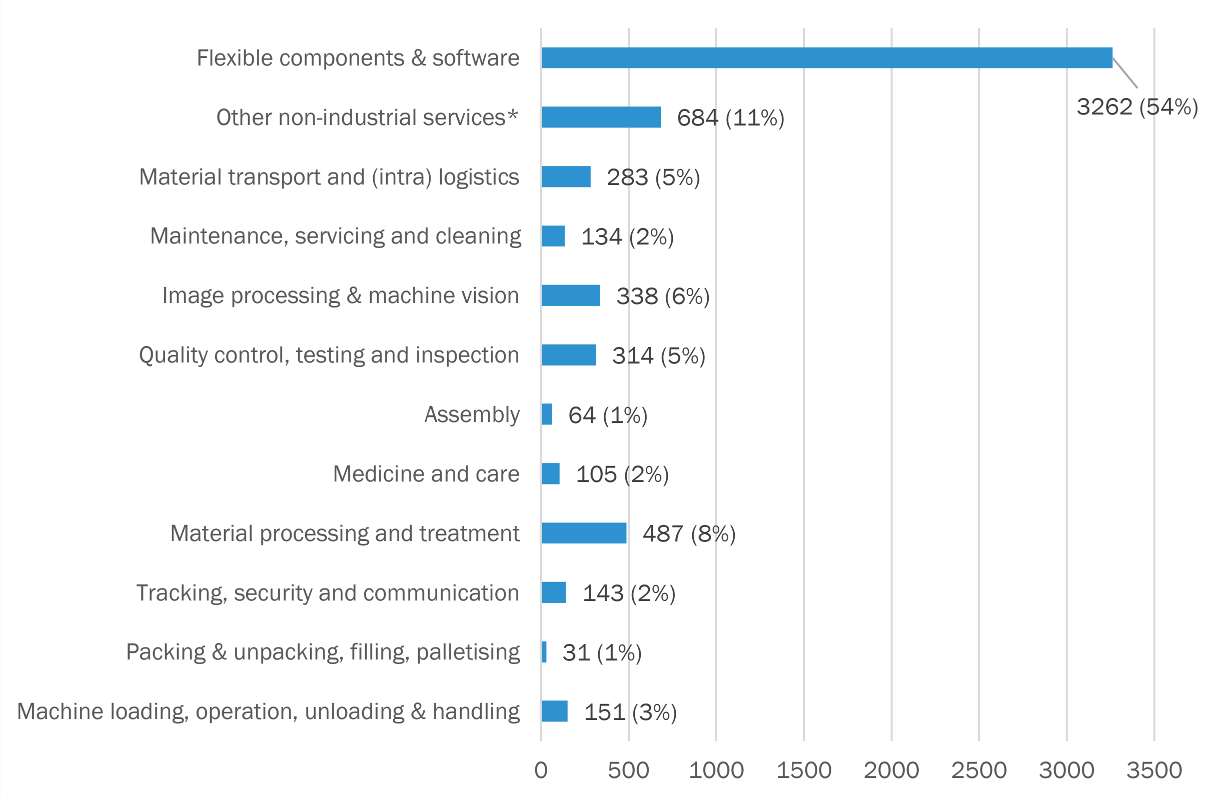
The absolute number is given behind each bar and the corresponding share of the total is sown in brackets.

Image processing and machine vision, which spans both software and hardware, accounts for a significant share **(6%)** and is often associated with the use of AI. Linked to this is the specific application of **quality control (5%)**, which also frequently relies on image processing and is therefore often associated with AI. Taken together, these two segments account for around **11**%, indicating a certain focus. Finally, mobility is also a significant factor, both in the form of material transport and (intra-) logistics (7%) and as part of other non-industrial services (12%), which includes autonomous driving in particular. Autonomous mobility is also intertwined with image processing & machine vision, because autonomous driving requires accurate perception of the environment. The focus described above shows that Berlin-based companies have a particular strength in these AI-related fields of robotics. These fields are at the forefront of technological developments and offer corresponding growth potential. Whether this growth potential can be exploited depends on many factors, including the availability of capital, the development of tailor-made technical solutions for existing needs and, related to this, the establishment of relationships with both innovation partners and customers.

Overall, it can be said that providers in Berlin serve an extremely wide range of application areas for robotics. No strong specialisation of the ecosystem as a whole can be identified at this level. Such a polyvalent ecosystem offers opportunities because, ideally, ideas and inspiration from different types of robotics and fields of application can cross-fertilise and leverage potential for cross-innovation. A broad-based ecosystem also provides a testing ground for discovering and developing one's own comparative strengths. This is supported by framework conditions that enable such experimentation, especially in the transfer between science and industry.

Medicine and care are represented to a lesser extent, accounting for 5% of the providers. However, there are a number of interesting companies in this area, such as the start-up **Bearcover**, which is developing a robot assistant for night shifts. Like this company, however, most providers of robotics in the medical and care sector are still very small and in the early stages of development. Only **Lifeward**, a developer of exoskeletons, stands out as a somewhat larger company in the segment. In the exoskeleton sector, **German Bionic** is also worth mentioning, which, as a successful scale-up, has now reached a medium size. However, the company is not primarily associated with the healthcare sector because its exoskeletons were specifically developed for industrial applications, which of course does not mean that they cannot also be used in nursing care, for example. This shows that there can certainly be crossover between the industrial and service sectors at the product level. If network structures take this into account and bring together players from as many areas as possible, this will support potential transfer aspects.

Figure 13: Distribution of employees from providers in Berlin across the fields of application for robotics



Source: Own representation based on own surveys.

* Other non-industrial services include, for example, robots for cleaning and passenger transport.
The absolute number of employees is indicated behind each bar, with the corresponding share of the total in brackets.

If the analysis is not limited to the number of provider companies that can be assigned to individual areas of application, but also takes into account the corresponding number of employees, the picture does not change fundamentally (see Figure 13). The category ‘flexibly deployable components & software’ increases by another 14 percentage points (54%) when viewed in this way, which shows that larger companies are also located here. In the other categories, particularly in the areas of ‘assembly,’ ‘maintenance, servicing and cleaning,’ and ‘medicine and care,’ the shares decrease when viewed in terms of employees. The three fields of application mentioned above therefore represent a disproportionately large target area for smaller robotics companies in Berlin.

Smaller companies, and start-ups in particular, are striving in new directions and breaking new ground, which is reflected to some extent in the figures mentioned above. These new avenues also include the development of novel markets. For example, Berlin-based companies are developing robots for sports training **(Reforce Robotics)** and for caring for dementia patients **(Momo Robotics)**.

Continuum Innovation

The small start-up is developing a highly mobile robot arm that, like an elephant's trunk, is capable of flexible three-dimensional bending. The arm is designed to enable the automation of tasks that previously had to be performed by humans due to challenging movement sequences, e.g. in the cleaning of machines in the chemical and pharmaceutical industries. The integration of advanced sensor technology and machine vision will enable the robot to work closely with humans in a safe manner. **Continuum Innovation** is currently in the product development phase and is already in contact with potential customers to identify their needs and requirements. As a finalist in the ninth Deep Tech Award, the company has attracted a great deal of attention. This enables it to establish important contacts and demonstrates the role that such competitions can play.[52]

Innovation is not limited to very small companies and start-ups. The somewhat larger company **Klero** (around 30 employees), for example, is expanding its target markets from the traditional industrial production line to areas such as medicine and healthcare, laboratories, the creative industries, trade fairs and training.

Suppliers of (AI-based) robotics in Berlin face all the same challenges as other companies, especially smaller ones. This applies in particular to financing and market access. These challenges are particularly acute for investment-intensive and innovative products, such as those from the (AI-based) robotics sector, which are often untried. In addition, there are a number of specific hurdles arising from the framework conditions, in particular the regulatory environment, which are discussed in section 5.

With regard to regional market access in Berlin, the discussions did not reveal any particular affinity of industrial user companies for Berlin-based suppliers and developers. Rather, small and medium-sized user companies often look for suppliers outside the region. Competition from established German and European providers is fierce. In some areas, they appear to be better positioned in terms of industry specialisation, size, proven experience, name recognition and cooperation structures. One factor here could be the lack of visibility of Berlin-based providers. This could be improved through networking formats and measures to raise Berlin's profile as a location for industrial (AI-based) robotics.

Interim conclusion: Robotics companies in Berlin

In summary, the robotics ecosystem in Berlin is characterised by the following factors on the supplier side:

[52] Deep Tech Berlin (n. d.)

- many small companies, an active start-up landscape and a few medium-sized players,
- the integration of AI, which is already well advanced in some areas, and a strong focus on industry,
- a high level of dynamism in the area of development and innovation, and
- few robot manufacturers in the narrower sense, many software developers and almost as many component manufacturers.

4.3 Science, research and development in Berlin's robotics ecosystem

In addition to the numerous research and development companies identified here among Berlin's robotics companies, there are around 30 scientific institutions working in the field of robot technology.[53] Furthermore, 65 professors are currently conducting research on AI in Berlin. Among the players are leading research institutions in the field of robotics, in particular the **Technical University of Berlin (TU Berlin),** but also application-oriented universities such as the **Berlin University of Applied Sciences (HTW) and the Berlin University of Applied Sciences (BHT)**, which conduct intensive research in the field of (AI-based) robotics in collaboration with several institutes. The TU Berlin focuses on robotics primarily at the software level with a strong emphasis on AI, but also addresses applied topics in industrial robotics. The universities integrate the hardware side more extensively, with a particular focus on humanoid robots. In addition, R&D institutes such as the **Fraunhofer IPK**, the **Berlin Institute for the Foundations of Learning and Data (BIFOLD),** the **German Research Centre for Artificial Intelligence (DFKI) Laboratory Berlin** and the **Zuse Institute Berlin (ZIB)** are important players and points of contact in Berlin's robotics research landscape.

Basic research, application-oriented research and education in (AI-based) robotics

There is still a great need for research in the field of (AI-based) robotics, from basic to applied research, especially in the broader spectrum of higher technology readiness levels.[54] The state of Berlin offers an **excellent higher education landscape**, characterised by leading universities such as the **Technical University (TU) Berlin**, the **Humboldt University (HU)** and the **Free University (FU) Berlin**, which play an important role in the fields of AI and robotics. For example, the TU Berlin offers courses on robotics and algorithms & data structures at its **Robotics and Biology Laboratory**, as well as the opportunity to test new applications.[55] In addition, the TU Berlin offers the module 'Industrial Robotics' for the degree programmes in Mechanical Engineering, Production Engineering and Information Technology in Mechanical Engineering, where students can acquire broad qualifications for the planning and implementation of robot-assisted automation tasks. Furthermore, practical robot programming is taught using examples from industrial operations.[56] At the FU Berlin, robotics is taught at the **Dahlem Centre for Machine Learning and**

[53] City of Berlin (n. d.)
[54] Asenkerschbaumer et al. (2023)
[55] Technical University of Berlin (n. d. c)
[56] Technical University of Berlin (n. d. b)

Robotics, which is affiliated with the Department of Mathematics and Computer Science.[57] There are specialist groups on topics such as:

- Intelligent Systems and Robotics
- Autonomous Vehicles
- Artificial and Collective Intelligence
- Logic and Automatic Proofs

Humboldt University offers a lecture on cognitive robotics, which covers software architectures for cognitive agents, environmental perception, actuators and sensor processing. The lecture is affiliated with the Faculty of Mathematics and Natural Sciences and the Institute of Computer Science. In principle, the degree programmes in engineering and mechanical engineering, electrical engineering, computational engineering and computer science also offer courses or have points of contact with the subject of robotics.

Networking in national and international cutting-edge research in the field of (AI-based) robotics

At the national level, the Federal Ministry of Education and Research (BMBF) has been funding the **Robotics Institute Germany (RIG)** for the next four years since 1 July 2024.[58] In addition to TU Berlin, many other renowned universities and research institutes are involved, such as TU Munich, the Karlsruhe Institute of Technology, RWTH Aachen University, the German Aerospace Centre, the Max Planck Institute for Intelligent Systems, the Fraunhofer Institute, the German Research Centre for Artificial Intelligence and others.[59] The RIG will serve as a central point of contact for cutting-edge research, training and innovation in AI-based robotics in Germany by connecting leading German robotics locations with outstanding research profiles. The RIG aims to represent German cutting-edge research internationally, develop joint training and further education measures for talent acquisition, and promote networking with relevant stakeholders in the robotics ecosystem. In addition, a national roadmap for excellent and transfer-relevant robotics research will be created to position the RIG as a point of contact at the international level.[60] Strengthening Germany's position in (AI-based) robotics and the Technical University of Berlin as a consortium partner in the RIG could also have positive effects specifically for the Berlin robotics scene, above all by raising Berlin's profile as a robotics location, which could attract capital, skilled workers, companies and customers.

TU, HU and **FU** have also joined forces with other partners to found the **Berlin Institute for the Foundations of Learning and Data (BIFOLD)**. As a central competence centre for fundamental AI research, it focuses in particular on big data management and machine learning, which are fundamental technologies for AI-based robotics.[61] Greater networking of Berlin's research on (AI-based) robotics with national and European institutions and research platforms has the potential to increase international visibility and research cooperation with Berlin's participation. Interesting

[57] Free University of Berlin (n. d.)
[58] Full partners of the RIG for joint research projects and industrial partnerships are: Technical University of Munich, Karlsruhe Institute of Technology (KIT), University of Bonn, Technical University of Berlin, Technical University of Darmstadt, University of Bremen, University of Stuttgart, RWTH Aachen University, Dresden University of Technology, Nuremberg University of Technology, German Aerospace Centre (DLR), the Max Planck Institute for Intelligent Systems, Fraunhofer Institute for Manufacturing Engineering and Automation IPA, System Engineering and Image Analysis IOSB, Fraunhofer Institute for Material Flow and Logistics IML and the German Research Centre for Artificial Intelligence (DFKI). The RIG consortium also includes 19 associated partners, who primarily participate in various events.
[59] Robotics Institute Germany (n. d.)
[60] Federal Ministry of Education and Research (2023)
[61] Technical University of Berlin (n. d. a)

institutions at the national level include the Max Planck Institute for Intelligent Systems in Tübingen, the German Research Centre for Artificial Intelligence with locations throughout Germany, the Fraunhofer Institute for Intelligent Analysis and Information Systems in Sankt Augustin, the Centre for Data Science at the University of Mannheim, and the Institute for Computer Science at the Ludwig Maximilian University in Munich. At European level, the European Laboratory for Learning and Intelligent Systems, founded in 2018, is particularly noteworthy. This is a pan-European AI network that focuses on basic research, technical innovation and the societal impact of and through AI. Other European scientific players, such as the Centre for Artificial Intelligence at the University of Amsterdam and the University of Cambridge, are also organised within this network.

Berlin has established itself as an internationally networked metropolis that attracts talent and world-leading scientists through numerous conferences and research programmes. This international networking contributes significantly to the dynamism and innovative strength of Berlin's research landscape. With regard to local industry, several interviews emphasised that there is still room for improvement in technology transfer between research and industry. Some companies expressed a desire for a stronger application orientation in line with the needs of (medium-sized) industry in the region and criticised the overemphasis on theoretical concepts and the lack of focus on the needs and issues of the local economy in the field of AI and robotics research. The creation of concrete, practical projects at the location is seen as an important step in promoting the innovative strength of the location. There is potential at the location, for example, to establish cooperation structures by means of targeted incentive systems for research that promote the translation of scientific results into marketable applications and strengthen or create communicative interfaces between academic research and industrial needs.

(AI-based) robotics at the BHT

Of particular note is the combination of computer science, mechanical engineering and electrical engineering found in the degree programme in humanoid robotics offered by the **BHT** and in the **HARMONIK research group**. This interdisciplinary approach to comprehensive training in robotics is rare. Elsewhere, robotics is often linked to computer science and neglects the hardware component. The BHT also offers other location-specific specialised degree programmes such as Computational Engineering and Design, Automation Systems and Technical Computer Science – Embedded Systems. In addition to traditional courses such as mechanical engineering and computer science, Berlin's wide range of courses also includes specialisations such as information technology in mechanical engineering, automotive systems, computational neuroscience, design & computation and scientific computing. Local companies benefit from this in two ways: through the training of skilled workers at the location and opportunities for joint research activities and cooperation.

In addition, the Berlin University of Applied Sciences (BHT) opened the '**House of Robotics**' on Kurfürstenstraße in 2025. This centre focuses on research, development and application of technologies in the fields of robotics and artificial intelligence. The aim is to bring together scientists, companies, start-ups and other industry players in an interdisciplinary manner in order to intensify cooperation and promote the exchange of ideas. The activities on offer include workshops, seminars, research projects and practical applications that impart both theoretical knowledge and practical experience.

Non-university business-oriented research and transfer in the field of (AI-based) robotics

In addition to academic education, non-university and business-oriented research institutions such as the **Fraunhofer Institute for Production Systems and Design Technology (IPK)** and the

German Research Centre for Artificial Intelligence (DFKI) play a key role in promoting innovation in robotics. Together, these institutions form a strong research ecosystem for AI-based robotics in Berlin, characterised by interdisciplinary approaches and cooperation between science and industry. At the same time, there is a general lack of application and transfer orientation within scientific research in these areas.[62] According to the interviews, this gap also exists in Berlin despite the existing structures. In order to bridge the gap between theory and practice, it is essential to promote basic and application-oriented research while implementing or strengthening targeted measures to promote and support transfer. Only an integrative approach can ensure that innovative research results actually reach industry and society.

The interviews highlighted that knowledge exchange between universities and industry, supported by initiatives such as the **Merantix AI Campus Berlin**, the **AI Campus Hub Berlin** and the **StarTUp Incubation** at TU Berlin, contributed significantly to the practical implementation of research results. According to statements from the workshop, the incubators offer a good range of services and provide very effective support for academic spin-offs. Many working students from universities are also active in start-ups and small companies, which strengthens the transferability of research results to the economy. These activities need to be further developed. To this end, greater understanding and coordination of requirements between industry and academia are essential. Consolidating existing cross-sector communities such as the Berlin Robotics Network into a transfer-oriented innovation network can support the continuous identification and communication of market needs and requirements and develop formats that strengthen the exchange between sectors on working topics and the market orientation of research topics and spin-offs.

Hubs and flagship projects for market-oriented development of (AI-based) robotics

Important intermediaries and spaces with activities and players in the field of (AI-based) robotics are Berlin's **future locations** and **campus projects**. The latter play a special role as interfaces between science and industry, especially in the development of disruptive technologies such as robotics. They promote the exchange of ideas, resources and know-how for the development of innovative solutions that are tailored to the needs of industry and at the same time integrate the latest scientific advances. Important future locations in this context are the **Urban Tech Republic** and **Siemensstadt**, with the **Werner-von-Siemens Centre for Industry and Science**. Other initiatives that are particularly relevant in the context of robotics are the **Motion Lab** and the **Human.VR.Lab**, the **Berlin Center for Digital Transformation** and the **Reallabor of the Regional Transformation Network for the Automotive and Supplier Industry Berlin-Brandenburg (ReTraNetz-BB)**. These future locations and initiatives are of great importance as they act as catalysts for innovation and provide a platform where interdisciplinary cooperation can flourish. By integrating research, development and practical applications, they enable companies to engage with new technologies at an early stage while taking the needs of society into account. The strengths of these institutions lie in their ability to create an agile environment in which prototypes can be developed, tested and iterated quickly. In addition, they contribute to the training of qualified specialists by offering practical learning opportunities and research projects.

Another example of an initiative that supports the development of new technologies through industry-specific collaboration between start-ups, companies and research institutions is **Z-Lab**, an incubator and open innovation hub of the Zeppelin Group in Berlin for digital solutions to increase productivity and simplify work in the construction industry. There, the exchange of know-how is promoted and opportunities are created to jointly develop and test innovative robotics solutions for the construction industry. The **Bosch Innovation Campus Berlin** also enables start-ups to

[62] Asenkerschbaumer et al. (2023)

quickly test and iterate their products, thereby increasing their marketability. They also gain access to the resources and expertise of an established industry partner. Also worth mentioning is **The Drivery**, an innovation hub in Berlin that is home to numerous start-ups such as **N Robotics** and **Enway**, which are working on advanced mobile and autonomous robotics solutions. The presence of such large industrial partners as sparring partners for innovative tech start-ups and spin-offs was cited in interviews as a decisive factor in the development of the robotics ecosystem. However, large industrial anchor partners are less represented in Berlin than in robotics locations such as Munich or Stuttgart. This results in a greater need for networking with such industrial locations. At the same time, stronger links with established medium-sized companies in the region should also be promoted.

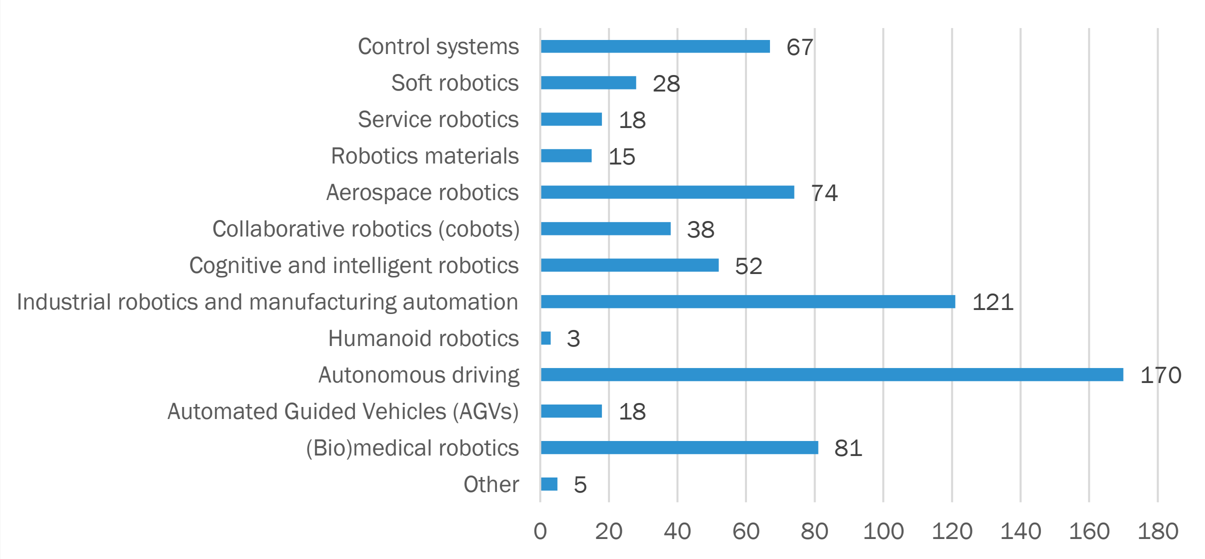
Berlin is significantly better positioned when it comes to cooperation with software companies. **wattx** is a relevant example in this context. As a company builder, wattx operates in the capital and works closely with various industries to develop innovative products and companies. The company focuses on the development and integration of software and brings specific experience in the fields of artificial intelligence and manufacturing. In addition, waxx offers comprehensive services in the field of business development. This practical orientation and interdisciplinary cooperation with partners from different sectors contribute to the creation of tailor-made solutions that integrate both technological innovations and market-relevant business concepts.

Publication analysis in the field of (AI-based) robotics with industry relevance in Berlin

An analysis of scientific **publications with a clear industrial relevance** from the **Open-Alex** database[63] between 2020 and 2025 reveals several key areas in Berlin's robotics research landscape. According to the analysis, researchers at Berlin-based scientific institutions published **690 scientific publications** related to industrial robotics during this period. In 2024, the research topic of robotics recorded significantly more publications (**160 publications**) than in previous years (between 112 and 136). The abstracts and titles of the publications were classified for analysis in several dimensions according to the type of robotics or robotics research field in order to obtain a picture that is approximately comparable to the categories in section 3. **170 of the publications** can be assigned to **autonomous driving** (see Figure 14). The second largest focus is on **industrial robotics and manufacturing automation** with **121 publications**, accounting for 18% of publications in the field of robotics. In addition, according to the publication analysis, **(bio)medical robotics** and **aerospace robotics** are relevant research areas at the location. Comparatively small, albeit growing, research fields in Berlin are **cognitive and intelligent robotics** with **52** and **collaborative robotics (cobots)** with **38 scientific publications** at the location. In the field of **collaborative robotics**, only **3** to **6 publications** were published in each of the years 2020 to 2023 that can be primarily assigned to this field. In 2024, there were already **17**.

[63] Open Alex (n. d.)

Figure 14: Scientific publications in Berlin by robotics category

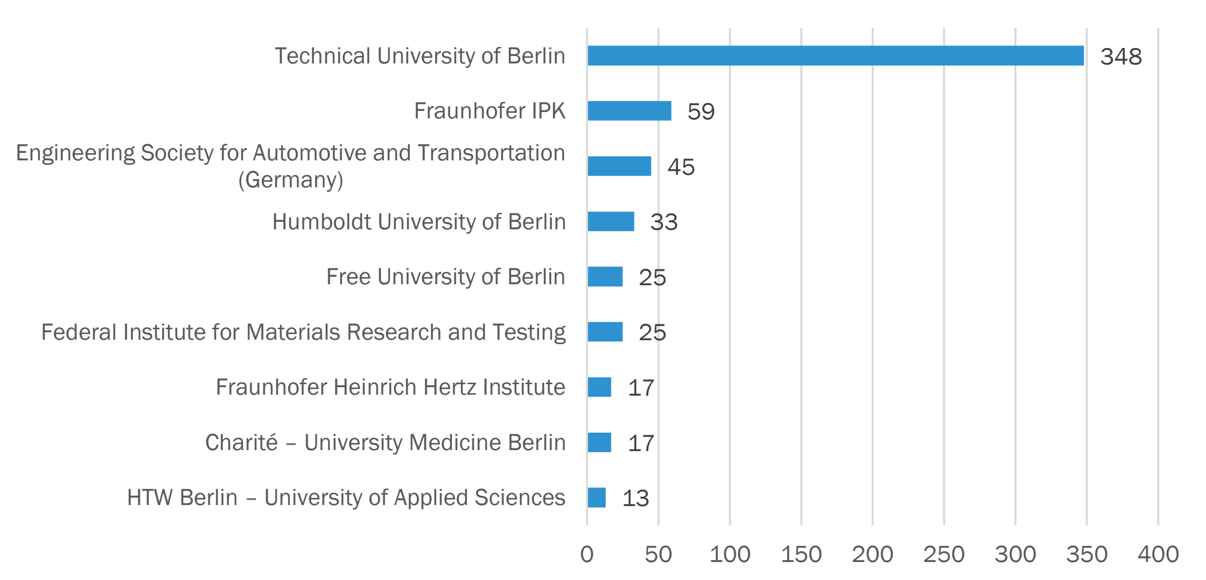


Own representation based on the Open Alex publication database.[64]

Around half of the scientific publications relating to robotics and relevant to industry were produced by researchers at the **TU Berlin (348)**, followed by the **Fraunhofer IPK** with **59 publications**, the **Ingenieurgesellschaft Auto und Verkehr (45)**, (main field of research: autonomous driving), the Humboldt University of Berlin (33), the **Free University of Berlin (25)** and the **Federal Institute for Materials Research and Testing (25).** Overall, TU Berlin and Fraunhofer IPK lead the field of research in several industry-relevant categories, with TU Berlin at the forefront in areas such as **industrial robotics and manufacturing automation, aerospace robotics**, and **cognitive and intelligent robotics**. In the field of **collaborative robotics**, however, the Fraunhofer IPK published the most publications **(18).** The following figure lists the top players.

[64] Open Alex (n. d.)

Figure 15: Berlin institutions with the most publications in industry-relevant robotics



Own evaluations based on the Open Alex publication database. [65]

A comparison with selected robotics locations in Europe (Munich, Stuttgart, Saxony, Odense, Delft/Rotterdam) shows that Berlin **(690)** ranks ahead of Odense **(282)** in terms of the number of robotics publications, but behind Saxony **(943)**, Delft/Rotterdam **(1540)** Stuttgart **(1,586)** and Munich **(2,431)**. The localisation coefficient indicates whether the publications of a location in a specific field represent an above-average (>1.0) or below-average (<1.0) share of the total number of publications of all locations examined. Due to the relatively small total number of publications, relative focal points can be seen in some fields, such as industrial robotics (1.2) and service robotics (1.9), cognitive and intelligent robotics (1.1) and collaborative robotics (1.1) (see Table 8 in the annex). Furthermore, a relative comparison with these leading European robotics locations shows that Berlin is only at the forefront in a few cases, but in most cases ranks among the top three of the six locations examined. This confirms the picture of a comparatively less specialised and therefore broad-based research landscape in Berlin, which offers research expertise in a wide range of robotics topics. The detailed results for the localisation coefficients in the various research areas of robotics can be found in Table 8 in the annex.

Patent applications in the field of (AI-based) robotics in Berlin

Patent applications provide insight into the application orientation of regional innovation processes, as they show how research results are put into practice. They thus highlight potential applications and technological developments at the location. To this end, patent applications in the **PATSTAT database**[66] in Berlin in the field of (AI-based) robotics were evaluated based on the patent descriptions and compared with selected robotics regions in Europe. As the analysis of the patents shows, **Berlin (72)** has a substantial, albeit small, number of patent applications in the field of (AI-based) robotics since 2015, which is higher than that of **Saxony (53)** and just behind the robotics regions of **Odense (186)** and **Delft/Rotterdam (101)**. However, it is equally clear that **Stuttgart (653)** and **Munich (1519)** have a significant lead over Berlin in terms of patent

[65] Open Alex (n. d.)
[66] PATSTAT (n. d.)

applications in the field of robotics. This is also due to the fact that many large robotics suppliers and many large industrial companies are located in and around Munich and Stuttgart, which are often the main drivers of patent activity due to their resources and broad-based R&D activities. Patents are usually filed at the company's headquarters, which in the case of large-scale industry is rarely in Berlin. This is consistent with the findings of the Meyer Industry Research study (2025) cited above, which found that the leading robot manufacturers in Germany are located in the south (and west) of the country.

It should be noted that the patent analysis only covers patents that can be directly assigned to (AI-based) robotics through semantic evaluation – many patents that may be relevant to robotics upstream or peripherally are not covered. It can therefore be assumed that there is a higher overall number of patents with specific relevance to (AI-based) robotics at all locations examined. On the supplier side, Berlin's robotics ecosystem is characterised by the fact that there are many suppliers in the software sector and, to a lesser extent, in the components sector, but few robot manufacturers in the narrower sense. Against this background, it is not surprising that Berlin does not occupy a leading position in terms of patents in (AI-based) robotics.

Funded research and development in the field of (AI-based) robotics

In order to obtain an overview of the thematic R&D priorities and players involved in innovation funding in the state of Berlin and to compare them with the robotics locations in the cities of Munich and Stuttgart and the state of Saxony, federally funded **research and development projects** were analysed. The data is based on the **Federal funding catalogue (FÖKAT)**, [67] which contains most of the funded R&D projects from federal funding programmes. The analysis examined projects that were launched in 2021 and are still ongoing or have already been completed by February 2025. An analysis of the R&D projects funded by the federal government in the field of technology and innovation promotion shows (see Figure 16) that since 2021, companies and scientific institutions in the state of Berlin have launched around **85** innovative individual projects or sub-projects in the field of (AI-based) robotics – a share of 6% for Germany as a whole. Nationwide, **1,416** individual R&D projects or sub-projects in the field of (AI-based) robotics were launched in the same period. The robotics projects in the state of Berlin have a total funding volume of **€51.2 million**, while nationwide, a funding volume of **€782.2 million** was invested in the period under review (Berlin's share: 7%). In absolute terms, Berlin is competitive with leading German robotics locations such as Munich, Stuttgart and Saxony in the field of funded projects in the technology field of (AI-based) robotics: In Munich, **€54.9 million** was raised for **83** R&D projects in the same period, in Stuttgart **€47.4 million** for **85** projects, and in Saxony **€56.4 million** for **146** projects in the field of AI-based robotics.[68]

Around **60%** of the R&D sub-projects on robotics in Berlin are carried out by companies and just under **40%** by science and research institutions, with a similar distribution of funding. This distribution of funding projects and funds in favour of companies is quite unusual in funding data analyses, especially in urban science locations, and shows that Berlin-based companies are active in (AI-based) robotics research and are particularly successful in attracting funding. The high level of participation by companies in R&D projects also indicates that robotics research and development at the location is practice-oriented. At the same time, it points to active interactions and networks between academia and companies. This is an indicator of a dynamic innovation landscape in the field of (AI-based) robotics in Berlin, which enables theoretical research results to be

[67] Federal funding catalogue (FöKat) (n. d.)
[68] The comparison examined funded R&D projects in the same period whose implementing bodies are located in the following regional areas: Munich: City of Munich, Munich district; Stuttgart: rural and urban districts in the Stuttgart region; Saxony: Federal State of Saxony.

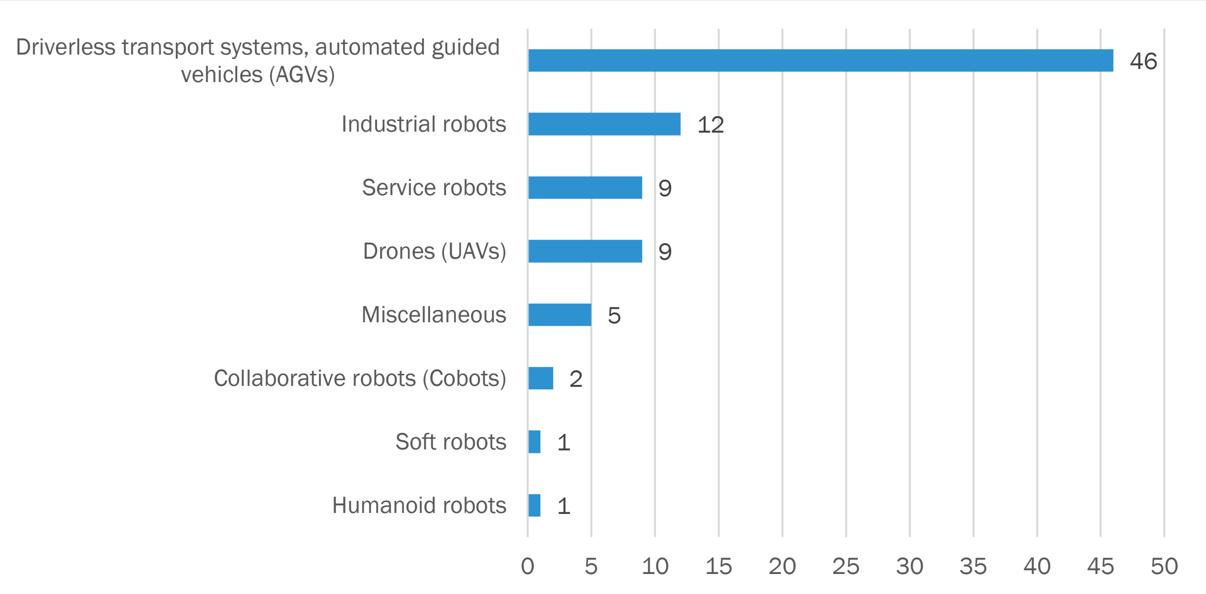
efficiently transferred into marketable technologies through entrepreneurial cooperation. Berlin thus benefits not only from a strong scientific foundation, but also from an active and innovative business landscape that is willing to invest in future-oriented technologies.

Overall, only about **26%** of the funded R&D projects in robotics in the state of Berlin have a recognisable link to industrial applications. Among the R&D projects carried out by companies, the share of projects with an industrial focus is only **31%,** which means that, compared to the industrial focus of the suppliers funded research and development, a relatively small proportion is aimed at industrial value creation. This reveals shortcomings compared to other more industrial robotics locations such as Munich **(47%),** Stuttgart **(74%)** and Saxony **(49%),** which have a significantly higher proportion of R&D projects with an industrial focus. It can be seen that funded research in Berlin invests more heavily in basic research and services (especially mobility) and comparatively less in direct industrial applications. Given the broad-based and predominantly industrially oriented robotics landscape at the location, there are great opportunities to attract more funding for R&D projects in the field of industrial robotics applications.

The funded projects (see Figure 16) focus on research and development of technologies for autonomous vehicles and driverless transport systems (AGVs). In second place are R&D projects focused on industrial robotics. Compared to the distribution of robot types among companies in section 4.2, mobile robots and driverless transport systems (AGVs) play a significantly greater role in funded research and development than providers. Twenty-two of the 85 projects are industry-related and focus on industrial robots. Other types of robotics relevant to industry, such as cobots, do not form a focal point here (two R&D projects).

Overall, around **33%** of the 85 R&D projects identified (see Figure 16) are researching artificial intelligence in the context of AI-based robotics, primarily in the areas of image processing and predictive maintenance and inspection. In projects with an industrial focus, **more than half** of the R&D projects are AI-related. This indicates that artificial intelligence is now seen as an essential component of industrial robotics innovations at the location, especially in the context of advanced image processing methods and in the field of maintenance and inspection. The fact that Berlin's R&D landscape is highly competitive in the field of AI-based robotics is also evident when compared to other robotics locations with a similar proportion of AI-related robotics projects, such as Munich **(40%)**, Stuttgart **(34%)** and Saxony **(26%)**.

Figure 16: Number of R&D projects funded by the federal government according to the type of robotics re-searched in Berlin



Source: Own representation based on FöKat.[69]

No particular focus on industrial application sectors or fields can be identified in the federally funded research and development in Berlin on (AI-based) robotics. Although metalworking, the optical industry and the construction industry each have the most projects with three R&D projects each, there is overall great diversity in the industrial fields of application: among other things, the projects address the chemical industry, (intra)logistics, the aerospace industry, the energy industry and environmental technology, as well as the automotive and textile industries.

An R&D concentration index, which compares the number of projects per capita and the volume of funding per capita in Berlin with the number of projects per capita and the volume of funding per capita in another region, allows a weighted comparison between regions and higher-level areas (see Table 3).[70] The calculation shows that, compared to the federal government, **1.2 times more funded innovation projects** were carried out in Berlin between 2021 and 2025 in the field of (AI-based) robotics. In terms of funding volume, **1.4 times more funding was obtained in the state of Berlin than the federal average**. Since most of the projects are joint projects involving companies and scientific institutions, the high concentration of R&D in the field of (AI-based) robotics indicates that there is above-average collaborative research and development activity in this field in the state of Berlin and that the location has an R&D focus in this technology area. A high concentration of projects and funding can be attributed to many factors, including a broad and diverse scientific base at the location, well-networked research institutions and stakeholders, and specialised expertise or effective strategies for attracting funding in the technology field. These conditions create attractive conditions for companies and researchers to promote the

[69] Federal funding catalogue (FöKat) (n. d.)

[70] The number of projects per capita and the funding volume per capita in this analysis are calculated from the total funding amount or number of projects in a region divided by the number of employees subject to social insurance contributions. The index is calculated from the per capita total of the region under review divided by the per capita total of another or higher-level region.

transfer and broad diffusion of innovative developments in the field of (AI-based) robotics at the location into (industrial) applications.

Table 3: Weighted index for R&D concentration in the state of Berlin compared to other regions

	Federal	Munich	Stuttgart	Saxony
R&D concentration (number of projects) in Berlin compared to	1,2	0,8	0,8	0,7
R&D concentration (funding) in Berlin compared to	1,4	0,7	0,8	0,9

Source: Own representation based on FöKat.[71]

In direct comparison with the strongest German robotics locations such as Munich, Stuttgart and Saxony, the weighted index shows that Berlin lags slightly behind these regions in terms of R&D concentration in (AI-based) robotics (see Table 3). This suggests that, although Berlin has above-average R&D capacities and potential in the field of (AI-based) robotics compared with the total R&D activities in robotics in Germany, it has not yet achieved the same density and intensity of funded R&D activities as the selected comparison regions in the field of robotics technology. With regard to the potential of the location, however, the analysis of funded R&D projects nevertheless demonstrates Berlin's competitiveness and shows that strategic investments in strengthening scientific-industrial R&D networks and increasing project activities can help to further consolidate Berlin's position in national and international comparisons and expand its innovative capacity in the field of industrial and (AI-based) robotics.

i

Interim conclusion: Science, research and development in the field of (AI-based) robotics in Berlin

In summary, it can be said that the robotics ecosystem in Berlin has a critical mass of players in the field of science and research and is also relatively strong in terms of R&D activity in the field of robotics compared to the rest of Germany. There is room for improvement, particularly in terms of industry orientation and research transfer:

- Berlin has an outstanding university and college landscape in the field of (AI-based) robotics, including the Technical University of Berlin, which produces a large proportion of the publications in this field in Berlin.
- Berlin also has an outstanding landscape of research institutes and networking facilities in the field of (AI-based) robotics.
- Compared to other cities in Germany and abroad, Berlin produces many relevant publications in the field of industry-related (AI-based) robotics, particularly in the areas of autonomous driving, industrial robotics and biomedical robotics.
- One weakness is the small number of large local research and development companies, which is reflected in lower patent figures compared to German robotics centres such as Munich and Stuttgart.

[71] Federal funding catalogue (FöKat) (n. d.)

- Funding for (AI-based) robotics in Berlin is significantly higher than the national average, with autonomous driving in particular receiving support for many projects. However, funding for (AI-based) robotics, and especially for industry-related (AI-based) robotics, lags significantly behind leading locations such as Stuttgart and Munich.

5 Framework conditions for (AI-based) robotics in Berlin

5.1 Regulatory framework for (AI-based) robotics

Product Safety and Occupational Safety Act, Machinery Directive (Machinery Ordinance)

Germany has a wide range of regulations governing the field of robotics (see Table 4). The **Product Safety Act** regulates the safety requirements for robots and other products on the German market. It is also the national implementation of the **European Machinery Directive**, which is supplemented by the German Machinery Ordinance. In principle, the Act harmonises the placing of machinery (including robots) on the market in the EU. In addition, minimum standards for basic safety and health protection requirements are defined.[72]

Table 4: Schematic representation of relevant legal frameworks for robotics in Germany and the EU

Regulatory level	Instruments
Germany	Product Safety Act, Occupational Safety and Health Act, Road Traffic Regulation, Federal Data Protection Act, Act on Copyright and Related Rights
EU	European Machinery Directive, European General Data Protection Regulation, Data Act, AI Act

Own representation.

The expert discussions revealed that the current Production Safety Act and the EU Machinery Regulation, which will come into force in 2027, are considered by some in the robotics ecosystem to be overregulated and an obstacle to the industrial marketing and implementation of innovative robotics technologies. This is particularly true with regard to AI integrations, as the new regulation imposes far-reaching safety requirements on, among other things, the use of AI and cybersecurity risks. From the respondents' point of view, these strict requirements complicate the implementation process for (AI-based) robotics solutions.

This issue is also addressed by the Federation of German Industries (BDI). Although it welcomes the EU Commission's legislative proposal, which creates a value-based framework for dealing with AI and focuses on high-risk AI systems, it sees room for improvement, particularly with regard to the overly broad definition of high-risk AI systems. The BDI calls for industrial AI applications to be exempted from the regulation in order to avoid overregulation that could hinder innovative developments. This is particularly important because an appropriate framework will help companies

[72] European Union (2006)

combine their industrial strength with the opportunities offered by AI and increase their competitiveness vis-à-vis countries such as China, the United States and Israel.[73]

Overall, two main problem areas can currently be identified:

Firstly, **personal manufacturer liability** on the part of management when introducing new technologies is seen as a significant risk, particularly for SMEs. This is especially true when legal regulations do not take technical specifics into account and allow for considerable leeway in interpreting breaches of duty. If an AI-controlled system causes an error, responsibility for this can be attributed directly to those responsible for managing the business.[74] This leads to reluctance in the development and marketing of (novel) robotics integrations, as concerns about legal consequences are a deterrent. AI further complicates the situation, as it is unclear who exactly is liable in the event of damage (software developer vs. robotics manufacturer). This results in significant liability risks for users. Clear guidelines for legally compliant AI systems and simplified communication of these guidelines (to a lesser extent) are necessary to create legal certainty, reduce the conformity assessment and compliance effort, and make business activities more predictable.

Secondly, in addition to the lack of clarity in the provisions, the **inadequate adaptation of legislation to the current state of technology** is also highlighted. Although AI offers considerable innovation potential, its use in regulatory technology is currently very limited. A key problem is the need for statistical risk assessment in decision-making, which is often considered potentially error-prone in a safety-relevant context (§ 3 ProdHaftG).[75] According to the applicable regulation, even a low probability of functional failure means that AI-controlled machines cannot be approved. A factor here is that AI-controlled robots are often regarded as 'black boxes' because their decision-making processes are not transparent to outsiders. Uncertainties about which robots will pass certification are a barrier to investment. To counteract this dilemma, the AI Act has defined clear requirements for transparency, traceability and safety testing since 2024 in order to promote the responsible use of AI technologies (see section: Data protection laws, data security and AI Regulation). However, this supplements existing laws on technical requirements and does not address problems resulting from inappropriate requirements for industrial robots, for example. In the context of AI, this concerns, for example, transparency and documentation requirements that are difficult to implement or demanding risk assessments.[76]

Certification processes require financial and time resources. This is a major hurdle, especially for small businesses, because it makes experimentation and rapid iteration unattractive. The interviews confirm that the requirements and challenges in the area of standardisation and certification of robotics systems, particularly with regard to safety aspects, are currently considerable.

In order to better exploit the potential of AI-based robotics, experts emphasise that existing legal frameworks need to be adapted. These currently mainly address machines without artificial intelligence. A solution to this problem is being worked on at EU level. Among other things, consideration is being given to introducing legal personality for AI systems, which could even release manufacturers from liability.[77] The results of the negotiations on this issue are still pending.

In addition to the Product Safety Act, further regulations are relevant for (AI-based) robots (see Table 4). For example, the **Occupational Safety and Health Act** contains provisions to protect

[73] BDI (2021)
[74] Lawyer search service (2024)
[75] Bitkom (2020), Schürmann Rosenthal Dreyer (2024)
[76] IHK Munich and Upper Bavaria (n. d.)
[77] Herfurtner (n. d.)

employees from hazards when using robots in the workplace. It stipulates that employers must take appropriate measures to ensure the health and safety of employees when they work with robots. It is therefore particularly relevant for the use of collaborative robots and interacts directly with corporate efforts to make robots safer. This applies to both the software and hardware aspects of sensor technology. Berlin's robotics providers have a certain focus in this area and possess the relevant expertise. This presents opportunities for growth for these companies.[78]

Data protection laws, data security and AI regulations

Further regulations are relevant for the AI component of AI-based robotics. The **Federal Data Protection Act** and the **Act on Copyright and Related Rights**, the **European General Data Protection Regulation (GDPR)**, the **Data Act** and the **AI Act** are relevant for AI developers because AI must be fed with large amounts of data and processes large amounts of data during operation.[79] The collection and processing of personal data in particular is subject to strict requirements. Industrial data classified as machine data does not fall directly under the scope of the GDPR. However, there is machine data, e.g. from human-operated motor vehicles, where it is not entirely clear which regulations apply. This uncertainty regarding the relevant legal norms is in turn a hindering factor for the use of technology. The European Commission estimates that making previously inaccessible industrial data usable could increase the EU's GDP by €270 billion by 2028. The exchange of industrial data is particularly relevant in the field of robotics in order to adapt production to the digital transformation through the use of machine and artificial intelligence. The Data Act grants users data access and data usage rights.[80] This means that they can control their data and its use and, if necessary, pass it on to third parties. Employees must therefore give their consent if their personal data is collected and evaluated when using AI-based cobots. This can result in high transaction costs, as complex work processes may involve the collection and processing of both industrial and personal data.

Data and general cyber security in the field of (AI-based) robotics is also described in the discussions as a major challenge for the use of technology. (AI-based) robots collect and process a large amount of sensitive (environmental) data. In addition to visual data, this can also include movement and coordination data, acoustic and voice-based data, or network and metadata. Control over this data is essential to comply with data protection guidelines and ensure user trust. Here, robotics players find themselves largely dependent on large American tech companies, which may in turn pursue their own interests in data use. Companies expressed concerns that they often have no direct influence on the security standards and practices of these corporations.

The expansion of shared data spaces for secure data exchange, such as **Catena-X** and **Manufacturing-X**, and the corresponding **data sovereignty** are seen as key opportunities. In addition, German users and developers are taking further measures to reduce their dependence on large American tech companies. They are relying on their own solutions and using open-source software, which offers them greater flexibility and transparency in terms of security standards.[81] They are also investing in cybersecurity measures and training to comply with data protection guidelines and strengthen user trust. These strategies promote data sovereignty and help create a secure environment for data exchange.

The **AI Act** came into force in August 2024 and aims to guarantee the fundamental rights and safety of users of AI systems. This should strengthen trust in the technology and promote

[78] Süddeutsche Zeitung (2025)
[79] Intersoft Consulting (n. d. b), Intersoft Consulting (n. d. a)
[80] German Chamber of Industry and Commerce (n. d.)
[81] Karlitschek, Frank (2024)

innovation and investment. The law classifies AI applications into different risk categories. Applications with the lowest risk (e.g. AI-based video games or spam filters) are not subject to additional regulation for the time being.[82] Applications with limited risk (e.g. chatbots) are subject to specific transparency requirements, e.g. that users know they are interacting with AI systems. Additional requirements apply to high-risk AI systems. This concerns the use of AI in critical infrastructure or healthcare, for example. The use of AI in these areas must always be subject to human supervision. AI applications whose risks are classified as unacceptable are prohibited. These include social rating systems and manipulative AI. This results in extensive reporting obligations for industry. Companies that develop or use AI systems are required to assess their applications according to defined risk categories and to meet specific requirements. Particularly high-risk applications require comprehensive measures, including the implementation of risk management systems to identify and mitigate risks, ensuring data quality, and creating detailed technical documentation to demonstrate compliance. In addition, companies must ensure transparency by guaranteeing the traceability of AI functions and providing relevant information to users. Continuous monitoring of system performance and incident reporting are also necessary. These requirements aim to promote safety, transparency and the protection of fundamental rights. Companies must therefore adapt their development and implementation processes to meet the requirements of the AI Act.[83] The regulation of basic AI models such as ChatGPT, which underpin many generative applications, is problematic. Depending on their computing capacity and use, these models are subject to different regulations on transparency, cybersecurity and energy efficiency. There are also concerns about practical implementation: the application to specific borderline cases would be left to the courts. For example, different mechanisms for checking whether an AI system complies with the law could distort competition. Critics also complain that the AI Act could hamper AI innovation, particularly in small and medium-sized enterprises. They cite the potentially high costs of complying with EU regulations as the reason for this.[84]

Certification and standards

With regard to the regulatory framework, discussions show that developers and users of AI-based robotics face challenges because the implementation of highly specialised AI solutions in robotics is complex and costly in regulatory terms. User companies often receive robotics solutions that are not yet standardised and must adapt them to the specific requirements of their operations. At the same time, developers of AI-based robotics face the challenge of ensuring high safety standards and operating within a legal framework that is uncertain, at least for them, while seeking to develop and integrate innovative, self-learning systems. CE certification, which requires engagement with and compliance with extensive EU regulations, is cited as a particular obstacle.

Dealing with regulatory frameworks

Regulatory requirements place a greater burden on smaller companies than larger ones because they often have less knowledge and experience than larger companies with corresponding departments and fewer resources for obtaining information and dealing with regulations. Startups usually have to comply with the same regulations as established companies.

[82] However, this could also change with the use of generative AI. EU Artificial Intelligence Act (2024)
[83] Industrial magazine (2025)
[84] Industry of Things (2024)

As Berlin's robotics ecosystem is dominated by smaller companies and start-ups, it is particularly \affected by the regulatory framework. Many of the costs of regulation are invisible because business activities do not take place in the first place.

This makes it all the more important to provide companies with the best possible support in obtaining certification and complying with legal requirements, e.g. through advice and fast approval processes. It also helps to promote the provision of test environments. Experimentation spaces, such as those offered by Siemensstadt or Urban Tech Republic, and real-world laboratories can help demonstrate how a technology works in a real environment, thereby removing marketing barriers, among other things. The legal framework for conventional robotics, which is tested or used in industry under real conditions, is already very well defined, as robots are no different from other machines in regulatory terms. The situation is different for AI-based robotics, where the challenge lies in certifying a dynamic system. Clear rules that give this new technology enough scope to develop would be desirable.

In its coalition agreement, the new German government has announced an offensive with regard to the regulations mentioned here. Among other things, the regulation of industrial AI is to be made innovation-friendly, which includes the appropriate design and implementation of the AI Act. The European liability rules are also to be reviewed in the context of AI. In terms of data protection, consistency, uniform interpretations and simplifications are to be ensured. At the same time, the coalition agreement calls for the use of AI in companies to require employee training and fair regulations regarding the handling of data in the workplace. The specific details of the measures are still open.[85]

5.2 Framework conditions in the funding landscape and innovation policy

Due to its relevance as a key industrial technology, (AI-based) robotics plays an important, albeit not always visible, role in innovation policy and funding at state, federal and EU level. As it is a cross-cutting technology, various funding programmes include this field of technology without explicitly addressing it. In addition to financial support, the innovation and industrial policy framework also includes infrastructural support as well as opportunities for further training, networking, information and advice.

Strategic anchoring of (AI-based) robotics in innovation policy

Innovation policy and technology-oriented strategies formulate concrete objectives and define areas of action for the research, development and application of a technology. They shape the framework for cooperation in innovation ecosystems. There is a lack of appropriately focused strategies for (AI-based) robotics at state, federal and EU level.

(AI-based) robotics plays a role in Berlin's innovation strategies as a cross-cutting and key technology, but is not explicitly highlighted as an innovation field or priority in the strategy documents. In the cross-state **Innovationsstrategie Berlin-Brandenburg (InnoBB 2025)**, (AI-based) robotics is therefore relevant for all clusters defined there: health economy; energy technology; transport, mobility and logistics; ICT, media and creative industries; and optics and photonics, but nowhere prominently.[86] At the level of the State of Berlin's independent innovation and industrial policy, AI and robotics in industrial production were integrated for the first time as one of four key

[85] CDU, CSU, SPD (2025)
[86] Innovative capital region (n. d.)

technologies in the **Masterplan Industriestadt Berlin 2022-2026 (MPI)**. As a result of this prioritisation, a number of specific robotics projects and support formats are also being implemented within the MPI in line with cross-cutting objectives and general priorities for action in areas such as innovation promotion, skills development, framework conditions, communication and networking.[87]

At the German federal level of economic and industrial policy, there is no explicit strategy for (AI-based) robotics. The industrial strategy of the Federal Ministry for Economic Affairs and Energy (BMWE, formerly BMWK) from 2023 highlights robotics as a strength in Germany and reaffirms the need for diffusion in SMEs. It sees robotics as a tool for relieving the burden on workers and combating the shortage of skilled labour.[88] The German government's AI strategy addresses the great potential of AI applications for increasing autonomy and learning ability, but, as in the federal government's industrial strategy, no specific goals or areas of action are identified in connection with the technology.[89] At the research and innovation policy level, the Federal Ministry of Research, Technology and Space (BMFTR, formerly BMBF) has strategically addressed the topic of robotics in its **Aktionsplan Robotikforschung** and identified areas for action in the following four fields:[90]

- Make innovations in basic technologies usable for robotics.
- Bundle and network cutting-edge robotics research.
- Promote skilled workers for the robotics of the future.
- Put intelligent robotics into practice.

The new German government is planning a high-tech agenda for research, in which AI is named as the first of the key technologies. According to the coalition agreement, robotics is also one of these key technologies. Robotics and AI are considered together: 'We are establishing Germany as an AI nation. This means massive investments in cloud and AI infrastructure and in the connection between AI and robotics.'[91] Special attention is also being paid to improving the situation for start-ups, which is particularly relevant for the dynamic field of (AI-based) robotics in Berlin as a start-up location. In its coalition agreement, the new German government has at least announced that AI and robotics are to be among its priorities in the field of business and innovation – although concrete measures have yet to be formulated.[92]

At the EU level, there is no explicit robotics strategy, but a concrete strategy with defined goals and areas of action has been developed through the public-private partnership **SPARC** and the independent initiative **euRobotics**, which is being incorporated into the work of the European Commission.[93] Furthermore, the high strategic relevance of (AI-based) robotics at EU level is demonstrated by the fact that it is defined as one of ten critical technologies for Europe's economic stability and is included in the Strategic Technologies for Europe Platform (STEP), which may also have relevant implications for the promotion of technology at the state level in Berlin.

[87] Berlin Senate Administration (2022)
[88] Federal Ministry for Economic Affairs and Climate Protection (2023)
[89] The Federal Government (2018)
[90] Federal Ministry of Education and Research (2024)
[91] CDU, CSU, SPD (2025), p. 4.
[92] CDU, CSU, SPD (2025)
[93] euRobotics (2024)

Robots and drones are also becoming increasingly important in the military sector. At EU level, the new White Paper on European Defence identifies drones and drone defence as one of the key areas for defence capabilities.[94] This will open up market and funding opportunities for companies in this field, including those in dual-use areas such as AI and machine vision. A number of Berlin-based companies such as **Germandrones, EvoLogics, Promethion Industries** and **Quantum Systems** (showroom in Berlin) are active in the drone sector.

Due to the lack of concrete technology-oriented strategies and objectives for (AI-based) robotics at the federal and EU level, regional strategy development may gain relevance for the local innovation ecosystem as a point of reference in the future.

Project funding and financing opportunities for (AI-based) robotics

Funding programmes for innovation projects and other financing offers are important instruments for preventing market failure in innovative and risky technologies and for stimulating investment in the development and implementation of (AI-based) robotics. In addition, R&D collaborative projects are good initiators of cooperation and knowledge and technology transfer between research and industry.

A wide variety of open-topic programmes are available at state, federal and EU level for companies and projects in the field of (AI-based) robotics. In the area of investment and innovation promotion, the state of Berlin offers grants, loans, equity investments and advisory programmes for SMEs, in particular through the **Investitionsbank Berlin** (IBB). Within the framework of the **Gemeinschaftsaufgabe Verbesserung der regionalen Wirtschaftsstruktur** (GRW), subsidies are available for investments in the implementation of industrial robotics, for example. In the area of low-threshold and unbureaucratic investment promotion, however, the expert discussions highlight a need for support. The **Digitalprämie Berlin**, which has now expired, was particularly appreciated by the companies surveyed as an effective funding instrument. The programme was particularly notable for its simple application process and rapid disbursement of funds, which successfully initiated investments in digital work, production and management processes, measures to improve IT security, and digital consulting and training services.

For technological innovation projects in the field of (AI-based) robotics, the state provides grants and loans for individual projects and joint projects between science and industry through programmes such as **Pro FIT, Berlin Innovativ** and **Transfer BONUS**. The grants for contracts awarded to scientific institutions under the Transfer BONUS funding programme are highlighted in the interviews as a useful measure for strengthening knowledge and technology transfer between research and industry. In order to initiate the transfer of research results in science and prevent frequent market failure after the completion of research projects, Berlin successfully funded validation projects in a pilot phase with the **ProValid** programme, but the continuation of the programme is not certain. At the federal level, the **Zentrale Innovationsprogramm Mittelstand** (ZIM) and **KMU-innovativ** are particularly relevant for innovation projects for the companies surveyed and those developing in the field of (AI-based) robotics, as they specifically address the needs of SMEs, such as flexible and unbureaucratic funding. The federal government also funds a number of broad-based flagship projects for ecosystem development in AI-based robotics, in science in particular the **Robotics Institute Germany (RIG**) with the participation of the TU Berlin (see section 4.3) and, in industry, the **RoX project**.[95] Both projects aim to create radiating R&D

[94] European Commission (2025)
[95] RoX (n. d.)

ecosystems for AI-based robotics, but it was noted in expert discussions that the interfaces between the two projects are still weak.

There are also numerous funding instruments at EU level, e.g. in **Horizon Europe**, the current framework programme for research and innovation for 2021 to 2027. With the help of the **EIC Accelerator**, for example, innovative companies, especially start-ups and SMEs, are to be supported in the development and market launch of disruptive technologies such as AI-based robotics.[96] In addition, the **STEP Regulation** aims to promote the development and production of critical and emerging strategic technologies and their respective value chains in the EU. With its focus on digital and deep tech innovations, STEP also covers robotics, autonomous systems, digital technologies and, in particular, artificial intelligence technologies. Projects in the field of robotics that contribute to the development or manufacture of relevant technologies or strengthen their value chains may therefore be eligible for funding under the STEP Regulation.[97] It is therefore important to keep an eye on the ongoing integration of STEP into funding programmes and guidelines. Even against the backdrop of tight state and federal budgets, there are opportunities for SMEs in the (AI-based) robotics ecosystem to make greater use of EU funding for innovation projects in the technology field and to intensify internationalisation and R&D cooperation in the European single market.

Despite the variety of funding programmes and financing options, discussions with providers and developers show that funding programmes need to pay greater attention to the introduction and development of technologies with a high degree of maturity towards a marketable product. In addition, robotics requires significant hardware investments, which are not always eligible for funding. An example at EU level of larger projects and broad SME participation in the field of (AI-based) robotics are market- and SME-oriented instruments such as the **Interregional Innovation Investments** (I3) under the **European Regional Development Fund** (ERDF), which address a technology readiness level between 7 and 9 (highest level) and enable broad dissemination of funding through a cascade financing model.[98] It is therefore important to make greater use of programmes such as these and to design local funding programmes that are more market-oriented but less complex and bureaucratic than European funding programmes (e.g. complex European consortia, long waiting times).

Since the AI-based robotics ecosystem in Berlin includes many start-ups, start-up and spin-off programmes are also very important at the location. Among other things, the **Berlin Start-up Stipendium** as a state programme, but also the **EXIST programmes** such as the **Gründerstipendium** at federal level, already offer effective and needs-based instruments for start-ups and spin-offs from science, which could be promoted and utilised even more effectively.

Promotion of networking, visibility and cooperation

Promoting networking is an important tool for strengthening the innovation ecosystem (AI-based) robotics and developing effective cooperation platforms between research institutions, companies and public administration. Well-developed and organised networking structures can facilitate the transfer of knowledge and technology and the implementation of innovations, and by presenting a united front, they contribute significantly to Berlin's positioning and attractiveness as an important location for robotics.

[96] European Innovation Council (n. d.)
[97] European Commission (2024)
[98] European Commission (n. d.)

In the operationalisation of the Innovationsstrategie Berlin-Brandenburg (innoBB 2025), clusters are being promoted along common industrial and economic focal points in the region where the (AI-based) robotics ecosystem is not visible and independently networked or organised.[99] At the state level, **Berlin Partner for Business and Technology** was able to initiate the Berlin Robotics Network in 2022 based on existing networking needs. This serves as a platform for exchange and cooperation between science and industry. With the inclusion of this key technology in the **Masterplan Industriestadt Berlin 2022-2026 (MPI)** in 2023, the Berlin Robotics Network was funded as a project with the aim of consolidating network structures and increasing visibility. In addition, there are a number of information and exchange events (e.g. MPI Conference or MPI Deep Dives) that address all players in the ecosystem and focus on robotics. The result is an early phase of promotion for a regional innovation network, which is primarily characterised by community building. Berlin Partner organises regular meetings and cross-cluster events for the Berlin Robotics Network and offers information formats to promote synergies and position Berlin as a leading robotics location.

Interviews with stakeholders involved in robotics development and application in Berlin show that the **Berlin Robotics Network** is well known among stakeholders and that its networking activities are used to facilitate exchange between companies, research institutions and start-ups. They facilitate access to resources and the exchange of knowledge about the technology and its fields of application. The expert discussions also revealed a need for greater commitment, cooperation projects and momentum on the part of supplier and user companies, as well as a strategic orientation and greater visibility of the innovation network both internally and externally. This will also increase the attractiveness of the location for industrial customers, investors and talent in the field of (AI-based) robotics. In order to be perceived as a robotics location, the ecosystem currently lacks an independent brand identity, e.g. through its own web platform and communication tools. The Deep Tech campaign launched by the State of Berlin and the inclusion of robotics in this campaign offer starting points for strengthening the location brand and visibility for key technologies externally, but in formats such as the Deep Tech Award, they tend to be more inward-looking and focused on the location itself.[100]

Approaches to bring together robotics players in Berlin more visibly exist beyond the Berlin Robotics Network in the scientific community, such as the platform **robotics.berlin**, which is coordinated by the TU Berlin and provides an overview of players, research and educational opportunities in the field of robotics. The platform does not currently engage in ongoing networking and cooperation activities.

Berlin still lacks a self-sustaining innovation network driven primarily by the players themselves, with participatory governance structures and a concept for ensuring its long-term viability, although the Berlin Robotics Network shows great potential for further development in this area. Examples such as the member-oriented cluster organisation Odense Robotics in Denmark show how a regional innovation network can be developed into an internationally visible full-service platform. With highly professional cluster management, the mixed-financed cluster has developed a needs-based service portfolio with technology-specific support services for networking, ecosystem mapping, start-ups, innovation matchmaking, marketing, internationalisation and skills, and is internationally regarded as a best practice example in this field.[101]

[99] Innovative capital region (n. d.)
[100] Berlin.de (n. d.)
[101] Odense Robotics (n. d. b)

Another network and cooperation tool that can play an important role, particularly for AI integration in robotics, is the **#AI_Berlin platform**. It was launched by Berlin Partner for Business and Technology in cooperation with the ICT, Media and Creative Industries Cluster and other partners. The new **#ai_berlin hub**, which is being created within this framework with the support of the Senate Department for Economics, Energy and Public Enterprises, aims to strengthen networking between research, industry and application and promote cooperation in the future. In application areas such as health, industrial production and mobility, the hub will enable AI and robotics to interact as key technologies and initiate cooperation. In addition, the **Women in AI & Robotics association** supports women through mentoring, educational programmes, hackathons, youth groups and similar networking events to address the gender gap in the field of research, development and design of future-oriented technologies. Furthermore, the **Berlin Robotics Meetup** is a regularly organised, informal meeting for people interested in robotics, which serves as a platform for exchanging experiences and interests related to this topic. In the context of the increasing integration of AI into robotics, cross-clustering approaches between the robotics and AI ecosystems at the location offer great potential for the future.

There are also a number of funding formats for networking in the field of robotics at the federal and EU level. In addition to the ecosystem projects mentioned above, such as the Robotics Institute Germany and its German Robotics Conference (2025) in Nuremberg, the conference '**KI-basierte Robotik 2024**' (KIRO) took place for the first time in Berlin as part of the BMFTR's 2024 Aktionsplan Robotikforschung. The event aimed to promote exchange between players from the robotics ecosystem and industry and politics and was jointly initiated by the BMBF and BMWK.[102] At the level of nationwide intermediaries, the **Deutsche Robotik Verband** has also been founded, although hardly any companies from Berlin are represented in it.[103] At the EU level, the **European Robotics Forum** held in Stuttgart this year and the independent network initiative **euRobotics** are the flagships for Europe-wide networking in the field of (AI-based) robotics.[104]

Real-world laboratories, infrastructural support and innovation spaces

The regulatory challenges (see section 5.1), the physical requirements for robots and the large number of start-ups in Berlin demonstrate that innovations in (AI-based) robotics require both regulatory and physical freedom for development, manufacturing and testing. Infrastructure funding plays an important role in the development of the ecosystem. In the area of hubs, technology parks, accelerators and incubators, Berlin offers a wide range of publicly and privately funded opportunities, such as the **Berlin Zukunftsorte** and **Campus Projects**, the newly emerging **#ai_berlin hub**, the **Motion Lab**, the **Werner-von-Siemens Centre for Industry and Science**, the **Z-Lab** and the **Bosch Innovation Campus** (see section 4.3).

With the programme to promote business-oriented real-world laboratories, the testing of innovations with commercialisation goals will also be supported from 2025 onwards. Robotics innovations are also included in the concept phase, although the majority of real-world laboratory concepts are aimed at economic applications in public spaces rather than in industry. Nevertheless, they can be a catalyst for the successful transfer of technology and business model projects and enable practical applicability to be tested and optimised. For greater industrial value creation, future real-world laboratory concepts could focus on practical challenges of industrial

[102] Federal Ministry of Education and Research (2024)
[103] German Robotics Association (n. d.)
[104] European Robotics Forum (n. d.)

implementation of (AI-based) robotics, e.g. in relation to the Machinery Directive, data protection or occupational safety (see section 5.1).

The federally funded **ReTraNetz-BB** (Regional Transformation Network for the Automotive and Supplier Industry Berlin-Brandenburg) addresses these issues at the Production Technology Centre Berlin, where it offers industrial companies innovative robot technologies such as camera-assisted cobots for testing and creates a test environment for validating and optimising new technologies. In addition, training programmes are offered to promote acceptance of the technologies and prepare employees for the new requirements.[105] A central aspect of the ReTraNetz project is to promote cooperation between research institutions such as the Fraunhofer IPK and companies, thereby supporting knowledge transfer and innovative approaches to digitalisation in the industry. By focusing on the needs of companies while taking the challenges of digitalisation seriously, ReTraNetz is making a decisive contribution to unlocking new value creation potential in the automotive and supplier industry and securing the long-term competitiveness of companies.

Consulting and information services for (AI-based) robotics

Consulting and information services offer companies in the (AI-based) robotics ecosystem valuable guidance on topics such as funding programmes, skills and regulations. There are numerous general advisory services on these topics at state, federal and EU level, but few are specifically tailored to robotics. In Berlin, for example, the **Digitalagentur** offers comprehensive support for companies undergoing digital transformation as an advisory contact point and intermediary for existing services and funding opportunities, including in the field of robotics. In addition, tools such as the **Kompetenzatlas Industrie 4.0** at Berlin Partner offer support in finding companies with expertise and an overview of services in specific technology fields, although robotics companies are not yet comprehensively covered here. There are also a number of AI-related services in Berlin. **ProKI Berlin**, for example, offers training and consulting services to enable industrial companies to understand and apply AI methods independently. And the **AI Campus** offers support for building AI and data skills through innovative digital learning opportunities. In addition, the federally funded **Mittelstand-Digital Zentrum Spreeland** provides support to SMEs by offering workshops, consultation hours and practical assistance to facilitate their entry into AI and robotics applications.

The expert discussions highlighted the need for specialised consulting and support services to deal with regulatory hurdles in the marketing and implementation of (AI-based) robotics. SMEs in particular have difficulty navigating the complex legal requirements and need support. The scope of the regulations and the associated technical challenges, such as the incompatibility of existing machine controls with new robot systems, lead to increased adaptation costs and high expenses. Unclear regulations create uncertainty regarding safety requirements, prompting companies to take additional measures such as enclosing cobots. The administrative burden imposed by European regulations, in particular the Machinery Directive, also hinders the use of robots and restricts companies' flexibility. In addition, the regulatory environment for AI-based robotics is perceived as complex, as innovative applications are often not clearly integrated into existing regulations. Despite the availability of advisory services, these are often not well known or do not cover the specific needs of companies. It is therefore crucial to develop targeted support measures to help companies overcome legal and technical challenges.

[105] ReTraNetz-BB (n. d.)

6 Digression: Effects of (AI-based) robotics on the workplace

The use of (AI-based) robotics in industry offers great potential for productivity and value creation, but requires careful consideration of the associated changes to operational processes and the social and ethical challenges. Transparency regarding decisions on the use of technology and its benefits, as well as accompanying training measures, are important in order to counter mistrust and equip operational staff with the (digital) skills needed to work with these technologies.

Opportunities and challenges for employment

The potential of artificial intelligence and robots to enable more efficient and intelligent processes and transform the world of work is undisputed.[106] The use of technology will change activities and work organisation and lead to the development of new occupations and roles in the workplace. According to estimates, up to 97 million new jobs could be created worldwide in the shared field of work between humans, machines and algorithms.[107] Forecasts assume that by 2025, working time will be equally distributed between humans and machines.[108] This means that human labour could become largely irrelevant for some activities in the future as a result of automation. Taking AI as an example of automation technology, studies assume that software based on large language models (LLMs) will be used in 47 to 56% of work tasks in the future. In addition, 10% of the activities of 80% of employees (in the US) could be taken over by LLMs.[109] Accordingly, fully usable AI could threaten approximately 300 million full-time jobs in Europe and the US.[110] The combination of two automation technologies such as AI and robotics expands the scope of automation, which means that both positive and negative effects on job structures could arise in the scenarios outlined above. However, estimates of the potential employment effects of (AI-based) robotics are highly speculative, as the actual development depends on a multitude of external factors that are difficult to predict. These include, for example, how autonomous and intelligent the systems will actually be, how they will be accepted and handled by employees, and, last but not least, how the legal framework will be designed, for example to avoid mass unemployment.[111]

Opportunities and challenges in workplace design

The way in which people and technology interact is increasingly becoming a key factor in the successful design of the working world. The Federal Ministry of Labour and Social Affairs (BMAS) has examined scenarios for how human-technology interaction could develop in the working world.[112] The focus here is on a human-centred approach. Workplaces should be designed in such a way that technology supports human strengths rather than replacing them. AI and automation should therefore be used in a targeted manner to take over repetitive and physically and mentally stressful tasks and relieve employees (e.g. in palletising, machine feeding or night shifts). Creative and socially interactive as well as complementary technical activities should continue to rely on human skills.

[106] Hammermann (2023)
[107] Asenkerschbaumer et al. (2023)
[108] Asenkerschbaumer et al. (2023)
[109] Eloundou et al. (2023)
[110] Briggs & Kodnani (2023)
[111] Klingbeil-Döring (2023)
[112] Federal Ministry of Labour and Social Affairs (2023)

In view of the existing shortage of skilled workers and demographic trends with an ageing workforce, companies are striving to increase their attractiveness as employers through the complementary use of robots in certain work processes. For example, **Klosterfrau** introduced cobots into its palletising processes to eliminate heavy lifting by humans, thereby reducing physical strain and the risk of injury at individual workstations. **Promess** uses robots for machine feeding to relieve employees of monotonous work and night shifts and to counteract the shortage of skilled workers.

The integration of (AI-based) robots requires an in-depth understanding of internal operating structures. This enables companies to decide whether and where the use of robotics makes sense, for example with regard to specific automation requirements or emerging personnel and skills shortages. The technological advantages can only be exploited if functioning internal management processes are in place and there is reliable knowledge about the potential of automation and AI. When introducing and using technology, companies, especially SMEs, often need external support to be able to consider all relevant factors influencing their investment decisions.

Education and lifelong learning

The integration of (AI-based) robotics into the world of work has a profound impact on the skills requirements of employees and requires comprehensive training and further education.

A successful transformation of business processes is only possible if both the workforce and management are actively involved. When new technology is introduced, there is often a lack of qualifications for operating the systems and equipment. It is essential to find out which additional qualifications affected employees need and who is best placed to provide them. The systematic assessment of employee needs in dealing with new technologies offers the opportunity to identify specific training requirements at an early stage. In many companies, there is also a lack of organised co-determination, which makes it difficult to develop such systems. In companies without co-determination, exchange on an equal footing must be promoted in order to minimise the risks associated with investments in new technologies and to ensure that employees can acquire the necessary skills. Effective communication on the part of management is crucial here; instead of one-sided instructions, open dialogue should be encouraged to strengthen the workforce's confidence in the transformation.

Offers such as those provided by the Federal Employment Agency, such as guaranteeing at least 120 hours of further training with certified providers, can be used to provide support.

Social and ethical challenges and data protection

The integration of AI and robotics into the world of work brings with it a host of social and ethical challenges. Experience in companies shows that employees tend to be more sceptical about AI than robotics. Consequently, technology introduction processes should always be accompanied by information and communication activities so that issues of acceptance can also be adequately addressed.

Key challenges in integrating (AI-based) robotics into existing working environments also lie in the design of data protection and data security. In collaborative work with AI-based robots, e.g. AI-based cobots with camera systems, data is continuously generated that can be evaluated from various perspectives. It is crucial that the processing of this data complies with European data protection standards. At the same time, companies want existing systems to be adapted and used in such a way that the new technologies maximise productivity gains. Data-intensive technologies such as AI-based robotics raise the question of where, by whom and how generated data is stored and used. Particularly in companies that have not yet been digitised to a great extent (especially SMEs) and lack experience in handling such data, the complexity and wide range of possibilities for using the data pose risks of illegitimate data use.

These concerns about data collection and processing are shared in particular by employees in relation to job losses. One example is that employees fear that their work productivity and efficiency can be recorded, monitored and analysed by AI systems. In order to allay these fears and build trust, it is advisable to always combine the introduction of AI with transparency and intensive communication and to accompany it with appropriate steps in company agreements. Such regulations can ensure that data is collected anonymously, thereby protecting the privacy of employees. They can also clarify and document issues relating to job security or necessary changes to working conditions. In addition, companies would be well advised to work with European technology providers, as these are more familiar with the strict European data protection standards and can offer comprehensive advice and support in this context. At the same time, there are hardly any alternatives to the large American providers Google, Microsoft and Amazon, especially among cloud providers with powerful AI models.

Another aspect is the participation of employees in the successes of integrated robotics technologies. Employee participation in the productivity gains achieved through new technologies is rare in practice, but could not only increase motivation and acceptance of change, but also help to promote social justice within the company. Works agreements could also be a suitable means of ensuring a fair distribution of productivity gains. This would ensure that all employees benefit from the positive effects of technology.

7 SWOT analysis

In order to synthesise the results of the previous analyses and to bridge the gap to concrete recommendations for action, a SWOT analysis is carried out below. This summarises the strengths, weaknesses, opportunities and risks that characterise Berlin with regard to (AI-based robotics). The SWOT analysis is based on the results of the quantitative data evaluation and qualitative investigations, namely literature review and expert discussions, as well as the evaluators' expert knowledge gained from previous projects. The SWOT analysis, in turn, is an important basis for the subsequent fields of action and recommendations.

7.1 Industrial application of (AI-based) robotics in Berlin

Table 5: SWOT analysis of industrial applications

Strengths	**Weaknesses**
■ Diverse range of industrial application examples for proven industrial robotics (in a standardised structured environment). ■ Innovative application examples of collaborative robots and AI-based robots in SMEs (beacons). ■ Medium-sized and large user companies, specifically in metal processing and mechanical and plant engineering, have experience and contacts with the use of (AI-based) robotics. ■ Highly innovative local companies that can offer customised robotics solutions.	■ Low diffusion of innovative (AI-based) robotics in industry and predominantly isolated applications. ■ Pronounced corporate cultural barriers and awareness gaps with regard to robotics. ■ Many small companies with little capital, experience/expertise and human resources to integrate (AI-based) robotics.
Opportunities	**Threats**
■ Diffusion of robotics technologies, especially in industries where they have been little used to date (chemicals, pharmaceuticals, paper, construction, food). ■ Noticeable pressure to automate (e.g. due to a shortage of skilled workers) and, as a result, openness to and search for solutions. ■ Innovative local landscape with many opportunities for cooperation and learning from best practice examples. ■ (AI-based) robotics as a technologically dynamic field that is constantly producing new solutions, opening up new areas of application and making the integration of (AI-based) robotics easier and cheaper.	■ Economic risks associated with the implementation of cost- and resource-intensive robotics, especially in small businesses. ■ AI implementation in particular is fraught with complex and largely unpredictable regulatory risks. ■ Risk aversion and reluctance to invest, especially among smaller businesses, due in part to economic uncertainty.

Own representation.

There are many successful applications of robotics, particularly in larger industrial companies in Berlin – in tried-and-tested areas and, to a lesser extent, in newer, innovative fields of application. Beacons of robotics in Berlin's industrial companies include the collaborations already underway between **Gestalt Automation** and **P&G Gilette** on AI-based cobots and between **Wilhelm**

Dreusicke and **Alfred Rexroth** on the design and integration of a robot arm. **Wilhelm Dreusicke** demonstrates how new business models can be developed. The example of **HWL Löttechnik**, which has also already been described, demonstrates how even a small company can successfully integrate innovative AI-based robotics into work processes in order to optimise them and at the same time reduce the workload of its employees.

The examples show that experience in the use of AI-based robotics is already available in various cases. User companies can draw on local, highly innovative suppliers who are able to develop and offer customised robotics solutions in close cooperation. In contrast, many smaller industrial companies in Berlin have not yet integrated robotics into their operational processes, or have done so only to a limited extent. Innovative robotics, including AI-based robotics, has so far only been used in isolated cases. The low level of diffusion is due to a lack of expertise and experience in robotics, limited financial and human resources, and a risk aversion towards (investment) measures that change operational processes, which is often found in small businesses.

In addition to regulatory aspects, the economic environment also influences innovation and investment decisions. In view of the difficult economic conditions, SMEs in particular are reluctant to invest, which is hampering the diffusion of robotics. Stagnation in the digitalisation and modernisation of production could hamper the competitiveness of Berlin's industrial companies in the medium and long term. Given Berlin's industrial base, the economic potential for (AI-based) robotics is high. Best practice examples in Berlin show how the integration of (AI-based) robotics can be successful. Given the pressure to automate, the need to implement new technical solutions and a wider range of cheaper and easier-to-integrate robots, companies now have a good opportunity to open up to (AI-based) robotics. This is particularly true for industries where (AI-based) robotics has played a minor role to date.

7.2 Companies providing and developing (AI-based) robotics in Berlin

Table 6: SWOT analysis of suppliers and developers

Strengths	Weaknesses
■ Specialisation of start-ups in software and AI components for innovative industrial robotics. ■ Critical mass and high value creation depth and diversity for ecosystem formation. ■ Highly qualified specialists at the location. ■ Broad range of support and funding structures for start-ups, innovation and research. ■ Strength in customised robotics solutions.	■ Weak internal and external networking and visibility beyond Berlin. ■ Fragmented corporate structure and lack of established driving forces to act as anchors and promoters. ■ Lack of examples of series-produced and market-established solutions/robotics OEMs and comparatively few patents. ■ Small companies with little capital for investment. Few large industrial companies as application markets and a small number of large industrial anchor customers (such as Siemens, P&G), resulting in high customisation requirements and low production volumes.
Opportunities	**Threats**
■ Scale-up and market development of highly innovative solutions and players, e.g. in the field of robot perception and navigation. ■ Growth of the robotics player and innovation landscape and a large number of start-ups. ■ Stronger commitment to national and international funding for R&D and cooperation in critical technologies. ■ Cluster-like structures can develop their own momentum and attract additional companies, skilled workers and capital.	■ Berlin's industry often focuses on supplying Europe (e.g. the Netherlands) when investing in robotics. ■ High competitive pressure, even in highly innovative areas (e.g. humanoid and AI-based robotics). Difficult for smaller suppliers to survive in the market. ■ Bureaucratic hurdles (lengthy approval procedures, uncertain liability guidelines for AI and robotics).

Own representation.

Berlin has a broad, diverse and, in some areas, highly structured pool of providers in the field of (AI-based) robotics. There is a particular focus on software and AI, especially in connection with image recognition and processing as well as navigation. The highly qualified specialists available locally and well-developed support programmes for start-ups, research and innovation foster a dynamic, highly innovative research and business landscape. This is primarily characterised by small companies, especially robot manufacturers (OEMs). This results in strengths such as high dynamism and the availability of customised robotics solutions, but also weaknesses such as low financial power for scale-ups, the lack of larger established companies that can act as drivers and promoters, and few established series solutions in the field of robotics. The latter point is also related to the fact that there are only a few large industrial customers based in Berlin. Furthermore, investment decisions and the search for solutions by the user industry are less limited to regional aspects and are primarily oriented towards Europe. Although the wider metropolitan region has a number of larger industrial companies, Berlin and its surroundings show a weakness in comparison to Germany's industrial centres. This is further exacerbated by the low level of networking and visibility of Berlin-based suppliers.

This position means that Berlin-based suppliers may find it difficult to stimulate sufficient regional demand and are at a disadvantage compared to robotics manufacturers who are located in close proximity to their customers. Overarching regulatory and data protection requirements, which affect the entire competitive environment, can also have a negative impact by slowing down the existing momentum. The innovative strength and high momentum of Berlin-based companies offer opportunities if they succeed in tapping into national and international markets, bringing their products to series production and making the leap from small to medium-sized enterprises. Funding and cooperation available in this critical technology area can provide support. Strengthening individual companies and the ecosystem as a whole can ideally develop a dynamic that attracts and unleashes new productive forces through stronger networking and greater visibility.

7.3 Science, R&D and transfer of (AI-based) robotics in Berlin

Table 7: SWOT analysis of science, R&D and transfer

Strengths	Weaknesses
▪ R&D specialisation in AI-based robotics and high overall concentration of robotics R&D. ▪ Internationally visible and internationally networked cutting-edge research. ▪ Participation in flagship robotics and AI projects (such as RIG, BIFOLD). ▪ Training of highly qualified specialists on site.	▪ Lack of market and industry orientation in R&D in (AI-based) robotics due to a lack of incentive structures in science. ▪ Hardly any R&D cooperation with medium-sized industry at the location. ▪ Transfer deficits between science and industry – lack of understanding and coordination of requirements.
Opportunities	**Threats**
▪ Increased significance of the topic at national, European and international level. Opportunity for cooperation and funding. ▪ Expansion and consolidation of existing science, cooperation and transfer networks (e.g. robotics network).	▪ Transfer deficits that hinder economic exploitation in the field of (AI-based) robotics and impair the exploitation of the potential of the robotics ecosystem. ▪ Tight budgetary resources that hamper transfer and innovation activities.

Own representation. © Prognos AG 2025

Berlin has an excellent, internationally visible and networked scientific landscape and a high concentration of R&D in the field of (AI-based) robotics. This offers many opportunities for cooperation, spillover effects and, last but not least, a pool of highly qualified specialists for supplier companies. However, this is not yet being exploited sufficiently. Research and industrial application often fail to come together, as evidenced by a low level of industry orientation, a small number of local collaborations and patent applications, and general transfer deficits. Important reasons for this are the incentive structures in science, which in most cases are not geared towards transfer and application, cultural differences between science and industry, and the high activation energy required for cooperation spanning science and industry.

The greatest risk is therefore that the scientific potential cannot be exploited locally due to transfer deficits and that research institutions seek supra-regional cooperation partners. Related to this, scarce budgetary resources threaten transfer activities in particular, which tend to be a lower priority for research institutions. However, these risks are offset by opportunities. The topic of (AI-based) robotics is steadily gaining attention, which facilitates the mobilisation of research budgets and the establishment of fruitful collaborations in science. The great opportunity for Berlin as a business location lies in the fact that transfer deficits can be eliminated and transfer barriers overcome in order to better exploit the scientific and technological potential.

8 Recommendations

Analyses of the ecosystem, the demands and opportunities of (AI-based) robotics in Berlin show that there are considerable opportunities for supplier and user companies as well as for research at the location in the further development and strengthening of this technology field. However, there are also hurdles and shortcomings that are holding back the development and implementation of (AI-based) robotics in industry. Both sides need to be tackled by all stakeholders in the innovation ecosystem in the following areas:

- Strengthening the innovation ecosystem, networking and transfer
- Strategic development and improvement of visibility
- Creation of investment incentives and greater application orientation in R&D funding
- Building skills and involving the workforce in the introduction of (AI-based) robotics
- Designing innovation- and application-friendly regulations

The fields of action include various recommendations that address the potential, challenges and objectives in the relevant area of action, identify specific stakeholders and target groups, and estimate the time frame in which the effects are expected to occur. There is potential for synergy and complementarity between some of the recommendations, which makes it clear that they should be designed to work together in order to increase their effectiveness.

8.1 Field of action 1: Strengthening the innovation ecosystem, networking and transfer

Berlin has a critical mass of innovative players in the value chain of (AI-based) robotics. Despite initial networking successes, this innovation ecosystem of supplier and user companies, academia, government and intermediaries is still fragmented overall. SMEs and start-ups in particular often still have few or no partners in the field of (AI-based) robotics. This fragmentation hinders application-oriented development and the diffusion of existing technical solutions. There are also many shortcomings in networking and transfer between science and industry, which are reflected, among other things, in a lack of industrial application orientation and a low number of partnerships in R&D at the location. Coordinated bundling of these actors and a stronger transfer orientation in science, industry and innovation policy can help to leverage the great innovation and growth potential at the location.

Goals in the field of action

- Establishment and consolidation of an organised innovation network in the field of (AI-based) robotics
- Strengthening the transfer of applications, knowledge and technology and the dissemination of innovations
- Stronger positioning and networking of robotics players and activities at the location externally, including internationally

Recommendation

Intensivierung von Vernetzungsaktivitäten von Akteuren im Bereich der (KI-basierten) Robotik

Supplier companies, (potential) user companies and scientific institutions in Berlin should establish and expand their networking and transfer activities in the field of (AI-based) robotics. This means, among other things, making better use of existing information, transfer, participation and networking opportunities (see section 5.2) and initiating partnerships. This involves networking provider companies, scientific institutions and (potential) user companies with each other, as well as networking these groups among themselves. In order to further strengthen cross-technology cooperation between the robotics and AI ecosystems, close networking with initiatives such as #AI_Berlin should be sought in order to strengthen synergies and spillover effects. Networking activities can aim at joint projects, but can also serve the more low-threshold purpose of exchanging experience and knowledge (peer learning), e.g. when considering regulations with regard to the introduction of new technologies and providing an overview of the funding landscape and best practice examples. Activities such as road shows and appearances at trade fairs, conferences and events can serve to promote networking and at the same time improve the visibility of the participating companies and scientific institutions as well as Berlin as a robotics location. Networking does not only mean networking within Berlin, but also includes supra-regional and international networking, e.g. to utilise external expertise and overcome local weaknesses such as a lack of series readiness and production.

- **Actors:** Companies, scientific institutions
- **Target Group:** Companies, scientific institutions
- **Time frame:** Medium to long term[113]

Recommendation

Establishment and consolidation of a service- and member-oriented innovation network (AI-based) robotics

In order to support and continue networking efforts by individual companies and scientific institutions, existing structures such as the Berlin Robotics Network should be further developed and consolidated into a service-oriented and actively managed innovation network for robotics. This includes the establishment of an independently operating network management team and the professionalisation of needs-based, member-oriented services. Corresponding efforts also include, for example, the development and maintenance of a technology-specific and web-based information and marketing platform for stakeholders (including a brand identity and structured data collection across the ecosystem), the continuous monitoring of trends and local needs, and the development of a joint strategy in line with the MPI. On this basis, systematic matchmaking

[113] Rough estimate of the time frame. Short term: Possible effects within approximately one year. Medium term: Possible effects within approximately 1-3 years. Long term: Possible effects after 3 years or more.

processes between innovation actors and industry can be improved, internal and external cooperation can be initiated and supported, and networking and collaboration formats such as cross-clustering can be consolidated. In addition to economic policy actors, companies and scientific institutions are also called upon to contribute content and financial resources: Consequently, an integrative governance structure is required in order to set and pursue priorities. A financial sustainability concept (e.g. mixed financing from membership fees, office and project funding, fees and charges for services) is also desirable in order to enable long-term implementation prospects that are not exclusively dependent on public funding. The organisational and service models of strategically operating robotics clusters such as Odense Robotics can serve as role models.

- **Actors:** State of Berlin, Berlin Partner, companies, scientific institutions
- **Target group:** Innovation ecosystem (AI-based) robotics in Berlin
- **Time frame:** Long term

8.2 Field of action 2: Strategic development and creation of visibility

Berlin is currently not widely perceived as a location for (AI-based) robotics, particularly in the field of industrial applications. Although the topic is part of the Masterplan Industriestadt Berlin 2022-2026 (MPI), it has so far played only a minor role in the regional innovation strategy (InnoBB), although this is currently being revised with an open outcome. Broad strategic anchoring of the topic of AI-based robotics with a corresponding mission statement will increase visibility both internally and externally and promote both the commitment of stakeholders in the robotics ecosystem in Berlin and the perception of AI-based robotics as a potential growth driver for the Berlin economy. In addition, visibility also addresses the presentation of solutions in user industries in order to promote the diffusion of market-ready robot technologies, particularly in sectors such as the chemical and pharmaceutical industries or in small businesses, where, according to the analysis, they are not yet widely used.

Objectives in the field of action

- Increase visibility of Berlin's locational advantages in the field of (AI-based) robotics, such as AI and software development skills
- Align the location profile with the strengths of the combination of AI and industrial expertise
- Increase Berlin's attractiveness for investments, skilled personnel and settlements in the field of (AI-based) robotics
- Anchorage in the new editions of Berlin's central state strategies InnoBB and MPI

Recommendation

Strategic anchoring of (AI-based) robotics in the new innovation strategy and in the Industrial City Master Plan

The topic of (AI-based) robotics should be firmly anchored in Berlin's new innovation strategy and further expanded in the Industrial City Master Plan. In addition, an independent and complementary technology-specific robotics or automation strategy originating from the ecosystem is conceivable. Strategic anchoring requires the backing of suitable measures that contribute to a mission statement and SMART targets. The latter includes monitoring with regular reviews of implementation progress and is intended to provide a stable framework for action for all players in the field of (AI-based) robotics. Strategic anchoring should be developed together with relevant stakeholders, as already provided for in the innovation strategy process. The State of Berlin is not the only actor that can drive forward such a strategic anchoring process. Berlin Partner or, if necessary, an innovation network for robotics could also take on this role, provided that sufficient capacities are available.

- **Actors:** State of Berlin, actors in the field of (AI-based) robotics in Berlin
- **Target group:** Actors in the field of (AI-based) robotics in and outside Berlin
- **Time frame:** Long term

Recommendation

Measures to increase the visibility of the topic and the location

A series of further measures should be undertaken in cooperation and coordination with various stakeholders in order to strengthen Berlin's visibility as a location for (AI-based) robotics. This includes initiating and marketing flagship projects, (further) developing a map of stakeholders and competencies, participating in trade fairs and conferences, and getting involved in international initiatives and network formats (such as euRobotics). Companies, professional and industry associations, and network organisations are called upon to take the lead in this regard. However, the state government can also play an active role as an advisor, coordinator, (financial) sponsor and, in certain cases, initiator of joint activities (e.g. trade fairs). It is therefore recommended that the established brand of the deep tech campaign be extended to other location marketing and communication activities that, like the examples mentioned, can achieve a stronger external impact. The initiation of a ‘Robotics made in Berlin’ label should be considered.

- **Stakeholder:** Companies, associations, networks, State of Berlin
- **Target group:** Stakeholders (companies, scientific institutions, investors, skilled workers) in the fild of AI-based robotics, especially outside Berlin
- **Time frame:** Long term

Recommendation

Preparation of good practices in relevant application industries

Another measure involves the preparation and presentation of success stories in all relevant Berlin industrial sectors and companies. Good practices for the successful implementation of (AI-based) robotics in Berlin industrial companies can be presented and ideas for inspiration can be provided in various sectors. The target groups are primarily Berlin-based industrial sectors in which few robotics applications were identified during the analysis (e.g. the chemical and pharmaceutical industries). The presentation of industry-specific case studies, experience reports and interviews with pilot users will highlight the concrete advantages and challenges of integrating (AI-based) robotics solutions in different industries and enable low-threshold peer learning.

- **Actors:** Berlin Partner
- **Target Group:** Actors (companies, scientific institutions, investors, skilled workers) in the field of AI-based robotics, especially outside Berlin
- **Time frame:** Long term

8.3 Field of action 3: Creating investment incentives and practical orientation in R&D funding

With its many start-ups and researchers, Berlin's (AI-based) robotics ecosystem provides a wealth of innovative ideas that have yet to be successfully launched or marketed. And in terms of industrial applications, there is still great potential for automation in almost all sectors in Berlin, which can be tapped by implementing robotics. User companies must make investments in equipment and personnel. Supplier companies must refinance their investments in research and development, as well as the expansion of their production and marketing. For many SMEs and start-ups, low equity capital is a major obstacle to investment in innovation and automation. Combined with the uncertain economic situation and a culture of innovation that is still underdeveloped in some areas, the propensity to invest is often low. Financial resources and incentives in the form of low-threshold and rapid funding can counteract this, although tight budgets mean that the available funding must be focused on specific areas.

Goals in the field of action

- Accelerate technology diffusion in Berlin companies
- Create investment incentives for user companies in (AI-based) robotics
- Strengthen external funding acquisition
- Increase market orientation in funding projects

Recommendation

Introduction of an automation bonus

A low-threshold and unbureaucratic automation bonus would pay SMEs that invest in (AI-based) robotics for automation a share of these investments as a bonus. An automation bonus would be a financial incentive with a clear thematic focus on automation technologies such as robotics. The possibility of using funds from the federal government's special fund for this purpose should also be examined. Open-ended measures such as the Berlin Digital Bonus, but also programmes such as **Invest BW** or **Digital Jetzt**, could serve as models. Complementary to this, an information and provider platform could make the technology and integration offerings in the region more visible and incentivise local business relationships.

- **Actors:** State of Berlin, Federal Government
- **Target Group:** SME user companies
- **Time frame:** Short to medium term

Recommendation

Use of leasing models for robots in industry

In order to avoid high initial investment costs, particularly for SMEs, industrial companies should increasingly test robotics applications through leasing models. Robotics-as-a-Service solutions and leasing are increasingly available and are particularly suitable for low-threshold and flexible robotics applications such as cobots or mobile robots, where little needs to be changed to existing machines, systems and infrastructure. The models offer financial flexibility through initially lower and calculable costs and enable innovative solutions to be adopted at short notice and insights to be gained for long-term investment decisions. The spread of this measure could also be supported by bundling Berlin leasing offers on a platform (Berlin platform providers such as Generation Robotics, CNC24 and others could also get involved in this).

- **Actors:** SME user companies
- **Target group:** SME user companies
- **Time frame:** Short to medium term

Recommendation

Increased use of federal and European funding programmes

Greater access to federal and EU funding could mobilise additional research funding in the field of (AI-based) robotics. Information and advisory services as well as incentives can raise awareness of funding opportunities, make them more attractive and help with the preparation of applications. In addition to the State of Berlin, this would also be a task for a network or similar structures that could pass on relevant specific experience in the area of funding. The State of Berlin could also focus more on the design of programmes such as the ERDF and, in this context, STEP. However, companies are also called upon to make use of existing offers, exchange experiences and explore possibilities.

- **Actors:** State of Berlin, networks, companies
- **Target group:** Providers, scientific institutions
- **Time frame:** Medium term

Recommendation

Expanding support for market orientation and dissemination of (AI-supported) robotics products

Promoting cooperative research and development (R&D) in advanced stages of development with a concrete proximity to market launch helps to strengthen interaction in research, validate application options and implement pilot projects. The adaptation of the guideline for the continuation of ProValid should therefore be completed as soon as possible. Validation, prototype development, pilot projects and the market launch of technologies should be promoted more strongly, insofar as this is compatible with the European State Aid Framework. Market orientation can be supported by multi-stage, success-based funding for projects in which further funding is linked to the achievement of exploitation-oriented milestones. In addition, public enterprises in the state with their diverse application potential for (AI-based) robotics can increasingly contribute to market-oriented regional R&D cooperation as innovative users, thereby supporting market development and the external dissemination of technologies.

- **Actors:** State of Berlin, public enterprises
- **Target group:** Suppliers and developers, scientific institutions
- **Time frame:** Medium to long term

8.4 Field of action 4: Building skills and involving the workforce in the introduction of (AI-based) robotics

The potential offered by the interaction between artificial intelligence and robotics is enormous and, according to Asenkerschbaumer (2023), could result in up to 97 million new jobs worldwide. However, comprehensive training measures are necessary to ensure that employees are prepared for the requirements of using (AI-based) robotics. Currently, scepticism and risk perception dominate in many cases, which inhibit the acceptance and thus also the introduction of new technologies. This also limits the exploitation of their productivity potential. To counteract this, the targeted development of (digital) skills is essential. This is the only way to successfully integrate entrepreneurs and workforces into the transformation process. Issues of co-determination and data security should be actively addressed. Building trust in these areas is crucial to strengthening the social fabric and reducing fears. Such an approach can clearly demonstrate that these technologies are intended to support human strengths, not replace them.

Goals in this field of action

- Strengthening the rationality of investment decisions in robotics technologies
- Utilising the advantages of new technologies and integrating them into everyday work
- Facilitating the implementation of robotics technologies for their successful integration into the work process

Recommendation

Information and communication initiative

An information and communication initiative should be launched to promote dialogue with and between industry associations, chambers of commerce, trade unions and works councils. The aim is to position Berlin as a pioneer in the use of AI-based robotics in production and to communicate the associated opportunities and best practices. This initiative should include information events, workshops and joint campaigns to raise awareness of the advantages and possibilities of these technologies and to intensify the exchange between all stakeholders.

- **Actors:** Industry associations, chambers, trade unions and works council
- **Target group:** The general public, industry and investors
- **Time frame:** Medium to long term

Recommendation

Training standards and certifications

High-quality training measures for AI-based robotics should be developed in cooperation with the chambers to ensure that they are aligned with current technological standards and market requirements. This includes the creation of module plans and curricula for various technologies and the establishment of a certification process for training institutions and programmes. Such programmes should also be continuously developed to keep pace with technical developments. Chambers and associations such as the VDMA can play a role here.

- **Actors:** State of Berlin, chambers, associations, companies, educational institutions
- **Target group:** Actors (companies, educational institutions, skilled workers) in the field of AI-based robotics
- **Time frame:** Medium to long term

Recommendation

Promote co-determination, further training and cooperation

Promoting co-determination, further training and interdisciplinary cooperation is crucial for the successful integration of robotics and artificial intelligence in the world of work. These aspects create an open dialogue that reduces fears and promotes acceptance of new technologies and employees' interest in further training. Technology developers, users and employees should therefore be actively involved in the change process. Collective agreements or company agreements on the transparent use of artificial intelligence are also important in order to gain the trust of employees and optimise the integration of new technologies. Smaller companies in particular should also carry out strategic personnel planning and systematic skills assessments to determine the training needs of their workforce and offer appropriate further training measures.

- **Actors:** Companies, work councils, trade unions, skilled workers, academia
- **Target group:** Companies
- **Time frame:** Short to medium term

8.5 Field of action 5: Designing innovation- and application-friendly regulations

The integration of (AI-based) robotics in industry often encounters complex regulations. The complex and sometimes unclear or insufficiently coordinated regulations and certification processes pose major challenges, especially for smaller companies and start-ups. They often have to comply with the same comprehensive regulations as established large companies, even though they do not have the same resources or the necessary expertise. This often leads to considerable reluctance to implement new technologies, making market access and diffusion much more difficult. Regulatory frameworks also offer potential for new technology applications. They can help establish safety and quality standards that strengthen trust in new technologies. A supportive infrastructure is therefore essential. Although relevant advisory services and assistance are available in some cases, they are often not very specific and not sufficiently well known.

Objectives in this field of action

- Designing regulatory measures in line with incentives for investment and the promotion of entrepreneurial initiatives
- Enabling companies to comply with regulatory requirements securely and efficiently
- Practice-oriented legal frameworks and transparent support mechanisms to strengthen investment security and trust in new technologies

Recommendation

Streamlining, clarifying and making regulations and certification requirements more practical

Existing regulations should be streamlined and redesigned in a way that makes it easy for companies to understand how to comply with them. This includes clear and clearly communicated rules on technology introduction and corresponding operational safety requirements, as well as information on the requirements that (AI-based) robotics must meet and how liability issues should be handled, if applicable. AI-based robotics in particular requires regulatory clarity (see section 5.1). Well-designed exemptions and a graduated approach to regulation can also help reduce the burden on small businesses when introducing and using new technologies. Real-world laboratories and the Real-World Laboratories Act offer an interesting approach that should be continued and expanded as far as possible, particularly for piloting industrial applications. To ensure that regulations keep pace with the state of the art, regular practical checks should also be carried out, in which industry and regulatory authorities work together in consultation and testing processes to review the practical suitability of existing regulations and identify any need for adjustment.

Berlin should, for example, work through the Federal Council and in cooperation with other potential supporters, for example within the framework of the conferences of economics ministers, to ensure that regulations are further developed in line with the need for action described above.

- **Actors:** Federal Government, EU, State of Berlin within the scope of its co-determination powers
- **Target group:** Provider and user companies
- **Time frame:** Short to long term

Recommendation

Creating a culture of empowerment in public administration, e.g. through real-world laboratories

The Berlin administration should review its areas of responsibility, make targeted use of existing scope for action and firmly establish a mission statement for innovation-oriented action in order to establish an administrative culture that promotes innovation and investment. These measures will enable the administration to proactively create an atmosphere that intensifies dialogue with businesses and effectively supports their concerns. Emphasising a service orientation that encompasses not only rapid decision-making but also a transparent flow of information and speedy processing times plays a crucial role in this regard. This promotes constructive cooperation, which makes it possible to optimally exploit Berlin's innovation potential and position the city as an attractive location for investment. One way to foster a stronger culture of innovation and experimentation would be to intensify and flexibly activate the real-world laboratory approach when promising projects are brought to the administration and encounter regulatory hurdles. This could be established, for example, through a permanent call for proposals for real-world laboratories or a permanent real-world laboratory contact point (see, for example, Digi-Sandbox.NRW).

- **Actors:** Berlin administration/State of Berlin
- **Target group:** Entrepreneurs (users and developers)
- **Time frame:** Short to long term

Recommendation

Establishment of a peer learning platform for businesses

In order to pool knowledge on legal interpretation and promote effective practices in interpreting legislation, communication on solutions and successful projects should be stepped up. One way of doing this would be to provide a platform for peer learning, e.g. in the form of an interactive online database and communication forum. This should be populated by experts and companies with case studies and documentation on successful projects and their practical implementation. Topics such as regulation and, where applicable, certification should also be addressed. In addition, checklists and guidelines for compliance with common regulatory requirements could be made available centrally. This could be supplemented by regular workshops or webinars with experts. The physical and virtual exchange media offer companies the opportunity to share relevant issues and individual solutions and to communicate in the spirit of peer-to-peer consulting.

- **Actors:** Berlin Partner, chambers, associations, State of Berlin, companies
- **Target group:** Companies
- **Time frame:** Medium to long term

9 Glossary

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10 Annex

Table 8: Localisation coefficient for different areas of robotics research

	Berlin	Delft/ Rotterdam	Saxony	Munich	Odense	Stuttgart
(Bio-medical) robotics	0,89	0,96	1,24	0,88	1,15	1,09
Aerospace robotics	1,08	1,65	0,78	0,95	1,60	0,44
Automated guided vehicles (AGVs)	1,11	0,91	1,13	0,94	0,30	1,18
Autonomous mobility/driving	0,97	1,15	0,73	1,16	0,27	0,91
Cognitive and intelligent robotics	1,09	0,93	1,01	1,20	1,08	0,69
Collaborative robotics (cobots)	1,06	0,70	0,88	1,18	1,78	0,92
Control systems	0,93	1,13	0,65	1,16	0,68	0,92
Humanoid robotics	0,52	0,54	0,88	0,78	1,68	1,94
Industrial robotics and manufacturing automation	1,24	0,34	1,09	0,94	1,13	1,55
Material robotics	1,09	0,94	2,02	0,58	1,78	0,92
Service robotics	1,87	0,61	0,91	1,15	1,02	0,82
Soft robotics	0,63	1,17	1,87	0,35	2,19	1,27

Own calculations based on the Open Alex publication database.

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