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2021 - 2025

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REPUBLIC OF TÜRKİYE
MINISTRY OF INDUSTRY
AND TECHNOLOGY



PRESIDENCY OF THE REPUBLIC OF TÜRKİYE
DIGITAL TRANSFORMATION OFFICE

N A T I O N A L
A R T I F I C I A L I N T E L L I G E N C E
S T R A T E G Y
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NATIONAL ARTIFICIAL INTELLIGENCE STRATEGY
2021-2025



<https://cbddo.gov.tr/en/nais>

August 2021



REPUBLIC OF TÜRKİYE
MINISTRY OF INDUSTRY
AND TECHNOLOGY



PRESIDENCY OF THE REPUBLIC OF TÜRKİYE
DIGITAL TRANSFORMATION OFFICE

“We believe that the time has come for our country to make a new human-oriented breakthrough in artificial intelligence.”

Recep Tayyip ERDOĞAN
President

Foreword



Recep Tayyip ERDOĞAN
President

The first quarter of the 21st century is a period in which the incompatibility between social, economic, and political structures transformed by digital data and algorithms and the notions of the analogue era comes to light. The radical transformative impact of rapidly developing artificial intelligence powered systems on production processes, occupations, daily life and institutional structures has brought mankind to the brink of a new age. With their ever-expanding scope of application, artificial intelligence technologies are expected to have a greater impact on the global economic structure than the Internet revolution.

Al-Jazari of Şırnak, who is considered the founder of cybernetics, achieved the “impossible” for his time with the hydraulic machines he developed centuries ago. As the Thessaloniki Ordinarius Professor Cahit Arf, who took the first contemporary step towards artificial intelligence in our country, emphasized in his 1959 presentation titled “Can Machines Think and How?”: “finding a way to our desire for knowledge depends on the spread of confidence in reason”. Many Turkish citizens of similar traits working both in Türkiye and abroad from the past to the present have been contributing to the advancements in the field of artificial intelligence. With this confidence, we believe that the time has come for our country to make a new breakthrough in the field of artificial intelligence.

We are living in a period where all countries are taking serious steps towards the potential gains of artificial intelligence. However, artificial intelligence technologies, which have many opportunities to offer in terms of socioeconomic development, also bring some uncertainties and risks to the agenda. Unknowingly, we are transforming from people struggling with nature to individuals stuck among algorithms. In addition, artificial intelligence systems trained with our codified preferences, judgments and discourses also lead human beings to question themselves. This situation is actually an opportunity for our nation. We will take steps beyond shaping our development paradigm around economic welfare and public order in the field of artificial intelligence.

Taking part in the field of artificial intelligence is not a matter of choice as it is one of the strongest pillars of our development goals in line with the “Digital Türkiye” vision and the “National Technology Move”. By designing artificial intelligence systems with an understanding reflecting the development and operation of artificial intelligence systems in accordance with our common values, we have the opportunity to add value to the entire humanity by making a new techno-economic breakthrough combined with our deep-rooted civilization experience.

The National Artificial Intelligence Strategy is a comprehensive effort, to which all the relevant stakeholders have contributed in order to support this transformation that is currently being experienced on a global scale and fed by artificial intelligence technologies, on behalf of humanity and to ensure that our country benefits from this process to the maximum extent possible.

I would like to thank all public institutions and organizations, non-governmental organizations, academics, and private sector representatives who contributed to the preparation of the Strategy, especially the Digital Transformation Office and the Ministry of Industry and Technology. I wish that the National Artificial Intelligence Strategy, which we will be implementing with the contribution of all relevant parties in the next five years will yield auspicious outcomes for our country.

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Abbreviations

AI

Artificial Intelligence

CAHAI

Ad Hoc Committee on Artificial Intelligence

COHE

Council of Higher Education

DTO

Presidency of Türkiye Digital Transformation Office

EU

European Union

GDNT

General Directorate of National Technology

GDP

Gross Domestic Product

GPAI

Global Partnership on AI

ICT

Information and Communication Technologies

ILO

International Labour Organization

IT

Information Technologies

ITU

International Telecommunication Union

MOIT

Ministry of Industry and Technology

MONE

Ministry of National Education

NAIS

National Artificial Intelligence Strategy

NDD

National Data Dictionary

NGO

Non-Governmental Organization

OECD

Organisation for Economic Co-operation and Development

OECD ONE AI

OECD Network of Experts on Artificial Intelligence

SME

Small and Mid-size Enterprise

STIPC

Science, Technology and Innovation Policies Council

TDZ

Technology Development Zone

TURKSTAT

Turkish Statistical Institute

TÜBİTAK

Scientific and Technological Research Council of Türkiye

ULAKBİM

Turkish Academic Network and Information Center

UN

United Nations

UNESCO

United Nations Educational, Scientific and Cultural Organization

USA

United States of America

WEF

The World Economic Forum

“We have the opportunity to add value to the entire humanity by making a new techno-economic breakthrough combined with our deep-rooted civilization experience.”

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Executive Summary

The National Artificial Intelligence Strategy (NAIS) was prepared in line with the Eleventh Development Plan and the Presidential Annual Program for 2021. The Strategy determines the measures that will put our country's efforts in the domain of artificial intelligence (AI) on a common ground between the years 2021-2025 and the governance mechanism that will be established to implement these measures.

NAIS was prepared by the Digital Transformation Office of the Presidency of the Republic of Türkiye (DTO) and the Ministry of Industry and Technology (MoIT) in accordance with “Measure 473.1” in the Presidential Annual Program for 2021. NAIS is of an exploratory nature since it is the first national strategy of our country in this field and due to the rapid advancements in AI and the evolution of strategies in other countries over time. The strategic priorities, objectives, measures, and governance mechanisms determined in this context have been designed to respond to the opportunities, risks, and uncertainties that may arise for our country over time.

As part of NAIS preparations, interviews were conducted with public institutions, universities, private sector organizations, NGOs, and international organizations on physical and online platforms, workshops were held and domain experts of different disciplines were asked to provide their evaluations. In this framework, the Strategy was finalized by taking into account the global trends shaped by the paradigm shift in economic and social life that emerged due to AI, as well as the recent situation and development goals of our country. In this context, the vision of NAIS was determined as: **creating value on a global scale with an agile and sustainable AI ecosystem for a prosperous Türkiye.** In order to realize this vision, NAIS was designed around 6 strategic priorities in line with both national policies and needs along with the AI strategy recommendations of international organizations:



Figure 1. National AI Strategy Vision and Strategic Priorities

Within the framework of these strategic priorities, **24 objectives** and **119 measures** were formulated. These objectives and measures outline the actions that the implementing institutions will determine in detail. The priorities of the NAIS, as well as the objectives and measures determined in this context, have been designed in harmony with our country's vision of "Digital Türkiye" and the "National Technology Move".

As the domain of AI technologies expands, the compliance pressure on individual habits, ways of doing business, professions, and institutional structures triggers a radical transformation in the socioeconomic structure. Although it is clear that this transformation has started and will continue to accelerate, the means and speed of the interaction of this transformation with existing social, institutional, and economic structures are unclear. Therefore, it is inevitable that a long-term national strategy to be determined in the field of AI, where such uncertainties exist, is to be based on the creation of an ecosystem that experiments, discovers, learns, and constantly updates itself accordingly. Moreover, in order to adapt Türkiye's socioeconomic structure to rapid developments in AI, it is necessary to act prudently enough not to make major mistakes on the one hand, and act quickly enough to take advantage of opportunities on the other. In this regard, the structure of NAIS is suitable for both experimenting and implementing, and it aims to create an agile and sustainable ecosystem that can manage the transformation in the socioeconomic structure and reduce possible inefficiencies in the functioning of this ecosystem as much as possible. Due to the above-mentioned uncertainties and the ongoing dynamic process, it will be necessary to review the needs, possibilities, and opportunities and shape the steps accordingly during the implementation period of the NAIS. It is observed that other countries have updated their strategy documents in the process because of similar needs. Due to all these reasons, the common points in NAIS and the guides planned to be prepared in this context are living and constantly evolving references.

The focus of NAIS is on strategic consistency and end-to-end governance, which will have repercussions at the inter-institutional and internal level, with competence areas consisting of quality data, advanced skills, and technical infrastructure. Thanks to the measures to be implemented, it is aimed to create value from data through AI applications at institutions and at the sectoral level, to carry out AI projects effectively, and to increase the maturity level of our country's AI ecosystem within this framework.

In line with this main focus and objectives;

- The employment of researchers and practitioners to develop organizational competencies in AI will be supported throughout all public organizations, especially in central public institutions, as well as the private sector and universities. Efforts to increase the quality and quantity of employment in AI by enriching the training content, including the existing online platforms, will be carried out with the private sector, relevant NGOs, and universities. Professional definitions and competencies will be determined for the development of skills in the field of AI. With new undergraduate, graduate, and supporting research programs to be launched at universities, the number of new graduates with domain-specific competencies will be increased. Incentives for increasing scientific productivity in the field of AI will be improved. Thematic programs in which pre-higher education students will receive training on algorithmic and critical thinking, ethics, and AI applications will be generalized.
- Steps will be taken to increase the number and quality of AI start-ups. In this context, cooperation with start-up networks, technology development, innovation, and

incubation centers will be strengthened. Activation of AI-oriented venture capital funds will be prioritized. In this direction, public incentives and supports specifically addressing the field will be improved. Interdisciplinary projects will be brought to the fore by establishing clusters and centers of excellence where advanced R&D activities can be carried out.

- Administrative, legal, and technical works on easy access to quality data, which is essential for AI projects and activities, and secure data sharing between institutions and sectors will be carried out. Testing and implementation processes of AI products and services will be improved through infrastructures that are in operation and those that will be newly established for high performance computing, ready platforms, data storage, rapid transmission, and secure sharing. The capacity of existing R&D centers will be improved, and commercialization processes will be accelerated by emphasizing collaborations with public institutions and organizations, the private sector and universities. Thanks to the Open Government Data Portal and the National Data Dictionary, the data quality of public institutions will be increased and production and sharing of anonymized datasets will be accelerated. A “Public Data Space” will be established to ensure secure data governance among public institutions. In order to generate more value from this data, activities that support external participation and develop the open-source ecosystem will be carried out.
- Researches will be carried out to ensure the adaptation of administrative and legal regulations to AI-induced socioeconomic transformation and to evaluate its possible consequences beforehand. Activities addressing ethical and legal aspects of AI applications will be carried out, and international studies in this field will be followed. By creating regulatory sandboxes and test-beds, the development, testing, and commercialization processes will be facilitated for start-ups. Data capacity will be improved to better understand and track transformation dynamics.
- Our country will be ensured to participate actively in trustworthy and responsible AI studies carried out at the international level. In addition, activities will be carried out to launch international projects in our country, and cooperation with international organizations will be supported. Participation in projects with cross-border calls, particularly the multi-annual financial frameworks of the European Union and the Union Programs within this scope, will be encouraged.
- Structural and workforce transformation of public institutions and private sector organizations will be supported in line with the developments in AI. AI Maturity Model and AI Project Management Guide will be prepared to accelerate the structural transformation and put it on a healthy footing. With the Public AI Platform to be offered as a service, the pre-implementation preparation process and experience transfer will be facilitated. It will be ensured to create problem pools and identify usage scenarios for both public institutions and the private sector. The Trustworthy AI Seal approach will be tested to encourage the use of reference models in application development and operation. Considering the new professions emerging with AI, training and certification programs for the existing workforce will be carried out with sectoral collaborations.

The action plans to be implemented within the scope of the measures outlined above will be prepared by the responsible public institutions under the coordination of the DTO and the MoIT.

A two-layered governance mechanism has been established in order to effectively implement the measures and action plans to be prepared within the scope of NAIS. The first layer will coordinate strategically, while the second layer will coordinate at the administrative and technical levels. In the first layer, high-level coordination and decision-making mechanisms are involved, while the technical and administrative mechanisms for the effective design and execution of the works to be implemented in accordance with the NAIS will be created in the second layer.

On the other hand, two different AI development environments will be established for public institutions and organizations and the common use of the AI ecosystem. In this context, the “Public AI Ecosystem” to be implemented under the coordination of the Digital Transformation Office Big Data and AI Department, will ensure following and supporting AI and advanced analytics projects of central and local government institutions and organizations in line with the guidelines to be prepared.

In addition, under the coordination of the MoIT General Directorate of National Technology Department of Digital Technologies; “Sectoral Co-Creation Laboratories” will be established within the TÜBİTAK Artificial Intelligence Institute for the common use of the AI ecosystem. These laboratories, which will be expanded in line with the needs, will support institutions with infrastructure and data spaces to be provided for them so that multi-stakeholder sectoral AI applications can be developed and tested. The laboratories will facilitate institutions defining problems, creating usage scenarios, sharing and annotating data, and meeting with domain experts and industry representatives.

In this document, the definitions of the concepts and related technologies in the field of AI are also included in the Annex in order to establish a common language in terms of the concepts used.

The high-level objectives foreseen to be reached in 2025, which is the end of the implementation period of NAIS, are as below:

- The contribution of AI to GDP will be raised to 5%.
- Employment in the field of AI will be increased to 50,000 people.
- Employment in the field of AI in central and local government institutions and organizations will be increased to 1,000 people.
- The number of graduate-level diploma holders in the field of AI will be increased to 10,000 people.
- AI applications developed by the local ecosystem will be prioritized in public procurement and commercialization will be supported.
- Contribution will be provided actively to the regulatory studies and standardization processes of international organizations in the field of trustworthy and responsible AI and cross-border data sharing.
- It will be ensured that Türkiye ranks among the top 20 countries in international AI indexes.

Introduction

This section briefly defines the concept of AI and explains how strategic priorities are determined, and the NAIS is prepared.

What is Artificial Intelligence?

In its most general form, AI is defined as the ability of a computer or computer-controlled robot to perform various activities in a manner similar to that of intelligent creatures. The term AI is used for systems equipped with human cognitive abilities such as reasoning, meaning discovery, generalization or learning from past experiences in dynamic and uncertain environments.

AI is a discipline that is fed by other digital technologies, especially big data and computation, and also neuroscience. AI-powered systems use advanced algorithms that learn from the features and patterns in the data, can be updated accordingly, and are able to search and make predictions.

The rapid development and spread of high performance computing, cloud computing, the Internet of Things, and blockchain technologies in recent years have paved the way for the emergence of new AI techniques and applications. Similarly, thanks to big data techniques used in processing digital data, large datasets are made available to AI applications. The development of quantum computing technology will enable solving much more complex problems using AI. It is expected that future developments in the aforementioned technology fields will lead to a wider range of applications for AI and performance improvement in the domain.

On the other hand, although AI benefits from neuroscience, contrary to its name, its functioning mechanism does not resemble the working and conceptualization structure of the human brain. For this reason, the concept of AI is divided into three categories: “narrow”, “general” and “super” AI. AI systems cannot perform multitasking in a single, human-like body yet. While AI systems can be successful in carrying out routine, procedural, and patterned analytical intelligence tasks, their use is very limited in tasks involving emotional intelligence and high uncertainty that require design, empathy, and adaptability. In this context, conceptual and technical discussions on the limits and future of AI continue as well.

More detailed explanations about AI technologies and their historical evolution and definitions of terms and concepts used in the NAIS are provided in the Appendix.

Overview of the National Artificial Intelligence Strategy

Since the end of the 1990s, various policies for the information society have been implemented in our country, and with the transition to the Presidential Government System in 2018, the importance of digital transformation was brought to a higher level. In this context, the realization of “**Digital Türkiye**” has begun to be strongly emphasized on both political and administrative grounds. The Digital Türkiye vision aims for a globally competitive Türkiye with the increase in productivity it provides by using digital technology, products and services in social, economic, and public activities, and the value it creates from data. On the other hand, the effect of turmoil and structural transformations in the global economy has resulted in the localization of critical technologies becoming an important political priority for both increasing social welfare and strengthening national security. In this context, policies and practices that will increase Türkiye's global competitiveness, strengthen its economic and technological independence, and provide breakthroughs in critical technologies have been structured under the “**National Technology Move**” as an objection to monopolization in scientific and technological developments.

In this framework, it is the common goal of the Digital Türkiye vision and the National Technology Move to contribute to the establishment of an economic order in our country based on innovation and creating value from data, by implementing AI in all areas of socioeconomic life and increasing locality in the development of AI technologies.

In line with this common goal, AI was determined as one of the critical technology areas for our country in the Eleventh Development Plan and the 2023 Industry and Technology Strategy. Measure No. 473.1 of the 2021 Presidential Annual Program prepared within the framework of the Eleventh Development Plan commissioned the preparation of the National Artificial Intelligence Strategy to the DTO and MoIT.

The maturity level that AI technologies have reached today and future expectations regarding effects of these technologies in different application areas require that policies and strategies in areas such as digital government, cyber security, smart cities, broadband infrastructure, manufacturing industry, software industry, education, and employment should be taken into account during the preparation of a national strategy document on AI. In this context, NAIS was prepared in line with the Digital Türkiye vision, the National Technology Move, and high-level national policy documents, taking into account sectoral and thematic strategy documents.

Determination of Strategic Priority Areas

While determining the strategic priority areas of the NAIS, the priorities highlighted in our country's national policy documents and sectoral and thematic strategies were taken into account. In addition, the tendencies and approaches of international organizations in the field of AI, other relevant national strategy documents prepared by various countries, and the measurement methodologies of international benchmarking studies were also evaluated.

Various international organizations are setting recommendations and priorities to advance the transformative impact of AI on the socioeconomic structure in a constructive way. Organization for Economic Cooperation and Development (OECD) Council *adopted Recommendation on Artificial Intelligence*, which our country is a party to and was later recognized by the G20 and the European Union (EU), provides recommendations on “research-development”, “digital ecosystem”, “regulatory framework”, “AI domain experts”, “labor market” and “international cooperation” to the countries.¹

Considering the strategies of EU countries, policy headings regarding “AI domain experts”, “transition from laboratory to market”, “networking for generalization”, “regulation” and “infrastructure” stand out.² Similarly, the World Economic Forum (WEF) recommends focusing on the areas of “capacity”, “investment”, “adoption”, “expansion” and “regulation”.³

Similar headings stand out in international comparison studies as well. In the *Government AI Readiness Index Report* prepared by Oxford Insights and the International Development Research Center (IDRC), it is seen that analyzes are made on 3 the main axes of “public administration”, “technology sector” and “data and infrastructure”.⁴

The *AI Index Report* prepared by Stanford University Human-Centered Artificial Intelligence Institute is based on “research and development”, “economy” and “inclusion”.⁵ Another study is the *Global AI Index* prepared by Tortoise Media, which includes comparisons made within the scope of “investment”, “innovation” and “implementation” axes.⁶

It is evident that the main axes are similar in the national policy and strategy documents of various countries.^{7,8}

In the *Conceptual Report* prepared by the Informatics Association of Türkiye on *Opinions and Proposals for the Development of Artificial Intelligence in Türkiye*, the challenges of our country in the field of AI were evaluated under the headings of “infrastructure”, “human resources”, “stakeholder roles”, “legal and ethical dimensions”, “standards”, “data sharing” and “strategies”, and solutions were proposed. In this direction, it is suggested to focus on the creation of an AI ecosystem and its integration into international systems, the development of AI technologies in Türkiye, discussing the legal and ethical dimensions of AI, and creating solutions.⁹

The adopted AI policies mainly focus on the following 6 main areas of influence according to the aforementioned studies:

- **Training experts equipped with advanced AI skills and harmonization of the education system in this context:** Artificial intelligence is related to many technical fields such as cloud computing, robotics, Internet of Things, augmented reality, data science, cyber security and is affected by developments in them. Therefore, both the development of AI technologies and the successful implementation of these technologies in all sectors require researchers and practitioners with advanced technical skills.
- **Increasing the number of R&D studies in the field of AI, developing entrepreneurship, providing access to high-quality data and technical infrastructure:** Intense R&D studies, pre-competitive collaborations, and innovative initiatives are required in order to be successful in AI since the field is newly developing. In this context, regulation of intellectual property rights in line with the changing needs is also important for the sustainability of innovation. In addition, since the development and implementation of AI technologies requires data collection, storage, sharing, and processing on a large scale, secure and scalable technical infrastructures and governance mechanisms should be established to allow this.
- **Establishing an appropriate ethical and legal framework for AI:** AI technologies becoming more common and widespread is changing the expectations and assumptions about human-machine interactions. For the first time in history, identity, rights, values, and responsibilities for human-made objects have

become the subject of intense debates. The implementation of AI technologies also raises privacy and national security concerns in many cases. In addition, the widespread use of AI-powered autonomous or semi-autonomous decision-making mechanisms raises ethical problems such as the protection of human rights and the prevention of discrimination. Therefore, building an effective AI ecosystem requires establishing an appropriate ethical and legal framework that takes into account the technological nature of AI.

- **Developing international cooperation in the field of AI:** Thanks to the effect of remote working methods facilitated by current technologies, it is possible to reach competent workforce anywhere in the world. In addition, it is possible to develop more successful AI technologies and applications through the joint use of data repositories with domain experts and technical infrastructure resources that belong to different countries. Moreover, the development of AI technologies and the collection of large-scale data that usually belongs to the citizens of different countries, cause tensions between large technology companies and the countries that own the data, leading to discussions on digital sovereignty. Therefore, there is a need to develop international cooperation in the field of AI in order to manage the above-mentioned tensions and benefit more from AI technologies on a global scale.
- **Managing the impact of AI on employment and professions:** Since AI technologies facilitate the automation of routine and repetitive jobs, there are extensive discussions on various platforms regarding issues such as preventing employment losses that may occur in large segments of society working in such jobs; communication, creativity and group working skills necessary to be productive in a work environment where AI is heavily used; current and next generation of employees gaining the ability to work with machines; impact of remote and flexible working models on the current labor market and employer-employee relations as well as social security systems. In this context, in order to protect and strengthen the innovation and productivity of the national economy in the age of AI, it is necessary to ensure the adaptation of existing employees to the new working environment that has emerged with the generalization of AI technologies, to manage the social tensions that will arise in this process, and to equip the youth with competencies suitable for the labor market of the future.
- **Transforming institutions and companies with AI applications:** Thanks to AI technologies, it is possible to make proactive decisions by processing a large amount of collected data on the inputs used in business processes, products, and services. This situation presents opportunities in terms of increasing competitiveness by increasing productivity both at the company and country scale. In order to realize this potential, effective measures need to be taken on several issues such as technical infrastructures that need to be created at sector and/or company scale, applications that have to be developed, the workforce that has to be trained, and business processes that have to be redesigned. In this context, it is important to establish multi-stakeholder coordination mechanisms.

NAIS has been designed around the “organizational competence”, “strategic consistency” and “governance” dimensions within the framework of strategic priorities determined by considering the above-mentioned impact areas and our country’s national, sectoral, and thematic policies and strategies. As shown in Figure 2, NAIS focuses on three core AI competencies, namely “skills”, “data” and “infrastructure”. The organizational competence dimension focuses on activities aimed

at increasing the maturity of core competencies within institutions. The governance dimension aims to provide administrative and technical coordination within and between institutions for the continuous development of basic competencies. Finally, the strategic consistency dimension complements the organizational competence and governance dimensions and aims to coordinate at the levels of public policy, NAIS, sectoral transformation, and international organization for the sustainability of the AI ecosystem.



Figure 2. Dimensions of the National AI Strategy

NAIS defines the strategic measures that will enable to follow a maturation route that starts with raising awareness for individuals, companies, and public institutions and progresses as testing, implementing, managing, and finally realizing the structural transformation. For this purpose, these measures have been grouped under the following strategic priority areas:

- AI Experts and Employment in the Domain
- Research, Entrepreneurship, and Innovation
- Technical Infrastructure, Platforms, and Data
- Harmonization and Regulations in Socioeconomic Structure
- International Cooperation
- Structural and Workforce Transformation

Preparation of the NAIS

NAIS was prepared with a participatory approach by examining global developments in AI, the policies of international organizations and the strategy documents of various countries, and by taking the opinions and contributions of relevant domestic stakeholders. In this context;

- National strategies, plans and programs, especially the Eleventh Development Plan, Science, Technology and Innovation Policy Council (STIPC) Resolutions, 2020-2023 Smart Cities Strategy and Action Plan, 2023 Education Vision, 2023 Industry and Technology Strategy, 2020-2023 National Smart Transportation System Strategy

Document and Action Plan, and 2020-2023 National Cyber Security Strategy and Action Plan were examined.

- Interviews were held with the Presidency of the Republic of Türkiye and its affiliates (7), ministries (16) and affiliates (13), the private sector (38), NGOs (3), universities (26), and domain experts in different disciplines (103).
- In order to determine the current situation and institutional needs in the domain and ecosystem of AI, two workshops were held under the coordination of the DTO and MoIT that were attended by public institutions (40), private sector organizations (38), academia (26) and NGOs (4), where the strengths and weaknesses of our country and possible opportunities and threats were determined. Workshops and studies on AI on a national scale (10) were actively participated in, and needs/trends were identified.
- The works carried out by public institutions and organizations regarding the field of AI and its effects on the socioeconomic structure were evaluated.
- Ideas were exchanged with international organizations and experts from countries (4) that have prepared an AI strategy. Field studies of international organizations and leading countries, as well as the evaluations of consultancy firms and think tanks, were analyzed.
- “Artificial Intelligence Activity Survey” was held to collect information about the AI studies of companies operating in Technology Development Zones (TDZ) and companies with R&D centers.
- Case studies in the private sector and start-up ecosystem and the problems that can be solved at sectoral scale were examined.

Prepared in the light of the above-mentioned efforts, NAIS consists of 6 main sections:

- **Introduction** section briefly defines the concept of AI, provides an overview of NAIS explains how strategic priorities are determined.
- **Global Developments and Trends** section covers the works, projections and strategies of international organizations and other countries, as well as the main trends in the field of AI within the framework of strategic priority areas.
- **Current Situation in Türkiye** section evaluates the current situation of our country in the context of AI-related high-level policy documents and strategic priority areas.
- **AI Values and Principles** section explains the AI values and principles adopted to shed light on the determination of current strategies and the practices to be carried out in this regard in the coming period.
- **Strategic Priorities, Objectives, and Measures** section includes strategic priorities, the objectives determined within the scope of these priorities, measures determined in the light of AI values and principles to achieve these objectives, and the goals related to each strategic priority.
- **Governance Mechanism** section explains the governance mechanism for the implementation and coordination of the NAIS.

Global Developments and Trends

This section provides brief information about the global AI market and the AI strategies of countries and examines global developments and trends in the context of strategic priority areas.

NATIONAL ARTIFICIAL INTELLIGENCE
STRATEGY

Global Artificial Intelligence Market

AI technologies and AI-powered systems find applications in all sectors. As such, the social and economic opportunities have become increasingly evident and led to the start of global competition in the field. There are many studies that predict/estimate different global AI market sizes. The common point of them is that the market is predicted to grow rapidly; being positively separated from other technologies in this respect.

It is estimated that global spending on AI reached approximately US\$50 in 2020. The market size is expected to exceed US\$110 billion by 2024, with an annual growth rate of 20.1%. Software has the largest share in expenditures among hardware, software and services, and annual growth in the field is expected to be 22.5% in the next 5 years. Customer services, sales processes, cyber security threat detection and fraud analysis applications are at the forefront of the prominent usage areas. By 2025, 90% of new enterprise software is expected to embed AI functionality. It is also a general trend to add AI functionality to existing software. It is predicted that the growth rate of innovative and AI-based applications will be approximately 10%. By 2025, most user interfaces are expected to use AI through computer vision, voice assistants, natural language processing and augmented reality.¹⁰ It is estimated that more than 3 billion smart devices feature voice assistants in use in 2019 and that this number will reach 9 billion in the next 5 years.¹¹

The field of AI is expected to grow by 13-14%, contributing US\$13 - 15.7 trillion to the global economy by 2030. It is thought that the anticipated contribution will be due to the increase in productivity to be achieved with the help of automated processes and improved workforce, as well as personalization and product enrichment in line with consumer expectations. In this process, the USA and China are expected to make the largest contribution with an increase that is above the average.^{12,13} It is foreseen that the impact of AI technologies will not be limited to only certain sectors and ways of doing business, but will deeply affect the entire economy. The largest share of AI-driven global economic growth is expected to be in consumer goods, accommodation, and food services, with 15%. The second-largest growth is estimated to be 12.5% in the “technology, media, and communication” sector.¹¹

Artificial Intelligence Strategies Worldwide

As of today, more than 60 countries have published their AI strategy. The socioeconomic benefits of AI have led to the start of a global race that involves many countries. AI has become one of the main areas of competition and cooperation between countries. Several national policy and strategy documents on AI have been published since 2016. The USA, South Korea and China were among the main countries to publish their national AI strategies in 2016; followed by Canada, Japan and Singapore in 2017; Germany, France, India and the UK in 2018; and Russia in 2019. The first examples of strategy documents were R&D-oriented. To this day, they have gradually become unique plans covering the socioeconomic structure.

While some countries invest heavily in AI technologies to stay ahead of the AI competition, others take a more cautious approach. Countries that increasingly realize the economic and strategic importance of AI are investing significantly in AI-based applications. Having published their AI strategies between 2016 - 2019, leading countries in the field, namely the USA, China, United Kingdom, France and Germany, set their priority objectives as increasing investments, expanding application areas by making public their resources, and activating the R&D capacity and the workforce using AI. There are many common points among the objectives of the countries that have published their AI strategies:

- Emphasis on cooperation among AI ecosystem actors is an important feature shared by all strategy documents.
- The focus is on increasing investments, expanding the fields of application by opening up resources, and activating the R&D capacity and the workforce that uses AI.
- Human centricity and the development of ethical principles are determined as common values and the necessity of international cooperation is emphasized.
- The expansion of digital infrastructures such as 5G, fiber networks, high performance computing facilities and data centers, open-source software libraries and financial incentives in this direction is guaranteed.

AI has begun to take its place in government organizations as well. While some countries are establishing separate AI offices, others are assigning responsibility for AI applications to existing ministries and offices.

Global Developments and Trends in the Scope of Strategic Priority Areas

AI Experts and Employment in the Domain

Globally, AI hiring has been growing rapidly in recent years. Although international occupational classifications are not yet available, total employment in AI is estimated to approach 250,000 as of 2019. Compared to 2015, it is estimated that there is a 5-fold increase in AI employment in Information Technologies units, and a 2-fold increase in other service units.¹¹ This situation also indicates the increasing need for sectoral experience and domain knowledge of AI experts.

AI employment growth also differs across countries. Figure 3 compares the hiring percentage of professional business platform members with any AI skills listed in their profile between 2015-2016 versus 2019. Singapore ranks first in the list, and the rate of AI hiring in 2019 is 3 times higher compared to the average of 2015-2016. It is noteworthy that Türkiye ranks high on this list.⁵

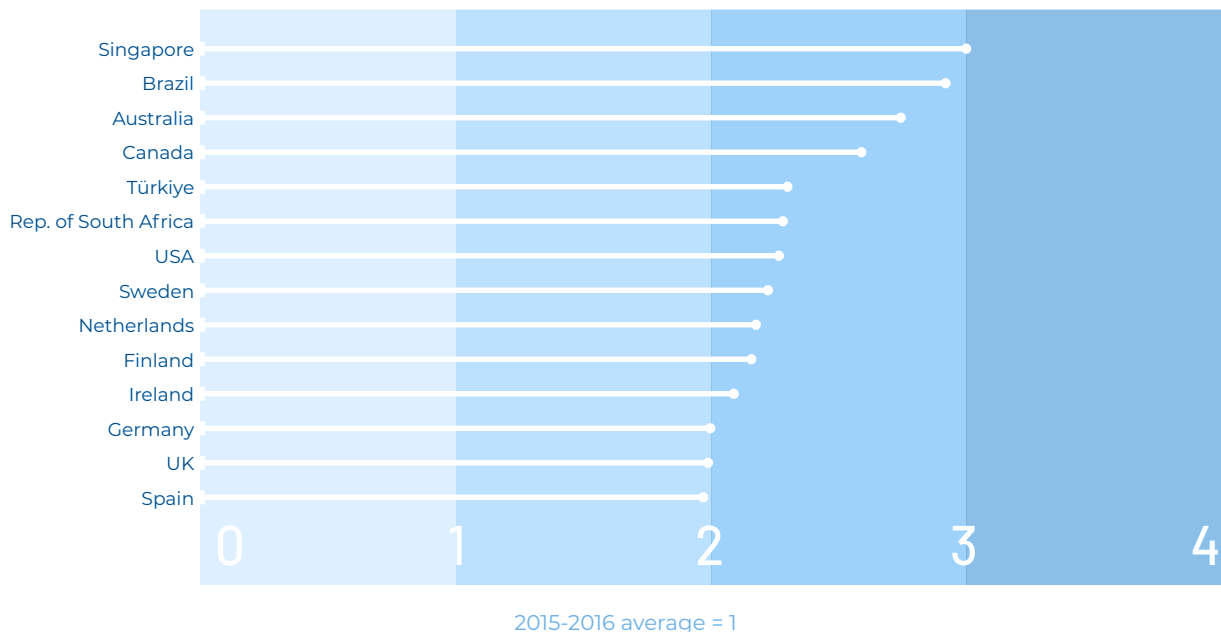


Figure 3. AI Hiring Index by Country⁵

On the other hand, over 60% of AI PhD graduates went to the industry in 2018, up from 20% in 2004.⁵ This indicates that academic knowledge in the field of AI is rapidly transferring to industry and production processes.

The number and impact value of the articles written by academia-private sector collaborations are also informative in this respect. Figure 4 shows the number of articles published with the collaboration of the academy-private sector and their impact values as of the end of 2019 for various countries. According to the figure, the USA is very successful in terms of both the number of articles and impact value. Although United Kingdom, Germany and China are the countries with the closest number of articles to the USA, their impact values are lower. On the other hand, although the number of articles published under the cooperation of the academia-private sector in Hong Kong, Switzerland and Singapore is less than in the USA, their impact values are higher.

Considering all the countries in the figure, it can be said that Türkiye is slightly above the average in terms of both article and impact value.

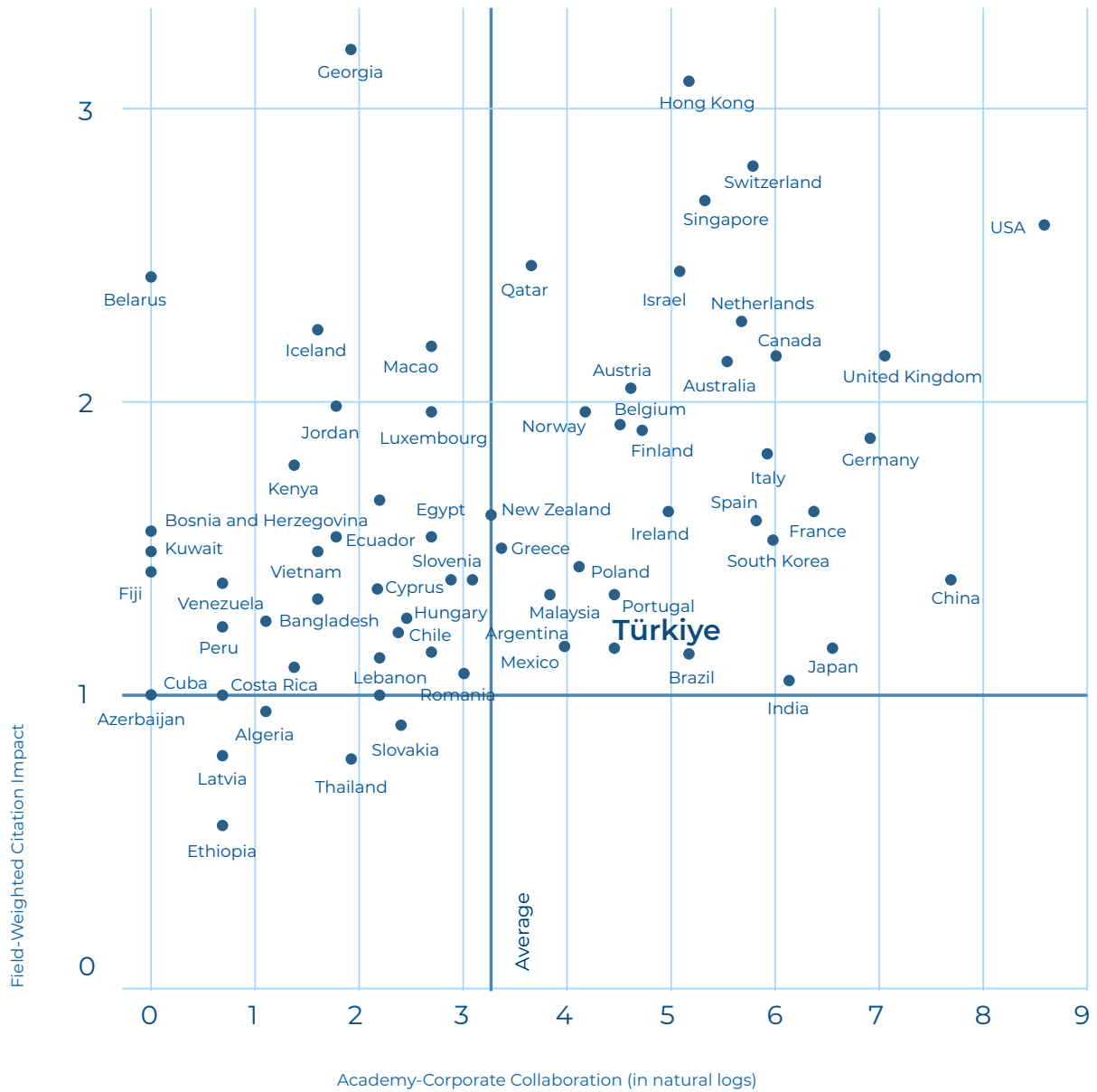


Figure 4. Number of Academy-Corporate Collaboration AI Papers and AI Citation Impacts of Countries, 2014-2018⁵

Looking at the regional distribution of publications in the field of AI, it is seen that most publications are from European countries. China published 10% of global AI publications in 2000 and this rate increased to 28% in 2018. However, the USA is the leader according to the H-index that is used to indicate scientific productivity and efficiency. The USA is the leader in computer vision, machine learning, data mining, and natural language processing research. Also, the USA is 40% above the global average number of citations.⁵

Looking at the 2019 international collaboration publications shown in Figure 5, it is seen that the two leading countries of the field, the USA and China, are in the first two places.⁷ The USA and China are followed by the EU, UK, and Australia.

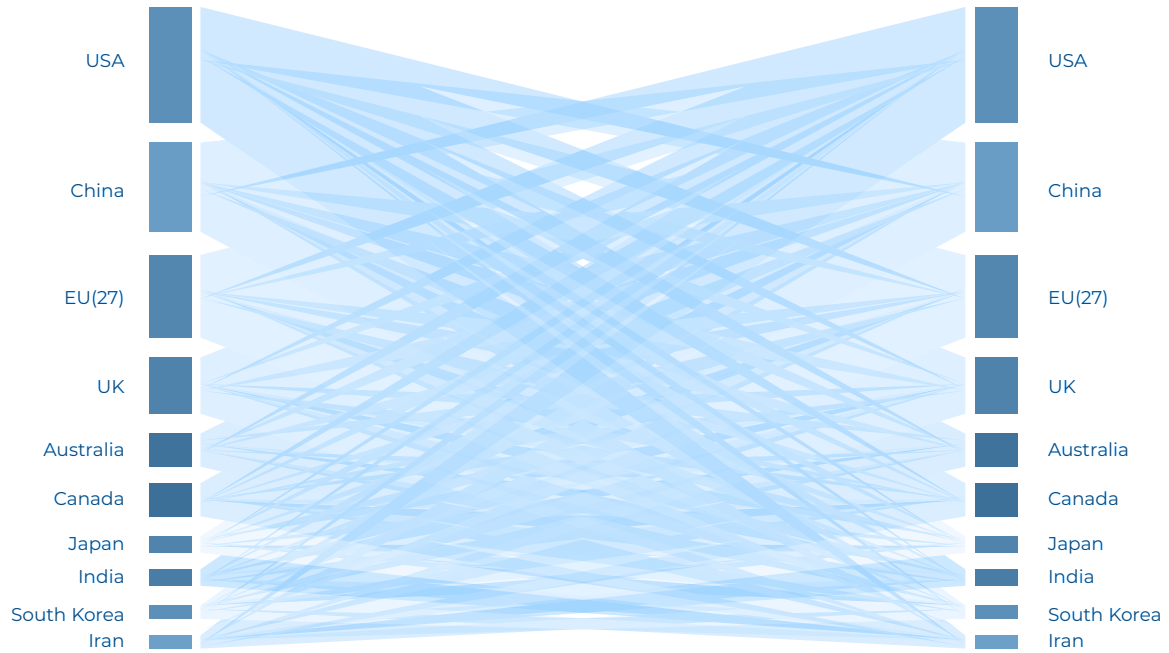


Figure 5. Distribution of International Collaborative AI Publications by Country, 2019⁷

In terms of AI expertise, according to WEF's analysis shown in Figure 6; employment growth in the field of "Data and AI", which is seen among the 7 emerging occupational clusters, is projected to be higher than in other clusters. As of 2022, 123 of 10,000 new jobs are expected to be from this cluster. Looking at the skill sets required for the occupation cluster, we can see that the skill set that will be most needed will be "advanced technology" knowledge with approximately 45%.¹⁴

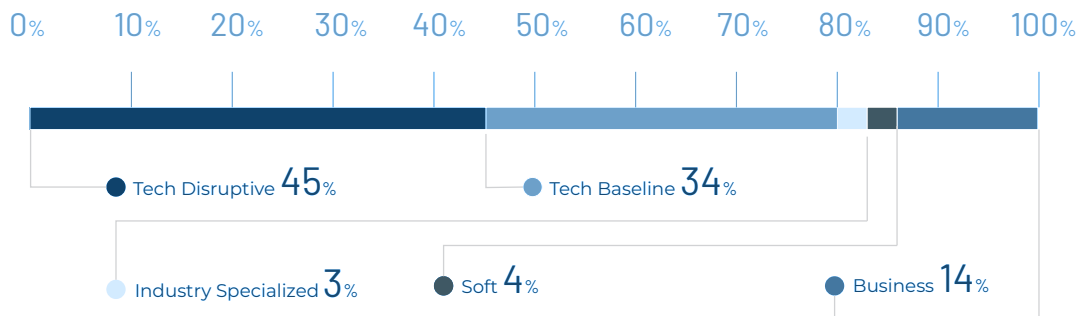


Figure 6. Share of Skills Sets That Will Be In Demand Worldwide in Data and AI Professional Cluster, 2022¹⁴

The development of advanced digital skills in AI and attracting talent from the whole world to the region are among the strategic priorities of the EU. In this context, the "Skills Agenda" was updated to develop the competencies necessary for green and digital transformation in the EU.

Many countries carry out efforts for accelerating R&D activities and the establishment of national AI centers and research institutes in order to train the qualified human resources necessary for AI works. China and Canada are creating "talent pools" consisting of competent people in AI. The United Kingdom has established scholarships, certificates, and training programs for AI researchers to provide more researchers to the institute. France, the USA, India, Japan, and Russia have also announced that they have undergoing efforts to develop advanced skills in the domain.

France and Germany declared the importance of attracting AI researchers to the region in cooperation with the EU, and that they will create the conditions that will enable EU countries to become centers of attraction. Likewise, China aims to be a center of attraction in this regard as well. In order to create a suitable environment for AI research, the United Kingdom provided the private sector with the investments needed by establishing public-private sector partnerships.

Despite all these ongoing efforts on a global scale, the shortage of AI experts is growing rapidly. There are differences between developed and developing countries in the last 5 years. Some of the professions with the fastest growing demand on a global scale are AI experts, data scientists, big data architects and software robot engineers.¹⁵

The lack of qualified employees in AI around the world leads countries to take special measures to make up for this shortage. For example, South Korea has announced that it plans to open 6 graduate schools in AI and train 5,000 AI experts by 2022.

The tendency of AI experts to work in a country different from the one they were trained in is also striking. According to research, one-third of the world's AI experts work in a country other than the country where they received their PhD.¹⁶

Countries allocate significant resources for the creation of qualified workforce in AI. For example, the United Kingdom plans to train more than 1,000 government-sponsored doctoral researchers by 2025 and to award Turing scholarships to support the first group of AI scholars, while China has launched a five-year university program to train at least 500 teachers and 5,000 students to work on AI technologies. This program will be carried out within the framework of cooperation between government institutions, private companies and universities. As part of the "AI + X" program, China has launched a program to open 50 world-class training and research institutions, 50 national-level high-quality online open courses, and 50 AI faculties.

The USA is planning grant support of US\$200 million for STEM+A education focused on computer science. France seeks to triple the number of AI graduates in three years by offering new courses and doubling the starting salaries of AI researchers in public institutions. It also aims to attract talent from all over the world to the country by significant salary increases that improve the quality of life and reducing bureaucratic requirements.

Research, Entrepreneurship and Innovation

The number of AI start-ups around the world is growing rapidly. Between 2014 and 2019, an average of US\$8.6 million per start-up was invested in a total of 15,798 AI start-ups around the world. During this period, investments in AI start-ups increased by an average of 48% annually. Cyber threat hunting, drug discovery, network optimization and advanced health biometrics are the prominent areas among AI start-ups. In 2019, global private sector investment in AI has reached US\$78 billion. Figure 7 shows that approximately half of the total investment for 2019 in terms of investment types was made by venture capital driven private investment and that merger and acquisition operations constitute an important investment item. On the other hand, the top 3 fields where the total investments made are autonomous vehicles (9.9%), drug and cancer studies (6.1%) and facial recognition (6.0%).⁵

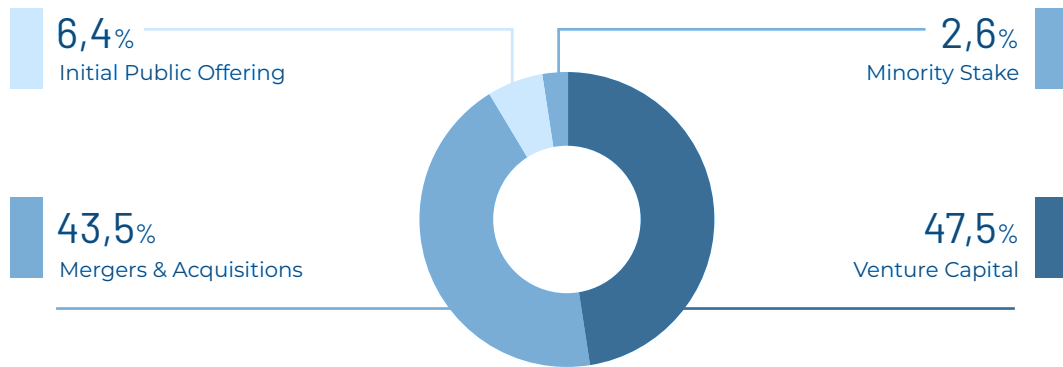


Figure 7. Distribution of Private Sector AI Investments Worldwide, 2019⁵

60% of the world's AI start-ups are from the USA and China. As of 2018, the number of AI companies is 2,028 in the US and 1,011 in China. In recent years, the acquisition of technology startups by global-scale companies as a growth strategy has been on the rise, especially in AI. For example, there were 8 acquisitions in 2010 and this number increased to 231 in 2019.¹¹

Patent applications for AI technologies and applications have been increasing rapidly as well. Scientific publications started gaining momentum in the early 2000s and there has been a significant increase in practical patents after 2010. Looking at the patent filings between 1980 and 2016, it is seen that the most important AI application fields are communication (24%), transportation (24%) and health sciences (19%).¹⁷

The number of agreements made as venture capitals indicates that angel/seed, early-stage and late-stage investments have decreased in the first half of 2020 compared to the previous year, but the interest of venture capital funds in AI is high despite the global economic recession.¹⁸

The AI strategies being followed differ depending on the economic strength of the countries and their research and entrepreneurship competencies. In this context;

- The USA has defined its goal as maintaining global leadership and announced that it will increase its AI investment budget by 70% in 2021, excluding the defense industry.
- To become the “World Leader”, China has set a target for the core AI industry to be worth US\$140 billion and the AI industry to be worth US\$1.4 trillion by 2030.
- South Korea has announced that it aims to be one of the leading AI countries in the world by aiming to invest approximately US\$2 billion between 2017 and 2022. The sectors that South Korea will invest in are autonomous cars, smart factories, drones, smart cities with smart infrastructure and green energy, which will also open the door to developments in AI.
- Israel aims to become one of the top five countries in the world in AI. Their funding for AI is US\$500 million annually. Israel stands out with over 1,400 AI start-ups in machine learning, deep learning and robotics. In 2018, 40% of investments in the start-up ecosystem were AI-based.

- Aiming to create an AI education and training ecosystem to develop and attract the best AI talents, France has announced that it will allocate €1.5 billion for AI development by the end of 2022. France is trying to set its innovation course with “innovative regulatory sandboxes” that will offer resources for testing use cases. It is predicted that AI research institutes in the country will be equipped with specially designed supercomputers for researchers.
- Having signed an “Artificial Intelligence Strategy Agreement” with the private sector, the UK aims to invest a total of US\$1.5 billion, together with the private sector's contribution by 2025, and to increase its total R&D investment to 2.4% of GDP by 2027.
- Germany has allocated a budget of €3 billion until 2025 to maintain Germany's competitiveness in the future by making Europe a leading center in the field of AI.

Countries also seek to develop regional R&D partnerships between universities, large companies and industry investors to enhance the AI research and entrepreneurship ecosystem:

- India aims to be the “CERN” of AI by opening its data to researchers to increase the global inclusiveness of AI solutions. Academic entrepreneurship is addressed through mechanisms such as the development of private e-cells in institutions such as IIT Bombay, IIT Madras and IIM Ahmedabad.
- Japan allocates significant resources to AI research, development and applications. For example, US\$550 million will be allocated to the field through the CSTI ImpPACT program.
- British Telecom has partnered with 15 universities across the UK to build AI-powered next-generation data infrastructure.

Technical Infrastructure, Platforms and Data

The global data volume, which is 55ZBⁱ today, is expected to reach 143ZB cumulatively in 2024. In other words, by 2025, there will be 19TB of data per person on average in the world. It is foreseen that the data to be produced in the next 3 years will be more than the data produced in the last 30 years. Although entertainment/personal (45%) and non-entertainment/public images (35%) constitute the majority of existing data, it is predicted that productivity/embedded system data (15%) will increase rapidly in 5 years and reach 30% of the total data volume due to digital transformation in the economy.¹⁹ This increase and change in data volume should be expected to drive a similar trend in the demand for AI products and services.

In order to conduct AI research and develop applications, both large-scale datasets in the relevant field and high-capacity informatics infrastructures that can process said data are needed. Since it is extremely difficult for individual stakeholders in the AI ecosystem to acquire these resources, countries often focus on building high performance computing infrastructures and open-source data and software libraries that can be used jointly, and try to improve data sharing among stakeholders in the ecosystem.

ⁱ 1 Zettabyte (ZB) equals 10²¹ bytes or 1 billion Terabytes (TB).

International organizations, on the other hand, aim to steer the field with structures such as technical working groups established specifically for certain issues, as well as making policy recommendations. For example, the International Telecommunication Union (ITU) has the “Focus Group on Machine Learning for Future Networks”, which aims to draft the technical specifications for machine learning for next-generation wireless communication networks. Overhaul of existing communication networks that were not designed with big data analysis and machine learning studies in mind is among the works of ITU.

Recently, the EU has started to finance cross-border projects on the use of big data. One of these projects is the Meaningful Integration of Data Analytics and Services (MIDAS). The purpose of this platform is to collect, map, manage, model, process and use existing heterogeneous healthcare data and other government data, along with external open data, to enable the creation of evidence-based, actionable information. The platform is expected to guide long-term policies better and enable the delivery of health services at the regional, national, and EU levels.

The widespread use of open government data in OECD member countries also positively affects the development and use of AI technologies. More countries are expressing that they have findings showing that open government data has an impact on the development and use of AI technologies. Based on these findings, the OECD recommends that efforts be made to establish standard frameworks for data formats and publication procedures, promoting higher data quality and accessibility for open government data, and mechanisms to allow feedback and suggestions from open data users.²⁰

Considering the importance of the reuse of data held by different stakeholders for the development of new products and services in the field of AI, the European Commission has published the *Communiqué Towards a Common European Data Space* in order to support the establishment of common data spaces at the EU scale.²¹ The Communiqué, which was created in line with the current data protection legislation, makes recommendations for the establishment of common data space in order to create an uninterrupted digital space that will enable the development of new data-based products and services in the EU. The Commission aims to improve access to privately-held data through industrial and personal data platforms, within the framework of data sharing and reuse agreements, in common data spaces.

Having global-scale technology companies with access to comprehensive data that can efficiently develop and apply AI technologies and applications in various fields, the USA has a significant advantage in this area. There are also innovation centers in the USA, where dynamic start-ups operate alongside the large technology companies in Silicon Valley. Universities and research institutions both conduct their own research and contribute to the product development of these companies by accessing the data of these technology companies. The USA also works to facilitate the creation of open-source software libraries and toolkits (such as Open NLP, Weka toolkit), thus aiming to facilitate access to data and technology resources needed for the development of AI products.

Korea Advanced Institute of Science and Technology operates an Artificial Intelligence Center that focuses on research in areas such as brain research, machine learning, quantum computing, multimodal perception and interaction, natural language processing, emotional intelligence, smart chips. It plans to invest approximately US\$1.2 billion between 2017 and 2022 for these researches. The South Korean government also wants all public institutions to open their data pools to developers by 2025.

Harmonization and Regulations in Socioeconomic Structure

The identification of new legal and ethical problems that arise with the spread of AI technologies in social and economic life, and the creation of new legislation and norms to solve such problems have an important place in the AI works of many countries and international organizations.

The United Nations (UN) brings together its work around human-centered and responsible AI concepts and highlights the contribution of AI applications to achieving sustainable development goals. For example, the UN Interregional Crime and Justice Research Institute launched a program on AI and robotics in 2015 to examine the effects of AI technologies on studies related to their field. In the same year, the UN General Assembly held an event named “Rising to the Challenges of International Security and the Emergence of Artificial Intelligence”. At the meetings initiated as a result of the work of the Experts Group, emerging problem areas between civilian principles and military requirements and different perspectives between countries were brought to the agenda within the scope of Lethal Autonomous Weapon Systems. On the other hand, activities on data privacy, data protection and data ethics are carried out within the UN special consultant expert group and the United Nations Educational, Scientific and Cultural Organization (UNESCO). The “AI for Good” initiative, launched by ITU in 2017, aims to establish a common understanding to identify the capabilities of AI technologies, develop technical standards and provide political guidance in this field. This structure is an impartial platform where governments, the private sector, and academia can come together and carry out various works in cooperation with relevant institutions.²²

The EU carries out efforts to establish an ethical/legal framework for the development of “human-centric and trustworthy AI” so that more data on the public sector can be prepared and made available for use. In this context, the AI High Level Expert Group (AI HLEG), which leads the works carried out in the EU, has published the *Ethics Guidelines for Trustworthy AI and Assessment List for Trustworthy Artificial Intelligence (ALTAI)*. This guide document defines fundamental rights and ethical values, which are important for the development of AI technology and applications, especially the transparency, accountability, and protection of personal data privacy. According to the definition, trustworthy AI has three components, which should be met throughout the system's entire lifecycle:²³

1. It should be lawful, complying with all applicable laws and regulations.
2. It should be ethical, ensuring adherence to ethical principles and values.
3. It should be robust, both from a technical and social perspective since, even with good intentions, AI systems can cause unintentional harm.

On the other hand, the European Parliament published a draft report in 2016 containing recommendations on civil law rules regarding robotics. The report mentions the general and ethical principles that audit and regulate the use of civil robotics and the progress of AI technologies for future AI-powered robotic systems and places particular emphasis on personal responsibility for robotics protocols and smart and autonomous devices.²⁴

In 2018, the *EU Declaration on Artificial Intelligence* was signed by the EU member states.²⁵ This declaration sets a roadmap in AI for the member states and the objectives that would enable EU countries to compete with the leading countries in AI. The declaration addresses concerns

such as the integration of AI into the economy, how it will be positioned in the fields of science and education, and AI ethics, which are seen at the center of technological change, and a call for cooperation was made to the member states on these issues. The declaration also discusses fundamental rights and values, especially transparency, accountability and ensuring the privacy of personal data, which are considered as a priority in all EU countries. In addition, it is also aimed to increase the accountability of the systems by contributing to the sustainability and reliability of AI systems. Although AI-powered decision-making processes can produce successful, fast and low-cost solutions with the *European Approach to Excellence and Trust in Artificial Intelligence Prospectus* published in 2020; it is also pointed out that such processes may pose risks such as low explainability, intrusion in private lives that may cause gender-based or other kinds of discrimination, and being used for criminal purposes. In order to minimize these risks, the document recommends adopting regulatory approaches for the development and use of AI systems.²⁶ The European Commission has published the draft legal regulation for AI, which is the first in this context.

At the international level, the process of standardization on trustworthy AI has also begun. ISO is carrying out efforts, and in this context, the “SC 42” subcommittee was established in 2017 and the *ISO/IEC TR 24028:2020* standard for trustworthy AI was published in 2020.

Autonomous vehicles are expected to be one of the AI-powered systems that are projected to cause significant changes in the socioeconomic structure. In the autonomous vehicle market, products are classified according to the level of autonomy. While it is expected that the highest level vehicles, which are aimed to offer the steering-less driving experience as fully autonomous at all times, will be developed in the next 10 years, it is evaluated that their adoption by society will not occur as rapidly.²⁷ The most important obstacles to the development of the market are considered to be customer concerns arising from issues such as cost, current regulations and cyber attacks. According to a global survey conducted in 2019, Turkish drivers rank the first as being the most interested in autonomous vehicles with a ratio of 67%. Our country is followed by Germany (54%), United Kingdom (48%) and, USA (47%). On the other hand, although the skepticism towards the safety of autonomous vehicles has decreased in recent years, it remains around 36%. It is seen that skepticism in China, France, and Türkiye is lower than in other developed economies.²⁸

In almost all national AI strategies, it is emphasized that the first step to be taken for the widespread and safe use of AI-based systems is the development of ethical principles. From this point of view, there are countries that continue to work towards becoming a “global thought leader”, including the ethical dimension of AI. China, the United Kingdom, and especially Canada have declared that they aim to lead international works in the field. China has made it clear that it wants to govern the formation of laws, regulations, and ethical norms regarding AI. The *Montreal Declaration for the Responsible Development of Artificial Intelligence*, published by Canada in 2018, is an internationally recognized work in this field.

International Cooperation

The need to develop international cooperation in the development of innovation and entrepreneurship in AI, improving digital infrastructures, generalizing open source libraries, and determining framework rules for privacy and ethical principles is an issue emphasized in AI-related policies and strategies of international organizations and many countries.

The EU has added the Digital Europe Programme to the multi-annual financial framework programs it has developed for the 2021-2027 period to improve skills capacity and infrastructure in critical technology areas. The following basic strategies have been put forward for AI, which is one of the 5 main objectives of the program:

- Keeping AI centers in Europe in touch with each other and improving the capacity of AI centers,
- Creating platforms that will facilitate access to AI resources,
- To support the development of AI applications in critical industries.

The *Coordinated Plan on Artificial Intelligence*²⁹ published by the European Commission in December 2018 emphasizes the necessity of establishing cooperation for the modernization of the education systems of the member states within the scope of the Digital Europe Program. In addition, the importance of cooperation between EU member states and non-member states is underlined for the creation of EU-wide common data spaces and AI open platforms, ensuring interoperability and actions that will appeal to the sector.

The emphasis on data governance and human-centric AI studies has been emphasized at the G20 summits held in recent years. Our President underlined that AI should be handled with a human-centric approach at the summit he attended in Japan in 2019. In the same year, an international initiative on data flows called “Osaka Track” was launched under the leadership of Japan. The aim of this initiative is to develop a framework for the “Data Free Flow with Trust” concept. In this context, a multidimensional architecture is proposed to develop international cooperation on data flows between countries. The document explaining the aforementioned concept draws attention to the importance of data security and the fact that countries adopting disproportionate restrictions on cross-border data flows may cause irreparable losses in terms of the citizen welfare and competitiveness of countries.³⁰

The “OECD Artificial Intelligence Experts Network (OECD ONE AI)” was established in order to facilitate international cooperation between AI-focused initiatives and organizations and to exchange information between experts in different geographies. Being an interdisciplinary and multi-stakeholder structure, OECD ONE AI brings together AI expertise from various disciplines, such as AI researchers, computer scientists, engineers and other technical experts. This platform also contains experts on social sciences, humanities, legal and ethical issues; as well as experts from national governments.

The *OECD Council Recommendation on Artificial Intelligence*, to which our country is also a party, was adopted on 22 May 2019 in order to strengthen the global AI policy ecosystem that respects human rights, democratic and ethical values.¹ These principles, supported by the EU, were soon adopted by the G20 as well. The document also provides recommendations for international cooperation on trustworthy AI.

In 2020, the “Global Partnership on Artificial Intelligence (GPAI)” was launched under the leadership of Canada and France and with the support of the OECD. The OECD acts as the secretariat of GPAI, which is the first international initiative on AI to which countries are a party. This international initiative encourages participating countries to conduct research and develop practices in line with the principles of “responsible AI” based on human rights, inclusion, and diversity.

On the other hand, AI applications have provided important gains in the international fight against the COVID-19 pandemic, which has created a social and economic emergency by affecting the world in 2020 and has brought new risk factors to the agenda. The works of the European Commission³¹ and OECD³² on the subject have especially focused on health data and related technologies. Regarding the use of AI technologies in the fight against the pandemic, the following findings were revealed in these works:

- AI-powered systems need more datasets, tools, and resources that are shared quickly and reliably in extraordinary situations such as pandemics. AI-powered monitoring tools that allow research without compromising privacy should be developed and utilized. Therefore, there is an important need to establish multidisciplinary and open science-based international cooperation to enable potential research and development efforts.
- AI has been implemented in various areas of epidemiological research modeling, such as estimating the number of cases for different public policy options, making predictions about the course of the pandemic. It can also help investigate the scale and spread of the “infodemia” to address misinformation and disinformation, including the emergence of hate speech.

Structural and Workforce Transformation

The use of AI technologies is important in terms of creating high value-added products and services both in the private sector and the public sector. Utilizing this potential requires the relevant actors to invest in their technological infrastructure and employees, and to improve their business processes and decision mechanisms with a data-driven approach.

There are certain challenges to expanding the application areas of AI all over the world. The top challenges to adopting AI are listed as a lack of skills (56%), understanding AI use cases (42%), and concerns with data quality (34%).³³

The WEF has developed and piloted common tools for governments to deliver AI solutions built with ethical principles in mind. The AI Procurement Toolkit for the Public and Private Sector prepared for this purpose includes concrete recommendations on purchasing, risk assessments, proposal drafting and evaluation.³⁴ In addition, a toolkit for recruitment, performance evaluation and promotion is being developed with the contribution of public institutions and private sector organizations in our country in order to base the use of AI applications in human resources on human-centric and ethical values.

In its report, the International Labour Organization (ILO) draws attention to the disruptive effects of the development of AI technologies on the labor market, as well as the inequalities that may arise in employment with the benefits of technological advances. By touching on issues

such as the forms of regulating the digital economy and appropriate data sharing methods, the opportunities and risks that will arise with the spread of AI in working life are pointed out.³⁵ In addition, the *Work for a Brighter Future Report* was prepared, which includes recommendations for the future of working life that is affected by different factors, especially digital transformation.³⁶ The *ILO Centenary Declaration for the Future of Work* was adopted at the ILO Centenary Conference held in 2019. The declaration recommends creating a human-centric agenda for all stakeholders and, in this direction, investing in the skills of employees, institutions related to working life, and decent and sustainable jobs.³⁷

On the other hand, there are different projections for the industries involved in the transformation of the workforce. As can be seen in Figure 8, the automotive and assembly, and telecommunication industries are expected to adopt AI technologies relatively faster, thus the largest workforce cuts and transformations in the next three years are expected in these industries. The research points out that the infrastructure, professional services, and high-tech sectors are more likely to expand their workforces through the adoption of AI.¹¹

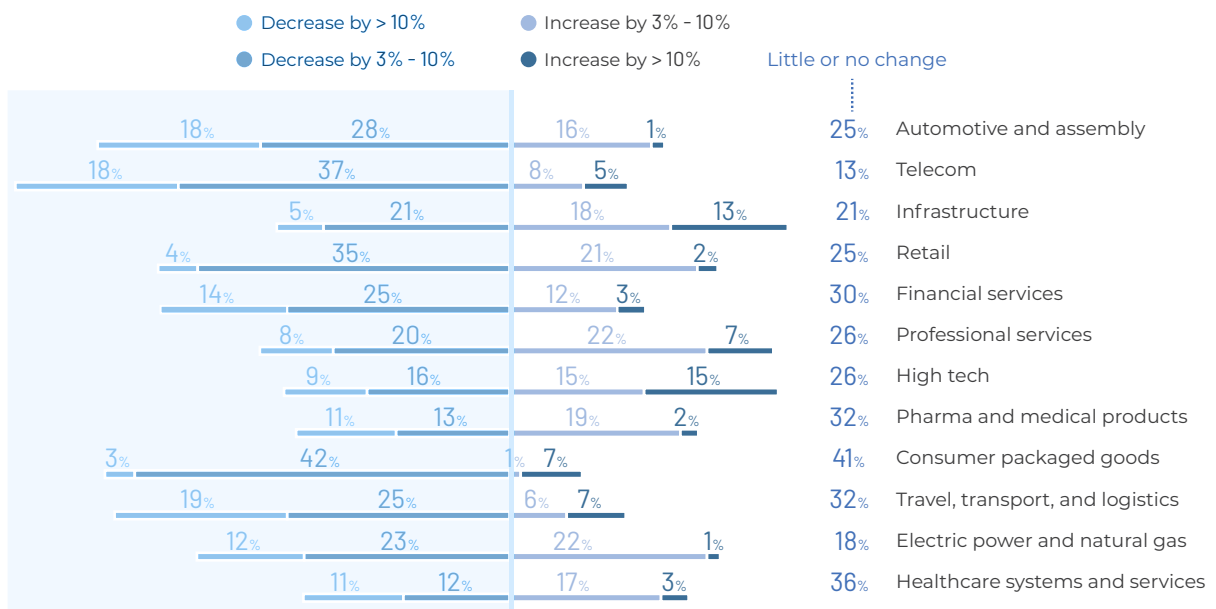


Figure 8. Predicted Workforce Changes Due to AI Adoption in Sectors Worldwide, 2020-2023¹¹

In general, it is seen that there is a significant transformation in the core skill needs that constitute the foundation of professional duties. Figure 9 shows projections for how core skill needs will change from 2016 to 2030 for the US and Western European countries. It is estimated that while the need for physical and basic cognitive skills will decrease, the need for social and emotional skills and technological skills will increase and total working hours will increase by more than 25%.³⁸

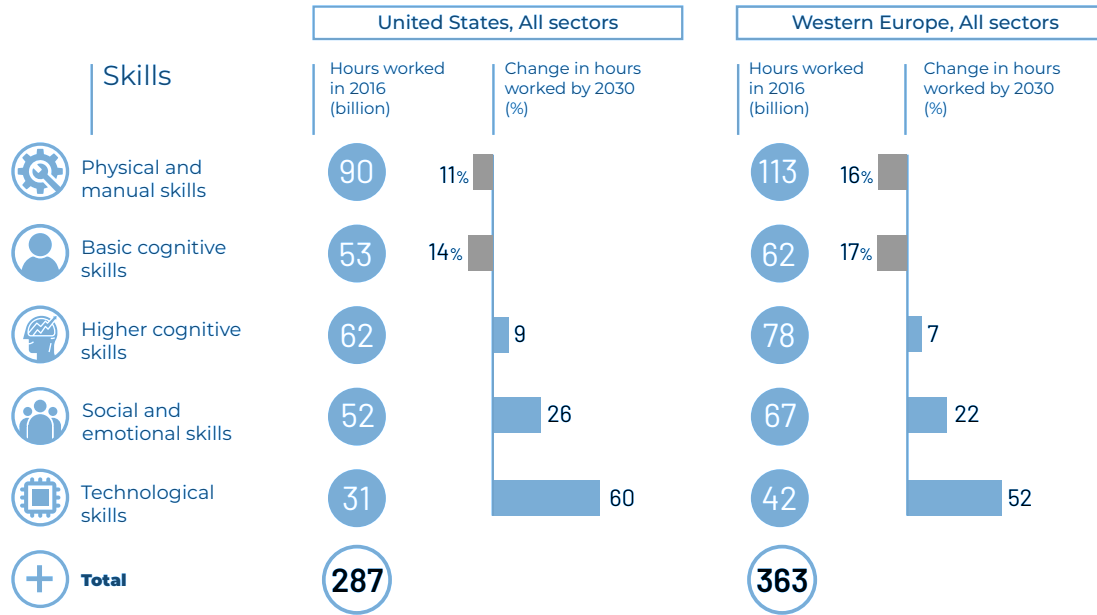


Figure 9. Change of Skills Demand in the Workforce for the US and Western Europe, 2016-2030³⁸

According to the WEF, over the next five years, half of all workers will need to upskill or reskill to prepare for changing and new jobs. On the other hand, digitalization of business processes (84%) and remote working (83%) are among the priority actions of organizations for human resources during the post-COVID-19 economic recovery period. They are followed by the process automation (50%) and the digitization of vocational skills training (42%).³⁹

Regarding the need for the skill sets required by digitalization in Europe, according to Figure 10, it can be said that the demand for competencies related to AI and data analytics, especially in the manufacturing industry and wholesale, retail, and transportation industries, will be high. As for the public sector, it is seen that AI domain skills will be of high priority, along with organizational architecture and organizational applications.⁴⁰

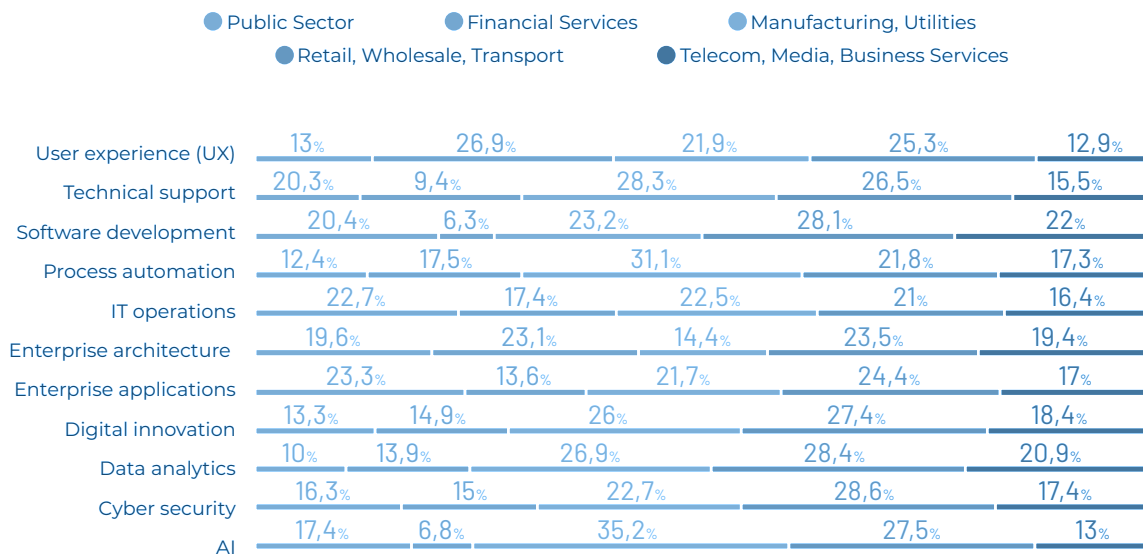


Figure 10. Distribution of Digitization Needs by Sectors across Europe, 2020⁴⁰

On a country basis, the USA and China focus on the structural transformation of the private sector and world leadership with their global scale companies and a broad-based approach. In its AI strategy, China has emphasized that becoming a world leader in AI is possible by “establishing an open and collaborative AI technology innovation system”.

While the transitivity between industry and science has increased in the United States over the last decade, attempts to achieve this transitivity in Europe have been very limited. The EU has strategically adopted positioning itself as a “regulatory actor” in digital technologies, especially in AI, in order to reduce the gap. With a population of approximately 400 million, Europe is one of the most developed markets targeted by technology companies. Through this approach, namely the “Brussels Effect”, Europe aims to both protect its market and consumers and to penetrate the markets of other countries by providing technology and product/service development with the standards it sets.

Many countries, especially Germany, attach great importance to the economic growth that will be brought on by AI, and in this context, steps are taken towards sectoral awareness and workforce transformation. Germany has declared that it wants to be a “seal of quality” in the development of AI technologies and aims to be a center of excellence in line with its industrial capacity.

France, on the other hand, aims for the EU to be an alternative to the USA and China in AI, led by France with its vision of “AI for Humanity”.

Russia and Israel put a strong emphasis on the implementation of autonomous systems in the defense industry.

The UK aims to raise funds with its industry target and thus to increase AI capabilities and has signed an agreement with the private sector for this purpose.

Japan uses the technology primarily to deal with the problems of its aging population. In line with this economic target they have set, they have taken the steps to meet the requirements needed by the private sector.

Estonia is developing the KrattAI platform, via which it creates a network of interoperable AI applications to provide public services with voice assistant support.

Finland has published an awareness training set for the fundamentals of AI, namely “Elements of AI”, which is accessible by everyone and available online. Targeted to reach 1% of the Finnish population, the application has already reached more than 500,000 users globally.

Current Situation in Türkiye

In this section, the outlook of our country in global AI indexes was reviewed, a general evaluation was made in terms of AI policies included in the high-level policy documents and institutions in this field, and the current situation was analyzed within the framework of the strategic priority areas determined.

Türkiye's Outlook in Global Indexesⁱⁱ

In the *Government AI Readiness Index 2020 Report* prepared by Oxford Insights and IDRC, the readiness of countries to use AI in public services was assessed.⁴ The study, in which there is an analysis consisting of 10 sub-indexes under the axes, our country ranks 67th among 172 countries. In the "Responsible AI" sub-index, our country ranks 31st out of 34 countries. Figure 11 shows the scores of our country in each dimension.

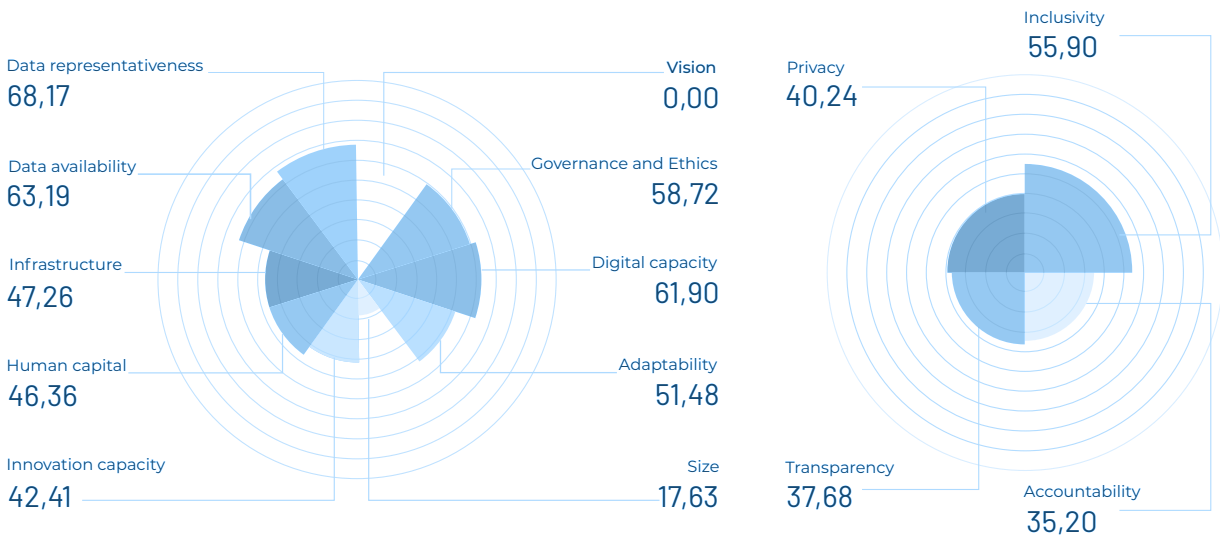


Figure 11. Türkiye's Outlook in Government AI Readiness Index 2020⁴

Another study is the *2019 Global AI Index* prepared by Tortoise Media.⁶ According to the study comprising an analysis of seven sub-indexes, our country ranks 41st among 54 countries. When analyzed according to the sub-indexes shown in Figure 12, our country performs better in "infrastructure", "commercial organizations" and "development".

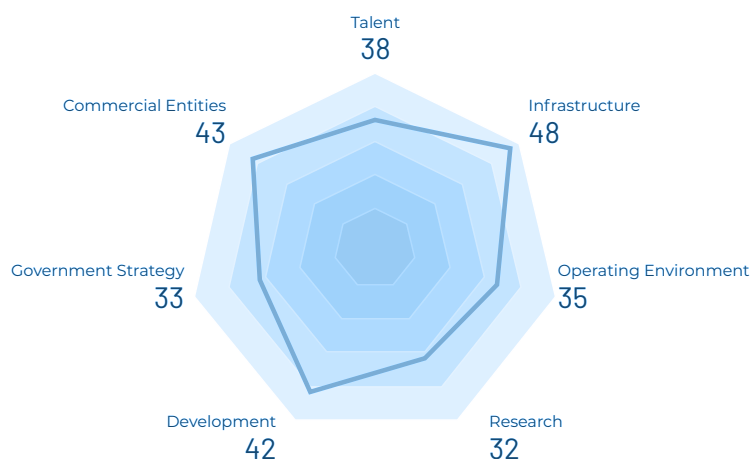


Figure 12. Türkiye's Outlook in Global AI Index 2019⁶

ii Although such indexes are generally accepted on an international scale, they are not official.

AI High-Level Policy, Legislation and Institutions in Türkiye

The Eleventh Development Plan contains an evaluation of the horizontal technology areas needed to ensure technological progress in determined priority sectors and development areas and technology trends in the world. In the Plan, AI was regarded among the determined critical technology areas such as the Internet of Things, augmented reality, big data, and sensor technologies. In addition, the Plan includes policies and measures for the development of domestic production capabilities in those technology areas, the use of these technologies in priority sectors to increase productivity, the transformation of the workforce so that they can work effectively with these technologies, and the use of these technologies for improving public services.

The Eleventh Development Plan Specialized Commission (SC) Reports also provide important evaluations addressing the needs and priorities of our country for its socioeconomic development in the face of the rapid development and disruptive effects of technology. For example, in the R&D and Innovation Ecosystem Strengthening SC Report; the necessity to *“make legislative changes that will allow the data in the hands of the government to be shared with the entrepreneurs who are developing products so that they have access to the data needed by big data and artificial intelligence applications”* is emphasized. In the Labor Market and Youth Employment SC Report, it is pointed out that *“policies should be prioritized for areas brought on by digitalization such as artificial intelligence, big data and the Internet of Things”*.

“AI and machine learning” and “big data and data analytics” were prioritized as the top two areas with the highest impact and feasibility in terms of economic impact, social benefit and national security among the 27 areas of technology that were determined by STIPC as part of the “Identification of Priority Technology Areas to Focus on within the Scope of Groundbreaking Strategic Approach”.

STIPC is currently preparing the “Artificial Intelligence Technology Roadmap”. The Artificial Intelligence Technology Roadmap includes the strategic targets to be determined in terms of AI-related technologies, the products and technologies that are critical to be developed for our country to achieve these targets, R&D projects for their development, and priority sectoral applications of the critical products/technologies developed.

In order to establish a long-term roadmap for AI, which is determined as the priority technology area in various national policy documents, the DTO and MoIT were appointed the task of preparing the “National Artificial Intelligence Strategy” with Measure 473.1 of the Presidential Annual Program for 2021 prepared in line with the Eleventh Development Plan.

Various issues directly or indirectly related to the development and application of AI technologies are also included in the following sectoral/thematic strategy documents:

- [2023 Industry and Technology Strategy](#)

- In order to realize the ecosystem understanding and centers of excellence in R&D, it is aimed to *“reorganize the incentive structure applied to on-site R&D so as to include the works done in factory areas, university laboratories, offices, and workshops by taking into consideration the relationship of R&D*

with production and operations in technology development processes, and software and artificial intelligence technology development environments that shape the future.”

- In order to increase the capacity of technology suppliers and initiatives and to bring new products and services to be developed to the industrialists who need them, it is stated that *“Collaboration with international companies will be made to enable the rapid introduction of disruptive technologies such as artificial intelligence and machine learning, robotics, and the Internet of Things, which are not ready yet and require time to invest in from scratch.”*
- It is aimed that *“Türkiye will produce at least 23 smart products with a world-leading market share or brand value in at least one of the disruptive technology fields”.*

- **2023 Education Vision**

- The main objective was determined as *“To raise qualified, moral individuals who are equipped with the skills of the age and the future and who can use these skills for the good of humanity, who are in love with science, who are curious and culturally sensitive,” and it is aimed to “create a digital education and training content development ecosystem with the participation of different actors and institutions in the Turkish Education System”.*

- **2020-2023 National Cyber Security Strategy and Action Plan**

- It is stated that *“the security criteria of next-generation technologies such as artificial intelligence, Internet of Things, blockchain and 5G will be prioritized in cyber security plans in the near future,” and it is aimed to “determine the usage areas of artificial intelligence and blockchain technologies for cyber security and to create added value with the domestic and national technologies to be developed.”*

- **2020-2023 Smart Cities Strategy and Action Plan**

- In line with the vision of *“Liveable and Sustainable Cities Adding Value to Life”*, it is aimed to *“create solutions by anticipating the problems and needs in cities, to provide urban services faster and at a higher quality, and thus to increase the satisfaction with the services and the quality of life as the ultimate goal”.*

- **2020-2023 National Intelligent Transportation Systems (ITS) Strategy Document and Action Plan**

- It is aimed to *“Establish an IoT network incorporating ITS components to store the data collected from these components within the big data environment and convert it into analyzable data and, optimize the transportation infrastructure using innovative technologies in artificial intelligence, deep learning, communication, and similar fields.”*

Institutional Structures

DTO Big Data and Artificial Intelligence Department

“Big Data and Artificial Intelligence Department” was established within the DTO as per the articles added to Presidential Decree No. 1 by the Presidential Decree No. 48 published in 2019. The Department is the first administrative unit established specifically for AI in our country with the main task of *“leading and coordinating artificial intelligence applications in public priority project areas”* and its duties are as follows:

- Developing strategies and providing coordination in line with the policies determined by the President for enabling the effective use of big data and AI applications in the public sector,
- Supporting projects and activities necessary for developing big data technologies in the public sector,
- Leading AI applications in the prioritized project fields,
- Carrying out big data analytics, security and privacy activities,
- Coordinating the preparations for a public data dictionary for enhancing inter-institutional cooperation and creating effective data-informed decision-making processes in the public sector,
- Developing strategies and providing coordination about national-level open data.

The Department supports the development of collaborations with universities, the private sector, and NGOs and the development of the AI ecosystem for AI capacity building in our country, especially with the administrative and technical coordination of public institutions and organizations.

Ministry of Industry and Technology General Directorate of National Technology

With the Presidential Decree No. 59 in 2020, the clause *“Creating policy recommendations and strategies in order to increase the R&D and production competencies of individuals and businesses in critical areas such as big data, artificial intelligence, and cyber security through the use of advanced technologies that have a high level of economic impact and the potential to accelerate development in multiple sectors, and ensuring the implementation of the determined policies and strategies, supporting R&D and investment activities and initiatives in related fields, making regulations and inspections regarding related fields and supports”* was added among the duties of the MoIT. The General Directorate of National Technology (GDNT) was established within the MoIT in order to establish the necessary institutional capacity for the activities to be carried out within this framework.

GDNT is responsible for carrying out activities in new technology areas to ensure capacity development and economic value generation on a national scale. The Decree appoints GDNT with tasks such as taking measures for the growth of the ecosystem for transformative technologies, especially big data and AI, supporting the development of businesses, increasing domestic and

national production capacity, and contributing to the training of researchers, within the scope of the National Technology Move; and in this direction, carrying out programs and projects with high impact at the country.

TÜBİTAK Artificial Intelligence Institute

Aiming to become a catalyst in the spread of AI technologies, TÜBİTAK Artificial Intelligence Institute was established in 2020, building on a new cooperation model that strongly interacts with the ecosystem and brings together different levels of competence. The Institute is the first to be established with a direct focus on a promising technology field that cuts horizontally across sectors and research fields. The main goals of the TÜBİTAK Artificial Intelligence Institute are as follows:

- Ensuring the emergence of products that provide pioneering, inclusive and sustainable solutions that meet the needs of our country and global trends, via the AI technologies to be developed,
- Training AI researchers,
- Playing an active role in the development of the start-up ecosystem in AI technologies.

It is foreseen that the cooperation on the basis of focal areas with stakeholders in the ecosystem will be managed holistically at the program level. The aim is to work with research units in different disciplines in a way that will serve the concept of a “system of systems”.

Other Institutions and Organizations

Institutional structures related to AI have been established at the level of ministries in our country as well. For example;

- “Section of Big Data and Artificial Intelligence” under the Directorate General for Information Technologies within the Ministry of Justice,
- “Artificial Intelligence and Wearable Technologies Unit” under the National Projects Management Coordinator under the General Directorate of Health Information Systems within the Ministry of Health,
- “Section of Process Management and Artificial Intelligence” under the Department of Communications and Information Systems under the Ministry of National Defense was established.

There are also institutional structures at the level of local governments. For example, “Section of Artificial Intelligence Education and Research” was established within Gaziantep Metropolitan Municipality. The section's objective is to organize activities and training aimed at raising awareness of citizens in this field.

Established under the Directorate of Turkish Health Institutes, the “Turkish Institute of Health Data Research and Artificial Intelligence” aims to carry out projects on the subjects of saving money by preventing unnecessary examinations, providing fast reporting and diagnosis.

Current Situation of Türkiye in the Framework of Strategic Priority Areas

AI Experts and Employment in the Domain

As of 2020, the total employment of the Information and Communication Technologies (ICT) sector is around 260,000 people, of which 120,000 are professionals in ICT. On the other hand, approximately 10,000 people are employed in IT in public institutions and organizations, including central and local governments. In general, there is an employment of approximately 480,000 people when ICT-related occupations in all sectors are considered.ⁱⁱⁱ Although it is considered that the AI employment situation is developing rapidly in terms of quantity and quality, reliable data on field-specific employment cannot be obtained due to the lack of occupational classifications in the field. The educational backgrounds of those working in AI for application development may be computer engineering, electronics, software, and mechatronics engineering, as well as mathematics, statistics, and physics. In addition, it is seen that specializations in different professions and disciplines such as AI engineering, robot training, data detective; and law, sociology, ethics, and economics have developed in line with the needs emerging in AI. This uncertainty in terms of the size of employment in AI is not unique to our country, but activities to obtain more reliable data regarding this field continue at the international level.

Our country is taking important steps in increasing the expertise and employment in AI, advanced digital skills, and information and communication technologies in general:

- AI was determined as a priority area within the scope of the 100/2000 Council of Higher Education (CoHE) PhD Project. Within the framework of the project where interdisciplinary work is prioritized, the employment of research assistants and lecturers in AI is set to increase in the coming periods.
- The “1 Million Employees” project, initiated under the coordination of the Ministry of Treasury and Finance, is among the most comprehensive initiatives carried out in the field of IT in general. The project aims to train 1 million citizens by 2023 and provides free online training opportunities, including AI, via the integration of the BTK Academy training platform and creates a pool of resumes for employers.
- As part of the 2023 Industry and Technology Strategy, the “Türkiye Open Source Platform” was established in order to train 500,000 software developers, to help these talents achieve worldwide success, and to produce software-based products on an international scale in our country. Among the works of the platform are two qualified software developer schools using a learning model for learning from each other and open source software projects, especially on natural language processing. Also, the National Technology Academy is established under the responsibility of the MoIT in order to contribute to the realization of the goals set regarding human capital. The Academy will offer programs to train qualified human resources with special expertise needed in new technology fields. Within the scope of these programs, special expertise definitions will be made especially in the areas of use where AI technology is prominent, and it will be ensured that the ecosystem is equipped with critical competencies.

ⁱⁱⁱ Private sector employment data is produced by TurkStat within the scope of Household Labor Force Statistics on the basis of ISCO-08 classification (25, 35, 1330, 2152, 2153, 2166, 2356, 2434, 7422, 4132, 8212). The results for the public sector are obtained based on different databases. Excludes academics and military personnel. The ICT Sector is evaluated on the basis of the NACE Rev. 2 classification (26.1-26.4, 26.8, 46.5, 58.2, 61, 62, 63, 95.1).

- Within the scope of the Uni-Data Project conducted by the Presidency of the Human Resources Office of the Presidency of the Republic of Türkiye in order to increase the overlap between the educated workforce and employment, it is aimed to evaluate the performance of undergraduate program graduates in the labor market on a departmental basis. The Education Workforce Research conducted by the Turkish Statistical Institute (TurkStat), which deals with the scope of the project in more detail, aims to shed light on the relationship between education and career development at the undergraduate level.
- Since generally accepted common criteria for determining skill and qualification requirements on the basis of AI occupations do not exist yet, information available on job posting sites and professional networks is the source for determining professional competence. With a project carried out by TurkStat in collaboration with TÜBİTAK B3Lab and aiming to analyze online job postings using big data methods, it is aimed to make analyzes to better understand employment supply and demand in the context of AI competency needs.
- Similarly, with the “Project for Removing the Vocational Skills Inventory and Improving the Matching Services on the Basis of Skills”, which is expected to be completed by the end of 2022 under the responsibility of the Turkish Employment Agency, it is aimed to outline the current occupational distribution of the general skill and qualification maps of our country. In this way, skills and qualifications will be evaluated as trends over time, and effective market matching will be achieved with the determination of future skills, qualifications, and occupations.
- Our universities are trying to adapt to the transformative effects of digital transformation through updated curriculums. In this context, undergraduate programs in the field of AI were opened in 4 universities, the first of which was launched in 2018. In addition, in order to enable specialization in the field, 14 masters and 1 doctorate programs in AI, as well as 24 master's and 5 doctorate programs in big data, robotics, and smart systems were launched. The number of research centers in relevant fields is also on the rise. 13 centers focused on AI and 20 centers focused on big data, robotics and smart systems have been established already.

A significant number of AI studies are also carried out in Türkiye. There are 1,218 academics working in the field.^{iv} Figure 13 shows that the total number of international indexed publications from Türkiye was 9,409 between 2009 and 2018.⁴¹ Türkiye ranks 16th in the world according to the number of AI publications. However, these publications are not sufficiently reflected in industrial applications as patents and products.

iv It includes academics who work in artificial intelligence, computer vision or machine learning.

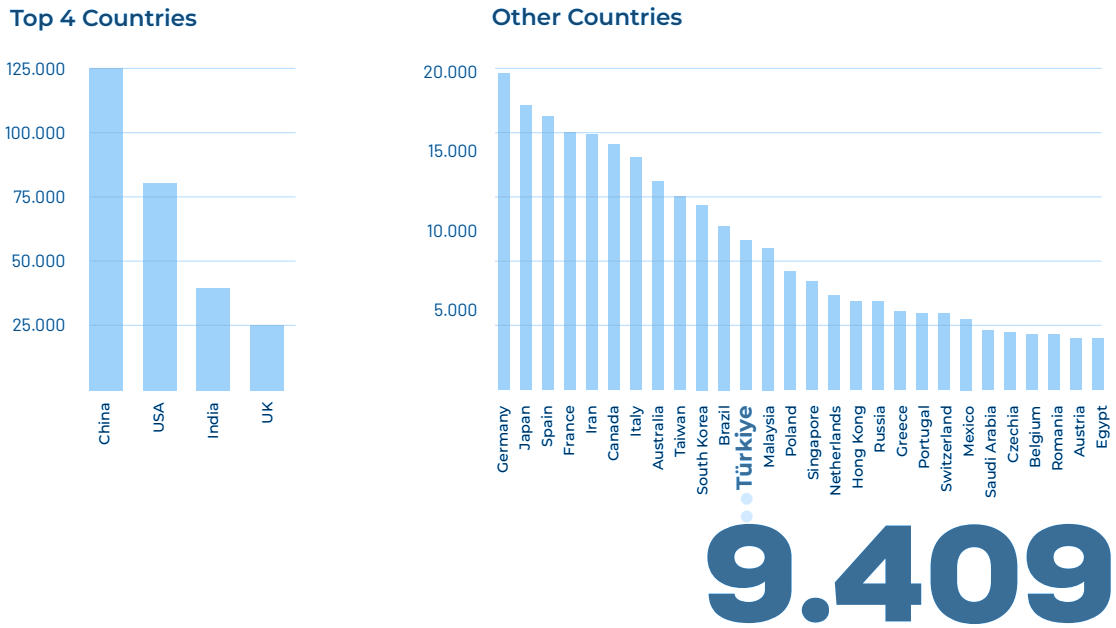


Figure 13. Total Number of AI Publications and Türkiye's Outlook, 2009-2018⁴¹

Field-weighted citation impact^v and the field-weighted download impact^{vi} indexes indicate that Türkiye's performance is around the world average. Although there are various factors that determine the impact potential of academic studies, this situation is considered as a development area for Türkiye. The field-weighted citation effect and the field-weighted download effect of the countries that are ahead of Türkiye in the ranking of total publications in the field of AI between 2009 and 2018 are shown in Table 1.

Country	Field-Weighted Citation Impact	Country	Field-Weighted Download Impact
USA	1,787	Italy	1,567
UK	1,482	Spain	1,342
Canada	1,475	Iran	1,317
Australia	1,390	Australia	1,308
Germany	1,340	UK	1,217
Italy	1,234	Canada	1,142
France	1,156	Türkiye	1,142
Spain	1,078	Taiwan	1,117
South Korea	1,021	Germany	1,075
Türkiye	0,915	South Korea	1,075
Iran	0,879	USA	1,058
China	0,823	Brazil	1,008
Taiwan	0,809	France	0,983
Brazil	0,780	India	0,983
Japan	0,745	Japan	0,800
India	0,738	China	0,767

Table 1. Field-Weighted Citation and Download Impact Values of Countries in AI Publications and Türkiye's Outlook, 2009-2018⁴¹

^v It is a measure of the ratio of the number of citations per publication to the world average.
^{vi} It is a measure of the ratio of the number of downloads per publication to the world average.

According to a study conducted on the InCites database for the TÜBİTAK 1004 application, taking into account all the publications included in the indexes between 2009 and 2018, the world average in terms of citations in AI and related technologies is 5.37, while the average in Türkiye is 6.21. As seen in Figure 14, our country performs close to the world average according to the rate of publication in Q1 and Q2 journals, which is an important criterion in terms of the quality and visibility of publications.

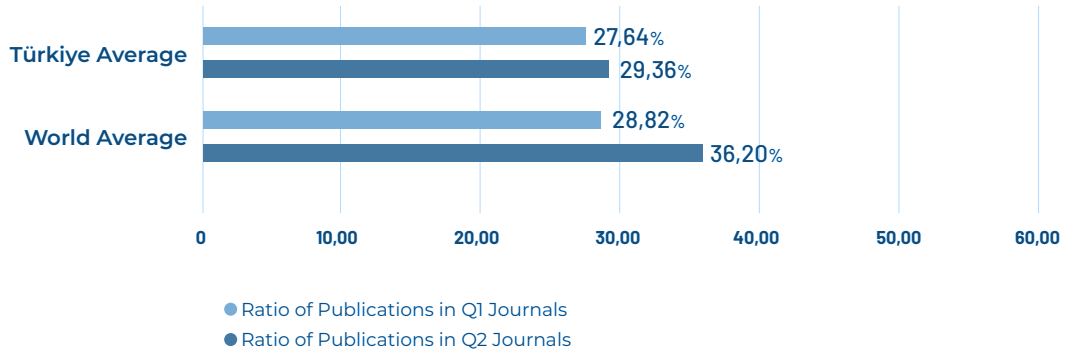


Figure 14. World and Türkiye AI Publication Quality Ratios, 2009-2018

Competency performances of universities are evaluated in comparison with each other in the TÜBİTAK study titled *Field-Based Competency Analysis of Universities*.⁴² AI competence analysis of our universities is presented in Figure 15. Türkiye ranks 16th in the world according to the number of AI publications. The number of graduate students in the prominent universities of the top-ranking countries is higher than the number of undergraduate students. However, it is noteworthy that this rate is around 30-35% in universities in Türkiye.

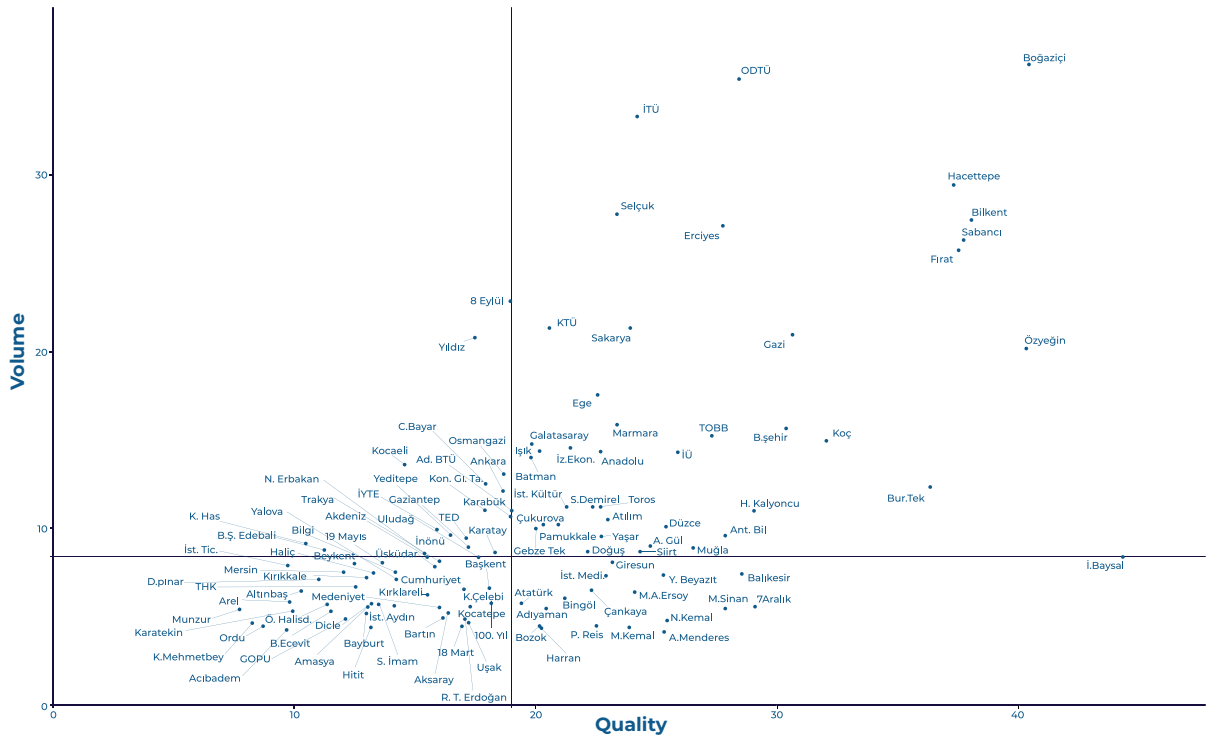


Figure 15. AI Competence Analysis of Universities in Türkiye⁴²

With the increasing interest in AI studies, many awareness and certified training programs and workshops for university students and the pre-higher education population are being implemented under the cooperation of academia, NGOs, the private sector, and public institutions. Prize competitions are organized as well. For example, the General Directorate of Vocational and Technical Education under the Ministry of National Education (MoNE) has been organizing robot competitions since 2007. In TEKNOFEST Aviation, Space and Technology Festival, which has been held since 2018, technology competitions are organized on subjects such as unmanned vehicles, natural language processing and intelligent transportation across different age groups. In addition, the “AI Education and Awareness Project” was initiated under the leadership of TOBB and TOBB Economy and Technology University, in which cooperation between NGOs and academia and the private sector is of particular importance. Within the scope of this project, it is planned to provide training for vocational high school students and teachers, university students and academicians, employees and companies, to a total of 50,000 people.

Although the above-mentioned activities have benefits especially in raising awareness, there is a need for a radical transformation in both higher education and pre-higher education model and curriculum in order to increase the quality in the field. In this direction, MoNE and CoHE are taking important steps together with their stakeholders. The MoNE published the document “2023 Education Vision for a Strong Future” and started to restructure the education system in this direction. CoHE, on the other hand, has started the process of determining the “Future Professions” roadmap, and within this scope, they have held workshops with high-level representatives of the academy and business world.

Equipping talented young people with basic competencies before higher education is also an important issue in order to expand the pool of expert human resources in AI. In this context, the “Deneyap Türkiye” project, which supports next generation learning skills, was initiated under the coordination of the MoIT. One of the most fruitful areas of the three-year training program in Deneyap Türkiye technology workshops in 81 provinces is AI. The project aims to equip 50,000 talented students with basic level AI competencies in five years.

On the other hand, the AI Education Project carried out by the General Directorate of Innovation and Educational Technologies of the MoNE aims to create an online AI education platform, train teachers and students in the field, and integrate AI education and AI coding, which is a basic skill for the future, into relevant education plans and practices. The project started in September 2019 and is planned to be completed in 2021. The book titled “Artificial Intelligence Education for Children” is among the outputs of the project. In addition, teachers were trained for AI education, and AI education videos were prepared to support these trainings.

Considering the current situation of our country, in order to train AI domain experts, increase employment and improve policy making capacity in these matters, first of all, it is necessary to determine professional definitions and qualifications for the field and to create an inventory of experts and researchers working in the field. In addition, launching postgraduate programs in the field, training academicians who can teach in these programs and encouraging students to participate in them are other important issues. On the other hand, another necessity is to equip talented young people with basic competencies to specialize in AI before higher education. In this context, subject-oriented next-generation education capabilities should be improved.

Research, Entrepreneurship and Innovation

TÜBİTAK, the leading institution for the management and financing of research in Türkiye, funds a large number of AI R&D projects. TÜBİTAK has provided a total of TRY 1.7 billion (at 2020 prices) to approximately 1,715 R&D and innovation projects carried out in the last 10 years. Figure 16 shows that approximately 25% of this funding is the support provided to the academy, while nearly 75% is the R&D support provided to the private sector for the development of the industry. 41.2% of the support for AI R&D projects was given to large enterprises, 31.6% to SMEs, and 2.3% to technology-based individual entrepreneurs for mentoring and seed capital purposes. Regulations have been made for SMEs and individual entrepreneurs to benefit more from the R&D support given to the industry.

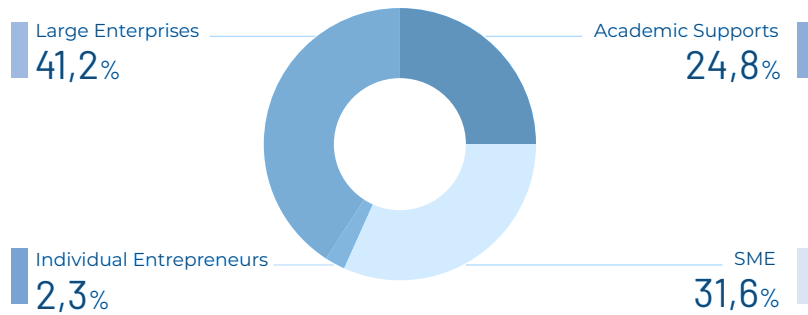


Figure 16. Distribution of TÜBİTAK AI Funds and Grants, 2009-2019

An analysis of the support provided by TÜBİTAK to the private sector over 1,290 AI projects in the January 2007-March 2020 period shows that the number of projects supported in the field of “digital transformation of the industry and advanced manufacturing systems” and the allocated support budget is higher than other areas of use, which is shown in Table 2. AI projects in this area account for 18% of the total funded AI project budget. The following fields are “digital transformation in commerce” and “smart life and health”. As for the field of social sciences, it is noteworthy to point out that fund allocated for AI is low.

Usage Area	Number of Projects	Total Project Budget (TRY) (2020 Fixed Price)	Budget Percentage
Digital Transformation of the Industry and Advance Manufacturing Systems	200	282.658.608	18%
Digital Transformation in Commerce	162	152.629.419	10%
Smart Life and Health	125	139.408.178	9%
Gaming, Media and Entertainment	120	133.749.626	9%
Digital Transformation in Finance Sector	95	127.778.712	8%
Defense and Security	67	116.823.161	7%
Mobility Sectors	46	82.142.583	5%
Energy and Mineral Resources	51	67.625.237	4%
Digital Transformation in Education	43	52.426.164	3%
Connected Life with 5G and Beyond	21	46.966.846	3%
Aerospace	17	44.992.474	3%
Food, Agriculture and Livestock Industry	25	28.029.761	2%
Social Sciences (Including Law)	11	11.945.636	1%
Digital Transformation in Prevention of Natural Disasters and Crisis Management	7	9.385.191	1%
Others	300	270.086.146	17%
Total	1.290	1.566.647.146	100%

Table 2. Financial Support Provided to the Private Sector by TÜBİTAK in AI and Its Distribution, 2007-March 2020

In Figure 17, double-word frequency analysis results of AI R&D projects of private sector organizations receiving TÜBİTAK grant are shown. According to the figure, decision support systems, image processing and big data projects receive most of the grant. These areas are followed by AI technologies such as deep learning, image processing, natural language processing, computer vision, machine learning, artificial neural networks, virtual reality, and face recognition.



Figure 17. Double-Word Frequency Analysis of TÜBİTAK R&D Project Supports Provided to the Private Sector in AI, 2007-March 2020

Companies that operate in TDZs and have R&D centers also make significant contributions to AI works. While the majority of these companies are operating in the fields of “Software”, “Defense and Security” and “Machinery”, the most active subjects in AI R&D and application are “Machine Learning”, “Foresight and Data Analytics” and “Computer Vision”. The AI fields in which TDZ companies and companies with R&D centers plan to carry out R&D studies in the future and the AI fields in which they are currently carrying out R&D studies are similar. While 56% of these companies have competent personnel working in AI, 30% have experts who have a master's or doctoral thesis in AI. In addition, 35% of companies state that they have or have access to data that they can use for AI domain. While 45% of TDZs and/or companies with R&D centers involved in AI are funded by TÜBİTAK and 7% are funded by KOSGEB, 14% finance their activities with their own capital.

There are also different programs carried out under the cooperation of public institutions and organizations, the private sector and universities. One of such programs is the AI JET BIGG Acceleration Program, which was initiated in cooperation with HAVELSAN Yıldız Innovation Center, TÜBİTAK and Hacettepe Teknokent Technology Transfer Center. On the other hand, AI applications stand out in online project competitions such as “Coronathon Türkiye”, “Hack the Crisis Türkiye” and “TR-Covid19 Joint Mind Platform” organized by civil initiatives as a part of the fight against COVID-19 in 2020.

An analysis of start-up networks in terms of AI has shown that there are 205 AI start-ups based in Türkiye. 11% of these focus on virtual assistants, while another 11% focus on image processing. Approximately 50% of the start-ups are located in technoparks and 73% are located in Istanbul.⁴³

Large-scale companies dominate AI investments with their internal investments. The most important sources of funding for new initiatives in the sector are venture capital and private

equity. The most funded fields are machine learning and computer vision. They are followed by natural language processing, autonomous vehicles and robotics. Companies are exploring new areas for the development and application of AI methods to solve customer-oriented use cases. Smart game systems, virtual assistants, smart city platforms are other examples of these areas developed through open source AI platforms.

In line with the aim of increasing value-added production in Türkiye, the “Technology Oriented Industry Initiative Program” was launched by the MoIT in order to concentrate on the funding and incentives and incentives provided by the ministry and its affiliated/related institutions to medium-high and high-technology sectors by managing them from a single point. An end-to-end design is planned by adding the incentive mechanisms of the relevant ministries to the program. The effectiveness of incentive mechanisms and the additional opportunities they will create can be improved using AI technologies. One of the main objectives of the program is to shift from core technology (in the laboratory) to a system (market) of products/services/systems, particularly in priority areas, provided that investments and incentives are competitive, flexible, and equally accessible to all.

With the “Innovative Software Competition” (Yenilikçi Yazılımlar Yarışıyor - Y3) program organized by the Presidency of Defense Industries, it is aimed to increase performance by competitiveness, work on innovative methods, steer the sector and create a competency repository in certain software development areas that are critical for defense needs, especially AI.

In order to develop innovative AI technologies and to increase their technology readiness, the “TÜBİTAK Artificial Intelligence Institute” was established to host the necessary activities and act as a catalyst, and efforts are underway for its structuring. It is aimed that the institute will develop start-up networks, use common infrastructures for joint development, and become an important center for advanced research. The basis of the institute's governance model is bringing its stakeholders together for research and development with an open innovation approach and ensuring pre-competitive cooperation.

Considering the situation in our country, it is one of the important requirements to increase public funds for activities in this field in terms of improving research, entrepreneurship, and innovation. In addition, measures should be taken to improve the number and quality of businesses operating in the field, which are the most important sources of innovation in AI. It is also important to ensure that venture capital funds, which are an important source of funding for technological start-ups, make investments in AI in our country. In addition to these, the creation of clusters that can provide synergy by bringing companies working in AI together will also be beneficial in terms of increasing the maturity of the AI ecosystem.

Technical Infrastructure, Platforms and Data

Defining the data access and sharing framework between institutions in order to develop the basic information systems needed for digital transformation on a national scale and common infrastructure, services and standards, and establishing or developing the tools to be used in the pre-processes necessary for the use of the said data in AI research are important in terms of strengthening the national AI ecosystem.

In order to develop inter-institutional cooperation and to create effective decision-making processes based on data in the public sector, DTO is working on creating the National Data

Dictionary (NDD), which will include standards and definitions for the data used by the public institutions in all applications, platforms and infrastructure layers. By determining data ownership/responsibility with the NDD, it is aimed to manage institutional memory independently of individuals and to minimize inter-institutional integration problems. With the implementation of the NDD;

- A common language will be established across public institutions,
- The national data inventory will be prepared,
- Data will be standardized and made singular,
- Data ownership/responsibility will be determined.

The DTO efforts regarding the NDD include the following:

- “Data Dictionary Creation Methodology” document was prepared.
- Mentor training was given to relevant personnel in all public institutions and affiliated and related institutions.
- The NDD system software infrastructure is operational and can be accessed at “<https://uvs.gov.tr>”.
- NDD Helpdesk was established within the DTO to solve the problems that may be encountered during the creation of data dictionaries.
- Data dictionary creation activities carried out in all public institutions and affiliated and related institutions are monitored.

With the “Open Government Data Portal”, another project of the DTO, the data generated by public institutions and organizations while performing their functions will be shared publicly within the framework of the principles of protecting intellectual property rights, privacy and national security. In this framework, “veri.gov.tr”, the national open government data portal, was designed in accordance with international examples using open source software infrastructure. The data that can be published on the portal were collected from institutions, anonymization and data cleaning studies were carried out and transferred to the test environment. “Open Government Data Circular Draft” was prepared to establish the legal infrastructure. It is expected that the portal will strengthen communication between stakeholders sharing and using open government data, encouraging collaborations in this context and triggering new studies to create value from data.

With the Data Labeling Platform (Data Hive), implemented by the Presidency of Defense Industries, a platform is being developed that will enable browser-based labeling of video, image and text data, which will then be used to collect labeled datasets for projects carried out primarily within the institution and to be realized thereafter. The project ensures that the training and test data such as text, image, video, sound and 3D point cloud, which are essential for the development of AI algorithms, can be crowdsourced and the labeled data are centralized.

In our country, important steps are taken in terms of investment in AI-related technologies. Various AI-related research infrastructure projects are supported through Public Investment

Programs. In this context, an important reference for high performance computing is the “Turkish National Science e-Infrastructure” project within the body of TÜBİTAK National Academic Network and Information Center (ULAKBİM). Thanks to the investments in the center, an effective and interactive computer network focused on current technologies is established and operated at the national level. Similarly, “Neuroscience and Neurotechnology Center of Excellence” project within ITU, “Robotic Technologies Research, Development and Training Center” project within METU, “Robotics and Artificial Intelligence Laboratories” project within Boğaziçi University, and the “Neuroscience and Neurotechnology Center of Excellence” project, carried out in partnership with Ankara University, Gazi University and METU, is included in the 2021 Investment Program and these projects continue to be supported. Thanks to the aforementioned projects, which directly and indirectly contribute to the development of AI technologies, research that will enable related studies to be conducted between universities and other research laboratories is generalized and raised to international standards.

Our country joined the EuroHPC Joint Undertaking for high performance computing activities in April 2019. In this context, our country made a joint application to the “Precursors to Exascale” call with Spain, Portugal and Croatia, and with the accepted joint proposal, Türkiye gained direct access to the supercomputer named “MareNostrum 5”. This infrastructure is being established in Barcelona and will be one of the few supercomputers in the world with a capacity of more than 150 Petaflops once it becomes operational in the middle of 2021.

Within the scope of a project carried out on the Türkiye Open Source Platform, text and audio datasets and open source algorithm libraries are being prepared on which researchers and entrepreneurs will be able to work and develop applications. It is aimed to launch products and brands in the field with the support of public institutions and global companies.

It is important to plan investments in AI technology in cooperation with the public and private sectors, in line with national opportunities for constantly developing hardware and software infrastructures, and to ensure the joint use of infrastructure investments by the ecosystem. In this framework, it is necessary to nurture the AI ecosystem through an interoperable infrastructure by creating multi-stakeholder interactions through a platform approach.

Harmonization and Regulations in Socioeconomic Structure

It is necessary to foresee possible social and economic problems that are expected to arise due to the widespread use of AI systems and to determine the measures to be taken against them within the framework of ethical and legal principles. In this context, adopting the approach that AI will be a tool for the welfare of humanity necessitates a review of the legal regulations in the relevant fields.

With the spread of AI applications, legal regulations that directly concern individual rights and freedoms should be made in a way that sets an example to the universal legal system as well. In this context, the *Law in the Age of Artificial Intelligence Report*, which focuses on the relationship between the law and AI in Türkiye, was published in 2019. The report mainly focuses on four issues:⁴⁴

- Recommendations are made about the requirements for the adaptation of law schools to technology, and the need to increase the number of qualified experts in the field is emphasized.

- It is emphasized the necessity of increasing technological competency in attorneyship.
- It focuses on AI technologies and the concepts of legal and criminal liability.
- Besides working on legal regulations and practices, evaluations are made about the importance and requirements of ensuring compliance in the EU harmonization process, and it is pointed out that the relevant regulations in Türkiye should be made quickly.

Among other efforts carried out in order to identify the needs to accelerate the adaptation of the socioeconomic structure to AI in our country is the workshop held in 2017 by the Türkiye Artificial Intelligence Initiative. According to the results of the workshop, the most important needs in our country in this regard are raising awareness, creating an AI ecosystem that will support communication and collaboration, accelerating the commercialization cycle through the private sector and public institution projects to be supported by intellectual property regulations, competence programs, technical infrastructure, innovation competitions and field examples.⁴⁵

It is considered that problems such as prejudice and biased choices, which vary depending on the country but nonetheless occur all over the world, may constitute an important obstacle in the way of obtaining social benefits through AI. In this context, the “Workshop on Prejudice in Artificial Intelligence Applications” was held by the Türkiye Informatics Foundation Starting Node Platform in 2019. Based on the results of the workshop, it is possible to classify the prejudices specifically for our country under the headings of education, health, regulation, information and security.⁴⁶

The preparation of an ethical framework that emphasizes data security and encourages the protection of privacy is very important to ensure the public's trust in AI. With this sensitivity in mind, the DTO has initiated the efforts to establish a National Data Governance and Privacy Working Group with the aim of bringing together experts working on the legal and technological sides of data privacy in our country and providing these experts a place where they can cooperate with relevant institutions. This working group is aimed to coordinate the relevant institutions and organizations in order to create the policy and guidance documents needed in the national context, establish a consultation mechanism for international activities, bring together experts working on the technical and legal side and provide a ground for cooperation.

The prerequisite for AI applications to find widespread use is to ensure that all stakeholders trust these technologies. In this context, considering the current situation of our country, it is necessary to raise awareness in society of the effects and possible risks of AI technologies on social life and to establish governance mechanisms that can confirm the compliance of these practices with ethical values. In addition, the legal infrastructure needs to be updated to allow AI applications to be tested and improved in various scenarios. Finally, the data governance mechanism needs to be improved so as to monitor the effects of developments in AI and facilitate policymaking regarding said effects.

International Cooperation

International cooperation is of great importance in order to keep up with the developments in R&D in emerging technology fields, to exchange experience, and to benefit from expansive talent and capacity opportunities in human resources. Türkiye has strong international cooperation in terms of R&D and innovation in AI. During the last 10 years, 75 AI projects carried

out in cooperation with international organizations correspond to 10.5% of the total public budget allocated for AI. In the EU Horizon 2020 Program, which includes our country and covers the period of 2014-2020, 358 different AI project applications were made, with a total of 469 participants. 49 Turkish partners received €14 million worth of funding for a total of 27 projects. Similarly, it is planned to participate in Horizon Europe Program covering the period 2021-2027 and Digital Europe Program, which will be opened for the first time. Along with the EU supported GN2, GN3, GN3Plus and EGI-InSPIRE big data and high performance computing projects, of which ULAKBİM is a stakeholder, R&D studies in Türkiye as well are carried out in cooperation with international organizations.

Looking at the ranking of international collaborations in academic studies shown in Figure 18, Türkiye ranks 25th in the world with a total of 1,922 publications published jointly with academics from other countries between 2009 and 2018.⁴¹

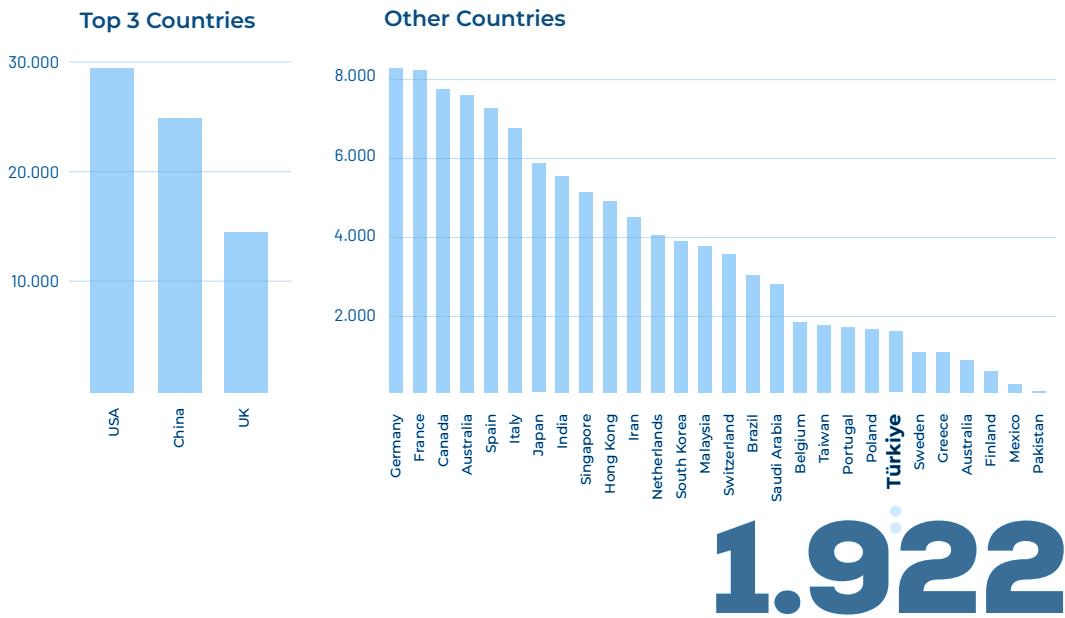


Figure 18. International Cooperation in Academic Studies in AI and Türkiye's Outlook, 2009-2018⁴¹

As shown in Figure 19, our country cooperates most with the USA and European Union countries in AI publications. Germany stands out among the European Union countries with which Türkiye cooperates in AI.⁷

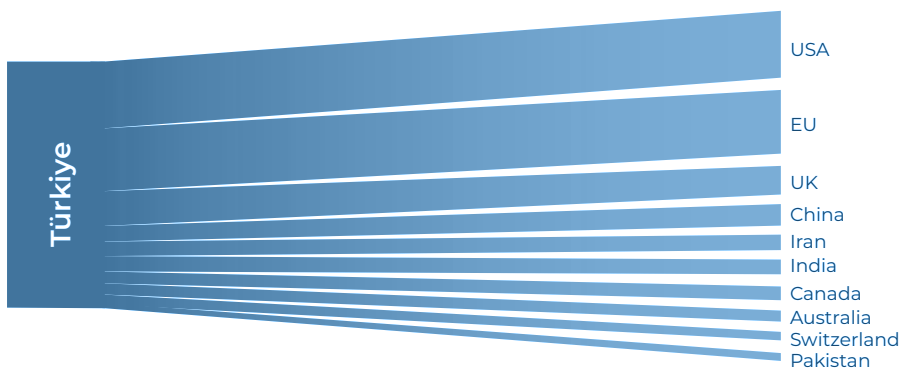


Figure 19. Distribution of AI Publications from Türkiye with International Collaboration by Countries, 2020⁷

At the Turkish-German Artificial Intelligence and Industry 4.0 Conference held in Germany on August 22, 2019, in addition to the cooperation of the two countries in AI, further cooperation in production-oriented fields such as the machinery industry was announced. This conference was followed by the Turkish-Hungarian Artificial Intelligence and High Technology Conference held online on October 15, 2020. At the event, besides the exchange of experience, potential bilateral collaborations and other cooperation opportunities within the scope of EU multi-annual financial framework programs were evaluated.

The *OECD Recommendation of the Council on Artificial Intelligence*, published in 2019 in order to strengthen the global AI policy ecosystem by focusing on ethical and democratic values, was adopted as the *G20 Artificial Intelligence Principles* as an appendix to the 2019 G20 Ministerial Statement on Trade and Digital Economy. At the G20 Digital Economy Ministers' Meeting and Leaders Summit held in 2019 and 2020, the adoption of cross-border data transfer for the development of the digital economy with the initiative of "Data Free Flow with Trust" and its support by our country is important for ensuring the harmony of international trends in the field of AI with the national vision. In this context, our country regularly takes part in the works addressing AI-related issues and data governance within the body of the G20. Activities are carried out for G20 countries to develop joint approaches and policies in AI, and knowledge and experience are exchanged through these activities.

Turkish experts and observers also participate in the OECD ONE AI working groups, where AI experts come together. With these working groups, it is aimed to prepare a guide that includes recommendations for national policies and an implementation guide focusing on the classification of AI systems and value-based trustworthy AI policies.

Our country actively participates in the meetings of the Ad Hoc Committee on Artificial Intelligence (CAHAI), which has 47 members. The committee's works, which aim to identify the elements of a legal framework for the development, design and implementation of AI based on human rights, democracy and rule of law standards, are followed closely. The committee focuses on establishing a legal framework for the development of AI algorithms, taking into account AI ethics and data privacy. Our country participates in and contributes to the Policy Development Group, Advisory and Support Group and Legal Frameworks Group, which were established as part of mentioned works.

Considering the current situation of our country, it is considered important to participate in global data governance and trustworthy AI initiatives in order to develop international cooperation in AI. Again, in this area, it is necessary to develop technology and design application development projects with partner countries or participate in the currently developed international projects and programs.

Structural and Workforce Transformation

Existing as an effective power in the competitive digital economy of the future requires keeping up with technological developments by designing new business models in accordance with AI, and redefining and developing workforce competencies in this direction. The OECD Report *Going Digital: Shaping Policies, Improving Lives* reveals that low-skilled workers are less likely to receive in-service training than medium and high-skilled workers. The report also presents the training status of employed workers in 2012 or 2015 based on their skill levels. Figure 20 shows that according to OECD data; while the average of low-skilled workers receiving training is 40.3%, this rate is only 28.2% in our country.⁴⁷

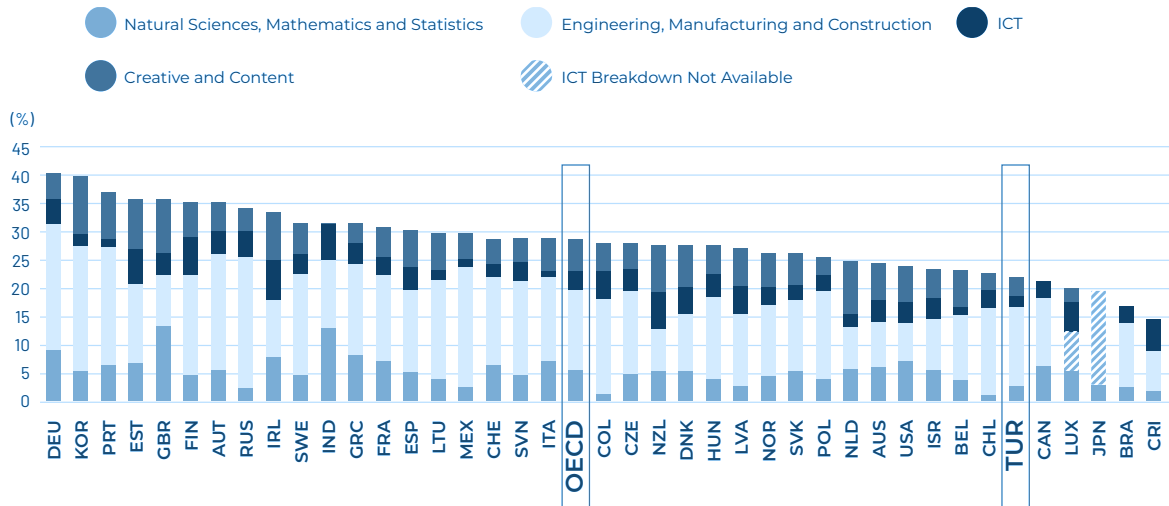


Figure 20. Distribution of Graduates from Key Fields of Study to Be Ready for the Digital Work Environment in All Higher Education Fields⁴⁷

In our country, efforts to transform organizational structures, ways of doing business and decision-making mechanisms, and pilot applications for services with high stakeholder interaction have been initiated in order to prepare public institutions for next-generation technologies and to have effective data-based decision-making processes. In this context;

- Within the Ministry of Justice, decision support systems development projects are carried out on topics such as voice assistant supported probation and enforcement using open source AI development software. Efforts are underway to develop a “chatbot” application for use in units such as the call center and help desk. In line with “Smarter UYAP”, works on “Use of Big Data and Artificial Intelligence in Enforcement Processes” are actively carried out. On the other hand, regulatory works are carried out regarding the remote employment of AI experts to meet the needs of the Ministry.
- Within the scope of the Occupational Health and Safety Information Management System, which continues its works within the Ministry of Labor and Social Security, the factors of accident risk are mathematically modeled and risk profiles are created, predictive modeling based on past work accident and occupational disease data, and an early warning system for employees, employers and occupational health and safety experts services are being developed.
- For homeland security purposes, the Ministry of Interior carries out works that will increase the capabilities of law enforcement officers by making use of AI applications in projects to be realized with real-time event integration and advanced analytical methods. In addition to real-time event support, works on AI applications are also being carried out in order to predict future events and risks.
- The Education Technologies Incubation and Innovation Center will be implemented in 2021 by the Ministry of National Education, General Directorate of Innovation and Education Technologies, within the scope of the World Bank's “Safe Schooling and Distance Education Project”. The Center will operate in METU Technopolis and will

work in cooperation with the public-private sector. Within the scope of the project, an innovation ecosystem in education will be developed, and through this ecosystem, new digital tools and pedagogical models will be developed and released, and blended education processes will be supported through the cooperation of various stakeholders. In this direction, working groups for AI education will be established, capacity building activities and R&D activities will be carried out for AI applications in education.

- The Ministry of Health is testing the use of robotic evaluation in radiological imaging techniques. Within the scope of the Teleradiology System, an AI application that diagnoses COVID-19 from Computed Tomography images was developed to assist physicians in the diagnosis of COVID-19. With this study, images are classified in a short time and the physician is given an idea regarding the diagnosis of COVID-19. Similarly, AI studies are carried out for detecting lesions and calcifications in mammography images and detecting Stroke (Present/Absent) and Stroke Type (Occupying/Bleeding) using a dataset composed of brain imaging radiology reports and the MR Diffusion images of the patient. Thanks to the integration, radiologists can run the AI algorithm on the relevant image, and thus, they can see the areas marked as lesion or calcified area. In addition, the e-Triage platform project named “Neyim Var?” aims to direct appointment requests to the right polyclinic.
- The Ministry of Agriculture and Forestry actively uses AI applications based on image processing in areas where quick decisions are required, such as fire and pest control. It develops new solutions incorporating phenological observation poles and photo traps in areas such as the sustainability of forest lands.
- The Ministry of Trade carries out pilot studies to accelerate the customs procedures with a focus on risk analysis by analyzing the data collected from different sources such as closed circuit cameras, vehicle imaging devices and customs traffic, which it has combined in the command and control center in Ankara within the scope of customs enforcement, using advanced data analytics and machine learning methods. On the Easy Export Platform, which is available for online use, an AI-powered smart export robot makes personalized recommendations to companies.
- The Presidency of Defense Industries has initiated R&D projects that use AI technologies for various problem areas and needs in defense and security. Some of the projects carried out in this context are Social Media Anomaly Detection, Event Tracking and Analysis, Deep Learning Big Data Analysis Platform, Social Media Analysis Performance Improvement, Global Positioning System Independent Autonomous Navigation Development, Classification and Identification of Surface Targets Detected by Radar, Autonomous Reconnaissance with Collaborative Robots, Guidance and Navigation, Artificial Intelligence Assistant Commander Developing Movement Styles, Artificial Intelligence Assisted Fire Control and Autonomous Driving for Land Vehicles, Artificial Intelligence Based Vulnerability Detection and Prevention in Software Defined Networks and Global Vulnerability Analysis.
- The operating costs of ships are optimized by processing the data in communication, navigational aids, ship automatic identification systems and long distance ship identification and tracking systems with AI applications by the Ministry of

Transport and Infrastructure General Directorate of Coastal Safety. Thanks to this optimization, it is ensured that the greenhouse gas emissions from ships, which are also prioritized by the International Maritime Organization, are reduced.

- Within the “COVID-19 Detection with Artificial Intelligence” project carried out by the DTO Big Data and Artificial Intelligence Department, the predictions made by the developed AI models using the X-Ray and Computed Tomography images and the reasoning for these predictions can be transparently presented to the relevant doctors. Similarly, within the scope of the Turkish Brain Project, which was implemented as a result of joint work with Gazi University Faculty of Engineering and Faculty of Medicine, a decision support system is being developed that will facilitate the detection and diagnosis of various anomalies from MR images by using AI technologies, thus enabling rapid treatment of emergency cases and reduce the possibility of various complications.

The use of industrial and service robots, which is another important area of AI use that is becoming more popular, is becoming increasingly widespread in our country as well. While the rate of industrial and service robot usage in private sector organizations is 5.1%, this rate rises to 19.6% in large-scale enterprises.⁴⁸ According to the International Robotics Federation, while there are approximately 40 robots per 10,000 employees in the manufacturing sector and 200 robots in the automotive sector.⁴⁹

In terms of improving the use of AI applications in businesses, it is important to understand how these applications are generalized within organizations. In a report prepared by an international consultancy firm, it is stated that 15% of the companies surveyed consider themselves at an advanced level in terms of AI maturity. In our country, the adoption of AI technologies by the finance sector is faster than other sectors with the use of applications such as voice assistants, financial risk analysis, and psychometric scoring. It is considered that AI applications will be used more in areas that directly reach the consumer, customer, user or citizen. On the other hand, AI applications are mostly (40%) implemented in the private sector in line with the demands of senior management. Demands for AI applications come from both service and IT units (55%), although IT units are considered to be more dominant.⁵⁰

Considering Türkiye's situation in this area, it is seen that there is a need for structural transformations for public institutions to benefit from AI technology and applications at the highest level. In addition, it is necessary to carry out activities to take advantage of the opportunities brought on by AI across all sectors. Another need is the harmonization of the existing workforce in line with the transformations that AI will cause in the employment market.

Artificial Intelligence Values and Principles

This section explains the AI values and principles adopted to shed light on the determination of current strategies and the practices to be carried out in this regard in the coming period.

AI ethical frameworks are published by international organizations in order to help strengthen a global policy ecosystem that protects

- **human rights,**
- **democratic values and**
- **the rule of law**

and to develop a common attitude by mitigating social concerns that may arise.

Our country is a stakeholder of human-centric AI principles determined by OECD, G20, EU, and UNESCO, and adopts “*trustworthy and responsible AI*” values and principles.

NAIS was prepared on the basis of values and principles detailed below. It is to be carried out with a human-centric approach in harmony, cooperation and coordination with the participation of central and local government institutions and organizations, private sector, academia, international organizations and NGOs. It is expected that these values and principles will act as a reference throughout the lifecycle of AI systems that will be developed or put into use in our country, in line with the guidelines to be prepared following the implementation of the NAIS.

AI Values

Respect for Human Rights, Democracy and the Rule of Law

Human dignity, human rights and fundamental freedoms must be essential throughout the lifecycle of AI systems. All AI technologies to be developed in our country should be designed in compliance with national ethical values and by prioritizing human rights, democratic values and the rule of law so that all members of society can benefit from such technologies. No human should be harmed physically, economically, socially, politically or psychologically at any stage in the lifecycle of AI systems. In interactions with AI systems throughout their lifecycle, people should never be objectified, their dignity should never be harmed, and human rights should never be violated or abused.

Flourishing the Environment and Biological Ecosystem

Environmental and biological ecosystem development is vital for humans and other living organisms to benefit from advances in AI. Therefore, they must be recognized and supported throughout the lifecycle of AI systems. All actors involved in the lifecycle of AI systems should adhere to relevant international and national legislation, standards and practices designed for the protection, restoration and sustainable development of the environment and ecosystem.

Ensuring Diversity and Inclusiveness

Respect, protection and promotion for diversity and inclusiveness must be ensured throughout the lifecycle of AI systems, in a manner consistent with demographic, cultural, social diversity and inclusiveness, as well as international human rights law, standards and principles. The scope of lifestyle choices, beliefs, ideas, expressions, or personal experiences, including the discretionary use and design of AI systems, should in no way be restricted at any stage of the lifecycle of AI systems. Technological infrastructure, training and skills gaps should be eliminated, and awareness level should be raised in order to benefit from AI systems and increase inclusiveness. The production, development and implementation of AI technologies should not result in discrimination in any way, and datasets should be audited in this regard. Effective public participation should be ensured so that all members of the society can make informed decisions about the use of AI systems and protect AI systems from undesirable effects.

Living in Peaceful, Just and Interconnected Societies

AI actors should play a facilitating role in helping everyone benefit from an interconnected future for a harmonious and peaceful life. AI systems should contribute to the harmony and interconnectedness of all living things and the natural environment throughout their lifecycle. AI systems should not objectify, differentiate, or endanger any party.

AI Principles

Proportionality

Legitimate goals and objectives must be adhered to throughout all stages of the lifecycle of AI systems and everything must remain relevant to the context of said systems. Adequate risk analysis should be carried out against any possible harm to human, environment or biological ecosystem and necessary measures should be taken to prevent damage. The AI techniques to be used should be determined in a way that is suitable for legitimate purposes and does not allow the violation of AI values.

Safety and Security

In order to ensure the safety and security of humans, the environment and the biological ecosystem, damage and vulnerabilities must be avoided throughout the lifecycle of AI systems. All AI systems to be deployed or designed must be robust, stable and reliable; and potential risks must be continuously evaluated and managed. For AI systems to be safe and secure, they must be supported by sustainable and privacy-preserving data access frameworks that can enable better training of AI models using quality data.

Fairness

AI systems should be designed to provide an equal and fair service to all stakeholders while adhering to the rule of law and fundamental rights and freedoms. The fairness of AI systems means that the benefits of AI technology are shared at local, national and international levels, while taking into account the specific needs of different age groups, different cultural systems, different language groups, people with disabilities, and disadvantaged, marginalized and vulnerable segments of the society. It should be ensured that decisions made based on algorithms do not give rise to discriminatory or unfair effects on different demographic populations. In order to prevent the emergence of unintentional discrimination in decision-making processes, monitoring and accountability mechanisms should be developed and those mechanisms should be included in the implementation process.

Privacy

Privacy is a necessary right for human dignity and human autonomy that must be respected and protected throughout the lifecycle of AI systems, at both the personal and societal levels. It is important to collect, use, share, archive and delete the data used in AI systems in accordance with AI values and principles. AI systems should be developed and operated in a way that does not compromise the privacy and protection of personal data. The source and means of a collection of personal data and how decisions made based on said data will affect people should always be auditable. Universal and cultural ethical rules and the confidentiality of personal data should also be considered with the same regard.

Transparency and Explainability

Person(s) and organizations involved in the lifecycle of AI systems should ensure that the AI system is transparent and explainable in accordance with its context. People have the right to be informed of a decision that was made based on AI algorithms and to request explanatory information from public institutions and private sector organizations in such cases. It should be possible to explain to the end user and other stakeholders in non-technical terms and in plain language, why, how, where and for what purpose the decisions made based on automatic and algorithmic decisions, the data leading to said decisions and the information obtained from that data are used.

Responsibility and Accountability

Person(s) and organizations involved in the lifecycle of AI systems are ultimately responsible for the proper functioning of AI systems and the application of AI principles. In line with their roles in the lifecycle, the context of the system and technological possibilities, these actors and their ethical responsibilities should be able to be related to their liabilities regarding their decisions and actions. Accountability should be appropriately distributed among actors. Necessary mechanisms for human audit, impact analysis and risk assessment should be established. Technical and organizational design should guarantee auditing and traceability of compliance with AI values. Audit data should be available for third parties to research and review behavior patterns of the AI system, in accordance with their mandate.

Data Sovereignty

International rules should be adhered to in the use of data throughout the lifecycle of AI systems and the sovereignty rights of the parties should be respected. Measures should be taken to activate secure data circulation in line with international obligations, national legislation and AI values in the regulation of digital data produced in or passing through areas of sovereignty. Data sharing between individuals and institutions should be provided in accordance with the measures taken and the legal framework. In situations where the legal framework is unclear, AI values and principles, especially human rights and privacy, should be prioritized.

Multi-Stakeholder Governance

The participation of different stakeholders throughout the lifecycle of AI systems is essential for inclusive and agile AI governance, the benefits of AI passing through society, and for AI to contribute to technological progress and development. Stakeholders of AI systems include public institutions, NGOs, international organizations, researchers, academia, media, educators, policy makers, the private sector, human rights institutions, and other bodies established for the youth and children. It is important to adopt open standards and interoperability to facilitate collaboration among AI stakeholders. Agile governance measures should be taken in line with technological developments and new sociotechnical needs.

Strategic Priorities, Objectives and Measures

NAIS was designed in line with the strategic priorities determined within the framework of the vision stated below.

The strategy defines the objectives defined in line with these priorities, the high-level measures planned to be implemented to achieve these objectives, and the objectives expected to be reached through the implementation of the measures.

V I S I O N

“

**Creating value
on a global scale
with an agile and
sustainable AI
ecosystem for a
prosperous Türkiye.**

”



Figure 21. National AI Strategy Strategic Priorities and Objectives



Training AI Experts and Increasing Employment in the Domain

The number and quality of AI experts who will be the architects of the socioeconomic transformation will be increased, and the employment of researchers and practitioners in this field will be increased.

Objectives

Objective 1.1. AI domain expert employment will be increased in line with sectoral needs and priorities.

Measures

- M.1. In areas within the scope of Artificial Intelligence Technology Roadmap, the current situation and projected needs of the workforce will be determined regarding the competency areas and the number of people working in these areas.
- M.2. Sectoral skill maps, occupational definitions, classifications, skill sets, qualifications and national occupational standards for AI expertise will be determined within the framework of international norms.
- M.3. Remote and part-time working conditions of AI professionals will be improved.
- M.4. Foreign nationals and immigrants skilled in AI will be employed.
- M.5. Incentives to increase internship opportunities, on-the-job training and employment of AI practitioners in public institutions and private sector organizations will be implemented.
- M.6. Training and certificate programs will be organized in accordance with professional definitions and skill sets in order to employ more unemployed people and individuals who have the desire and potential to work in the field of AI as AI practitioners.
- M.7. Foreign AI experts will be encouraged to take part in projects carried out in our country through AI-focused international call programs.

Objective 1.2. Academic and technical capacity of universities in the field of AI will be developed and new programs will be opened.

Measures

- M.1. Considering the workforce analysis and projections, the number of associate, undergraduate and graduate programs related to basic AI research and application areas will be increased.
- M.2. AI-related programs to be opened by universities will be encouraged to specialize in sectoral/thematic areas in line with the characteristics and needs of the region, taking into account the projection of research personnel needs.
- M.3. Incentives will be implemented to increase the employment of research assistants and lecturers in AI.
- M.4. Incentives for increasing scientific productivity in the field of AI will be improved.
- M.5. Working and research conditions in Türkiye will be improved and made more attractive to the competent AI academicians who work abroad and their work with centers in Türkiye will be supported in order to attract them to Türkiye.
- M.6. Curriculum of education programs in all fields of science, especially in basic and social sciences and engineering, will be expanded to cover data science and AI as well.
- M.7. Development of distance education and online content specific to AI will be supported.

Objective 1.3. The number and quality of students receiving associate, undergraduate and graduate education in the field of AI will be increased.

Measures

- M.1. In line with the need projection and sectoral priorities for AI researchers, PhD studies in the field will be supported through thesis grants and educational scholarships.
- M.2. The number of AI-focused projects will be increased within the TÜBİTAK Industry Doctorate Program.
- M.3. Graduate studies on AI in social, human and administrative sciences will be supported.
- M.4. In line with the Artificial Intelligence Technology Roadmap and sectoral priorities, international joint publications and projects will be encouraged.
- M.5. Talented associate and undergraduate students interested in the field will be supported with career development, scholarships, mentoring and practical internship opportunities, and their achievements and works will be promoted as role models.
- M.6. In line with the strategic priorities and institutional needs in the field of AI, government scholarship quotas for graduate studies abroad will be increased.

Objective 1.4. In line with their interests, abilities and temperaments, pre-higher education students will be provided with algorithmic thinking, coding and AI applied training in accordance with their education level.

Measures

- M.1. The relevant curriculum will be strengthened on the axis of algorithmic thinking, AI technologies and ethical principles, and in this context, digital education content will be developed and encouraged to be widely used.
- M.2. Among the existing teachers, those with suitable qualifications will be encouraged to teach the curriculum in question, and in-service training will be provided, and if needed, either part-time or full-time new teaching personnel will be provided.
- M.3. Analytical platform, registry warehouse and management system components will be implemented to improve the learning ecosystem, taking into account international standards and open source solutions.
- M.4. Developing programs according to existing and/or new structures with educational models that will provide experience, interaction and deepening in the field of AI will be encouraged.
- M.5. Digital content for raising awareness on algorithmic thinking, coding and AI applied training will be developed and social events will be organized to increase competence.

The goals set under Strategic Priority 1 are as follows:

- Employment in the field of AI will be increased to 50,000 people.
- Employment in the field of AI in central and local government institutions and organizations will be increased to 1,000 people.
- The number of graduate-level diploma holders in the field of AI will be increased by 10,000.
- The number of academicians working in the field of AI will be increased to 5,000.
- It will be ensured that the number of postgraduate theses on social and technical fields of AI is at least 1,000.



Supporting Research, Entrepreneurship, and Innovation

In order to develop the AI ecosystem in our country, research activities, entrepreneurship and innovation in the field will be supported.

Objectives

Objective 2.1. Public support for the development and application of AI technologies will be increased, and monitoring and evaluation mechanisms will be activated.

Measures

- M.1. Public support for technology development, commercialization and entrepreneurship will be prioritized in line with the Artificial Intelligence Technology Roadmap.
- M.2. End-to-end support mechanism from development to export will be improved and incentives will be given regardless of location.
- M.3. Intellectual property legislation in AI will be reviewed within the framework of international norms and support for it will be improved.
- M.4. New incentives and supports will be provided for postdoctoral research programs to increase academy-corporate collaborations of advanced AI experts.
- M.5. Conditions for patents and exports will be created in incentives for the employment of competent workforce in AI.
- M.6. Depending on the needs, public procurement will be strategically utilized for domestic and unique AI hardware infrastructures and software platforms.

Objective 2.2. The number and quality of initiatives that develop original AI products, services and applications will be increased.

Measures

- M.1. Periodic AI start-up ecosystem reports will be published to increase the national and international visibility and the quality of the AI ecosystem.
- M.2. An inventory of AI start-ups and products will be created in coordination with start-up networks.
- M.3. A competition and support program will be established for the emergence of at least one global brand in the field of Turkish natural language processing.
- M.4. A certain amount of direct public financial support will be provided for public, university and industry cooperation projects in AI and for projects that will be carried out jointly by the AI centers of excellence.
- M.5. Academic entrepreneurship in the field of AI will be supported.
- M.6. Successful Turkish and foreign AI entrepreneurs in AI will be supported to mentor new domestic start-ups and to provide experience transfer in the productization process.

Objective 2.3. AI-oriented venture capital funds will be established and scaled up.

Measures

- M.1. Regulations that will facilitate and encourage venture capital funds to invest in AI in Türkiye will be implemented.
- M.2. Collaborations with national and international venture capital funds will be developed.
- M.3. Venture capital investments in AI will be monitored and reported regularly.
- M.4. The scope of public grants and incentives for venture capital funds that will invest in AI technology areas, especially natural language, image processing and decision support systems, will be expanded.
- M.5. A program will be implemented to identify AI start-ups that have the potential to become Turcorns (Unicorns) and to support them jointly with venture capital funds.

Objective 2.4. Clusters, where advanced R&D activities can be carried out in the field of AI and innovation and centers of excellence, will be established.

Measures

- M.1. Establishment of sector-specific concentrated thematic clusters and centers of excellence in certain regions will be encouraged.
- M.2. A network will be established between the thematic AI clusters and innovation and excellence centers, which will enable effective information sharing and facilitate joint work, and develop the potential to conduct business nationally and internationally.
- M.3. The participation of established cluster structures and centers of excellence in international standard-setting activities in AI will be encouraged.
- M.4. Global-scale AI technology and/or application companies will be encouraged to establish R&D centers in Türkiye.
- M.5. Regulations and incentive mechanisms will be established to facilitate the temporary or part-time assignment of academics and researchers in public institutions to AI centers of excellence.

The goals set under Strategic Priority **2** are as follows:

- It will be ensured that the ratio of AI R&D expenditures to total R&D expenditures is at least 15%.
- The number of start-ups in the field of AI will be increased to 1,000.
- The commercialization of developed AI solutions will be supported by prioritizing them in public procurement.
- At least 5 spin-offs operating in the field of AI technologies will be established from public institutions and companies.
- At least 1 global initiative will be established in the field of natural language processing.
- At least 10 pre-competitive cooperation projects will be initiated in the field of AI technology, especially in image processing.



Facilitating Access to Quality Data and Technical Infrastructure

Access to quality data and high-capacity technical infrastructure, which is the main requirement of AI studies, will be facilitated.

Objectives

Objective 3.1. Shared access opportunities will be provided to researchers and initiatives that need high performance computing infrastructures in AI studies.

Measures

- M.1. An inventory of high performance computing infrastructures in the hands of public institutions, universities, research centers etc. will be created.
- M.2. Shared use of existing infrastructures will be ensured, and capacity improvements will be made when necessary by monitoring the levels of infrastructure use.
- M.3. The establishment of joint technical infrastructures under the cooperation of the private sector, academia and NGOs will be supported.

Objective 3.2. A data governance mechanism will be established for the secure sharing of data to be used in AI and advanced analytical research.

Measures

- M.1. Regulations will be made to facilitate secure and uninterrupted data sharing between public institutions and organizations, the private sector, universities and research centers and to determine the relevant authorities and their responsibilities of institutions in this context.
- M.2. Data governance guides will be published to guide all functional operations.
- M.3. A “Public Data Space” will be established to ensure secure data sharing and analysis among public institutions.
- M.4. In order to meet the sectoral data needs, cloud platforms will be established in line with the concept of data spaces.

Objective 3.3. Open source software and algorithm libraries for AI will be compiled and made available to the AI ecosystem.**Measures**

- M.1. Activities within the Turkish Open Source Platform will be expanded so as to include all sectors.
- M.2. Activities and projects that support mass participation and help develop the open source ecosystem will be carried out.
- M.3. Taking into account the needs of public institutions and private sector organizations in AI, mechanisms for cooperation between Sectoral Co-Creation Laboratories and the Turkish Open Source Platform will be established.

Objective 3.4. Open data sharing will be generalized.**Measures**

- M.1. National Data Dictionary studies will be generalized across all public institutions.
- M.2. Open data guides will be published and secondary regulations will be made regarding open data sharing on the Open Data Portal and institution pages.
- M.3. Open government data works will be generalized across all central and local governments.
- M.4. Open dataset sharing of private sector organizations will be encouraged.

The goals set under Strategic Priority 3 are as follows:

- It will be ensured that the number of public institutions and enterprises providing access to common high performance computing infrastructures will be at least 200.
- At least 50 institutions will be included in the Public Data Space.
- At least 10 sectoral cloud platforms for data sharing will be established.
- The number of individual AI project developers will be increased to at least 1,000 within Türkiye Open Source Platform.
- At least 1,000 open datasets will be shared via the Open Data Portal.



Regulating to Accelerate Socioeconomic Adaptation

Regulations to facilitate and accelerate adaptation to the transformations that will result from the widespread use of AI in daily life and economic activities will be implemented, and activities and researches will be diversified to raise awareness.

Objectives

Objective 4.1. An agile and inclusive legal harmonization process will be implemented so that ethical and legal scenarios can be tested and discussed.

Measures

- M.1. International regulations will be followed for the elimination of AI-related risks and the application of AI values and principles, and suggestions will be developed to ensure our country's compliance with the regulations in the area.
- M.2. Reference models and guides that enable evaluating the ethical and legal aspects of AI applications will be published, taking into account international examples.
- M.3. In-service training will be provided to judicial personnel on intellectual property rights transformed by the impact of AI technologies on legal and criminal responsibilities.
- M.4. Legislation on creating and utilizing the regulatory sandbox for innovative AI applications will be prepared and guides will be published.
- M.5. Awareness in enforcing the legislation on personal data protection and data governance in the context of AI will be increased.

Objective 4.2. In order to support reliability in AI studies, a governance mechanism that will facilitate fairness, data privacy and ethical values control and algorithmic accountability will be implemented.

Measures

- M.1. An impact analysis framework will be established to monitor and evaluate the level of implementation of AI values and principles.
- M.2. Technical, procedural and educational tools will be developed for auditing trustworthy AI.
- M.3. Algorithmic accountability and audit guides covering all functional operations in the AI system lifecycle will be prepared, and application-based technical audits will be carried out.
- M.4. Educational content on data privacy, ethical values and principles that the AI ecosystem can benefit from online will be created and regularly updated.

Objective 4.3. Scientific research and awareness on the effects and risks of AI technologies and systems on the socioeconomic structure will be increased.

Measures

- M.1. Socioeconomic research will be diversified through project support in the fields of social, human, economic and administrative sciences and in coordination with NGO studies.
- M.2. Activities of NGOs and research centers on data quality, platforms, AI law and ethics will be supported.
- M.3. Content will be produced and activities will be carried out to raise awareness of large segments of society regarding the positive and negative impacts of AI technologies on socioeconomic life.
- M.4. AI Week activities will be organized for academic and awareness purposes under the cooperation of public institutions and organizations, the private sector, universities and NGOs.

Objective 4.4. Data capacity will be improved in order to evaluate the impact of developments in the field of AI on the socioeconomic structure.

Measures

- M.1. The scope of the Official Statistics Program will be updated and expanded in line with the statistics adopted in international platforms and national policies in AI.
- M.2. Regular thematic measurement, maturity research and analysis activities will be carried out under the cooperation of NGOs and universities, with reference to measurement works conducted at the international level.
- M.3. Sector-based AI impact analysis reports will be prepared for the detailed analysis of structural and workforce transformation.
- M.4. Education, workforce and brain-drain studies in AI will be carried out.

The goals set under Strategic Priority 4 are as follows:

- It will be ensured that at least 20 start-ups benefit from the regulatory sandbox.
- At least 10 sociotechnical research projects will be conducted in AI.
- Research on brain drain and reverse brain drain in AI will be published on a yearly basis.
- AI education workforce surveys will be published on a yearly basis.
- It will be ensured that 1 million people benefit from digital content shared on different platforms for promotional and informational purposes every year.



Strengthening International Cooperation

International multi-lateral and bilateral cooperation will be strengthened in order to follow international developments in AI, contribute to studies on international platforms, and increase the interaction of the domestic ecosystem with its stakeholders in other countries.

Objectives

Objective 5.1. Active participation in global data governance, trustworthy and responsible AI studies will be ensured.

Measures

- M.1. Active participation of relevant experts from our country will be encouraged in the studies carried out by international organizations.
- M.2. It will be ensured to participate in the Data Free Flow with Trust initiative and relevant technical standard-setting activities in this context.
- M.3. Turkish domain experts residing abroad will be consulted so as to benefit from their experience and corporate relations.

Objective 5.2. Participation in cross-border projects in the domain will be ensured, with a priority in the multi-annual financial frameworks of the European Union.

Measures

- M.1. Active participation in the framework programs will be ensured under the coordination of the responsible institutions.
- M.2. Necessary promotion and incentive mechanisms will be harmonized with national programs.
- M.3. It will be encouraged to generalize the outputs and applications of the projects that are taken part in across sectoral application areas.
- M.4. Field-specific international competitions and project calls will be opened in line with cross-border programs.

Objective 5.3. Joint projects and cooperation activities will be carried out at the international level with leading organizations in the field and strategically priority countries.

Measures

- M.1. Comparative analyzes with other countries will be supported within the scope of R&D and sectoral application areas.
- M.2. Mutual student, expert and academician exchanges with other countries will be supported.
- M.3. Experience in international data governance and trustworthy AI works will be shared.
- M.4. Administrative and legal regulations will be made for data sharing with the countries to be determined and technical infrastructure will be prepared.

The goals set under Strategic Priority **5** are as follows:

- Participation in at least 100 cross-border project calls in AI will be ensured.
- At least 2 Türkiye-oriented international reports will be conducted in the field of Trustworthy and Responsible AI.
- At least 10 international competitions and project calls will be launched in the field of AI.



Accelerating Structural and Labor Transformation

Structural and workforce transformation will be accelerated, which will ensure that public institutions and private sector organizations benefit from the innovations and opportunities brought about by AI at the highest level.

Objectives

Objective 6.1. DTO will establish a public AI ecosystem and technical infrastructure to speed up AI and advanced analytics studies in public institutions.

Measures

- M.1. An inventory will be created for field experts with AI and advanced analytics projects in central and local governments, and will be regularly reported for the parties to exchange experience with each other.
- M.2. An institutional AI maturity model will be prepared, and its use will be generalized at the service level and in monitoring institutional maturity.
- M.3. A guide will be prepared for the management of AI projects in public institutions and organizations.
- M.4. Technical infrastructure will be established for the development of AI and advanced analytics projects in line with the sectoral needs of public institutions and organizations.
- M.5. The Public AI-as-a-Service Platform will be established to increase technical competencies, thus facilitating the pre-implementation preparation process and exchange of experience.

Objective 6.2. The structural and competency transformation towards the effective use of AI technologies in public institutions will be accelerated.

Measures

- M.1. Thematic programs will be implemented to raise awareness of the potential impacts and competence needs of AI in central and local government institutions.
- M.2. Within the framework of the AI maturity model, a human resources program will be established to determine the workforce profile that will be needed in the institutions and to improve the competencies of existing personnel in this direction.
- M.3. AI audits and audit services/internal audit and internal control capacities of institutions addressing AI issues will be developed.
- M.4. A repository of problems and usage scenarios for public institutions that can be solved with AI will be created, and thematic and prize competitions to solve them will be organized.
- M.5. The use of AI applications and related technologies in smart city services will be generalized.
- M.6. Public service delivery processes will be improved by establishing an infrastructure for AI-powered process mining.

Objective 6.3. TÜBİTAK Artificial Intelligence Institute will be structured in a way that cuts horizontally across sectors and research areas in order to play an accelerating role in the development of the AI ecosystem.

Measures

- M.1. A transparent and participatory AI Portal will be established that will be a center of attraction for all stakeholders in the AI ecosystem.
- M.2. A database will be created to bring together universities with AI competence, academics and researchers carrying out studies, and research infrastructures.
- M.3. “Sectoral Co-Creation Laboratories” will be established for all sectoral application areas, in which the relevant public institutions and private sector organizations invest jointly.

Objective 6.4. Works focusing on sectoral implementation domains, prioritizing experience sharing, and being public to all stakeholders will be carried out.

Measures

- M.1. Priority sectoral application areas will be determined in line with the Eleventh Development Plan and STIPC resolutions.
- M.2. Events will be organized to bring together public institutions and organizations, the private sector, universities and research centers for easy access to sectoral data spaces, data sharing, data quality and value production, and joint actions will be taken under the cooperation of the parties.
- M.3. Sectors will be enabled to create problem and usage scenario repositories, which will then be used to organize thematic and prize competitions.
- M.4. It will be ensured that similar sectors develop and use joint AI architectures and common AI data standards.
- M.5. The Trustworthy AI Seal approach will be established and tested to encourage the use of reference models in application development and operation in accordance with the AI system lifecycle.
- M.6. The use of AI technologies by public institutions and the private sector will be measured and reported on a periodic and annual basis.
- M.7. Applied training and awareness studies will be carried out for AI-powered transformation in the manufacturing sector at Competence and Digital Transformation Centers (such as Model Factories, Digital Transformation Centers, Türkiye's Fourth Industrial Revolution Center).

Objective 6.5. With regard to new professions, training and certification programs for the existing workforce will be carried out and compliance will be accelerated with sectoral cooperation.

Measures

- M.1. Sectoral analyzes will be conducted on the impact of AI on existing and new occupations and the workforce.
- M.2. Occupational definitions for new and transforming professions and corresponding competency certificates and accreditation mechanisms will be developed.
- M.3. Employers will be encouraged to invest in the training of the workforce in AI through tax reductions and grants.
- M.4. An acceleration program will be created and certificate programs will be organized in order to identify the need for new skills that arise as AI technologies transform professions and ways of doing business, and to close the gap with the existing ones.
- M.5. Special programs will be implemented to equip the individuals whose employment opportunities will decrease due to the impact of AI on the labor market with new skills and to employ them.
- M.6. Field-specific distance education and online content capacity will be improved by utilizing corporate cooperation opportunities through online education platforms.
- M.7. Training programs will be organized for occupational health and safety, which are transformed by the use of AI systems.
- M.8. Training programs for decision-making using AI technologies and AI applications will be organized for the senior management of the sector and the units responsible for recruitment processes.
- M.9. Social dialogue mechanisms will be established between the employer and worker organizations regarding the transformation of professions and the impact of AI on the workforce.

Governance Mechanism

This section explains the governance mechanism for the implementation of the NAIS and the coordination of the process.

For the effective implementation of the NAIS, a two-layered and agile governance mechanism will be established based on the main dimensions of the Strategy, namely “Organizational Competence”, “Governance” and “Strategic Consistency”:

- “Steering Mechanism for National AI Strategy” for strategic alignment, maintaining the visionary attitude and high-level coordination.
- “AI Ecosystem Administrative and Technical Governance Mechanism” for administrative, technical and legal coordination, and application of AI values and principles, developing solutions and implementing actions.

The two-layered governance mechanism of the NAIS consists of 6 main elements and is defined and color-coded in Figure 22.

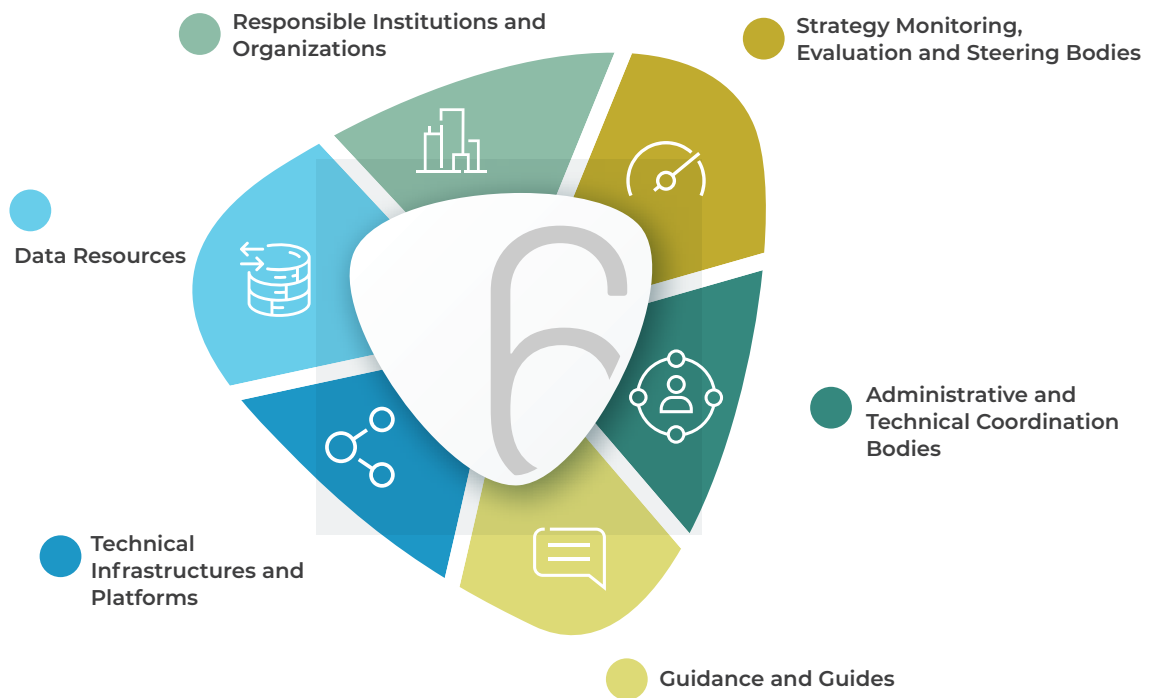


Figure 22. Key Elements of the National AI Strategy Governance Mechanism

National Artificial Intelligence Strategy Steering Mechanism

A “National Artificial Intelligence Strategy Steering Committee” will be established in order to ensure the necessary high-level coordination for monitoring the NAIS with a result-oriented approach and achieve the strategic priorities and objectives more effectively and quickly in line with the Digital Türkiye vision and the National Technology Move:

- The Committee will determine the ministries that will prepare and coordinate the implementation of the detailed action plans regarding the measures determined in the NAIS, provide high-level coordination for the preparation of the said action plans in harmony with each other, and ensure inter-institutional coordination by monitoring the implementation of the NAIS and said action plans at the highest level.
- The Vice-President will chair the Committee and secretarial services will be carried out jointly by the DTO and the MoIT.
- The Head of the DTO and the MoIT Deputy Minister will attend all meetings within the scope of the NAIS, and the deputy ministers of the relevant ministries, the President of CoHE and other representatives will be invited in line with the agenda.

An “AI Ecosystem Advisory Group” that includes representatives of the private sector, academia and NGOs will be formed in order to monitor the implementation process of the NAIS and to make suggestions to the Steering Committee to increase its effectiveness.

Furthermore, “Action Plan Coordination Groups” will be established for the ministries responsible for preparing action plans and coordinating their implementation. In addition to the DTO and MoIT, representatives from public institutions relevant to the actions will be included in these coordination groups. NGO representatives, academics and industry professionals deemed appropriate by the coordinating ministry may also be invited to join the coordination group.

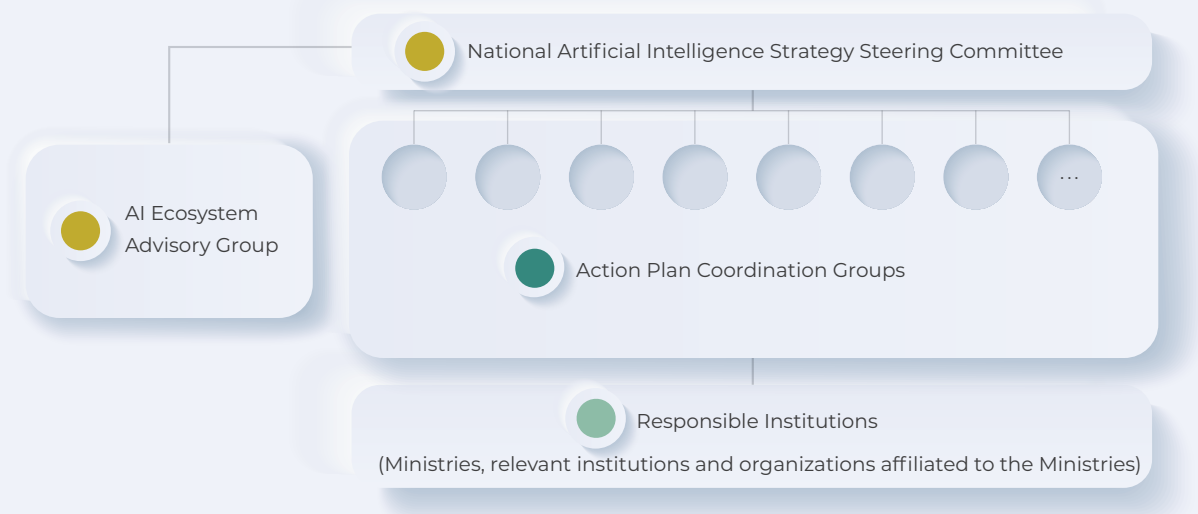


Figure 23. The Steering Mechanism for the Governance of the National AI Strategy

AI Ecosystem Administrative and Technical Governance Mechanism

The following governance mechanism will be established under the coordination of DTO Department of Big Data and Artificial Intelligence Applications, GDNT Department of Digital Technologies and TÜBİTAK Artificial Intelligence Institute in order to fulfill the necessary administrative and technical coordination functions necessary for the implementation of action plans at the level of ministries, to develop applications in line with usage scenarios and to increase institutional maturity levels.

- The “Public AI Ecosystem” will be established under the coordination of the DTO Big Data and Artificial Intelligence Department. Thus, it will be ensured that central and local government institutions and organizations, especially ministries, are supported in line with the follow-up of AI and advanced analytical projects and guides to be prepared. In this context; planned, developed and operated projects will be coordinated. In addition, an inventory will be kept for organizational structuring and employment of domain experts in institutions and organizations, and necessary coordination will be ensured to meet the needs in line with strategic priorities. The infrastructure to be created within the scope of the Public AI Ecosystem will be used depending on the sensitivity of the data to be processed.
- “Sectoral Co-Creation Laboratories” will be established within the body of TÜBİTAK Artificial Intelligence Institute under the coordination of GDNT Digital Technologies Department. The main objective of Sectoral Co-Creation Laboratories is the development of multi-stakeholder sectoral AI solutions. In this direction, sectoral management needs of the data, problems, and usage scenarios will be determined; including obtaining the necessary data, preparation, storage and sharing of the data. A sectoral AI expert competency inventory will be created and necessary activities will be coordinated to meet the needs in line with strategic priorities.
- Maximum coordination will be ensured in the joint management of the works of the Public AI Ecosystem and Sectoral Co-Creation Laboratories and in the use of common resources. Consisting of public administration and private sector-oriented institutional structures, this mechanism will enable the development of agile and sustainable solutions for the stakeholders in the AI ecosystem. The projects to be carried out in these structures, the competence levels of the institutions and organizations involved in the projects, and the project management processes will be supported by the AI Project Management Guide and Maturity Model to be prepared.
- Working groups will be established under the coordination of the Steering Committee Secretariat on “technical infrastructure and platforms”, “data governance”, “human resources”, “law and ethics” and “trustworthy and responsible AI”. These working groups will be composed of representatives of institutions and NGOs with responsibilities in the relevant field, academics, and domain experts. They will be responsible for compiling the most up-to-date information on the field, preparing the guides, updating the guides in line with the experience gained, and generalizing good examples. All working groups will prepare evaluation reports for the Steering Committee meetings. If deemed necessary, the Committee may establish new working groups or change the scope of existing ones.

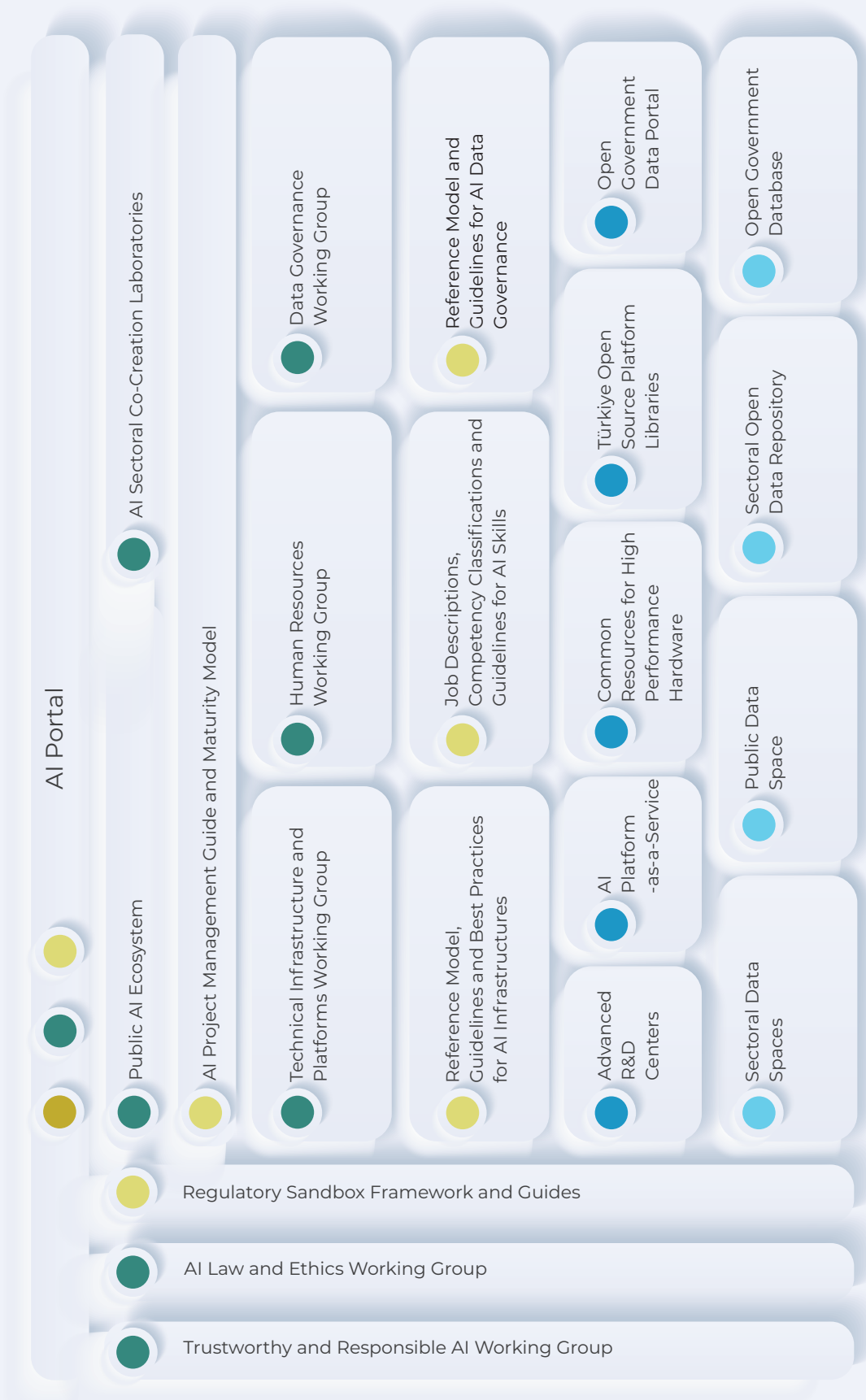


Figure 24. AI Ecosystem Administrative and Technical Governance Mechanism

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Annex. Artificial Intelligence Terminology and History

NATIONAL ARTIFICIAL INTELLIGENCE
STRATEGY

AI Terms and Concepts

The following terms and concepts are used in the NAIS, based on the OECD and EU definitions of AI:

AI Application:

An AI product or service developed from scratch using AI technologies or created by enriching existing products and services and subsequently put into use as needed. It can also be considered as an AI system or a subcomponent of an AI system.

AI Domain:

The domain that includes directly AI-related technologies and the AI systems that use them, and the activities of all the functions of the parties that make up the AI ecosystem within this scope.

AI Ecosystem:

The structure formed by parties and relevant stakeholders that provides the necessary human, technical, administrative, financial, legal and ethical framework for all stages of the lifecycle in AI systems.

AI Expert:

A competent and experienced person who researches or implements one or more AI technologies in the AI system lifecycle.

AI Practitioner:

A person who implements and adapts AI applications depending on the use case.

AI Researcher:

A person who does research and development in AI technologies.

AI System Lifecycle:

The cycle that encompasses the design, data preparation and model development process for AI systems, carrying out verification and validation, productization, operation and maintenance, and facilitates information sharing between stakeholders.

AI System:

A system designed to perform a function, consisting of solely software or a combination of software and hardware, by collecting and interpreting structured and unstructured data using AI technologies. It can be created by embedding AI technologies into an existing system or be entirely based on AI technologies.

AI Technologies:

Technologies developed with AI techniques and methods using relevant digital technologies.

AI:

Generally defined as the ability of a computer or computer-controlled robot to perform various activities in a manner similar to that of intelligent creatures.

Responsible AI:

AI based on the principles of well-being, respect for the right to make decisions, privacy, solidarity, democratic participation, equality, diversity, prudence, responsibility and sustainable development.

Trustworthy AI:

AI built upon value-based principles such as inclusive growth, sustainable development and well-being, human-oriented values and objectivity, transparency and explainability, robustness, security and trust, and accountability.

Historical Development of AI

Although the history of AI dates back to the 700s, its conceptual introduction into our lives is not that far away. It all started by British Scientist Alan Turing searching for the answer to the question “Can machines think?” in the 1950s. Around the same time, Ordinarius Professor Cahit Arf presented his work titled “Can Machines Think and How?” at Erzurum Atatürk University.

Basically, AI is a discipline that is directly and intensely related to computer science and mathematics. Nearly 70 years ago, the vision of AI was to build machines that could think, learn, and reason like humans. The first AI systems were developed using the “identify the problem-solve the problem-code the solution-apply the solution” method. These systems are labor-intensive systems that rely on traditional programming and mostly rule-based approaches. This period was called “the first wave” and was brought to an end by the so-called “AI winter”, as the theoretical studies had difficulty in finding a response in practice.

Setting out from the constraints of the first wave, instead of focusing on functions, researchers worked on the systems that create them, and thus developed the artificial neural network approach that is inspired by the neuron structure in humans. With the advent of 1980s, successful studies began to be carried out in this field. The structures defined as neurons in artificial neural network systems are modeled to be interconnected just as how actual neurons in biological nervous systems interact with each other. The aim here is to provide the AI with abilities such as learning, memorizing and revealing the relationship between data, as is the case is in humans. In the early 1990s, AI studies continued as theoretical studies that could not be applied in practice due to the limitations of the ability to operate on hardware available at the time. This period is called the “second AI winter”.

Especially in the 2010s, the developments in software, the increase in processing power and memory capacity, as well as the advances in cloud computing and distributed and parallel information processing technologies have facilitated access to large databases and their usability. The advanced processing power enabled the use of multi-layer artificial neural networks in practice, and thus began the period called “second wave”, where deep learning applications gained momentum. At this stage, AI applications have begun to take place in all areas of life, from autonomous vehicles to production facilities and sound and image processing systems used for various purposes. Therefore, we can say that we are living the “AI renaissance” today.⁵¹

The most common sub-fields of AI today are as follows:

- **Machine learning:** Systems based on algorithms that can learn from datasets and whose performance can be improved with more data over time.
- **Artificial neural networks:** Structures that learn how to perform a task by taking advantage of data features, usually without being programmed with any task-specific rules.
- **Deep learning:** A more specialized subfield of AI that relies on complex statistical models and algorithms with multiple layers of parallel processing that aims to model the way the biological brain works in a simplified manner. Due to the need for large datasets and powerful processing units to enable self-learning in deep learning, successful results have only been achieved in the last 20 years.

There are various techniques and methods in AI applications, and these techniques can sometimes be used on their own and sometimes in combination with other fields. This is also called an AI system. For example, it is necessary to use natural language processing techniques for some applications in audio technologies.

As a result, researchers have started to turn to AI technologies that can think, learn and reason like humans, in line with the emergence vision of AI in its beginning. The main stages of the development of this process, namely the “third wave”, can be expressed as follows:

Narrow AI: It is the name given to the first developmental stage of AI, which includes systems or applications that can only perform certain tasks. This stage describes the majority of applications so far. Chess and Go applications are among the examples for this stage, because the techniques used cannot go beyond their determined purposes. This stage also includes assistive AI, which is defined as the stage of work that supports people's work and facilitates their everyday lives.

General AI: It will be the stage when AI technologies will be able to do the things that human intelligence can do both by learning and by improving itself. Thus, it is expected that systems able to perform close to humans without human support in fields such as mathematics, physics, art and law will emerge.

Super AI: It will be the stage where the systems will be far superior to humans in terms of performance and achievement, and will be able to develop and learn beyond what humans can perceive, make and implement completely independent decisions. When and under what conditions this stage may take place or whether it will take place as predicted is completely based on predictions.

Figure 25 summarizes the evolution of AI history chronologically.

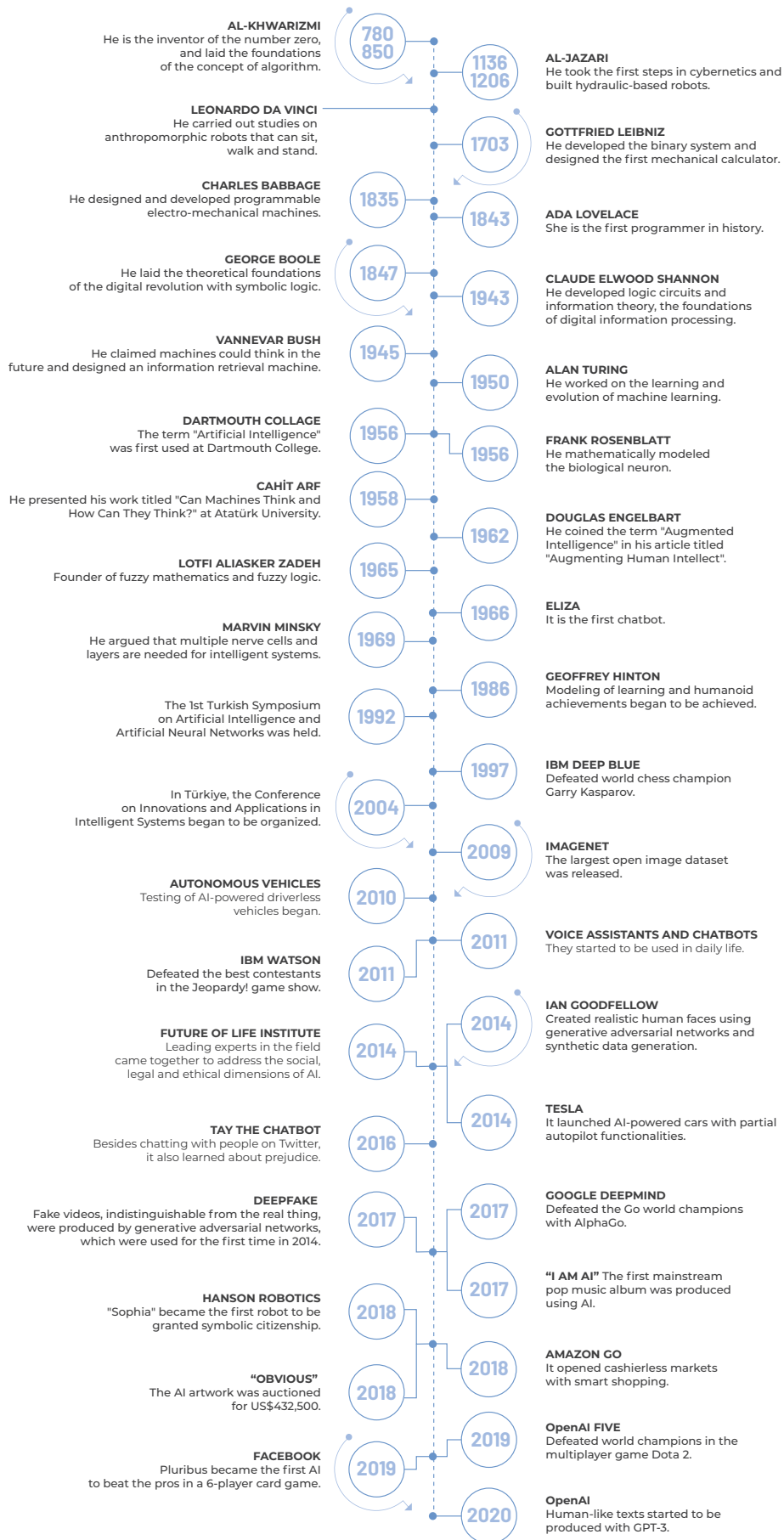


Figure 25. Chronological Summary of AI

N A T I O N A L
A R T I F I C I A L I N T E L L I G E N C E
S T R A T E G Y
2 0 2 1 - 2 0 2 5

N A T I O N A L
A R T I F I C I A L I N T E L L I G E N C E
S T R A T E G Y
2 0 2 1 - 2 0 2 5



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