ARTIFICIAL INTELLIGENCE

The state
of German
startups

2020

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PREFACE

AXEL MENNEKING

Head of hubraum - tech incubator of Deutsche Telekom

WE WANT TO KNOW:
WHERE DO GERMAN STARTUPS STAND IN ARTIFICIAL INTELLIGENCE?

Artificial intelligence (AI) is a key technology for the digital future. It promotes innovation throughout the entire ecosystem and can offer an enormous competitive advantage in digitization. It is therefore promising that, according to this study, AI already has a significant impact on the business model of 40 percent of German startups.

However, for an AI success story in Germany, more is needed: on one side, more intensive cooperation between startups, companies, and research. On the other, more support for the ecosystem with sufficient growth capital.

At around 74 percent, an above-average number of AI startups are actively seeking cooperation with established companies. But companies are still too reluctant to enter into commercial partnerships with young, innovative startups. To this end, Deutsche Telekom founded the tech-incubator hubraum in Berlin in 2013. Startups gain access to network technologies and product platforms in order to jointly develop products for our customers.

In addition, the "Hubraum Seed Investment Fund" supports startups in the first growth phase with capital, contacts and telecommunications expertise. But it takes a joint effort by everyone in the German ecosystem to catch up internationally when it comes to venture capital. In Israel, compared to us, almost 30 times the amount of capital per capita is invested in startups.

One final topic is very important to me when it comes to AI: responsibility. The more AI influences our everyday life, the more important digital ethics become. Everyone must design the use of this technology transparently, comprehensibly and without prejudice. People must be at the center of AI development.

Yours,
Axel Menneking

ARTIFICIAL INTELLIGENCE
THE STATE OF GERMAN STARTUPS

KEY FINDINGS

01_ **Artificial intelligence and startups – a perfect match:** AI technology has a clear impact on the business model of more than 40 percent of German startups. They are concentrated within the strong ecosystems of Berlin and Munich, which offer excellent access to talent and capital.

02_ **Close connection to established economic players:** 73.9 percent of AI startups in Germany run cooperation projects with established companies, significantly more than the average across all startups (67.1 percent). The relevance of innovative AI technologies for SMEs and corporations is also noticeable in the startups' strong focus on the business-to-business (B2B) segment.

03_ **Need to catch up with leading AI ecosystems:** Germany's AI landscape still has a long way to be on par with the best practice ecosystem Israel. This is true both in terms of the number of AI startups as well as in terms of investments – the per capita investment in AI startups in Israel is 30 times higher than in Germany.

04_ **AI needs science:** Almost 70 percent of AI startups confirm that they are currently engaged in cooperation projects with the scientific community – the average value for all German startups is only 54.6 percent.

05_ **Strengths in R&D are not harnessed to their full potential:** Germany's strength in AI research is a real advantage for the startup ecosystem. But this potential is yet to be tapped into from a business side, a deficit that also jeopardizes research activities.

06_ **Many blind spots:** Contrary to Israel, the activities of AI startups in Germany do not yet extend across all relevant industries. Many sectors in Germany, such as the education sector, have few if any AI startups.

07_ **Women are strongly underrepresented:** Women only account for 10 percent of founders in the AI sector, a significantly lower proportion than in the overall startup ecosystem in Germany (15.7 percent). This large deficit means that only a fraction of the available talent comes to fruition.
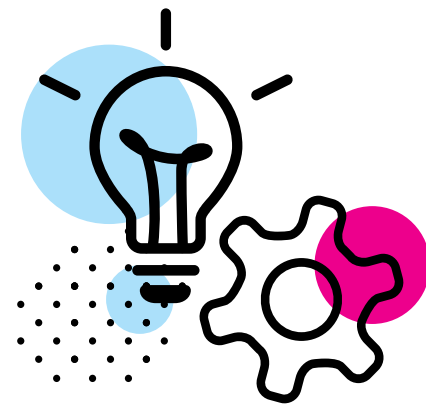
08_ **No ethics without practice:** The topic of ethics and the boundaries restricting the use of AI play an important role for the startup ecosystem in Germany. Above all, startups are asking for a more nuanced discussion and a stronger focus on concrete applications.

BACKGROUND

1.1 MOTIVATION AND OBJECTIVES

One of the most eminent AI researchers, Stanford University professor and entrepreneur Andrew Ng, predicted that "artificial intelligence is the new electricity" (Li 2017). Many other prominent personalities have made similar statements that highlight this technology's fundamental significance for the economic and social future (Perrault et al. 2019). It is therefore hardly surprising that the topic of artificial intelligence is shaping the debate about progress and social development like few other topics currently do.

The discussion in Germany usually perceives artificial intelligence as a kind of "Übertechnology": Possible ethical dilemmas posed by the "super-intelligence" (Bostrom 1998) are discussed widely, potential future ramifications for the labor market are subjected to critical scrutiny, and a battle for the global AI dominance between China and the USA is being postulated. The public discourse does, however, fail to adequately consider the question in which ways AI is put to real use. But for the German economy, the opportunities presented by AI lie precisely in its concrete fields of application – in putting AI to use for better products, simpler processes, and smarter decisions.
The establishment of a pre-

sence in and further development of the nascent business areas in this domain is of crucial importance for the competitiveness of Germany as a business location.
To succeed in exploiting the full potential of the opportunities brought about by this key technology becomes even more important in light of the enormous economic challenges entailed by the coronavirus pandemic.

This study titled "Artificial intelligence – where do German startups stand?" picks up the train of thought at precisely this point and focuses on three questions: What is the status quo in Germany with respect to innovative startups that put AI applications into practice? Which particular features and strengths distinguish the respective business location, and what are the challenges that await us during the further development of the ecosystem? Which new impetus can be gained from an examination of the startup economy for the ethical debate about putting AI to use?

1.2 FIELDS OF APPLICATION FOR ARTIFICIAL INTELLIGENCE

Due to the intensive use of data, AI has already become one of the core areas of digitalization, an area in which great innovative leaps are expected over the coming years. In light of the disruptive potential in this field, political players are talking about "changes to the production and value chains on a global scale, driven by new AI technologies" (German Federal Government 2018). In addition to the enormous opportunities to increase the efficiency in established industry sectors, the technology also opens up new business areas, such as voice recognition or autonomous driving.

In order to grasp the magnitude of the ensuing economic and social changes, it is essential to outline the substantive foundation of the concept we call "artificial intelligence." As a sub-domain of information technology, the focus of AI is on the creation of systems that are capable of accomplishing tasks that are usually associated with the human brain. Learning, drawing logical conclusions, and – to some extent – even abstract thinking are ascribed to the technology (European Commission 2019). An AI-based and therefore self-learning translation tool is, for example, capable of identifying linguistic rules on the basis of the information in existing texts it has access to. In recent years, this has increased the quality of translation and voice recognition software tremendously. Other areas such as autonomous driving, where a large

volume of heterogeneous data is collected, processed, and used, have only become possible through AI (Fraunhofer 2018).

This general definition is complemented by the distinction that can be made between strong and weak AI. Weak AI has clearly defined application areas in which the technical systems solve problems and continuously optimize themselves on the basis of new data. The concept of strong AI on the other hand stands for significantly higher intellectual capabilities that are not limited to certain application areas. While weak AI is already being used extensively in real-life applications, strong AI remains a field of research in which future possibilities of the technology are being examined. This study places its focus on the practical application of the technology, and thereby on weak AI. This forms the foundation for adding to the ethical debate about putting AI to use by discussing current fields of application and examining the perspective of the startup community.

1.3 METHODOLOGY AND FOCUS

At its core, this study examines the practical use of artificial intelligence; it focuses on existing applications and thereby gain insights into the current range of use cases. But how can this range be determined? We know from established companies that they are still fairly cautious when it comes to putting AI to use and, in most cases, limit the technology to a few areas. An international comparison to China and the USA shows that this tendency is particularly strong in Germany (Berger 2020). The startup ecosystem, on the other hand, boasts an extremely high affinity to AI applications: According to the results of the German Startup Monitor 2019, a good 40 percent of all startups in Germany confirmed that AI has a strong impact on their business model – and the trend is rising (Figure 1).
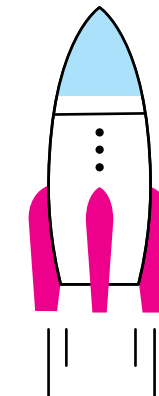
Figure 1: Significance of AI in the German startup ecosystem[1]

+13,8%

40,4%

35,5%

2018   **2019**
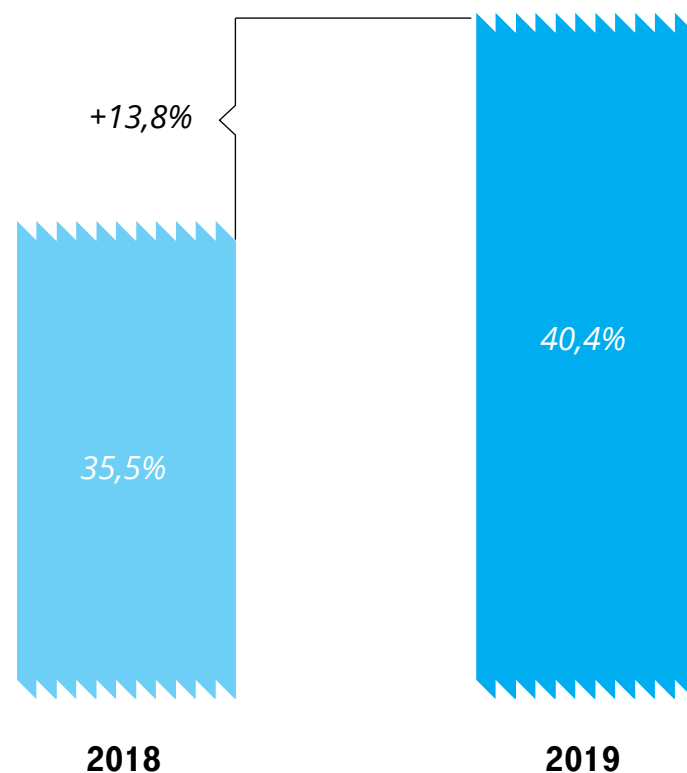
[1] *The figure shows the proportion of startups for which the impact of artificial intelligence on their business model is (very) significant.*

In order to capture the range of existing AI applications and thereby the innovative potential in this area, this study focuses on an analysis of startup companies. For the purposes of this study, startups are innovative growth companies that are no older than 10 years (Kollmann et al. 2019). An initial appraisal of the status-quo of AI startups is based on data from the DSM (Deutscher Startup Monitor, German Startup Monitor) 2019. This was the first time this data was clustered and examined separately for this specific purpose. For the purposes of this study, AI startups are companies that have stated that artificial intelligence has a very significant impact on their business model. This methodology allowed us to identify 404 startups that fall within our definitions.

In addition to an analysis of the data from the DSM, a comprehensive list of German AI startups was prepared for this study. The key information sources included the AI landscape of the Initiative for Applied Artificial Intelligence (appliedAI 2020), as well as the list of startups prepared by Asgard and Roland Berger (Roland Berger & Asgard 2018), which were reviewed on their topicality and supplemented by own research. This has allowed us to identify 285 AI startups in Germany and classify them by their use cases. In order to determine Germany's position on the international scale, the same analysis was carried out analogously for the AI ecosystem in Israel. The country, which, according to the Start-Up Nation Central platform, is home to around 1300 AI startups, represents an unrivaled best practice in this field. Against the background of the objective of examining a representative sample, a random selection of companies was drawn from the central database of startups in Israel (Start-Up Nation Central 2020).

Additionally, the appraisals of 24 founders and experts from the ecosystems of both countries were obtained – either in the form of 30-minute interviews or as brief statements on specific issues. They served as additional information material and assisted in the validation of the findings.

AI IN THE GERMAN STARTUP ECOSYSTEM

2.1 REGIONAL DISTRIBUTION AND HOTSPOTS

The key requirement for the emergence of innovative growth companies is the existence of an active ecosystem: successful startup entrepreneurs are needed, who contribute their experience, expertise, networks, and resources and thereby improve the environment for new companies (Mason & Brown 2014). Prominent examples of this effect can be found in the Silicon Valley and business locations such as London, Tel Aviv, and Shanghai. Significant differences with respect to the quality, visibility, and success of the respective ecosystem can also be found in the German startup landscape, where it is also the metropolitan areas that stand out from the crowd. According to the German Startup Monitor DSM, almost a third of startups are located in either Berlin (16.1 percent), Hamburg (7.4 percent), or Munich (6.9 percent) (Kollmann et al. 2019).

The analysis of the German AI startups shows that the concentration in the area of artificial intelligence is even significantly higher (Figure 2). Berlin is the uncontested AI hotspot with 36.5 percent, followed by Munich with 22.4 percent, and Hamburg with a share of 5.8 percent. This regional distribution of AI startups shows that the technology will only thrive in a very highly developed ecosystem. Accordingly, AI business models are predominantly found in the German startup hotspots Berlin and Munich, which both offer a particularly strong ecosystem in terms of investments, IT experts, and the supporting landscape (incubators, technical universities, etc.). This is also reflected in the distribution of venture capital in Germany – in 2019, the largest share of 58.3 percent of venture capital was flowing toward Berlin, 23.5 percent to Munich, and only 4.2 percent to Hamburg (Ernst & Young 2020).

Figure 2: Regional distribution of AI startups in Germany

Hamburg: 5,8 %

Berlin: 36,5 %

Munich: 22,4 %
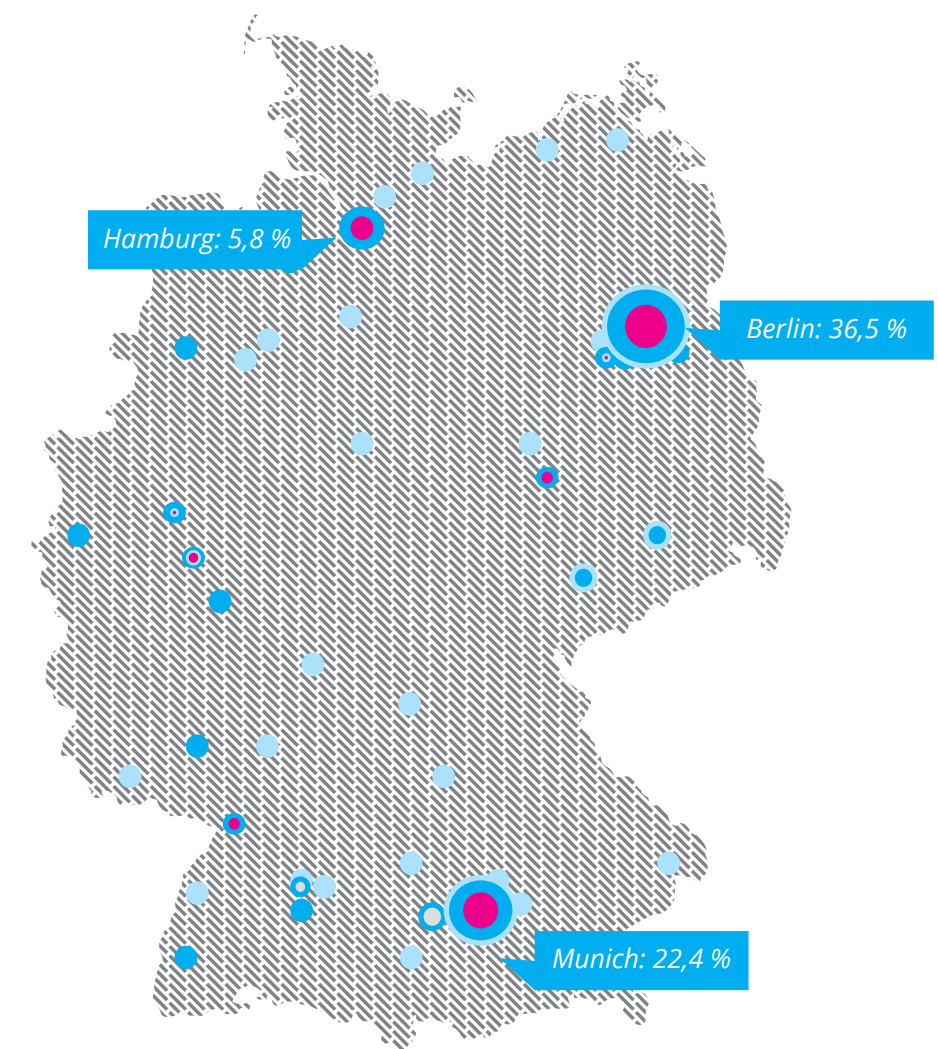
These numbers not only highlight the economic significance of internationally visible hubs such as Berlin, but also hint at unexploited opportunities across the whole country, especially in regions with excellent research facilities and a broad base of industrial companies as potential customers. Karlsruhe, a city with information technology strongholds such as the Karlsruhe Institute of Technology (KIT) and others, accounts for a respectable share of 3.6 percent and demonstrates that AI ecosystems can also thrive smaller business locations.

> *The German ecosystem in particular benefits from its location – Germany, Austria, and Switzerland as well as the neighboring regions boast many leading research facilities and universities along with market leading companies in various industry sectors – from healthcare to mechanical engineering. This assures the sustainable access to the best talent, the latest research, and comprehensive industry data and is a clear advantage over other regions. Another advantage of Germany's ecosystem is Berlin: the city is uniquely attractive for international talent and continues to offer overheads that are significantly lower than at other tech locations."*
>
> *Rasmus Rothe, PhD. (founder & CEO of Merantix, member of the Board of the German AI Association (KI-Bundesverband))*

2.2 BUSINESS AREAS, COOPERATION PROJECTS, AND EXPERTISE

In its recently published White Paper on AI, the European Commission highlights the entire breadth of opportunities AI applications offer for the development of the European economy (European Commission 2020). The German Federal Government also emphasizes the significance of artificial intelligence as a key technology for preserving the competitiveness of Germany's economy – in particular with a view on the broad SME landscape that stands to benefit enormously from targeted innovation transfers (German Federal Government 2018). This is also evident from the numbers: 73.9 percent of AI startups in Germany form cooperation projects with established companies, significantly more than the average across all startups (67.1 percent). The relevance of innovative AI technologies for SMEs and corporations is also noticeable in the startups' strong focus on the business-to-business (B2B) segment (Figure 3).

Figure 3: Customer focus of German startups[2]

Startups: 46,4% | 11,5% | 42,1%

AI Startups: 63,4% | 6,8% | 29,7%
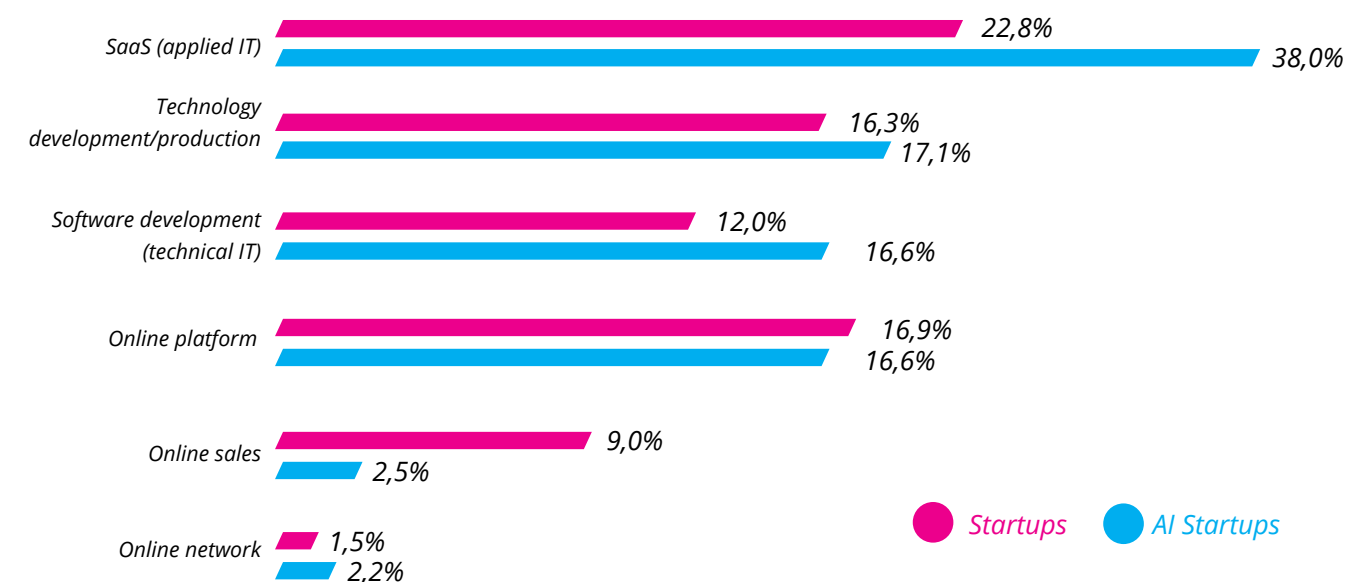
● B2B-Focus ● B2C-Focus ● No Focus
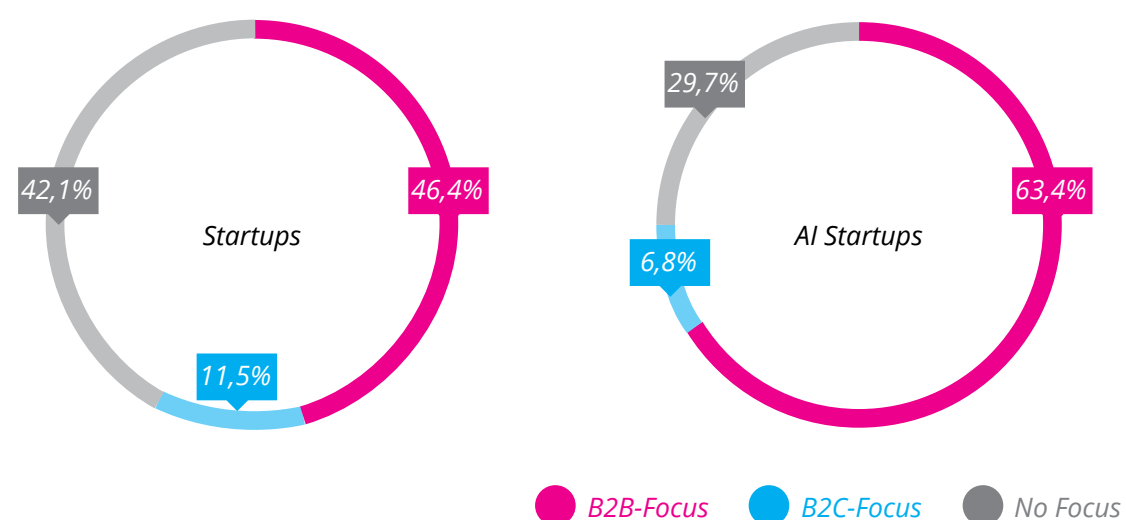
[2] The "customer focus" category refers to the area in which a startup generates more than 90 percent of its revenues.

The clear emphasis on the B2B segment is also evident in the business models of German AI startups: the by far most important area is software-as-a-service (SaaS), where startups provide customers and other companies with IT infrastructure and software as a service (Figure 4). An example of an application geared to industrial customers is the startup AiSight, which offers a tool for dynamic machine control. The use of self-learning AI models that work with different sensor data is intended to increase the efficiency of machine maintenance and thereby deliver cost savings. The legal system is another area that is being digitalized by AI startups such as the LegalTech rfrnz, which uses AI algorithms to expedite the analysis of contracts for law firms and legal departments. In addition to this focus on SaaS, the data also indicates a wide distribution of AI startups across the different business areas. The berlin-based startup MoBerries, for example, has developed an AI-based job matching platform that can optimize the search process for both parties and connect job seekers with suitable vacancies on the basis of qualifications and requirements.

Figure 4: Business models of startups in Germany

Business model	Startups	AI Startups
SaaS (applied IT)	22,8%	38,0%
Technology development/production	16,3%	17,1%
Software development (technical IT)	12,0%	16,6%
Online platform	16,9%	16,6%
Online sales	9,0%	2,5%
Online network	1,5%	2,2%

● Startups ● AI Startups

The software applications that AI startups focus on entail a strong demand for technological expertise and constant exchange with the international research community in relevant information technology disciplines – as practiced by institutes such as the German Research Center for Artificial Intelligence (DFKI). This is clearly evident from the proximity to scientific facilities: Almost 70 percent of AI startups confirm that they are currently engaged in cooperation projects with the scientific community – the average value for German startups stands at only 54.6 percent. As we will establish in Chapter 4.1, the range and quality of AI research is an important strength of Germany as a location for startups, but the full potential of this strength is yet to be exploited.

> *You don't purchase AI systems in the same way you purchase an Office package or new tax software. In many cases, the least it takes is development, if not real research, in order to identify the needs of the customer and develop, train, and test systems that cater to those needs. To achieve this, customers must learn to think digitally, and to precisely analyze their analog processes, and to collaborate with the developers to find out where AI is supposed to be helpful, which data is available, how quality can be measured, etc. This requires interdisciplinary teams (specialist department, IT, legal department) and time. Last but not least, the ordinary digital infrastructure must also be in place. This process requires a lot of effort and it still is 'the very first time' for many tasks and industry sectors. It looks like it will only get better once use case and standards have crystallized in this area. There are, however, plenty of them in the German B2B segment."*

Dr. Aljoscha Burchardt (Deputy Site Director of DFKI Berlin)

2.3 RESOURCES, FINANCING, AND GROWTH

The central importance of scientific expertise in connection with scalable digital business models makes artificial intelligence a strongly growing market. Harnessing this potential in business practice requires a lively startup ecosystem comprised of experienced founders as well as significant investments. An important indicator for an established network are busi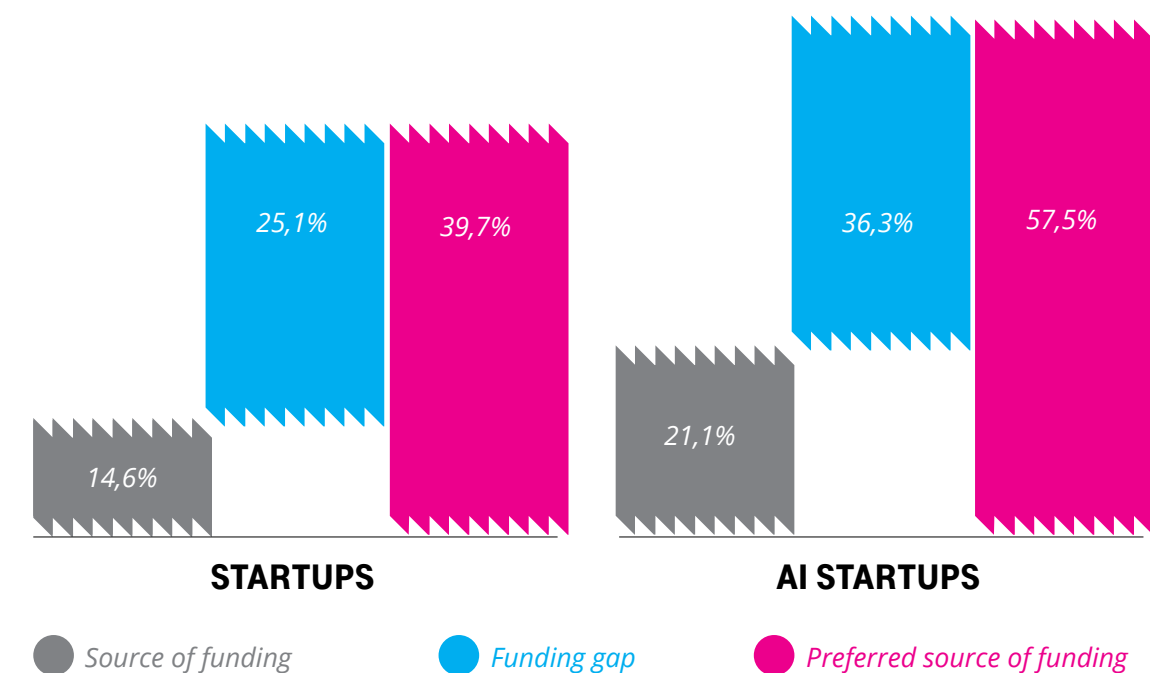ness angels, who not only make their capital but also their expertise and contacts available to the startups. With a share of 29.4 percent compared to 23.1 percent, startups in the area of AI receive capital injections from business angels more frequently than the remaining ecosystem.

The situation is similar when it comes to venture capital: 21 percent of AI startups succeeded in securing venture capital.

This value is a good five percentage points above the average and shows that investors consider the AI sector to be particularly promising (Figure 5). Well over half of the AI startups (57.5 percent) are also planning to use venture capital for their financing requirements – another indicator for the high innovative strength and scalability of many AI business models. At the same time, the significant gap between the objective of venture capital financing and its implementation so far indicates a lack of capital in the German ecosystem, and thus opportunities that are yet to be exploited to their full potential.

Figure 5: Startups in Germany with venture capital financing

STARTUPS			AI STARTUPS		
14,6%	25,1%	39,7%	21,1%	36,3%	57,5%

● *Source of funding*   ● *Funding gap*   ● *Preferred source of funding*

> *If someone today has a good business idea and is capable of using leading-edge AI to turn the idea into reality and on top of that has a good team, then seed financing is not a problem. Startups that are 'only' very good in AI are difficult. They often end up resorting to 'bootstrapping' with their project business, without ever developing any defensible and scalable business idea (that would generate recurring revenues). If this situation is aggravated by an inexperienced team, they will never get off the ground."*

Dr. Philipp Gerbert (Director of appliedAi)

GERMAN AI STARTUPS IN COMPARISON

3.1 BENCHMARK ISRAEL

Following this general contextualization of AI startups, we will now take a closer look at the activities and key focus areas of the German ecosystem. The positioning on an international scale is determined based on a systematic comparison with Israel, a country that represents an unrivaled best practice in the area of startups in general and in the field of AI in particular. This is, among others, evident from the great number and density of innovative AI startups: According to information from the Start-Up Nation Central platform, there are currently around 1300 AI startups in Israel. That is around four times the number in Germany, where around 300 AI startups can be identified. This difference is, especially in light of Israel's population of only nine million, impressive and illustrates Israel's enormous strength when it comes to AI.

In addition to the sheer number of AI startups, the total amount of venture capital invested makes the ecosystem in Israel stand out in comparison to other countries. Israel's lead is particularly evident when comparing the per capita investments (Figure 6): In 2018, per capita investments in Israel were almost 30 times higher than in Germany, and twice as high as in the USA. This strong concentration shows that the country not only has a large, but above all also a high-quality AI ecosystem.

"AI startups in foreign countries receive significantly more capital at an early stage, which they can use to bolster their sales and marketing activities. This allows them to achieve faster growth and, in many cases, also to attract additional investors in a shorter time – a loop is created. Germany has so many great startups in the field of AI. But in many instances, they only become visible to the outside world once they have already progressed very far in their product development and developed stunning AI solutions. Unfortunately, only a small proportion will make it that far. What we need is better, more courageous access to capital in order to succeed in international competition."

Dr. Anna Lukasson-Herzig (founder & CEO of Nyris)

"Israel has a very dense, broadly scoped and active startup ecosystem, which is a great cross pollinator for applications of artificial intelligence. AI is a powerful way to connect different dots – big data, machine learning, etc. The successful application of AI can provide a huge competitive advantage in diverse fields, such as Medical Science (Zebra Medical Imaging), Agriculture (Tarannis), Business Monitoring & Revenue Intelligence (Anodot, Gong.io) as a very limited sample. Startups seek to implement the knowledge and applications developed and tested here in Israel to grow fast internationally."

Alon Segal (Managing Director, Group Partnering & Devices Israel Deutsche Telekom)

Figure 6: Per capita investments in AI startups 2018 (Data: Perrault et al. 2019[3])

118 U.S. dollar

57 U.S. dollar

4 U.S. dollar
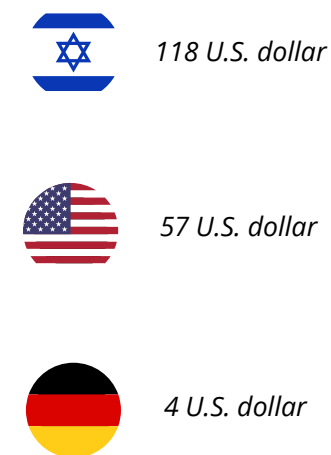
[3] The investments in AI startups shown are based on Crunchbase data and are publicly available as part of the AI index (Perrault et al. 2019).

But what distinguishes Israel as a startup location and best practice in artificial intelligence? One factor not to be underestimated is the specific geopolitical situation of the country and the ensuing central significance of its military. The Israel Defense Force educates a high number of IT experts and at the same time trains them in security-relevant remits. This broad practical expertise combined with the close connection to the venture capital community in the USA are key advantages of the business location in terms of the available brainpower and capital (Kon et al. 2014). Another factor is that, contrary to Germany, Israel only has a small domestic market and few local industries, which is why the majority of startups are targeting international markets right from the beginning.

> *Israel has a thriving and vibrant startup ecosystem with many founders in the field of AI. Due to the limited size of the Israeli market, startups address international markets early in their development. The government is also crucial for the success of the ecosystem: With the Israel Innovation Authority, the state supports innovative tech startups and this program also makes sure that they have a clear market fit with their product from the very beginning. The combination of the early need to face international competition and the focus on a clear product-market-fit is a key success factor for Israeli startups."*

Avichai Belitsky (founder & CEO of Youtiligent)

Other significant factors of success include the close ties between universities, research centers, and business (Bertelsmann Foundation 2017). Comprehensive R&D subsidies in the area of security-relevant AI technologies play a special role here (Kon et al. 2014). A prominent example of an AI success story made in Israel is the company Mobileye: Founded as early as 1999 by a Hebrew University scientist, this startup has developed into a pioneer in the field of image recognition and was acquired by Intel for 15 billion US dollars in 2017.

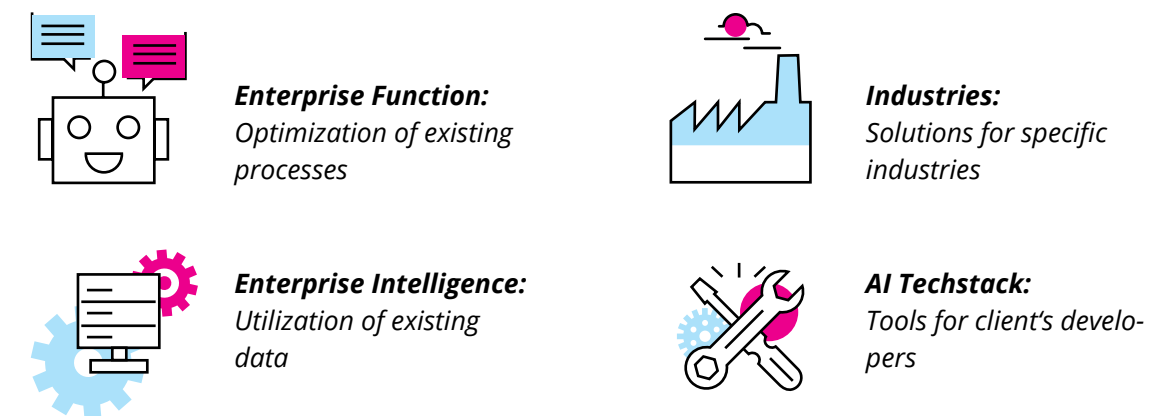## 3.2 FIELDS OF APPLICATION FOR AI STARTUPS

As already outlined in Chapter 1.3, the following analysis is based on the data of 285 startups in Germany and was prepared, reviewed, and supplemented on the basis of the AI landscape (appliedAI 2020) and a company list supplied by Roland Berger and Asgard (2018). The systematic comparison with Israel is based on an adequately large sample of randomly selected AI startups procured from the Start-Up Nation Central platform (2020)[4]. The logic followed in the classification of the startups is guided by entrepreneurial practice and implemented analogously to the approach taken by the AI landscape (appliedAI 2020).

Figure 7: The four major categories of AI startups

Enterprise Function:
Optimization of existing processes

Industries:
Solutions for specific industries

Enterprise Intelligence:
Utilization of existing data

AI Techstack:
Tools for client's developers

The Industries category includes startups whose AI solution was developed for a specific industry. A parking space finder that works with the help of computer vision would, for example, be classified in the mobility area. The Enterprise Function category includes AI solutions that optimize business processes and thus increase productivity. Frequently encountered examples are customer service chatbots that perform certain tasks in the communication with customers. The Enterprise Intelligence category comprises cases that put AI to use for the systematic analysis of collected data with the objective of generating new insights and services that cannot or only hardly be achieved with current methods of analysis. Startups that provide other companies with tools and software that allow them to develop their own AI solutions more easily and effectively fall within the AI Techstack category.

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[4] *The values for Israel determined on this basis represent approximations of the true proportions. The interpretation focuses on general trends in comparison to Germany.*

Germany: 53,0% · 18,9% · 17,9% · 10,2%

Israel: 57,5% · 27,5% · 9,4% · 5,6%

● Industries   ● Enterprise Function   ● Enterprise Intelligence   ● AI Techstack
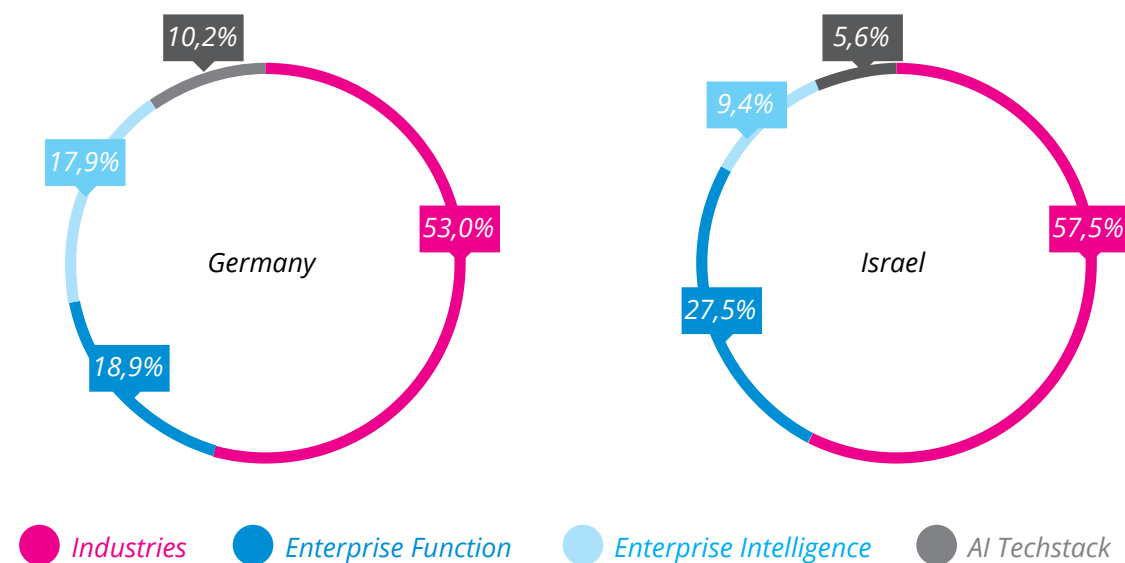
A comparison between Germany and Israel with respect to the four top-level categories already allows for the identification of initial commonalities and characteristics (Figure 8). It is apparent that around half of the AI startups in both countries can clearly be allocated to certain industry sectors that target specific markets with their products. Enterprise Function, meaning the AI-based optimization of relevant processes in a company, is the second-largest field in both Germany and Israel.

At the same time, differences with respect to the key focus areas are evident: For example, the share of German AI startups in the Enterprise Intelligence field is significantly higher than in Israel. While Israeli AI startups strongly focus on the development of solutions in specific industries or functional areas, such as sales or HR (Enterprise Function), their counterparts in Germany tend to base the development of business models more on the technical possibilities of data analysis. The comparatively large share of AI Techstack in Germany also reflects the gearing toward the requirements of the established economy, which not only requires finished products but also tools for the implementation of proprietary solutions. Israel's focus on the global market and Germany's emphasis on the domestic industry also become apparent through the following analysis of the industries and use cases in both countries.
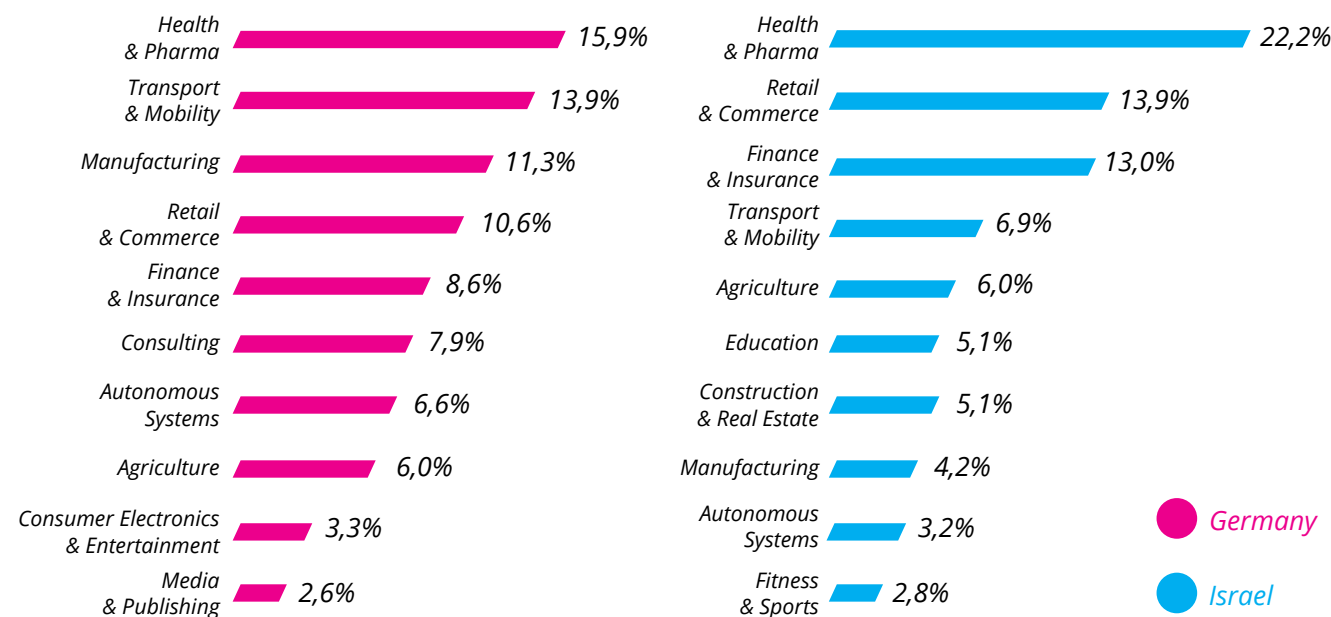
3.3 INDUSTRIES AND USE CASES

The background of the just under 300 companies in the still small AI community in the German startup ecosystem gives rise to the question whether AI startups in Germany are already sufficiently active in the most important sectors and in which areas there is little or no activity to date. Answers can be found in the comparison with Israel (Figure 9): The industries with strong AI activity in both countries include health, finance, mobility, and trade. A prominent example from the important health sector is Berlin-based AI startup ada: Their app is a tool for the analysis of symptoms and caters to society's growing need for health-related information. This and similar solutions for prophylaxis and early detection of illnesses are ascribed great importance in relieving pressure on the healthcare system. The high concentration of startups in the "Transport & Mobility" and "Manufacturing" sectors in Germany shows that the AI ecosystem benefits from the strength of the domestic industrial sector. At the same time, there is still enormous potential in the cooperation between AI startups and the established economy in Germany that can be exploited by significantly strengthening the startup ecosystem.

The automotive industry and the strong industrial sector in Germany provide a good environment for AI startups. But our ecosystem for AI startups is still a long way from where it should be. Because competition is a global phenomenon, startups from all around the world cooperate with German companies. This is aggravated by the fact that international startups often enjoy significantly better financing. Significantly more capital is therefore required for the further development of the AI ecosystem in Germany."

Holger G. Weiss (founder & CEO of German Autolabs)

Germany	
Health & Pharma	15,9%
Transport & Mobility	13,9%
Manufacturing	11,3%
Retail & Commerce	10,6%
Finance & Insurance	8,6%
Consulting	7,9%
Autonomous Systems	6,6%
Agriculture	6,0%
Consumer Electronics & Entertainment	3,3%
Media & Publishing	2,6%

Israel	
Health & Pharma	22,2%
Retail & Commerce	13,9%
Finance & Insurance	13,0%
Transport & Mobility	6,9%
Agriculture	6,0%
Education	5,1%
Construction & Real Estate	5,1%
Manufacturing	4,2%
Autonomous Systems	3,2%
Fitness & Sports	2,8%

● Germany
● Israel

A comparison along sectors with the best practice ecosystem Israel makes it clear that there are a number of blind spots: Israel already has a long line-up of use cases and industries that are not yet covered in Germany. This includes the education sector with 11 Israeli AI startups (5.1 percent), which is expected to experience significant growth amidst the coronavirus pandemic.

A look at the German AI startups in the area of Enterprise Function unveils another deficit (Figure 10). By focusing on "Sales & Marketing" and "Customer Services"

(53.7 percent), the German community is seeking its fortune in markets that are not very innovative and already saturated. Germany's presence in the disruptive and rapidly growing field of "IT & Security" is still fairly weak. In addition to the need to close the gap across all fields, the AI ecosystem in Germany is also facing challenges in its efforts to gain a foothold in innovative and future-proof business areas.

Other industries of enormous importance for the German economy, e.g. the energy or logistics sector, so far only play a subordinate role in the AI ecosystem. In contrast, the ecosystem in Israel has positioned itself on the global market, which allows it to even establish a foothold in industries with little or no presence in the country. Good examples are the many Israeli startups in the area of autonomous driving, which emerged despite the fact that there is not a single automotive manufacturer in the country. The most prominent example is the company Mobileye already mentioned above, which is now a subsidiary of Intel.
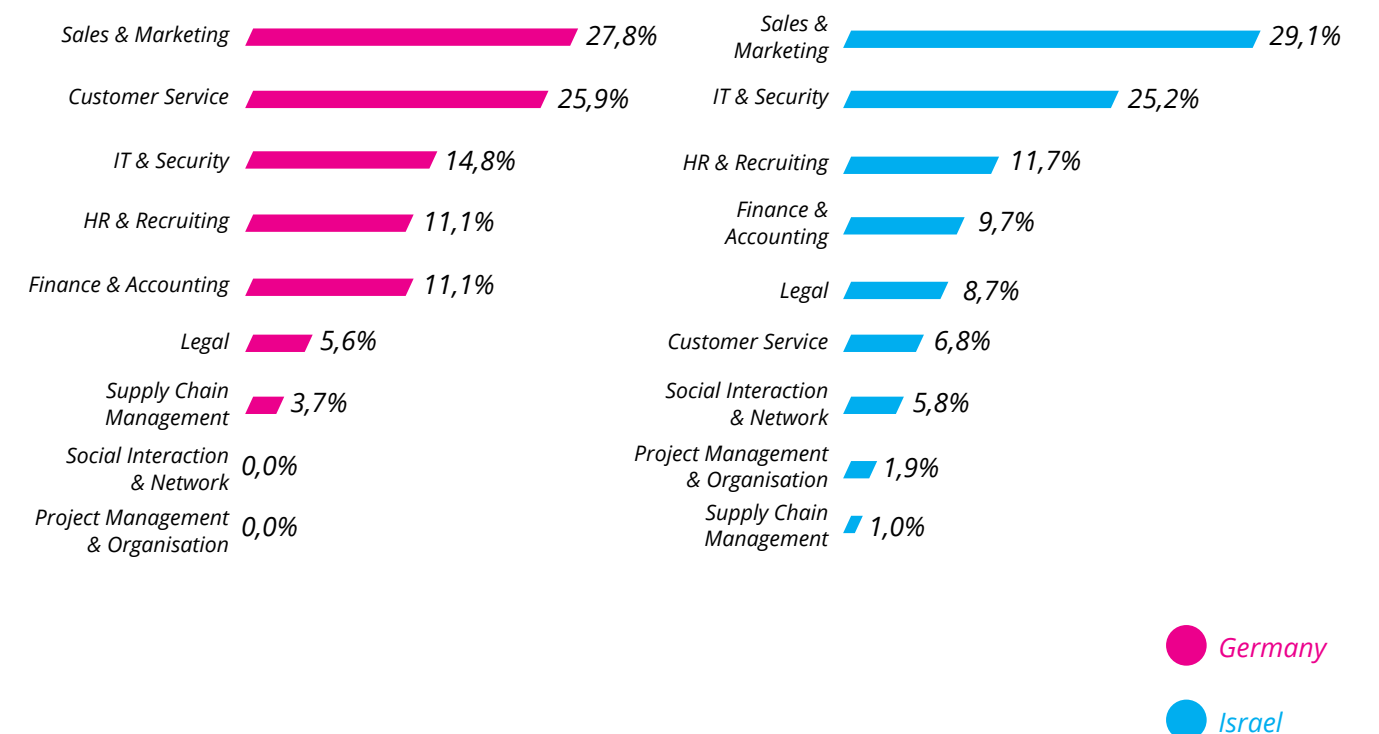
" *For German startups, their domestic market with a strong industry and many well-established companies is definitely a real advantage. At the same time, founders in Israel must get their products ready for international competition at an early stage and they also benefit from the large number of international investors in the country. As a result, Israeli startups do not develop products for individual customers, but aim to conquer larger markets. Being a global player also makes you a more interesting partner for big companies. And from our experience many companies in Germany are willing to cooperate with startups from abroad."*

Beni Basel (founder & CEO of ciValue)

Germany	
Sales & Marketing	27,8%
Customer Service	25,9%
IT & Security	14,8%
HR & Recruiting	11,1%
Finance & Accounting	11,1%
Legal	5,6%
Supply Chain Management	3,7%
Social Interaction & Network	0,0%
Project Management & Organisation	0,0%

| Israel	
Sales & Marketing	29,1%
IT & Security	25,2%
HR & Recruiting	11,7%
Finance & Accounting	9,7%
Legal	8,7%
Customer Service	6,8%
Social Interaction & Network	5,8%
Project Management & Organisation	1,9%
Supply Chain Management	1,0%

● Germany
● Israel

CHARACTERISTICS OF THE AI LAND-SCAPE IN GERMANY

4.1 UNLOCKING RESEARCH POTENTIAL

So far, potential remains untapped in Germany, especially for industry- and function-specific AI solutions. At the same time, a good 28 percent of startups are actively engaged in the areas of Enterprise Intelligence and AI Techstack, which com-

pares to only around 15 percent in Israel. Despite the Israeli ecosystem excelling in terms of the number of AI startups and covering nearly all AI use cases, there are application areas where strengths of the German ecosystem become apparent.

Figure 11: Distribution of AI startups by Enterprise Function

Geo Data	Audio Data	Market Data	Sensor Data	Internal Data	Text Data	Visual Data
3	4	5	6	9	11	13
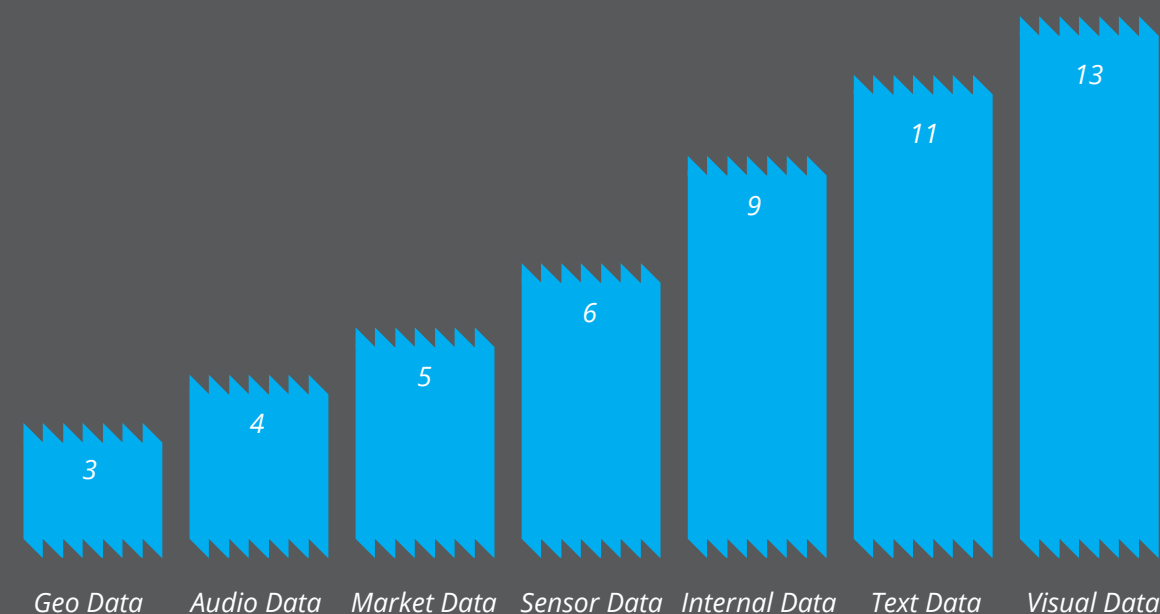
The category of Enterprise Intelligence accounts for a total of 51 German startups. They include Germany's arguably most prominent AI startup, Munich-based Uni-corn Celonis, which in recent years acquired customers all over the world with its process optimization solution. The breadth of solutions covered by German AI startups – from sensor data to voice and text data – is also impressive (Figure 11). The strength in this highly technical field, dominated by data analysis, indicates that AI research, next to market focus, is a crucial factor for the success of the ecosystem.

Figure 12: Number of scientific papers on AI, 2009-2018 (data: Perrault et al. 2019)[5]

Legend: China · USA · Europäische Union · davon Deutschland
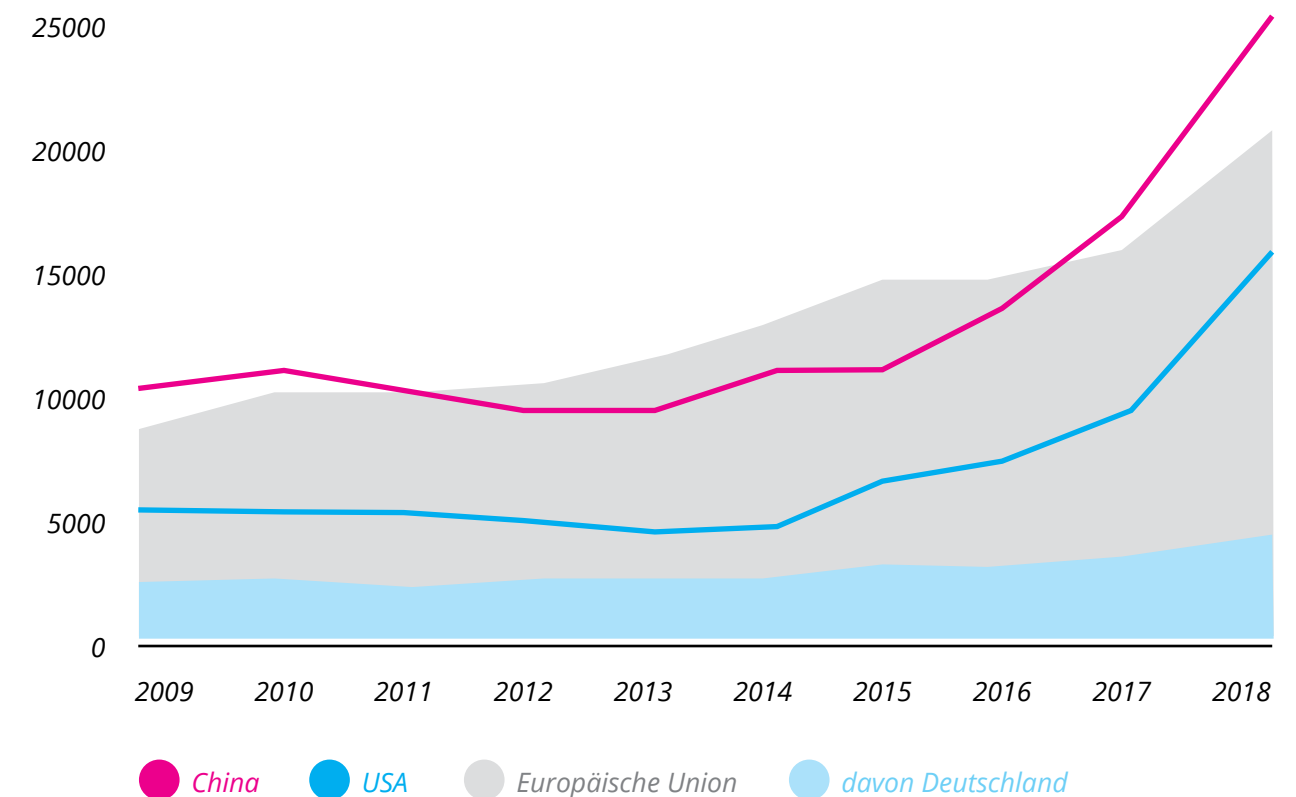
[5] *The presented data was sourced from the Scopus database of Elsevier and is publicly available as part of the AI Index (Perrault et al. 2019).*

Thanks to a long academic tradition in AI-relevant areas, Germany can rely on a broad research foundation in this field. Compared to Israel, more than seven times the number of AI-related scientific articles were published in Germany in 2018. Germany and Europe are also positioned well in the global competition with the USA and China for scientific AI expertise (Figure 12). What is lacking in Germany, however, is the entrepreneurial mindset and the corresponding ecosystem required to translate this expertise into practice. This transfer gap is increasingly reflected in the academic field: While the increase in scientific AI articles since 2015 in Germany is already high at 59 percent, the hotspots USA (+93 percent) and China (+130 percent) show much more significant leaps.

4.2 STRUCTURAL AND CULTURAL FRAMEWORK

The AI ecosystem in Israel is distinguished by the close relationship between scientific theory and practical application, with the military as an important facilitator. In connection with a good integration into the international VC market, the country boasts strong incentives for entrepreneurs who promote and cultivate the startup mindset – taking risks and thinking big. In the German AI ecosystem, the challenge lies predominantly in strengthening the capital resources available to AI startups and in further improving the transfer between theory and practice. However, the enormous opportunities this offers for Germany as a business location are so far barely being utilized. The analysis also shows that the scientific productivity benefits from a stronger integration of specific application fields as well.

If the country wants to become an (AI) innovation hotspot, it needs to successfully interlink the scientific with the business community. We need more intermediaries between research and industry. Israel is the perfect role model in precisely this area of technology transfer and the Germans have a lot to learn from the Israelis. Due to its history and geographic position, the entrepreneurship culture in Israel is completely different and we cannot simply emulate this 'entrepreneurship gene' one-to-one. But what we should definitely take on board from the Israelis and thereby 'strengthen Germany's strengths' is to have more courage and willingness to take risks and to have less fear of failure."

Andrea Frahm (Innovation Management & Strategic Partnerships at Helmholtz Association Israel)

## 4.3 FEMALE FOUNDERS IN THE AI SECTOR

Another huge opportunity for AI research and the entire ecosystem in Germany lies in the empowerment of women. While the proportion of scientific papers with at least one female member of the authoring team has more than doubled from 10.6 percent to 24.8 percent between 2003 and 2018, gender equality is still a long way off (Perrault et al. 2019). The imbalance is even more pronounced in the startup ecosystem (Hirschfeld et al. 2020): In Germany, the proportion of female startup founders has barely increased in recent years and currently stands at only 15.7 percent – and the figure is even lower for AI (Figure 13).

If we allow the development of important technologies to be the exclusive domain of an elitist, homogeneous group, we risk AI-based machines that discriminate against humans in return. We will only be able to prevent this from happening if we promote diversity within the AI industry. All genders, nationalities, age groups, and perspectives should collectively contribute to the development of unprejudiced AI systems. Female founders are frequently the initiators of this diversity. They are the drivers behind an essential process of change within the industry that opens the doors for people from a wide variety of backgrounds."

Tina Nord (Ambassador of Women in AI Germany)

Figure 13: Proportion of female startup founders in Germany

10,0%
AI Startups

15,7%
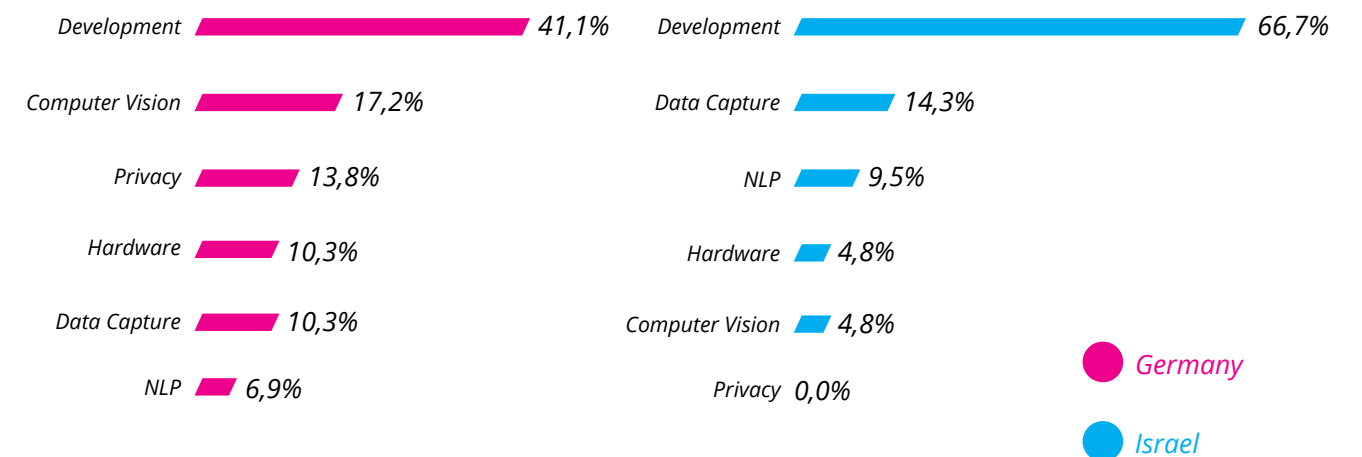Startups
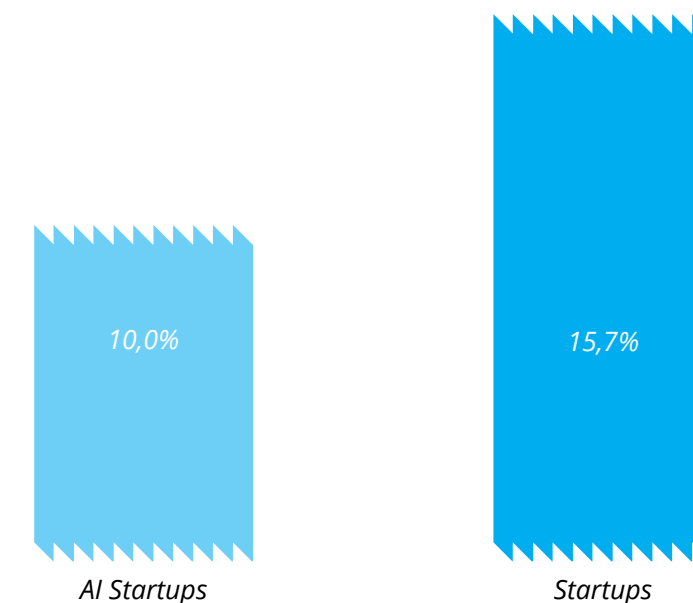
AI IN THE SOCIAL CONTEXT

5.1 STARTUPS, AI, AND PERSONAL DATA

The influence AI solutions have on our daily lives will continue to increase over the coming years. This makes it all the more important to develop the technology in an inclusive manner and to anticipate its consequences at an early stage. At the same time, however, the debate must not be limited to visions of the future, but must be conducted on the basis of current developments. A striking example: More than two thirds of all AI language assistants have a female voice and thus actively contribute to the reproduction of traditional role models and gender stereotypes. This is a systemic problem that firstly points to the issue of representation and secondly to the great importance of sensitivity to ethical issues in the technology sector.

An important aspect in the context of ethics and AI is the use of personal data and the safeguarding of privacy. Here, our data shows that this sector is establishing its own business area in Germany, which is without a match in Israel: In the AI Techstack field, 13.8 percent of startups in Germany are actively engaged in the area of privacy and provide tools that support other companies in protecting the privacy of their customers (Figure 14). The introduction of the GDPR has pushed this development politically and the question of how AI solutions can be implemented in a privacy-friendly manner will become even more important in the future.

Figure 14: Distribution of AI startups by AI Techstack

Germany

- Development — 41,1%
- Computer Vision — 17,2%
- Privacy — 13,8%
- Hardware — 10,3%
- Data Capture — 10,3%
- NLP — 6,9%

Israel

- Development — 66,7%
- Data Capture — 14,3%
- NLP — 9,5%
- Hardware — 4,8%
- Computer Vision — 4,8%
- Privacy — 0,0%

In addition to the role of privacy as a business model in its own right, this field is a prominent characteristic of German and European AI startups that distinguishes them well beyond the analyzed use cases. While the interviews conducted with Israeli startups and experts revealed that the debate about data protection and ethics in Europe is being acknowledged, the awareness of such issues is much greater in Europe.

> "In Germany, the debate about putting AI to use is too polarized: All technologies come with specific benefits and drawbacks, and it is our task to weigh them up and balance them. But this has to be done in a solution-focused approach so that we use the chances offered by AI. At the same time, there are undoubtedly certain areas that require clear rules and boundaries, such as the analysis of DNA or face recognition. Most European AI startups have a clear ethical compass that forms a good basis for our AI ecosystem."
>
> Marian Gläser (founder & CEO of Brighter AI)

5.2 AI AND ITS ETHICAL IMPLICATIONS

AI has long ago stopped being the exclusive realm of science and has firmly established itself in our everyday economic and social lives. In addition to the major tech companies, it is mainly startups that serve as vehicles carrying the technology into the most diverse business areas. Against this background, politics and the society at large are faced with questions concerning the potential ethical challenges associated with putting AI to use. What are we supposed to do if data-driven and therefore supposedly smart decisions turn out to systematically discriminate against certain population groups? In which way can our values be taken into account with respect to the development of AI solutions? How can the technology's logic be made transparent and controllable?

The debate on these and similar issues is being driven forward politically by the European Commission, the UN, and OECD, and at the national level by the German Federal Government's AI strategy as well as the AI Enquete Commission and the Data Ethics Commission. In addition, civil society and tech corporations that develop AI applications themselves or provide the necessary infrastructure are also driving the discourse. Despite different positions on individual issues, a consensus on the central meaning of ethical questions in the area of AI has formed at this intersection between politics, the general public, and the economy. Moreover, overlaps in content and a normative core of the

debate can be identified (Fjeld et al. 2020). Under the dictum of informational self-determination, this core is comprised of the issues of privacy, responsibility, security, transparency and explicability, fairness and non-discrimination, human control, technical expertise as well as the promotion of human values.

The practical relevance of these normative approaches is illustrated when taking a closer look at only one selected aspect: fairness and non-discrimination: Because AI often works with data collected in real life, there is a risk that social grievances and stereotypes are being reproduced or even reinforced. The use of AI in the judicial system, for example, comes with the risk of relying on morally flawed case law from the past as the basis for presumably more objective judgments in the present, thereby perpetuating injustices. A similar situation arises when AI algorithms are used for the selection of job applications. This entails, especially in the tech area, the risk of systematic discrimination against women as a result of the analysis of previously successful candidates being based on men's résumés and the information typically found in them.

A number of different stakeholders in Germany are trying to counter these risks with rules and guiding principles intended to help shape AI in line with social values. A good example are the Algo.Rules, which were developed by Bertelsmann Founda-

tion in an open and collaborative process with a large number of participants. In this project, the Foundation and iRights are working on nine fundamental rules as well as possibilities for their application in practice. Also of interest in this context is the AI seal of approval, developed by the German AI Association, which is based on an self-commitment by companies to comply with certain principles in the four

areas of ethics, impartiality, transparency, security and data protection. Both initiatives show that the general public as well as the political players are in favor of rules for the implementation of ethical issues in the development process of AI and that this is widely discussed.

"

Digital ethics is the key to success when putting AI to use. This requires users to have the skills needed for a responsible handling of new technologies. On the other hand, the programmers and technicians who make these technologies available and improve them have to do so responsibly, and they must know which guiding principles they are supposed to follow. Self-learning systems require defined boundaries they are permitted to operate within, and these boundaries are initially programmed by the developers."

Manuela Mackert (Chief Compliance Officer at Deutsche Telekom)

5.3 IMPULSES FROM PRACTICAL EXPERIENCE

When technology is put to use, it almost always harbors the hope of ensuring greater neutrality and fairness in addition to increased efficiency. The examples presented in the previous section have made it clear that this is not necessarily the case. Entrepreneurs are frequently faced with major challenges when it comes to taking ethical considerations into account, which is why there is still a wide chasm between normative principles on the one hand and their practical implementation on the other (Morley et al. 2019). In order to assist in constituting the most significant challenges and identifying potential blind spots in the

debate, this study examines – on the basis of the interviews conducted with them – the observations of entrepreneurs and puts them into context.

The interviews made it clear that the normative dimension of technology in general and AI in particular is a topic of enormous importance to founders in Germany. This is especially evident in the comparison to Israel, where the debate is also taken seriously, but not to the same extent.

In the German startup ecosystem, there is a highly differentiated discussion about

opportunities and potential risks associated with putting AI to use. The first important observation from entrepreneurial practice that can be derived is the criticism of the polarization of the social debate and the lacking relevance in real-life.

> *Regrettably, the AI debate often discusses science fiction scenarios, which are understandably more likely to result in the rejection of the technology than a realistic social discussion about values and boundaries for AI. There can be no question that we need a European framework that creates legal certainty for startups. But this framework must be guided by real-life opportunities to put AI to use, not horror movies."*

Ronnie Vuine (founder & CEO of Micropsi Industries)

The founders believe that the debate focuses too much on abstract images, i.e., science fiction scenarios along the lines of "Terminator" and fears associated with them. The debate also portrays AI as an autonomous and uncontrollable technology, rather than a technical tool that humans can use for specific purposes.

A second important aspect is closely related: the criticism of laying the focus on technology rather than its application.

This has the result that potential problems and risks are generally blamed on the technology while interests and human shortcomings are left out of the equation. This can cause regulations to fail their purpose or even be counterproductive. This blanket assessment also prevents benefits and drawbacks from being weighed up with respect to different potential applications.

> *Any effort to preclude humans and software from discriminating against groups of individuals is of utmost importance and ought to be supported. However, in the context of AI, I warn against a tunnel vision where all you see is the technology level. Algorithms that pose a risk in one application may be completely benign in another application. I often compare this with a database. The database can be used to store and quickly find photos of beautiful landscapes. But it can also be used to store and quickly find contents of a politically extremist nature. The technology that powers both scenarios is exactly the same. To regulate this technology irrespective of the specific area of application entails the risk of taking measures that are far too drastic and in the worst case this will turn out to be completely ineffective."*

Dr. Tina Klüwer (founder & CEO of parlamind, member of the Enquete Commission on artificial intelligence)

The last key issue concerns the legal framework. In this respect, startups want to see regulation at the European level. There is nothing – and this became clear in the interviews – that is more important to the founders than legal certainty. A uniform framework at the European level is seen as a desirable development. The size of the market opens up the opportunity to develop new and innovative business models besides the AI hotspots USA and China. Instead of the classic picture of a sleepy Europe lagging far behind, there appears to be the opportunity of charting Europe's own course in international competition.

> *An ethical debate is of course extremely important, and we have to evaluate where exactly we want to draw boundaries. The constant debate in Germany about regulation is a clear disadvantage for our ecosystem. Where other countries, for example, the USA, initially give leeway in certain areas and bring in regulation later down the line, Germany wants everything thought through before the race even starts. We should be more courageous, wore willing to give things a go and then put the necessary regulation in place – but always at European and not at national level."*

Michael Brehm (founder & CEO of i2x)

OUTLOOK

Germany's deficit in the area of innovative AI applications when compared to Israel should set the alarm bells ringing. A look at the USA and China shows that Europe is at risk of falling far behind other regions of the world. So far, Germany can still rely on its research expertise in the field of AI. But in order not to jeopardize this in the medium term, the transfer to economic practice must be accelerated even more in the future. The current crisis should in this context be utilized to set the right course for the future. In doing so, it must not be forgotten that the crisis has presented the startups with special challenges (Hirschfeld & Gilde 2020): Venture capital investments in Europe collapsed in the first six months of 2020 and the AI sector is severely affected with a decline of almost 25 percent (Dealroom 2020).

> *In the area of innovative technologies, it is of enormous importance to stay on top of things and make our economy fit for the future, especially now. Startups that are particularly hard hit by the corona crisis due to their usually limited capital base must be given targeted support. The government did respond quickly and launched the rescue package for startups – but what is needed now are visions for new impetus that can be turned into growth. The field of artificial intelligence must be a fundamental part in this endeavor."*

Franziska Teubert (Director, German Startups Association)

Germany and Europe want to make a decisive contribution to defining the way in which AI is used. This presupposes being at the forefront in this sector, both from an economic as well as a technological perspective. We also need a lively debate about ethics that gives rise to concrete notions about how we will put this technology to use. The feedback from the AI ecosystem shows that this discourse should focus much more on practical use cases if it wants to become more tangible and thereby more relevant for implementation. It is important to assure founders of planning certainty as well as the freedom to simply experiment. In order to succeed in international competition, rules must be defined at the European level and the AI sector must be given even stronger support through an ambitious investment program.

> *If we want to succeed in making Germany the preferred location of AI businesses, we will need a fixed set of legal regulations that facilitate rather than impede investment. This is the only way AI companies can be certain that the marketability of their business model is sustained in the future. The human-centered use of AI already reflected in the majority of AI applications in this country is our unique selling point and should be promoted by the political actors."*

Jörg Bienert (Chairman of the German AI Association)

If Germany succeeds in assuming a leading role in the field of AI, this would also benefit the country's established economy. AI startups are already driving innovation in the industrial sector through their focus on B2B business, thus making the German economy fit for the future. Strengthening this sector would allow the country to harness enormous potential in the coming years.
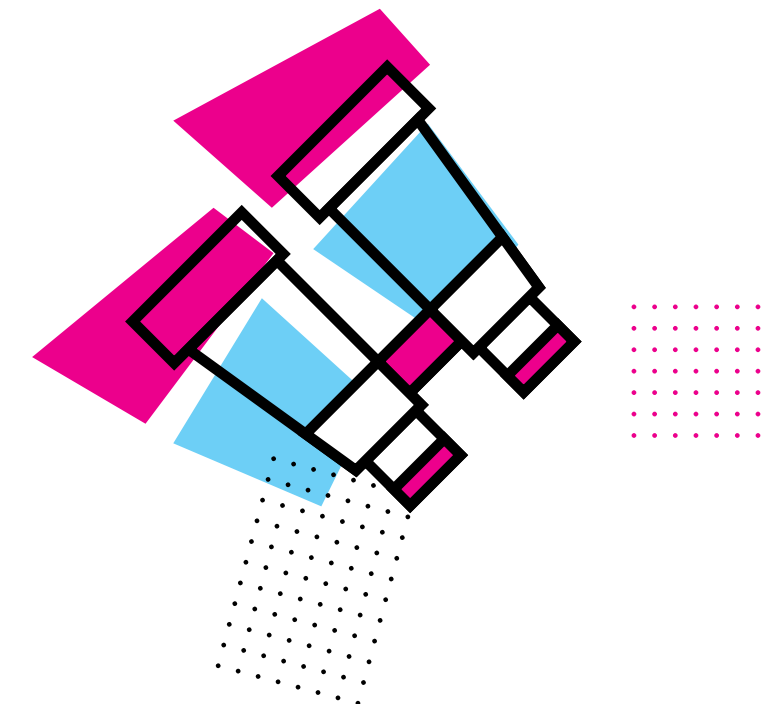
INTERVIEW PARTNERS AND VOICES FROM THE ECOSYSTEM

Beni Basel, founder & CEO of ciValue
Avichai Belitsky, founder & CEO of Youtiligent
Jörg Bienert, Chairman of the German AI Association
Michael Brehm, founder & CEO of i2x
Arne Bruhns, Senior Expert Compliance Deutsche Telekom
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Dr. Philipp Gerbert, Director of appliedAi
Marian Gläser, founder & CEO of Brighter AI
Dr. Tina Klüwer, founder & CEO of parlamind, member of the Enquete Commission on
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Franziska Teubert, Director, German Startups Association
Ronnie Vuine, founder & CEO of Micropsi Industries
Holger G. Weiss, founder & CEO of German Autolabs
Chen Zamir, founder & CTO of Fraugster

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PUBLISHER

Startups are the driving economic force of the future - visionary founders putting great ideas into practice. As the representative and voice of startups in Germany, the **German Startups Association** *has been committed to a founder-friendly environment since 2012 and currently represents more than 1000 startups. Within its net-work, the Startups Association enables an equal exchange between innovative young companies, established businesses and the political sphere. This report was realized in cooperation with the* **German AI Associati-on** *and the* **Institute for Applied Artificial Intelligence.**

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Jannis Gilde is responsible for the develop-ment and relations with the partner network of the German Startup Monitor as well as for data analyses in the research division of the Startups Association. He is also contribu-ting to further studies on the ecosystem as an author. Jannis holds degrees in political and administrative science from Zeppelin University in Friedrichshafen and the Free University Berlin.

PARTNER AND SPONSOR

hubraum connects the digital startup eco-system with Deutsche Telekom, linking tech entrepreneurs and high growth startup companies with the expert network, capital, and business opportunities of Deutsche Telekom. hubraum offers various programs out of three locations in Berlin, Krakow and Tel-Aviv. Startups can benefit from seed financing, co-working space, mentoring, networking events and connections to Deutsche Telekom business units as well as access to customers.

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