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AI Development in Germany After the Publication of German Nation AI Strategy, Problems and Solutions

Reza Nicknam[1], Seyyed Rouhollah Hadj Zargarbashi[2], Abtin Safavipour[3,*]

[1]Ph.D. in International Relations
[2]Assistant Professor of the Department of International Relations, Allameh Tabataba'i University, Tehran, Iran
[3]MA in Studies of German-speaking Countries
*Corresponding Author

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Abstract

Germany's effort to develop AI and make progress in this field became coherent and systematic after the publication of the German National AI Strategy in 2018. Germany's effort in AI development has four trends, namely the integration of AI in society and economy, building and maintaining the AI ecosystem, strengthening the country in terms of infrastructure and data, and finally research and development, which constitutes the essence and backbone of all the other trends. To drive its efforts forward in each trend, Germany should overcome the respective challenges. Furthermore, due to the novelty of the subject of AI and its fast-developing nature, AI has posed some challenges and issues in legal, political, and social fields that need to be addressed swiftly. Germans dominantly address these challenges either on national or European levels and mainly resort to research and academia, their mighty industrial sector, and legislation on federal and European levels to do so.

***Keywords*— AI, foreign policy, Germany , Regional Studies, Technology and international relations**

I. INTRODUCTION

Due to its vast applications in various fields like health care, transportation, finance, and national security, and also because of its rapid development, Artificial Intelligence is viewed as a transformative entity and a novel subject. Therefore, we witness international competition over resources related to AI, and different countries are devising plans and strategies to gain the upper hand in developing AI and benefiting from it. Germany has joined the league of countries that devised and published their plans and strategies for AI development in 2018, to strengthen its position in the global competition over AI, guarantee the development of AI responsibly and ethically, and facilitate the proliferation of its application in the society and economic sectors in a way that is in line with European values (Die Bundesregierung, 2018c). Germany has a rich record of innovation and vast industrial and scientific infrastructures and resources. There has been a research center in Germany dedicated to research in the field of AI for more than three decades, which is called DFKI[1], and makes this country one of the pioneers of AI research (DFKI). Although Germany is one of the pioneers of AI research and has a strong position in terms of industrial and academic strength to support research and development of AI and facilitate its application and use in society and economy, it is not considered a leading actor in the international arena in terms of research, development, and use of AI, nor has been successful in harvesting the benefits of AI compared to other countries that have similar technological, financial, and political status as Germany (BMBF, 2023). In this paper, we will go through the official documents, reports, and official websites of the German government, the EU, and non-governmental organizations in Germany that are active in the field of AI and technology. we examine these documents using the method of archival research and aim to answer the following questions:

> ***Main Question*: What are the challenges and problems that hindered Germany's progress in the field of AI?**
>
> ***Sub Question*: How the German government is addressing these problems**

[1] Deutsches Forschungszentrum für Künstliches Intelligenz

and challenges to push Germany's progress in the field of AI forward?

II. LITERATURE REVIEW

From the perspective of the European Economic and Social Committee, AI as the key concept in this research, has no single and precise definition, rather AI is a general main concept that includes several sub-concepts. Among these sub-concepts, we can mention 'Cognitive Calculation', 'Machine Learning', 'Augmented Intelligence', and 'Robotic AI' (EESC, 2017). According to the European Commission, AI is a system that possesses some level of authority and independence and can demonstrate intelligent behavior following an analysis and scan of the surrounding area, to achieve a certain objective (European Commission, 2018). Now that we understand, what is meant by AI in general from the perspective of official European documents, it is reasonable to look at the definition that "Desouza" has provided as he defines AI concerning government, which we believe is very relevant to this research, based on its scope and research question. AI in government refers to the design, construction, use, and evaluation of cognitive computing and machine learning to improve the management of government organizations and the decisions of leaders, to design and implement public policies, and to improve related governance mechanisms (Desouza, 2019).

There is high competition internationally between different countries to gain the upper hand and leading position in AI. Countries like China, the US, the UK, and Germany are in this competition (Savage, 2020). Discussion over AI is no longer limited to computer scientists and AI specialists, rather politicians and sociologists assert the importance and transformative nature. For example, the Russian president in 2017 said that whoever takes the lead in Artificial Intelligence will dominate the world (RT, 2017). Angela Merkel in 2018 said that AI is vital for Germany's growth and prosperity (Die Bundesregierung, 2018a). Furthermore, the German government recognizes AI as the key to the future world. Therefore they aim to turn Germany into a globally competitive actor in the field of AI research, development, and use (Die Bundesregierung, 2020). The first nation that publish an AI national strategy was Canada in 2017. Germany published its AI national strategy in 2018 and now we have more than 17 countries worldwide that published their strategies (Radu, 2021). Before publishing their national strategy for AI, Germans' rhetoric about governance and policy-making regarding AI was scattered. The publication of this document helped make Germany's efforts in governing and devising policies in the field of AI more coherent (Lemke et al., 2023). Through this strategy, the Germans aimed to allocate more support to developing AI in Germany and Europe and implement specific features based on European values to its development (Die Bundesregierung, 2018b).

There was a significant amount of research and development efforts in the field of AI in Germany, even before the publication of this country's national AI strategy. Devising this document helped Germany to stabilize and improve its position in AI research, development, and proliferation by introducing mechanisms for investment in this field, funding research, and acting in a more coherent way towards achieving Germany's goals in the field of AI (Savage, 2020, European Commission, 2021a). Implications of the effect of this strategy on Germany's AI development financially is that Germany invested 500 million euros in this sector in 2024, which shows an increase in investment that amounts to 200 million euros compared to the year before (Matthews, 2023). There is a network of six progressive national AI competence centers in Germany that includes DFKI[2], BIFOLF[3], MCML[4], The Lamarr Institute for Machine Learning and Artificial Intelligence[5], SCADS.AI[6], and TÜAI[7]. Apart from DFKI which was established in 1988, all the other centers have been created as a direct result of Germany's national AI strategy. This demonstrates the commitment of the Germans to make progress in AI technology. The Network of National Centers of Excellence for AI Research creates the foundations for the development of a futuristic AI in Germany (BMBF, 2022b). Another implication of the effect of the strategy and approach of Germany in AI policy-making nationally and internationally is Germany's effort to implement democratic values and human rights as main principles in AI development (Radu, 2021). Based on a collective view of the accessible documents regarding AI in Germany, one can claim that Germany's ultimate goal is to mobilize AI and all the efforts related to its development and proliferation to the benefit of public interests in this country. Furthermore, policy-making and governing AI in Germany follows a pattern of strategic investments, moral and value considerations, and international cooperations.

[2] Deutsches Forschungszentrum für Künstliche Inteligenz, German research center for AI, created in **1988**
[3] The Berlin Institute for the Foundations of Learning and Data, created in **2019**
[4] Munich Center for Machine Learning, created in **2018**
[5] Created in **2022**
[6] Center for Scalable Data Analytics and Artificial Intelligence, created in **2019**
[7] Tübingen AI center, created in **2023**

III. METHODOLOGY

According to Weber, a government or state is a bureaucratic and administrative facility, in which political decisions and executive processes, which include legislation, orders, and policies, can be monitored and tracked (Weber, 1980). Therefore, to highlight *the challenges and problems that hindered Germany's progress in the field of AI from the perspective of official documents* and to understand *how the German government is set to alleviate the problems* archival research is the appropriate method because it is concentrated on the investigation of the effects and activities of a bureaucratic system, like a government, think tanks, or non-governmental foundations and associations, in a particular country, in a specific field (Friedrich, 2022). In this essay we investigate the effects and activities of the bureaucratic systems, like the EU, the Bundesregierung[8], think tanks, and non-governmental foundations and associations, in Germany, about AI, its development, the problems and challenges related to it, and the measures taken by the bureaucratic system to alleviate them. Therefore, archival research perfectly fits the research agenda in this essay. Archival research is a systematic method, through which one can analyze high volumes of unprocessed documents regarding a specific subject to create a framework, which serves the purpose of tracking, categorizing, and comparing policies in a given field. In archival research, one investigates first-hand materials and documents, which decreases bias and error in analysis and increases the quality of the study (Friedrich, 2022). To understand the challenges and problems that hindered Germany's progress in the field of AI from the perspective of official documents and to look into the policies and measures that the German government and non-governmental actors have taken to alleviate the problems, we study the documents that the German government, federal ministries, the Bundestag[9], related think tanks, research organizations and universities, trade associations, specialized unions, and the European Union have published regarding AI and its governance through archival research.

IV. RESULTS: CHALLENGES AND MEASURES TO OVERCOME

Integration of AI in Society and Economy, Challenges and Measures to Overcome

Despite that the number of newly funded AI startups in Germany is growing, which is the result of having reliable digitized infrastructure and production processes on one hand and prestigious universities and research centers in Germany on the other hand, this country has not been able to achieve a considerable economic success internationally compared to its rivals (Sharbaf, 2022, BMBF, 2023, Stanford University, 2024, Stanford University, 2023, Stanford University, 2022).

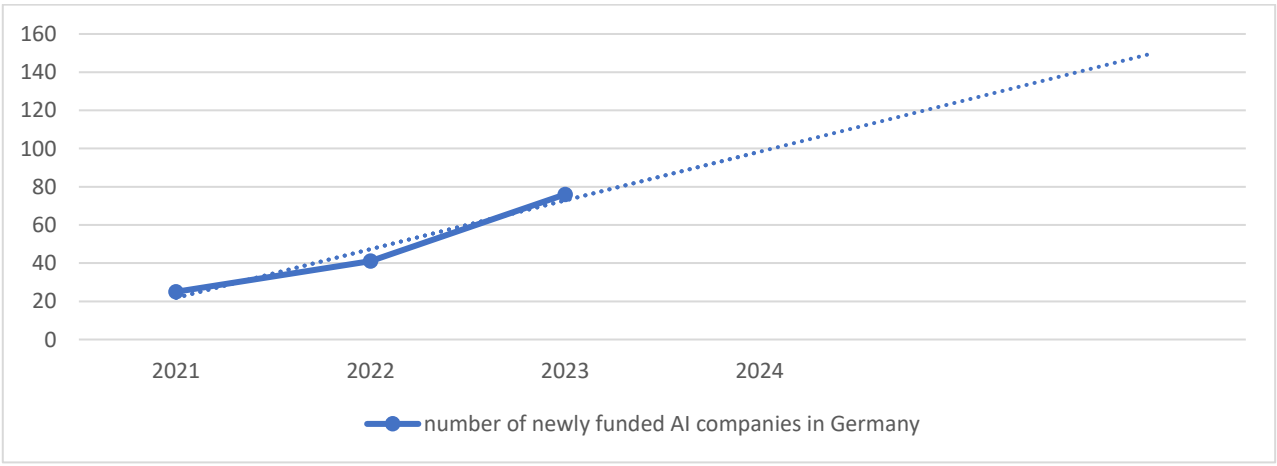

Fig.1: Expanding AI startup ecosystem in Germany

For instance, Germany ranks ninth globally after countries like Japan, India, France, Canada, the US, the UK, and China in terms of the number of startups active in the field of AI (BMBF, 2023, Stanford University, 2024).

[8] German government

[9] German parliament

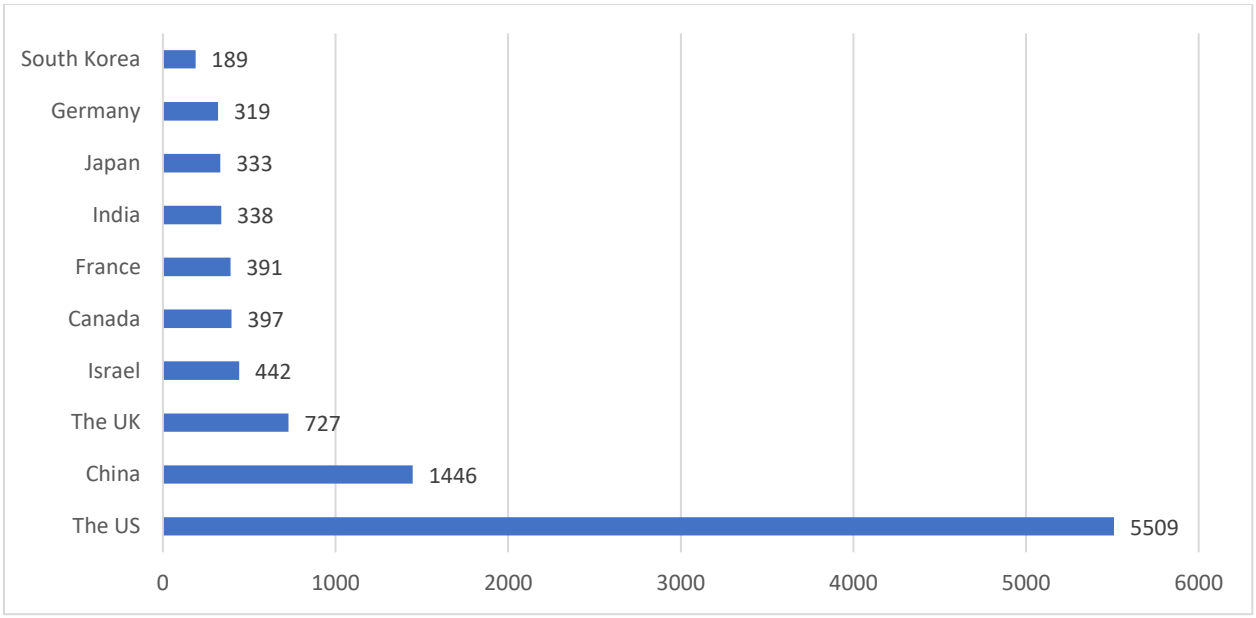

Fig.3: Global Comparison of the Number of AI Startups, 2013-2023

In terms of attracting private investment in the AI sector until 2023, the UK has invested twice as much, China 10 times, and the US has invested 32 times the amount that Germany has invested in this sector (Stanford University, 2024)

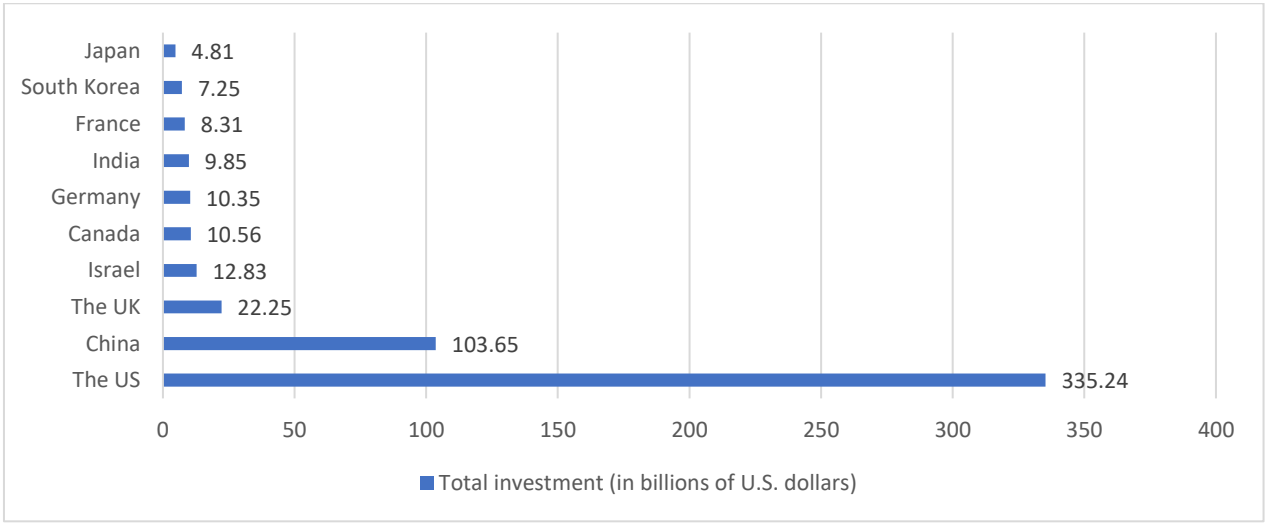

Fig.4: Global Comparison of Private Investment in AI, 2013-2023

In the following charts, we demonstrate the yearly private investments that the prominent countries that are active in the field of AI have made from 2018 to 2023, to compare their financial efforts in developing AI and demonstrate the gap between most of these countries and China and the US according to the data available in the Artificial intelligence index reports (Stanford University, 2024, Stanford University, 2023, Stanford University, 2022, Stanford University, 2021).

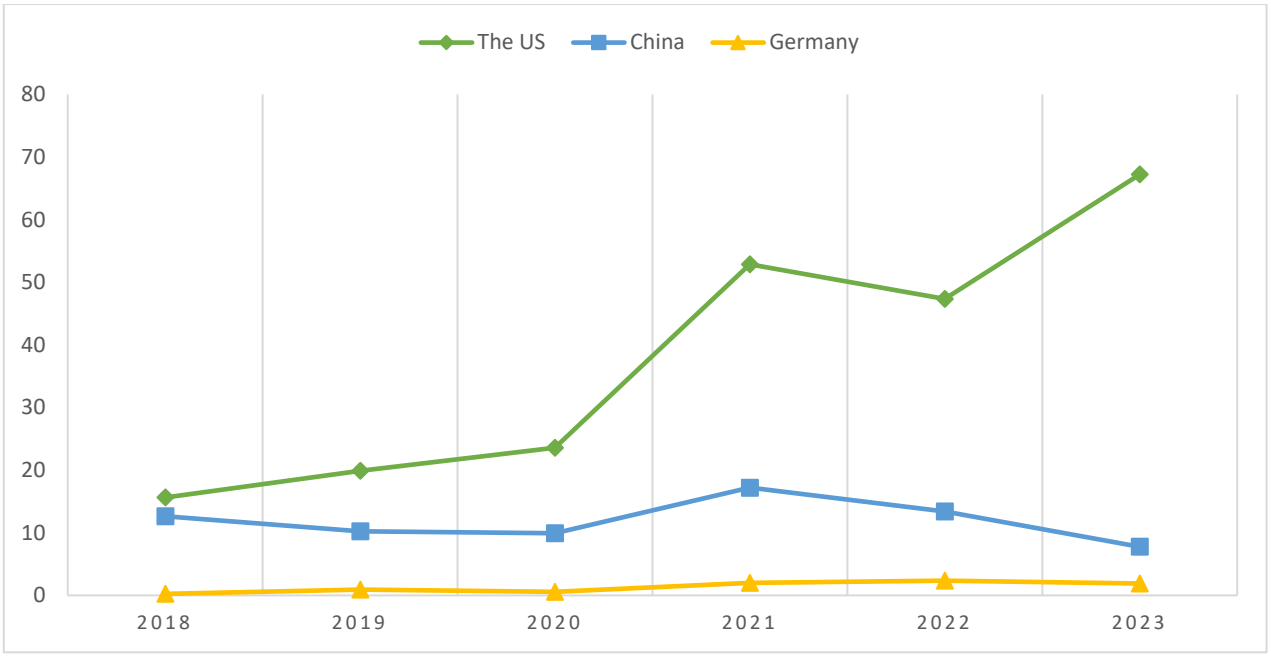

Fig.5: Yearly private investment in AI, 2013-2023, comparing Germany with China and the US

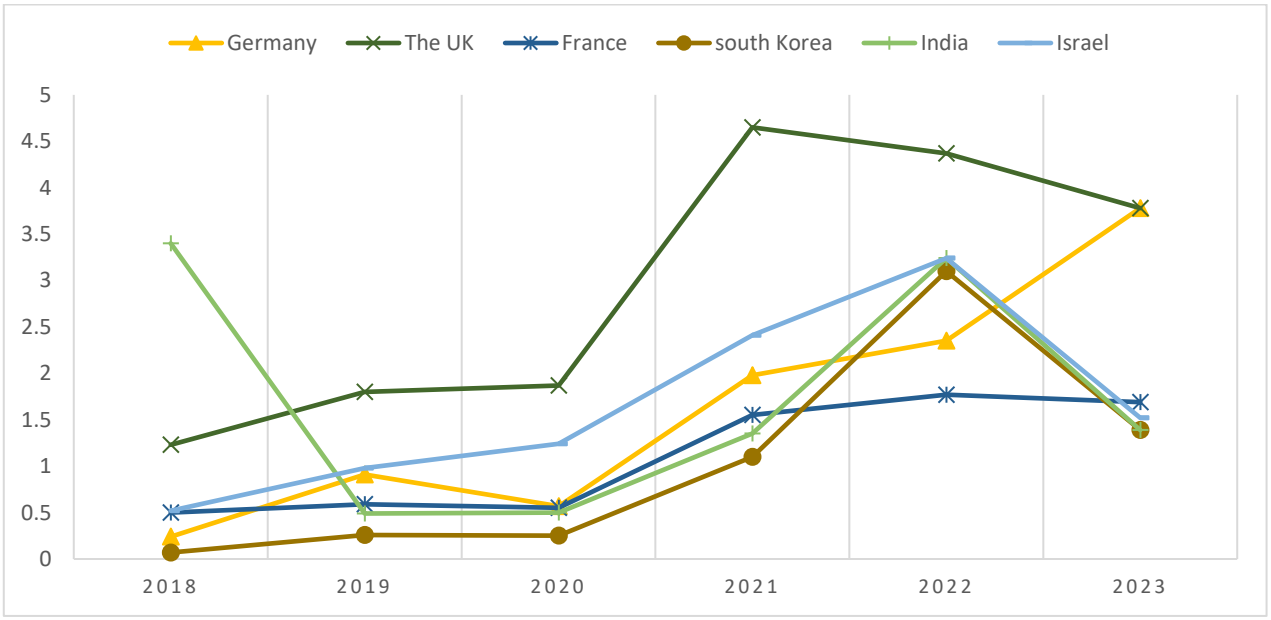

Fig.6: Yearly private investment in AI, 2013-2023, comparing Germany with prominent countries other than the US and China

With regard to AI patents, Germany ranks 5th to 7th globally after countries like China, the US, Japan, and South Korea (BMBF, 2023). Therefore, we can say that Germany's economic AI performance is mediocre and does not match its potential. According to an assessment by the Federal Ministry of Education and Research, the reason behind this relative lack of success is related to the challenges regarding the transferability of AI research results to economic and industrial sectors and the systematic and human-centered integration of AI technology in society and businesses (BMBF, 2023). To solve this problem, the efforts of the public and private sectors are put in motion.

In line with the efforts of the German government to make progress towards AI development and proliferation, federal ministries have been taking actions to integrate AI in the field of their specific duties, to facilitate the execution of their tasks through harvesting the benefits of AI.

The Federal Ministry of Education and Research[10] was one of the ministries that was involved in the creation and publication of the national AI strategy in Germany. This ministry has contributed to the development and creation of the necessary hardware for AI systems in Germany, establishing AI service centers, promoting the use of artificial intelligence in small and medium enterprises, and promoting AI applications to solve problems. One example of the latter is the establishment of AI application centers[11], where AI is put to use to solve problems like reducing the amount of garbage and promoting a circular economy through AI-assisted recycling (BMBF, 2021). The Federal Ministry of Education and Research is also focused on training and recruiting experts for research and development purposes to increase the application of AI even further. Among its efforts, we can point out the creation of 100 university professorships in the field of artificial intelligence, the establishment of AI labs, and designing and implementing different projects centered on artificial intelligence in the educational and research environment (BMBF, 2022a).

In 2013, the *Federal Ministry of Transportation and Urban Development* in a decree by Angela Merkel was required to include the tasks related to digital and data policies as well as digital communications among its assigned tasks and take over the affairs related to the digital field. Subsequently, its name was changed to *the Federal Ministry of Transportation and Digital Infrastructure*[12]. Ever since, this ministry's objective has been to expand digital infrastructures in Germany, devise plans and policies to support innovation and entrepreneurship, speed up digital development, and improve Germany's digital governance and competitiveness internationally (BMDV, 2022). These new tasks have been in accordance and aligned with this ministry's traditional tasks. This ministry actively promotes research, development, and experimentation of new AI-based technologies in transportation and urban development fields, on one hand, to save resources and achieve environmentally neutral transportation, on the other hand, to improve connections between population centers, overcome traffic, and improve safety (BMDV, 2018).

The Federal Ministry of Environment[13] has introduced an initiative called AI- lighthouses[14], which intends to counter environmental challenges with the help of AI. This ministry advocates the design and development of sustainable AI systems and harvests the benefits of AI to promote the protection of the environment and climate (BMUV, 2022).

The Federal Ministry of Food and Agriculture supports research efforts that help ensure sustainable agriculture and management of agriculture and food sources. This ministry believes that harvesting the benefits of AI can help it achieve its goals, therefore at the moment it supports 36 joint research projects with a value of 44 million Euros to promote the application of AI in farming, food chain, and healthy nutrition management, and the development of rural areas. Through the integration of AI in the field of agriculture, innovative ideas for the improvement of agriculture and development of rural areas can be put into action and sustainable jobs and new services can be created, which in turn improves public welfare services and also ensures biodiversity (BMEL, 2022).

The Federal Ministry of Economy[15] belongs to the group of federal ministries that created Germany's national AI strategy; therefore, it has a key role in promoting the application of AI in different industrial and economic sectors in this country. This ministry advocates the integration of AI-related innovations in Germany's national economy and specifically focuses on supporting the numerous SMEs[16] to access and benefit from the opportunities that AI has to offer (BMWK, 2020).

The Ministry of Labor and Social Affairs has introduced initiatives like AI-observatory and AI-Studio to direct the development and application of AI in this country. AI observatory is an essential tool for the implementation of national AI strategy, monitors and analyzes the effects of AI on the field of work and society to orient AI design to maximum compatibility with public interests and facilitate its integration and application in work and society in a responsible manner (BMAS, 2020, KI-Observatorium). In the AI studios, the employees and workers are encouraged to receive training to use AI, share their experience of using AI with the developers, and contribute to the design and development process. The purpose is for the employees and workers to trust AI and view it as their support (BMAS, 2023).

Industries and private economic enterprises also contribute to the further integration of AI in society and the economy by injecting their funding and investments in research and development projects in AI and other technological fields. In return, they benefit from the breakthroughs resulting from these research projects. We can call this relation a

[10] Bundesministerium für Bildung und Forschung, **BMBF**
[11] Anwendungshub
[12] Bundesministerium für Digitales und Verkehr, **BMDV**
[13] Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz, **BMUV**
[14] KI-Leuchttürmen
[15] Bundesministerium für Wirtschaft und Klimaschutz, **BMWK**
[16] Small and medium-sized enterprises

profitable mutualism, which boosts the transferability of research results to the society, businesses, and industrial sectors, and in turn, increases economic growth, creates business opportunities, and makes further research and innovation possible (BMBF, 2022a). SMEs create about 35 percent of total corporate turnover in Germany and 59 percent of job opportunities in this country (BMWK, 2019). Despite the considerable share they hold in the German economy, only 15% of SMEs have declared AI applications in their activities (Seifert et al., 2018). The reason is that they do not possess sufficient resources to test out the opportunities, limits, and risks associated with AI applications on their own. While the SMEs due to scarcity of their resources prefer not to approach untested areas such as AI, the government has sufficient resources and motifs to support the SMEs in this regard. Production technology center located in Leibniz University in Hannover is one of the facilities, where SMEs can benefit from state support and test out the application of AI with low costs to eventually integrate it into their businesses (Produktionstechnischen Zentrum Hannover, 2022).

Building and Maintaining AI Ecosystem, Challenges and Measures to Overcome

Despite that the rapid growth and development of AI globally offers vast benefits, it also creates challenges for the German economy and society, because Europe is lagging behind in developing AI models. In particular, for Germany, this means that safety in the technology arena has lower standards, and data sets have lower quality. Therefore, German enterprises become mere users of AI foundation models instead of contributing to their design. Consequently, Germany is on the verge of falling down a spiral of dependency. To avert this risk and contribute to the design of foundation models of AI, there needs to be massive computational capacities, which Germany currently lacks. According to a feasibility study by Germany's federal AI association, this country needs to establish computational infrastructure for the specific purpose of AI development, the creation of AI foundation models, and their application in the economy (KI Bundesverband, 2023a). To deal with this challenge and catch up in the global AI competition, Germany increases its support of initiatives like Cyber Valley. Cyber Valley is Europe's largest research consortium in the field of artificial intelligence, which was established in 2016 to bring together academic and industrial actors to cooperate in AI research and the commercialization of research results as marketable services and products. Cyber Valley is a regional artificial intelligence ecosystem with global appeal, and in 2018 it became an important part of Germany's national artificial intelligence strategy. Cyber Valley is a key component in increasing Europe's AI competitiveness, especially against the US and China (Max-Planck-Gesellschaft, 2020). Besides Cyber Valley, Germany also hosts DFKI, which is one of the largest and oldest AI research facilities internationally, which together with numerous AI startups contribute to AI development in this country.

Data and Infrastructure, Challenges and Measures to Overcome

Compared to other countries that are actively planning and investing to make progress in AI, Germany faces many legal barriers to collecting and storing the data that is necessary for AI research. Due to the importance of research efforts in the field of AI in general and the fact that the research results affect AI policy-making and the agility of policymakers in reacting to the latest developments in this field depends on the outcome of the researchers' efforts, experts highlight the importance of prioritizing research interests over other important factors like data protection and therefore praise the Research Data Act (GCEE, 2023, RatSWD, 2024). Data is a key factor and a very important resource in developing AI systems. Yet there are legal and infrastructural barriers preventing German actors from fully benefiting from this key resource. There is a large amount of data being produced on a continuous basis from the daily activity of people and enterprises. The problem is that the collection, storage, and use of data should legally be done in accordance with people's privacy and rights, which can be restricting to AI developers. Besides, the collected data are not standardized and not stored centrally. Furthermore, a large portion of the produced data goes unnoticed. Apart from that private and public sectors do not have enough motivation to share the data that each of them can access, because the regulations in this matter are ambiguous and the benefits are not clear. To solve these problems the German government agreed to the initiative proposed by the federal AI association[17] called Big AI Models for Germany[18]. Based on this initiative and in the data institute project[19], Germany created a high-performance data center, where the data are stored efficiently and without redundancy under the data and privacy regulations and in a standardized fashion. The data are categorized and made visible, so the research institutes and developers can access them more easily. Furthermore, the data institute provides consultation and guidance for the startups that want to access data, so their activity in AI development and application would not go in violation of German and European laws and regulations in

[17] KI Bundesverband
[18] Große KI-Modelle für Deutschland
[19] Dateninstitute

this regard (KI Bundesverband, 2022, KI Bundesverband, 2023a).

Legal and Political Framework, Challenges, and Measures to Overcome

he main framework for artificial intelligence laws and regulations in Germany is determined by the country's constitution and the European Union's Charter of Fundamental Rights (Deutscher Bundestag, 2020). Besides federal legislation, European laws have a direct effect on AI regulation and governance in Germany. EU AI law, which is the world's first comprehensive legal framework for artificial intelligence, is a good example. On March 13th, 2024, the European Parliament passed the EU AI Act and recognized it as a law. The full implementation of the EU AI law is required from all member states within 24 months (Yakimova and Ojamo, 2024). Europe's main factor for policy-making and devising regulations for AI is for these policies and regulations to be human-centered and respectful of European values (European Commission, 2021b).

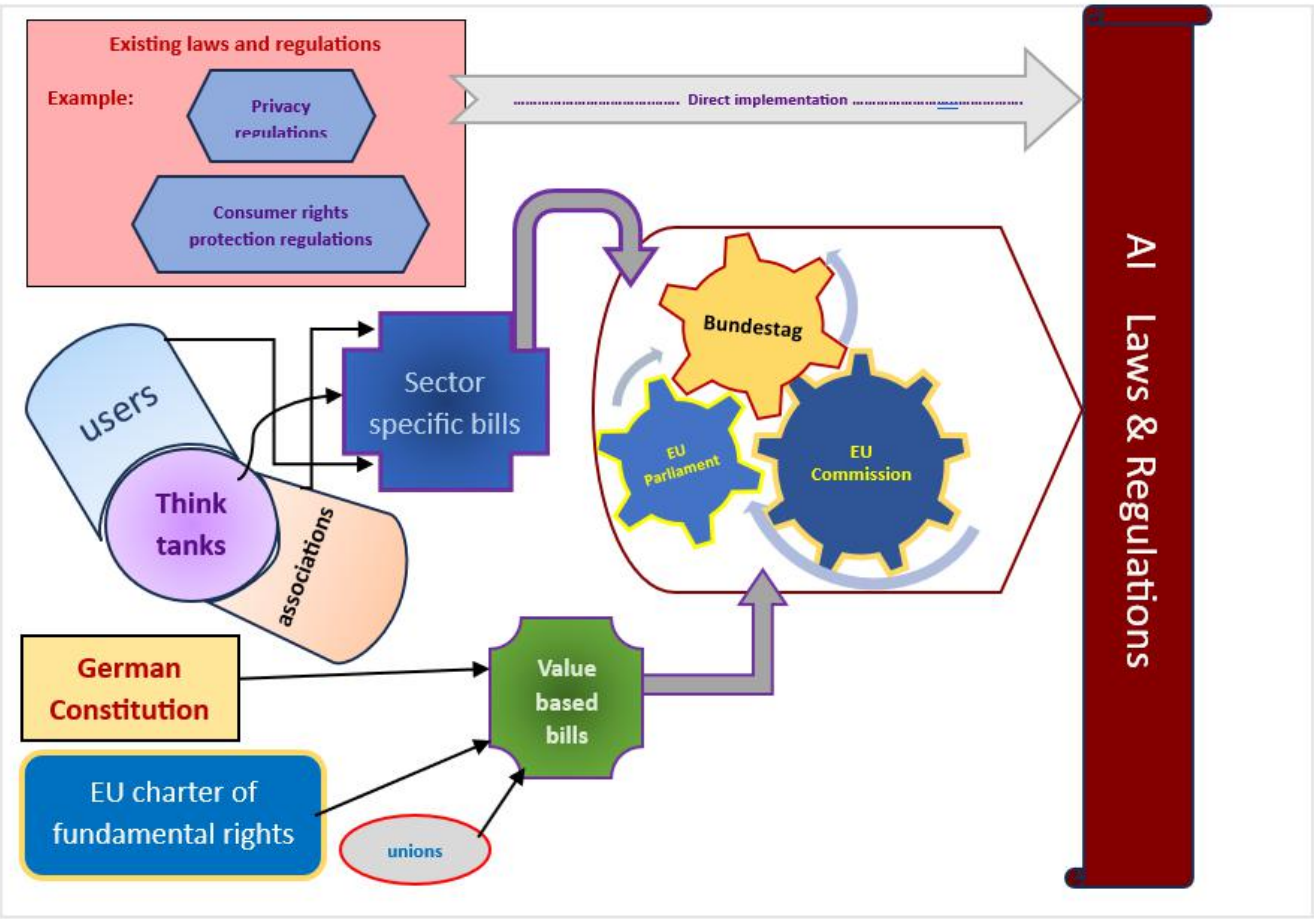

Fig.7: Schematic view of the factors in motion to form the AI Regulations and Laws

It is considered politically expedient to refer to European ethical guidelines and values for European policy-making in the field of AI. Because on the one hand, non-European forerunners in the field of AI and big technology companies that enact regulations and principles in this area, do so without consideration of European principles and values. On the other hand, the lack of governance and dominance regarding data and AI infrastructure on the side of the Europeans leads to further dependency of Europe to American and Chinese technology and service providers that do not necessarily abide by European laws and values (Bal and Gill, 2020, Henning Kagermann and Ulrich Wilhelm, 2020). Apart from keeping European countries and AI enterprises from being completely overrun by non-European giant technology firms, like Meta, Microsoft, Baidu, and Alibaba, etc.; the most significant advantage of the EU AI law, due to its value-based and human-centered essence is legally stopping unclear and discriminatory applications of AI and preventing its destructive effects. The downside of this legislation is that it can potentially slow down AI-related economic growth and hinder innovation through overregulation (Algorithm Watch, 2023, Applied AI Institute for Europe, 2022, KI Bundesverband, 2023b).

Social Matters, Challenges, and Measures to Overcome

AI-based systems can affect people's behavior and perception in various fields in society and have the potential to direct the collective sentiments and conducts in society (Deutscher Bundestag, 2020, Deutscher Ethikrat, 2023). Artificial intelligence can potentially transform societies positively, although there is a serious concern that the use of new tools by public and private organizations will have a negative impact on human and personal rights, freedom, liberties, and other fundamental values (Article 19, 2018). To be able to lean toward AI and leverage it to make progress, the government, society, and businesses should cooperate to identify the positive and negative points of AI. Therefore, the German government constantly creates and expands research capacities in the field of AI, supports the creation of education and training centers, and allocates state funding to research and training in AI systematically (BMBF, 2022a). An example of these efforts is the establishment of AI-Observatory under the direction of the Ministry of Labor and Social Affairs.

The effects of AI have wide social implications. It can affect the labor force and employment. AI can address the need for labor forces in certain areas through automatization. In countries like Japan and Germany that are suffering from an aging population, this can be viewed as a solution to keep the economy sustainable and growing (Acemoglu and Restrepo, 2019). Despite the common belief, the automatization and the use of AI-based systems do not have a significant effect on the overall level of employment, and the loss of some job opportunities in the production sector is compensated by increasing profit and productivity that facilitate the creation of new job opportunities in the service sector and other sectors. We are witnessing the balance of job opportunities and displacement of human labor in industries that use robots and artificial intelligence. Automatization of the production processes reduces labor income and increases productivity and profit, which leads to higher job security for the workers. However, the decrease in the income of workers and the increase in the income of businesses, widens the income gap between workers and managers further, which strengthens social inequality (Dauth et al., 2018). Inequality in the labor market is not always reflected in the loss of jobs and income, but rather the quality of work and employment conditions in the new jobs that are created due to the proliferation of AI matters. In the digital, internet, and AI related job market, working is usually remote and online, which makes the employment of people from less developed regions outside the EU possible. Therefore, this labor market is dominantly unclear, not following labor laws in Europe, and is made up of contracts that are not permanent and impose harsh working conditions on the employees (Bird et al., 2020). AI facilitates the unfair distribution of power and profit, as it can act as a means to concentrate technological, economic, and political power in the hands of a few significant internet and technology giants, namely Google, Meta, Microsoft, Apple, Tesla, SpaceX, and Amazon. Through wielding this great power and influence, they can affect and even direct governments, lawmakers, social communities, and political parties. Financially they are capable of making heavy investments to increase their social and political influence, buy off new innovative ideas and startups, and create or direct public discourse, especially through social media that they own, to be in line with their interests (Nemitz, 2018).

AI and technology developers should pay attention to safeguarding privacy, personal rights, and human dignity as they design their systems. AI can violate people's privacy. Autonomous AI-based systems are equipped with sensors that collect information and data from their surrounding without the consent of the people in their vicinity. AI can be used to identify people, who like to remain unknown. Besides, with the help of AI, data and information that are inherently public and non-sensitive can be deduced and used to create sensitive information about people. There are valid concerns about people's privacy being violated through their digital devices, like smartphones, that continuously listen and record their conversations and collect their data. Furthermore, data mining software combined with machine learning can help to discover the interests, habits, and political and social tendencies of people in a society. Implementing machine learning on big data can lead to discovering new patterns and extracting people's information (Article 19, 2018, Manikonda et al., 2018, European Parliament, 2016). To address these concerns, the EU has passed the General Data Protection Regulation[20]. This regulation generally applies to data and pieces of information that are inherently personal and in many cases can not address the concerns and ethical issues regarding privacy that we face today (Bird et al., 2020).

Artificial intelligence is used to make decisions based on collected information. These decisions have different consequences and sometimes significantly affect people's lives. Artificial intelligence systems alone are not capable of making ethical decisions and cannot independently evaluate and judge their decisions in terms of ethical standards and values. Therefore, it is necessary to consider the ethical requirements and integrate these considerations into the fabric of the AI system as they are being developed (Article 19, 2018, Hirsch-Kreinsen and Krokowski, 2023).

[20] GDPR

Additionally, according to Article 14 of the EU AI Act to keep the function, decisions, and assessments of AI systems in conformity with social values and people's rights, there needs to be a human oversight function in place (European Commission, 2024). An example of a potentially harmful AI application is its use for surveillance and detection of troublesome people in society. The positive side of using AI in this regard is that it helps the police enforce the law, maintain security in society, and prevent crime. The negative side is that such application of AI can violate personal and fundamental rights of people. Besides, one poor or biased assessment by the AI can ruin someone's background and destroy a natural person's life. Therefore, to prevent bias and discrimination, the EU AI law in its article 5 categorizes the application of AI for social scoring and profiling to predict the probability of conducting a criminal offense as strictly prohibited. Furthermore, the use of AI systems by law enforcement according to Article 6 and Annex III of the EU AI Act is categorized as high-risk and based on Article 13 and Article 26 of the EU AI Act must be subject to strict limitations, transparency and ongoing assessments by proper technicians and organizations (European Commission, 2024).

Pre-requirement of liberty is privacy and one of the most fundamental rights in democratic societies is freedom of speech. These rights can be affected and violated by AI (Article 19, 2018, Bird et al., 2020). Artificial Intelligence is used to counter hate speech, fundamentalism, and misinformation campaigns. The automatic detection and elimination of such content that is assessed as illegitimate by the AI increases the threat of censorship of content that is basically OK, especially since this screening operation is managed by private contractors that can be easily influenced by governments and big enterprises. Apart from the unfair distribution of power, which was explained before in this article, AI can pose a threat to democracy via two other structural issues, which are data collection and monetization of these data by big enterprises and the fact that the reality of the world in which people live and interact with each other can be determined through algorithms and artificial intelligence. Through surveillance and assessment of people's data and behavior online, their tendencies and interests can be discovered and used to create a profile for the relative user. These profiles and data will be sold to other enterprises to create personalized, and highly efficient commercials to target the relative people, who most probably will be subdued and purchase the product or services offered to them. This is called surveillance capitalism (Owen, 2018). This method can also be used to target a political message to the people most likely to be affected by it and spread fake news in a targeted manner among those, who most probably believe it. Additionally, algorithms determine what people see and with whom they interact based on their interests, as they are surfing the web or scrolling through their social media (Harambam et al., 2018). In the age of AI, the internet, and technology this can shape the reality of people's world. The determination of people's interaction mostly with other likeminded people and framing the content they see and hear based on their interests and agreeableness of the content, which is made possible through AI and algorithms, traps people in a chamber of echo, which in turn intensifies the ideational polarization of the society that can endanger social solidarity and integrity.

V. DISCUSSION

Germany does not possess large technology corporations like the US or China and the amount of funding and support for AI development, research, and proliferation that can be provided in Germany from its government or private sector like technology companies is far less than what the Americans or Chinese can mobilize for this purpose (KI-Observatorium). Unlike the US that can leverage the massive technical, infrastructural, and financial potential of its technology companies including Alphabet, Amazon, Apple, Meta, and Microsoft, or China that not only leverages its most prominent technology firms like Baidu, Alibaba, Tencent, and Xiaomi but also benefits from the full and coherent support of Chinese government, the Germans have to rely on other assets to push AI development forward and stay in the global competition. Germany's assets are on the one hand its robust industrial and economic power and on the other hand its prominent academic centers and universities. Besides, unlike the US, China, and other competitors in the field of technology and AI, Germany is a part of a larger community of countries that more or less share its values, goals, and interests. This community is the European Union and its member states share a common understanding that they need to act collectively and coherently in various fields including AI, if they wish to make progress and benefits and stay in the international competition.

We can confidently claim that Germany is an international actor in the field of AI. Germany's approach to mitigate and solve the problems and challenges that hinder its progress in the AI arena is to offer a combination of national and European measures. On the national level, we see that Germany resorts widely to the capacities of the Bundesregierung[21] by mobilizing federal ministries and

[21] German federal government

offering funds and support for non-governmental actors and SMEs to expand their technological and AI competencies. The government also encourages private enterprises to invest their money and facilities into research efforts to benefit from the results of the research in the form of new innovative approaches or cutting-edge technologies in their businesses later. Most notably Germany uses these capacities and potentials to address challenges that hinder the integration of AI in society and economy and also address the matters related to data and infrastructure. Considering that Europe, Germany included, compared to the US and China is underdeveloped in terms of investments, technology, and technological infrastructure, Germans took a more communal approach to develop and maintain a globally competitive and significant AI ecosystem at a European level. Germany hosts centers like DFKI and Cyber Valley and also has more sophisticated academic centers and a stronger and richer economy. Therefore, in this communal effort, Germany assumes the leadership role and with the cooperation of France pushes Europe's progress in AI forward. In legal and political matters regarding AI, Germany's approach is again communal at a European level. Yet this time instead of leading the effort, Germany has a more susceptive tendency and regulates its effort based on European regulations like GDPR and EU AI Law. Through this approach, Germany will be able to assert its influence and values globally through the European Union. The social effects of AI are more or less similar globally. Although the efforts of Germany to mollify AI's harmful social side effects and harvest its benefits for society take place in a European communal setting, they are applicable in other countries as well.

VI. CONCLUSION

In this research we have investigated the official documents and websites in Germany and Europe, using the archival research method, to find out about the challenges and problems that hindered Germany's progress in the field of AI and realize how the German government is addressing these problems and challenges to push Germany's progress in the field of AI forward. According to our findings, Germany's efforts in AI development can be categorized into four trends. These trends are as follows:

1. Integration of AI in society and economy
2. Building and maintaining AI ecosystem
3. Strengthening the country in terms of infrastructure and data
4. Research and development, which constitutes the essence and backbone of all the other trends.

To drive its efforts forward in each trend, Germany should overcome the respective challenges. Furthermore, due to the novelty of the subject of AI and its fast-developing nature, AI has posed some challenges and issues on legal, political, and social levels that need to be addressed quickly and swiftly, so that it wouldn't jeopardize society, value structure and way of life, and humanity in general. An overview of some of these challenges as reflected by the German and European official documents and their respective solutions is presented in the Table.1.s

Table 1: An overview of the problems and solutions regarding AI and its development in Germany

domains	Problem	Solution
Integration of AI in society and economy	Mediocre economic performance globally concerning AI technology	• Mobilization of the Facilities and capabilities of the federal ministries and making them integrate AI in their fields of action and duties • Supporting research and monitoring efforts in the field of AI by the government • Encouraging the private sector to invest their money and facilities in research efforts and then integrate and apply the results into their field of work.
	Transferring AI research results to economic and industrial sectors	
	Systematic and human-centered integration of AI in society and businesses	
Building and maintaining the AI ecosystem	Lagging behind in the development of AI models	• The foundation of Cyber Valley in Germany and increasing the support offered to it. Cyber Valley is the largest European research consortium in AI and a key component in Europe's international competition over AI against the US and China. • Creating a network of six progressive national AI competence centers in Germany including DFKI, BIFOLF, MCML, The Lamarr Institute for Machine Learning and Artificial Intelligence, SCADS.AI, and TÜAI
	Lower quality of data and technology standards in Germany than international counterparts	
	Germany is at risk of becoming a dependent user of AI products, services, and infrastructures of foreign origin	
	Lacking enough computational capacity and infrastructure for AI purposes in Germany	

Data and infrastructure	Legal barriers and limitations in Germany for collecting and storing the data necessary for AI research Infrastructural barriers regarding data accessibility and use for AI developers in Germany	• Prioritizing research efforts over other values and limitations and passing the Research Data Act in Germany to make it official • Proposing and executing the initiative called Big AI Models for Germany by the federal AI association to create high-performance data centers and provide consultation
Legal and political matters	Lack of governance and dominance regarding AI infrastructure and data in Europe The threat of becoming dependent on Chinese and American products and being forced to abide by their regulation and terms, which may contradict the German and European ones	• Referring to European ethical guidelines and values to make policies in the field of AI and protecting the Europeans by stopping unclear and discriminatory effects of AI • Resorting to a value-based and human-centric approach in creating laws and regulations and influencing AI laws and regulations globally through the Brussels Effect.
Social matters	Personal rights, freedom, and liberty of people being undermined through the application of AI Increase in social inequality Unfair distribution of power and profit through AI application Social profiling and violation of privacy Undermining democracy and violation of freedom of speech	• More investment by the public and private sector in Germany on establishing and expanding AI research capacities to identify positive and negative aspects of AI and address them by creating more sophisticated education and training means and measures. • Using the surplus profit created through automatization and application of AI to create new job opportunities and increase job security for employees • Integrate values such as respect for privacy, personal rights, and human dignity into the design of the AI systems • Apply legislative means such as GDPR and EU AI Law to safeguard privacy and other values • Devise more legislation to protect democracy and ensure social equality and fairer distribution of power and profit

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