

INDUSTRY FORWARD



Technology



People



Development

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Welcome to the inaugural issue of Industry Forward, a new publication by TSKB Economic Research.

As economists working within a development bank, we believe that discussions on industrial development are ultimately discussions about people. Through this publication, we aim to bring together evidence, policy debates and insights from economic life under the broad theme of “Industry and People”.

Despite the rapid advances in digital technologies, artificial intelligence and automation, projections for potential growth have been declining across many economies. At a time when technological change is reshaping production and daily life alike, this is a paradox worth examining. Therefore, one of the puzzles we address here is the apparent disconnect between technological progress and economic performance.

Periods of profound transformation also require moments of reflection. While public debate often focuses on where economies should be heading, questions of how to get there deserve equal attention. Development is not merely a question of setting objectives; it is about identifying the institutional, financial and productive capabilities needed to achieve them. We hope this publication will contribute to that discussion.

Industrial policy will naturally feature prominently throughout our work. Following the work by Juhász et al. (2023), we define industrial policy as policies that seek to achieve public objectives through the structural transformation of economic activity. Obviously, effective industrial policy begins with a clear understanding of national priorities and the economic transformation required to attain them. Structural transformation, after all, lies at the heart of the development agenda.

Nevertheless, we believe the scope of the transformation needs to be broader. In recent years, green and digital transitions have become an inherent part of policy discussions around the world. While these transformations will remain important themes for us, we also seek to turn the spotlight on a third dimension: social capital. Within this broader framework of a triple transition, we will explore the role of social capital, human capabilities and institutional capacity in supporting development.

No discussion of structural transformation would be complete without addressing finance. Development banking and development finance play a critical role in mobilizing long-term resources, supporting productive investment and helping economies navigate periods of change. This is something we will cover more often in this publication.

Globally, there is renewed interest in the enabling role of the public sector in technological development. Activities which generate innovation and long-term productivity gains often require substantial upfront investment and involve significant uncertainty. Designing institutions and financing mechanisms that align private incentives with broader development objectives remains a central policy challenge. This renewed debate confirms that industrial policy is an economic issue with clear public responsibility. Advancing productivity, supporting sustainable growth and creating decent work ultimately depend on the quality of policy design and implementation.

This publication is our attempt to raise a **red flag** on the importance of these issues, while extending our invitation for you to be a part of responsible steps forward.

Industry Forward At A Glance

New Industrial Policies

NIP enhances the policy implementation capacity of development banks, while the transformation of the development finance architecture is redefining the position of these institutions within the financing chain.

Not Longer, but More Productive Work

In aging societies, strengthening human capital, technology, and investments together will be crucial to maintaining economic dynamism.

Artificial Intelligence Moves from Screens to Factories

As of 2026, the AI narrative is moving beyond screens to factories, data centers, and energy infrastructure.

Employment Weight Is Maintained as the Share of GDP Declines

Despite the decline in industry's share in global GDP, its weight in employment is being strategically maintained.

The Physical AI Revolution

In addition to generative AI, physical AI is emerging as artificial intelligence gains the ability to perceive, make decisions, and take action in the physical world.

Technological Transformation Extends Beyond Digitalization

Approaching technological transformation solely through the lens of digitalization limits the scope of the transformation.

Indigenous Innovation and Strategic Competitiveness

As part of its growth strategy, China has been developing technology through indigenous innovation in areas it considers critical since the early 2000s.

Industrial Policies Are on the Rise Globally

According to IMF data, industrial policies are increasing rapidly worldwide; between 2009–2023, the average number of industrial policy measures implemented by 75 countries reached 454.

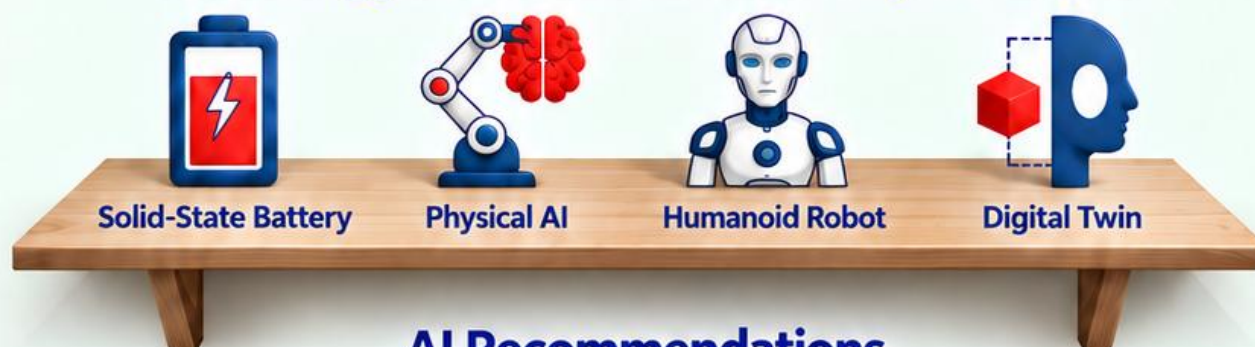
Change in Global Workforce Skills by 2030

While 29% of the global workforce is expected to upskill in their current roles, 19% is expected to transition to different roles.

Creative Destruction for an Ecosystem-Friendly Transformation

Both the energy transition and efforts toward efficient resource use, waste reduction, and circularity require a process of creative destruction based on replacing conventional technologies with new ones.

Technology Shelf: Tomorrow's Key Concepts



AI Recommendations



Book

The Industrial Revolution in World History (Peter N. Stearns)



Podcast

Manufacturing Happy Hour



Documentary

Factory Documentaries (Quintus Studios)



Report

The Future of Entry-Level Jobs in the Age of AI (WEF)



Film

Modern Times (1936)

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ECONOMIC RESEARCH

Within the Technological Transformation

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We have been using electricity as a fundamental energy input since the end of the 19th century. Transformers, one of the key components of the electricity grid, some of which can be as large as a shipping container and weigh around 400 tons, enable electricity to be transmitted at high voltages from where it is generated to other locations. One of the most interesting features of transformers, which are difficult both to manufacture and, at the moment, to procure, is that their basic operating principles have remained unchanged for many years. Copper wires wound around large steel cores use the interaction between electric current and magnetic fields to step voltage up or down (Payne & Cox, 2026). Despite this seemingly stagnant picture—electricity remaining a fundamental technology while the transformer technology we use to transfer it has remained largely unchanged—we are witnessing an acceleration in technological transformation.

The ICT Revolution and Digitalization

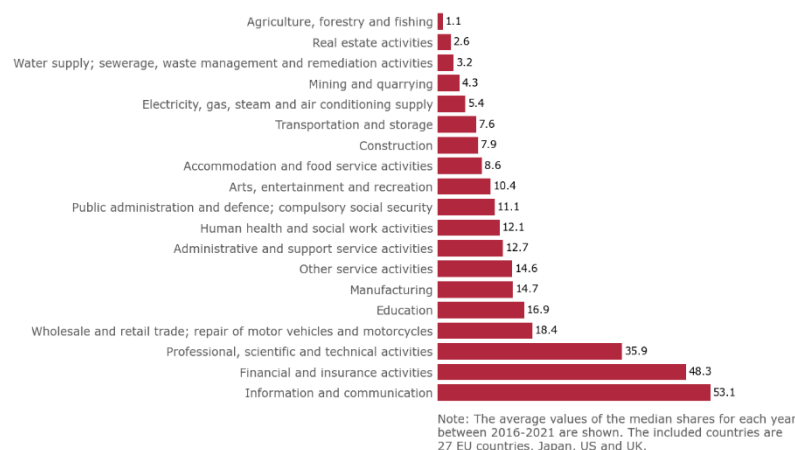
The fifth industrial revolution, which can be described as the Information and Communication Technologies (ICT) revolution and whose starting point can be placed in the 1970s, continues to fuel a long-lasting wave of digitalization (Perez, 2010). The production of ICT technologies—including chips, integrated circuits, computers, other electronic products, telecommunication equipment, software applications, telecommunications services, internet and data services, and cloud services—constitutes the core digital economy. Yet the digital economy extends beyond the production of these fundamental digital technologies. On the one hand, new technologies and economic activities such as e-commerce, the platform economy, digital content, automation technologies, artificial intelligence (AI), blockchain, and fintech have emerged by leveraging these technologies. On the other hand, both core digital technologies and the new technologies built upon them are increasingly being used in existing economic activities (Güven, 2025). As a result, digitalization is taking place at different scales and with varying degrees of impact.

Moreover, a new wave is emerging in the digitalization trend with the rise of AI technologies. Generative AI, which is based on big data, artificial neural networks, and high-computing-capacity chips, has the potential to become a general-purpose technology that can be used across a wide range of economic activities (Calvino et al., 2025). Similar to previous digital technologies, AI appears to have a very broad range of applications. In addition to generative AI, physical AI is emerging as AI acquires the capacity to perceive, make decisions, and act in the physical world. The use of physical AI as a technological component in robots, autonomous systems, smart machines, and sensor-equipped field systems also creates opportunities for industry (STB, 2026).

Despite this broad scope of digitalization, it is important to take into account the specific conditions of different economic activities. The impact of digitalization in agriculture and industry remains more limited than in some other areas. For example, the share of investment expenditure on ICT equipment (computing and telecommunication equipment), software, and databases in total nonresidential investment expenditures excluding R&D expenditures is relatively low in agriculture, manufacturing, and energy (Figure

1)¹. One of the main reasons for this is that the activities carried out in these sectors rely on machinery and equipment that extend beyond ICT technologies. Although these machines and equipment have become digitalized through the electronic circuits and software components they contain, they are based on knowledge and principles belonging to a broader set of technological fields. In summary, while digitalization has a broad sphere of influence, some economic activities such as agriculture and industry operate on a technological foundation that extends beyond digital technologies.

The share of ICT equipment, software and database investment expenditures in total nonresidential and non-R&D investment expenditures (%), 2016-2021



Source: EUKLEMS database, TSKB Economic Research

New Technologies for an Ecosystem-Friendly Transformation

This broad-based and accelerating trend toward digitalization is accompanied by other emerging technologies that are not entirely digital. The energy transition, one of the fundamental pillars of an ecosystem-friendly transformation, requires moving away from fossil fuels and generating energy from renewable sources. In fact, an ecosystem-friendly transformation necessitates a process of creative destruction based on replacing traditional technologies with new technologies for both the energy transition and more efficient resource use, waste reduction, and circularity. Technologies such as solar panels, wind turbines, batteries, electric vehicles, critical mineral processing, heat pumps, and electric boilers clearly highlight the technological dimension of the ecosystem-friendly transformation.

Furthermore, the contribution that technological innovation can make to an ecosystem-friendly transformation extends beyond these key technologies. For example, catalysts could be developed that convert nitrate in wastewater into ammonia more efficiently (Bloomberght, 2026). It may be possible to reduce water use in lithium mining by employing new techniques (Basu, 2026). Therefore, when we also take into account the technologies that will be used for an ecosystem-friendly transformation, we are experiencing a technological transformation that encompasses digitalization but is not limited to it.

¹ A similar situation can be observed in AI investment. For example, according to the results of the August 2026 business survey focusing on AI use among businesses operating in the New York and Northern New Jersey area of the United States, 15% of service businesses reported allocating substantial resources to AI use, while no manufacturing businesses reported doing so. Nevertheless, 61% of service businesses and 51% of manufacturing businesses reported using AI (Abel et al., 2026).

Industry for Technological Transformation

Industry has a special place in the technological transformation driven by many different technologies and affecting all economic activities, albeit at different levels. The main reason is that industry is the sector in which most of the advanced technologies are ultimately manufactured. Even AI applications that we access through a phone application—and which therefore create an image of a virtual technology in our minds—require industrial products. This is because data- and compute-intensive AI applications first and foremost require advanced chips to be designed and manufactured.

Similarly, technologies such as the Internet of Things, industrial robots, unmanned aerial vehicles, solar panels, wind turbines, batteries, and electric vehicles all demonstrate the special role of manufacturing in technological transformation. Precisely for this reason, keeping pace with technological transformation or taking a leading role in it requires prioritizing industry. Although a strategy based on expanding renewable energy generation capacity is indispensable for the energy transition, producing the technologies required to build this capacity domestically is of critical importance for economic growth, employment, foreign trade balance, and energy security.

Industrial Policy for Technological Transformation

The special role of industry in both technological and ecosystem-friendly transformation also lies behind the resurgence of industrial policy (IP)². A study identifying which of more than 47,000 policy documents published between 2010 and 2022 could be classified as IP documents shows that the number of IP documents increased thirtyfold over the period (Juhász et al., 2025). While the primary objective of IP for a long time was essentially to promote manufacturing and thereby facilitate structural change in the economy, it now has a much broader set of objectives, including accelerating the transition to net zero, mitigating the effects of climate change, strengthening



² Although industrial policies primarily aim to promote the development of manufacturing, they do not necessarily have to be limited to this sector. Services, for example, can also be supported through industrial policy.

supply-chain resilience, achieving strategic autonomy/competitiveness and national security in key sectors (Evenett et al., 2024). Strategic competitiveness is the most frequently stated objective in IP documents, while mitigating the effects of climate change ranks second. Emerging industrial policies in advanced economies largely target high-technology manufacturing³ and the energy sector, while in emerging market and developing economies, low-technology manufacturing also stands out alongside these sectors (IMF, 2025).

China's Technological Breakthrough

Another development that stands out in the context of technological transformation is China's growing capabilities and development of new technologies across an increasing number of technological fields. For a long period, the country pursued a growth strategy based on combining its massive and well-educated labor force with capital brought in through foreign direct investment in labor-intensive activities. Since the early 2000s, however, China has been developing technologies through indigenous innovation in areas it considers strategic (Lazonick & Li, 2023). Indeed, in 2024, China became the country with the highest R&D expenditure when adjusted for purchasing power. Its share of total global R&D expenditure increased from 4.8% in 2004 to 29.6% in 2024 (United States: 29%; European Union: 17.6%) (NCSES, 2026). Pursuing industrial policy intensively, China is gaining a competitive advantage by increasingly producing advanced technology products on a massive scale and disrupting global markets. In addition to developing new technologies, the country is also pursuing a diffusion-oriented technology policy, aimed at expanding the use of advanced technologies such as the internet, industrial robots, and AI throughout the economy, particularly in manufacturing (Güven, 2026).



³ The IMF defines high-technology manufacturing as encompassing high- and medium-high-technology manufacturing.

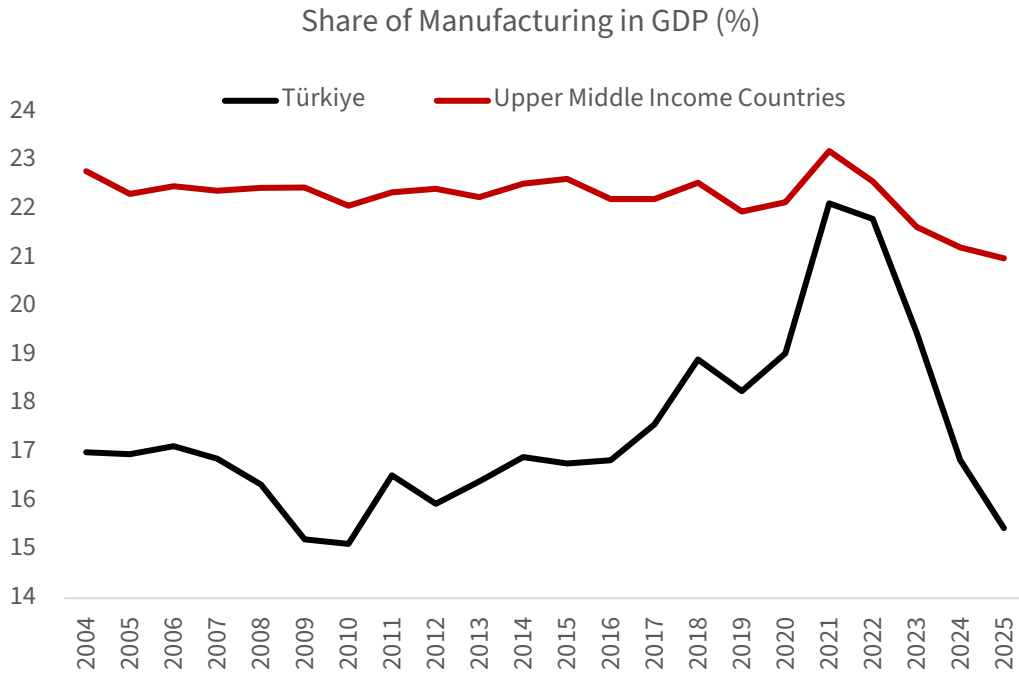
Industry Overview

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Despite the rapidly growing industrial policies and protectionist measures for critical industries that we have witnessed in recent years, the share of industrial production in the global economy is declining. According to World Bank data, the share of manufacturing in global gross domestic product (GDP) fell from 19.2% in 1997 to 14.9% in 2025, following a downward trend. The decline is especially striking among high-income countries: the manufacturing share in this group dropped from 17.8% in 1997 to 12.0% in 2025.

In the case of Turkey, a pattern different from the global trend appears, a trajectory with ups and downs. Although there was an upward acceleration from 2010 to 2022, a sharp fall followed after 2022. Exchange-rate and price fluctuations are among the factors that have increased volatility in Turkey over the past 20 years. Within the upper-middle-income country group to which Turkey belongs, the weight of manufacturing—steady up to 2021—has been declining over the last four years. Moreover, over the past two decades Turkey's value-added manufacturing output trails that of comparable countries.



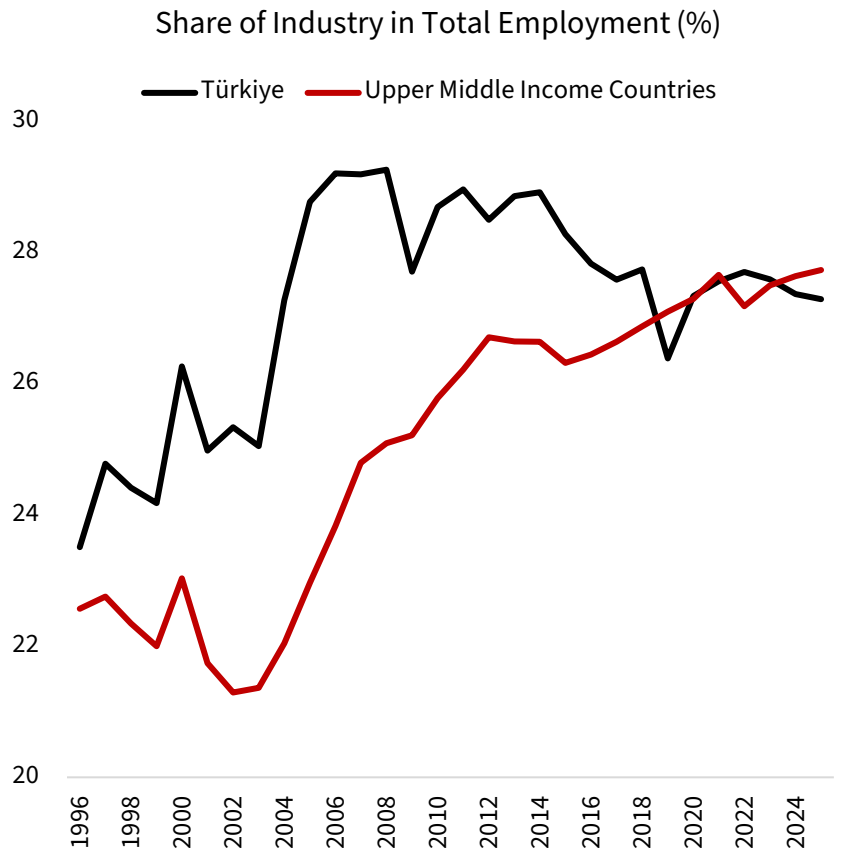
Source: World Bank, TSKB Economic Research

The industrial sector⁴ stands out not only for its contribution to total production but also as one of the activities with the highest share of employment. According to calculations by the International Labour Organization (ILO), the share of industry in total employment worldwide has risen modestly over the past thirty years, increasing from 21.5% in 1996 to 23.7% in 2025. In Turkey, the share of industry in employment rose until 2008 and then showed a limited decline thereafter. While Turkey's figure remains above the global average, it stood at 27.3% in 2025. For

⁴ The industrial sector encompasses manufacturing as well as energy and mining activities. Because the employment share of energy and mining is relatively low compared with manufacturing, the trends are primarily driven by manufacturing activity.

the upper-middle-income country group, the rise in industry's employment share after 2002 is noteworthy. Turkey diverged positively from similar economies before 2018, but in recent years the gap has closed and the rates are now comparable.

In sum, the data show that although manufacturing's share of GDP has been shrinking in recent years, its weight in employment is being preserved. Hence, behind industrial policies there is not only a drive to strengthen strategic competitiveness and prioritize national interests, but also a motivation to support employment.



Source: World Bank, ILO, TSKB Economic Research



Human-Centered Transformation in Industry

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When technological transformation in industry is mentioned, the first images that come to mind are usually autonomous robots, production lines managed by algorithms, and similar technologies. Yet, contrary to common perception, it is not machines but the “human” that lies at the center of industrial transformation.

In fact, this process does not make human labor less valuable; it changes the skills it requires. Technology and human labor increasingly work as complements rather than substitutes. It is the transformation of human labor from routine and manual tasks towards a structure in which people are freed from such tasks and can focus on production planning, as well as improving themselves and the systems they work with.

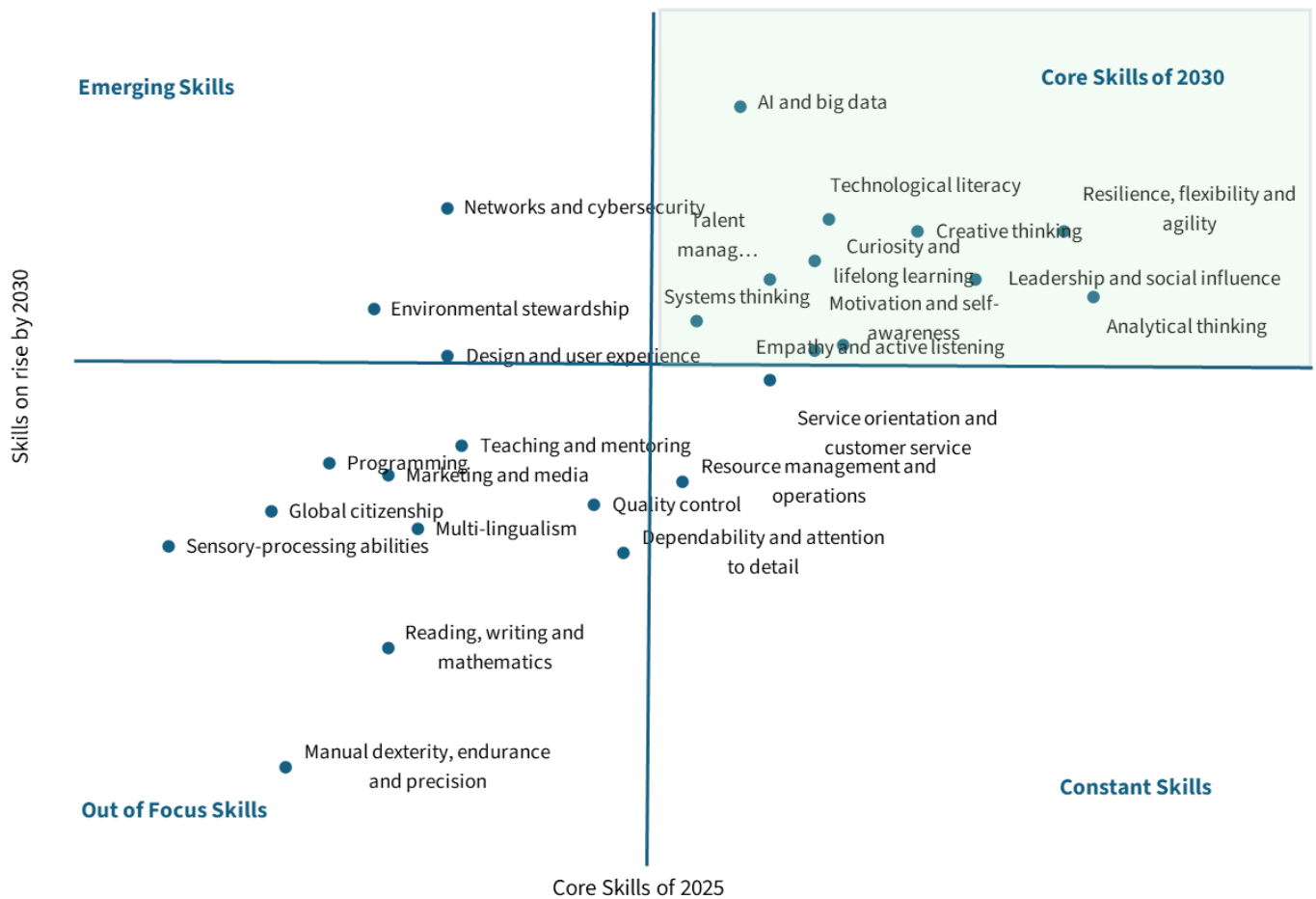
The new pace of production calls for a new cognitive architecture. The question we should now be asking is not whether machines or artificial intelligence will replace humans, but rather which competencies will enable humans to continue to play a role in this complex transformation.

While striving to understand and manage industrial transformation, failing to recognize the simultaneous need for skill evolution could trigger a major crisis. Although this phenomenon is termed a “skills mismatch” within the industry, its economic manifestation is ultimately “unemployment”.

Skills transformation gives rise to two related concepts: upskilling (developing existing skills) and reskilling (acquiring new skills). According to the World Economic Forum (WEF, 2025), 59% of the skills required in the global workforce are expected to change by 2030. While 29% of the workforce is expected to develop the skills needed for their current roles, 19% are expected to transition to different roles. However, the remaining 11% are estimated to risk being left behind due to a lack of capacity to develop their skills. Globally, this 11% represents approximately 120 million people. Yet, ensuring that no one is left behind is a critical mission if the transformation is to be just. In line with this mission, skills will either change or evolve. But how, and in what direction?



Skills of Future



A data-driven answer to this question would be appropriate, drawing on the WEF (2025) report, which is based on the largest global survey conducted to date within this scope. According to the graph, while skills related to AI and big data are expected to maintain their importance and continue to grow in significance in the near future, skills such as resilience, flexibility and agility, curiosity and lifelong learning, and analytical thinking will also remain prominent. These skills are particularly valuable because they also provide a foundation for developing other skills. On the other hand, the fact that skills such as multilingualism and global citizenship, which were once considered among the most important qualities, are now moving out of focus reveals some of the striking realities of this changing landscape. However, it should be kept in mind that in an environment where demands are frequently changing or transforming, uncertainty may be high, and the ability of studies to predict the future skill demands may therefore become increasingly limited.

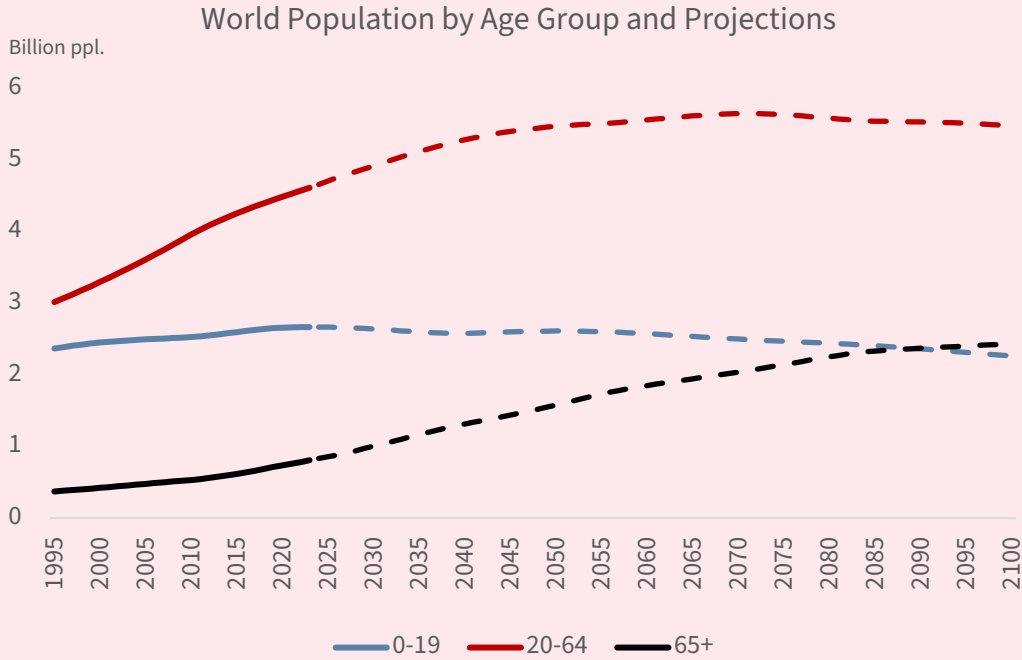
Regardless of which skills we move toward, in a transforming world, the role of human beings should not be merely to keep pace with change; it should be to shape both their own potential and the transformation they are part of, and to help steer it.

Seeking a New Balance in Aging Economies

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People living longer and healthier lives is one of the most important gains of our century. Yet when longer life expectancy is accompanied by a shrinking working-age population, economies face the need to find a new balance. In fact, the working-age population in some Asian as well as Eastern and Southern European countries is projected to shrink by more than one-third by 2050. This demographic shift is also expected to put downward pressure of around 8% on GDP per capita across the OECD over the next 30 years (André, Gal, & Schief, 2024). In Türkiye, the projected rise in the old-age dependency ratio from 16.2% in 2025 to 45.5% in 2060 points to a growing burden on the working-age population (TURKSTAT, 2026). Such a demographic transformation calls for a rethink across a wide range of areas, from the way we work and retirement systems to healthcare policies and the use of technology.



For this reason, maintaining economic dynamism in ageing societies makes productivity growth more important than ever. Yet the impact of ageing on productivity is not one-directional. While changes in physical and cognitive capacity that come with age can limit productivity, experience, accumulated knowledge, and social skills developed over time can help offset these effects. Moreover, the impact of ageing on productivity is closely linked to the types of jobs people do and the technological resources available to them. A study focusing on Japan and South Korea finds that older workers' employment in sectors with more intensive use of information and communication technologies is associated with positive outcomes for labor productivity (Lee, Kwak, & Song, 2020). Technology can therefore not only help overcome some of the constraints faced by an ageing workforce, but also enable experience and skills to continue creating value in the workplace for longer.

The economic effects of ageing are not limited to labor supply and productivity; a changing demographic structure can also reshape the direction of economic activity. On the one hand, technological innovation is creating new products and markets to meet the needs of an ageing population. On the other, it is encouraging the transformation of traditional sectors and the emergence of new ones. This impact is particularly visible in the services sector. Developments in healthcare and care services, telemedicine, and smart home applications show how the changing needs of ageing societies are being reflected in the economic structure (Li, Chen, Wu, Gao, & Zou, 2025).

Building on this, policies addressing population ageing should focus on strengthening both people's and the economy's capacity to adapt to a changing demographic structure. Expanding opportunities for lifelong learning and skills development, making it easier for businesses to adopt new technologies, and accelerating investment in areas of emerging demand associated with ageing are key elements of this transformation. Public policies also have an important role to play in creating an investment environment that supports this transition. In areas that require long-term investment, particularly technology, healthcare, care services, and accessibility, improving access to finance can help meet changing needs and facilitate the development of new economic activities. Ultimately, managing the economic consequences of ageing is not simply about enabling fewer people to work for longer. It is about building an economic structure in which human capital, technology, and capital investment reinforce one another.



Inside Corporate Transformation: A Pharma Story

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Analyzing large-scale datasets and identifying meaningful patterns are among the areas in which artificial intelligence (AI) excels. In the pharmaceutical industry, these technologies have the potential to transform R&D—the most value-added stage of the production process. As AI begins to guide research and improve its efficiency, many pharmaceutical companies have taken steps in recent years to capitalize on the emerging opportunities. AstraZeneca stands out among the companies achieving significant progress in this field.

The UK-based AstraZeneca is the world's seventh-largest pharmaceutical company, with USD 58.7 billion in sales revenue in 2025. In line with the target announced in 2024, the company aims to generate USD 80 billion in revenue by 2030. To achieve this goal, it plans to launch 20 new medicines in the coming years and regards AI as a critical component of its strategy. Indeed, AstraZeneca's innovation model stands out for having integrated AI across much of its value chain at an earlier stage than many of its competitors.

One of the first areas in which AstraZeneca has embarked on this transformation is drug discovery. Reinvent, the company's advanced AI-powered molecular-generation platform, has halved the time required to identify molecular structures that could potentially become new medicines (Waldron, 2026). AI is also contributing towards generating insights into diseases, designing more effective and better-tolerated medicines, and developing the most appropriate methods of drug delivery significantly increasing the likelihood of success in highly costly clinical trials and enabling medicines to reach

patients in need more quickly (Croasdale-Wood & Diethe, 2025).

As well as undertaking significant investments in technology companies, AstraZeneca has recently entered collaboration with Stanford University. By drawing on the university's expertise in computer science, engineering and biomedical research, the initiative provides a strong example of collaboration between industry and academia (Weatherall & Oflazoglu-Gruyters, 2025). AstraZeneca is also working to ensure that its workforce adapts to the transformation of its business practices. Through its training program, the company offers all employees the opportunity to learn how generative AI can be used in business processes and everyday life, regardless of their level of technological experience or proficiency (Estrada, 2026). Under a bronze-silver-gold certification framework, all employees above a specified level of seniority are required to successfully complete the training program and obtain at least silver-level certification. To date, more than 17,000 employees have earned certification through the program.

The pharmaceutical industry is crucial both for protecting human health and for reducing dependence on imported high-value-added products. Accordingly, the pharmaceuticals sector — classified as a high-technology industry— is also designated as a strategic and priority sector in Türkiye's policy documents, including the Twelfth Development Plan (2024–2028). In the coming period, we will also be closely following the domestic development of AI-powered systems supporting the creation of locally developed, original medicines.

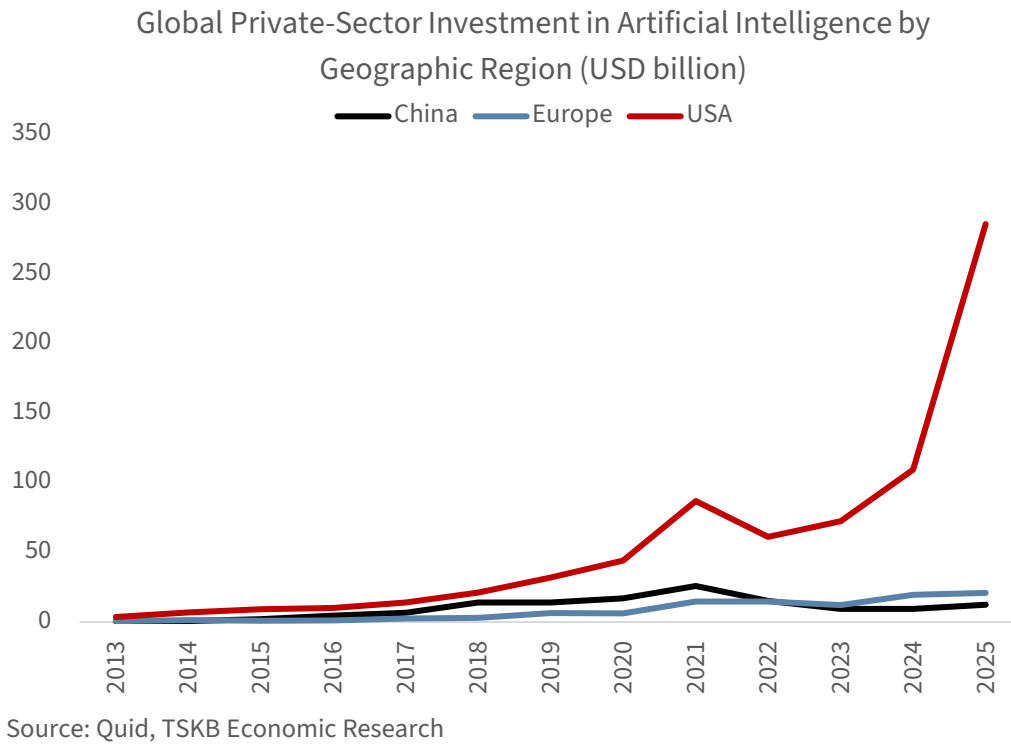
From Screens to Factories: The Future of AI

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As of 2026, the artificial intelligence narrative is increasingly moving beyond screens and into factories, data centers, and energy infrastructure. Corporate investment in AI more than doubled globally in 2025, while private-sector AI investment in the United States alone reached \$285.9 billion, more than 23 times the level in China (HAI, 2026). However, this capital is no longer flowing solely into algorithm and model development. It is also driving demand for physical assets such as data centers, power grids, semiconductor manufacturing capacity, and automation equipment.

For industry, AI's real economic value lies less in developing more capable digital assistants than in transforming how machines operate and how factories use resources. Maintenance systems powered by sensor data enable intervention before failures occur, reducing operational disruptions. Computer vision-based solutions integrate quality control directly into the production process (OECD, 2026). By assessing order flows, inventory levels, and production capacity together, AI can make planning more dynamic and increase capacity utilization. Productivity gains therefore no longer mean simply producing the same output with less labor; they also mean generating more output from the existing capital stock.



The effects of this transformation have also become visible in capital markets. Schneider Electric's sales rose 14% in the first half of 2026 to a record €21.2 billion, with the company highlighting data center demand as a key contributor to its strong performance (2026 Half Year Results, 2026). Siemens' digital business grew 18% in the first nine months of fiscal 2026, while its Smart Infrastructure division recorded triple-digit growth in orders from data centers (Press Release, 2026). Shares in ASML, a leading manufacturer of semiconductor production equipment, have gained approximately 55% since the start of the year, and the company's market capitalization has surpassed

\$550 billion (Bloomberg, 2026). These developments demonstrate that the AI theme is no longer confined to chip designers and large technology companies, but now encompasses a broader industrial value chain spanning electrical infrastructure, factory automation, and advanced manufacturing equipment.

The next phase of this transformation is physical AI: artificial intelligence that acts in the physical world through robots, sensors, motors, energy systems, and production lines. AI-driven autonomy and the convergence of information technology and operational technology, highlighted by the International Federation of Robotics (IFR) as key themes for 2026, are transforming robots from tools that repeat predefined commands into systems capable of adapting to changes in their surroundings (Top 5 Global Robotics Trends 2026, 2026). Industrial competitiveness in the coming years will therefore not be determined solely by who has the most powerful AI model. Companies and countries with access to reliable, affordable energy, extensive automation capabilities, robust machinery and sensor supply chains, and the engineering expertise to scale these capabilities will be better positioned.



Myth Buster

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MYTH: Technological transformation is only about digitalization.

Digitalization constitutes an important pillar of technological transformation. As sectors embed digital technologies into their business processes, new concepts such as artificial intelligence and blockchain take on a larger role within economic activity. Consequently, technological transformation is increasingly discussed through the lens of digitalization. The question now is if this perspective is sufficient to explain technological transformation on its own.

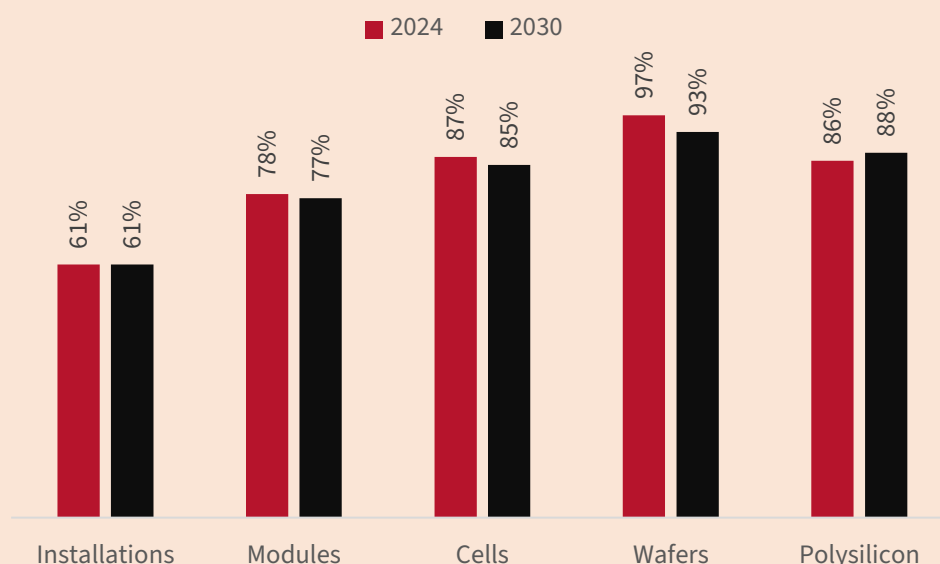
Technological transformation can be defined as a substantial change in production processes and energy systems, in addition to digitalization and AI applications (Tur, 2026). The common traits of the technologies driving this change are their contribution to efficiency and the radical alteration they bring to ways of working. Therefore, treating technological transformation solely through a digital-centric lens limits the scope of the transformation.

Solar-energy power plants offer an illustration of this limitation. As one of the most important means of tackling the impacts of the ecological crisis, renewable energy sources are gaining prominence with the share of renewables in global electricity generation having risen from 18.7% in 2000 to an estimated 34% in 2025 (Ember Energy, 2026) with solar energy accounting for 8.8 percentage points of this increase. Solar energy technologies, therefore, have caused a fundamental shift in energy systems. However, this is not a shift solely triggered by digital technologies.



The supply chain for solar energy starts with polysilicon. It then proceeds to silicon ingots, wafers, solar cells and, finally, to solar panels (IEA, 2022). China's dominance is evident in every stage of this chain. China's advantage in these technologies does not stem from digitalization. The country's competitive edge is derived from large-scale production networks, tightly integrated supply chains, and process efficiency (IEA, 2026). While digitalization may be used as a tool to improve these processes, it is not the sole driver of the technological transformation.

China's Share in Global PV Manufacturing Capacity (%)



Source: IEA, TSKB Economic Research

The manufacturing technologies of solar panels also serve as a reminder that the technological transformation is not confined to digitalization. Alternative technologies such as monocrystalline cells and TOPCon⁵ are gaining prominence in the production of solar panels; while both panel technologies rely on semiconductor materials, they are being advanced through innovations in cell design and manufacturing processes. Although they differ in terms of efficiency, TOPCon's market share, which stood at 23% in 2023, is projected to reach 86% by 2028 (IRENA, 2026). The considerably higher efficiency in the TOPCon product is a result of the ultra-thin silicon-oxide layer applied in the product (Fraunhofer ISE, 2026) - an efficiency-focused technological advancement that does not arise from digitalization.

Whether we are talking about solar panels, wind turbines, automobile components or textiles, the core argument remains unchanged. Technological transformation extends beyond digitalization; it is also fueled by concrete, material-based innovations in production technologies.

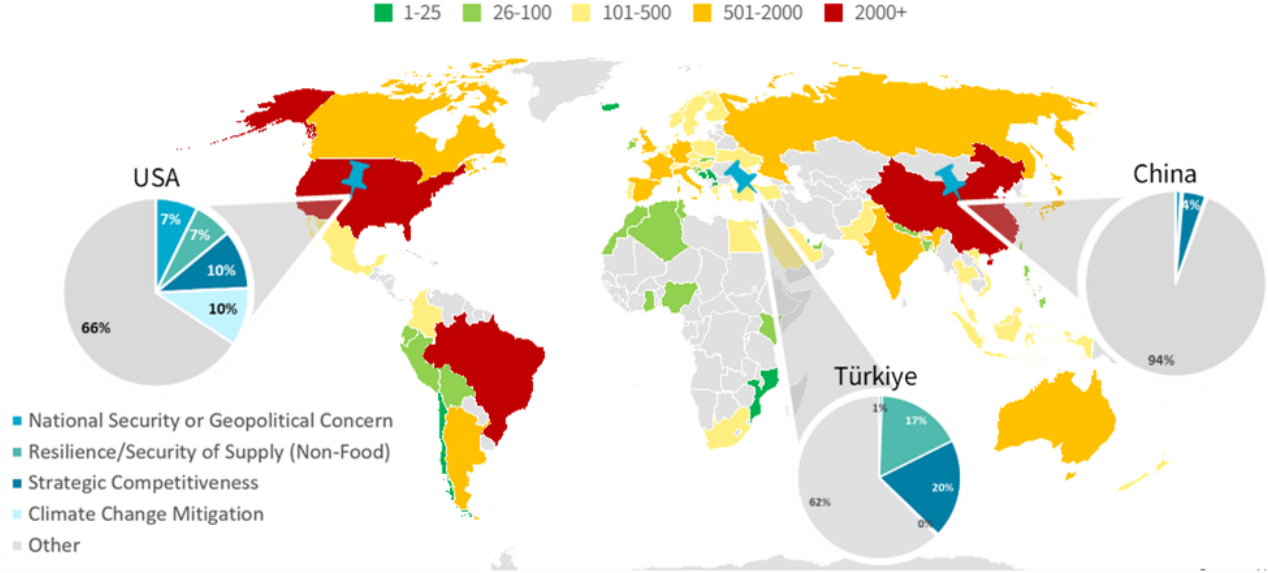
⁵ TOPCon stands for "Tunnel Oxide Passivated Contact" technology.

With A Map: Industrial Policies

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Number of Industrial Policy Implementations (2009-2023)



Source: IMF, Global Trade Alert, TSKB Economic Research

According to a study conducted by the International Monetary Fund (IMF), industrial policies are increasingly being rolled out worldwide, particularly since 2020 (Evenett et al., 2025). Between 2009 and 2023, a total of 34,068 industrial policy measures were implemented globally, covering a broad range of instruments, from tax cuts and import quotas to government assistance and production subsidies.

Across the 75 countries for which data is available, an average of 454 industrial policy measures were implemented over the 2009–2023 period. Only three countries implemented more than 2,000 industrial policy measures during this period: Brazil (2,520), the United States (5,618), and China (5,693).

In addition to the increase in the number of industrial policy measures since 2020, the shift in motivation behind these policies is also noteworthy. Between 2009 and 2019, policies were motivated predominantly by a desire to strengthen strategic competitiveness and mitigate climate change. Since 2020, however, motivations such as enhancing resilience and security of supply, as well as strengthening national security, have increasingly gained prominence. According to the IMF, the continued share of policies targeting climate change reflects the role of green stimulus packages introduced in the aftermath of the 2008 financial crisis and during the COVID-19 pandemic. More recently, in addition to the pandemic, the Russia–Ukraine war has also played a significant role in shaping the distribution of industrial policy measures through concerns over supply-chain resilience, national security and geopolitics.

In Türkiye, meanwhile, the main motivations behind the implementation of industrial policy measures during the 2009–2023 period were to strengthen strategic competitiveness (20%), as well as enhancing resilience and ensuring security of supply for non-food products (17%). For the host of COP31, industrial policies targeting climate change mitigation still appear to account for a relatively insignificant share.



From New Industrial Policy to New Development Finance Architecture

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Potential growth is declining across many advanced and developing economies (Çelik et al., 2023). This decline is both a consequence of existing global tensions and a source of new ones. Among the most immediate are shifts in the global division of labor and the balance of competitiveness, excess capacity in certain sectors, rising levels of indebtedness, and the pressures associated with the triple transition.⁶ One feature these challenges have in common is that they are becoming increasingly difficult to address through macroeconomic stabilization policies alone. Against this backdrop, New Industrial Policy (NIP) is gaining ground as a policy response, with its practices becoming more widespread and diverse.

The way NIP is implemented differs from traditional industrial policy practices (Juhasz et al., 2023). While this does not imply a rejection of traditional approaches, one of the distinctive features of NIP lies in the focus of policy design. Greater emphasis is placed on designing criteria tailored to individual firms and projects, identifying specific needs, conducting economic and financial analysis, monitoring progress, and providing technical assistance. In a sense, NIP seeks a “companion” to accompany firms as they transform in line with policy objectives. This is precisely where NIP intersects with the existing practices of development banks, which are built around project selection, economic and financial analysis, technical assistance, and the monitoring of development impact (Tur, 2026).

In considering the relationship between NIP and development banking practices, it is also important to recognize the parallel transformation taking place in the

global development finance architecture. The relatively linear model in which Multilateral Development Banks (MDBs) provide funding to national development banks, which then channel these funds to projects aligned with development priorities, is evolving. There is a growing emphasis on bringing actors across the financing chain together earlier and enabling them to collaborate more effectively.

Türkiye’s strategic flagship initiative for COP31, the Climate Implementation Bridge, also appears to reflect this search. The initiative is based on the idea that bringing financing actors into the process at earlier stages of project development can improve the matching between the project pipeline and available financing. As Mr. Mehmet Şimşek puts it, “sequencing” lies at the heart of the initiative: ensuring that project development, technical preparation, risk mitigation, and financing come into play in the right order (2026).

Development banking therefore sits at the intersection of two simultaneous transformations. While NIP is making the policy implementation capacity of development banks more valuable, the transformation of the development finance architecture is also redefining their position within the financing chain. Some elements of these two transformations are already under way; a larger part probably still lies ahead. Indeed, the 2027–2029 Medium-Term Program (MTP) objective of “restructuring development banking and enhancing its effectiveness” indicates that Türkiye is also part of this broader search.

⁶ For a more detailed discussion of our approach to the triple transition, see Tur (2026).



Several concepts that have recently risen to outshine in the technology world carry the potential to transform a wide range of sectors -from manufacturing and energy to transportation and logistics- in the years ahead. “Technology Shelf” briefly sheds light on what these concepts mean, where they are applied, and why they matter.

Solid-State Battery: This term refers to a battery technology that replaces the liquid or gel electrolyte -used in conventional lithium-ion cells to transport ions- with a solid electrolyte. A solid-state battery offers higher energy density, shorter charging times, and greater safety. Because of its advantages in range, weight, and battery safety, it stands out as a leading candidate technology, especially for electric vehicles.



Physical AI: Physical Artificial Intelligence (AI) denotes the ability of AI to go beyond making decisions solely in digital environments and instead perceive and interact with the physical world. It spotlights the capacity of autonomous systems -such as cameras, robots, and autonomous cars- to sense, comprehend, reason, and perform or manage complex actions in the real world. By ingesting data from sensors, Physical AI can convert that information into actions that an autonomous machine can execute.

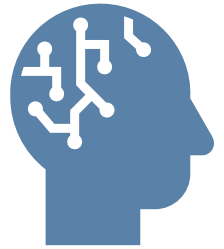


Humanoid Robot: Humanoid robots are machines engineered to mimic the structures and movements of the human body. They feature components that correspond to human anatomy (head, torso, arms and legs). Their ability to walk on two legs, to manipulate tools and devices designed for a human hand, and to learn different tasks through artificial intelligence distinguishes them from traditional industrial robots. Although their adoption in industry is still in its early stages, humanoid robots can already be deployed for jobs that are repetitive, physically demanding, or hazardous to worker safety.



Digital Twin: A digital twin is the digital representation of a physical asset, sensor, concept or idea from the real world. With a digital twin, a system’s performance can be continuously monitored, failures can be predicted before they happen, and a variety of scenarios can be tested without altering the physical system. This enables the reduction of maintenance costs and the optimization of resource utilization.

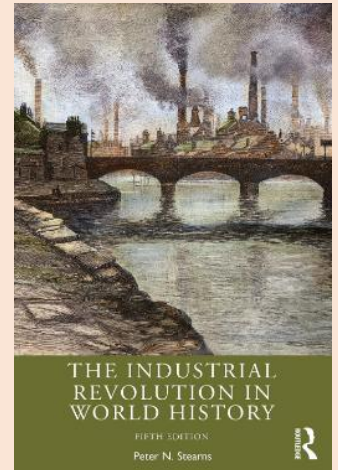




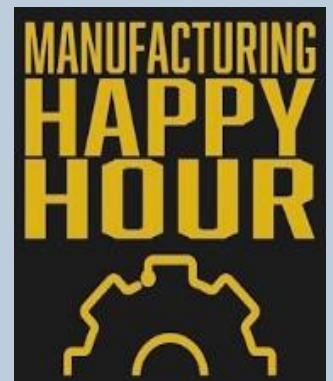
It might be a good time to explore the transformation of industry from past to future through different forms of media. With editorial guidance from TSKB Economic Research, artificial intelligence selects a book, podcast, report, documentary and film for Industry Forward readers, each offering a distinct perspective and approach to industry's evolving journey.



Book: Peter N. Stearns' *The Industrial Revolution in World History* (1993) presents a global and comparative account of industrialization. Stearns examines the Western origins of the Industrial Revolution, which began in Britain in the second half of the eighteenth century, along with its spread to non-Western societies including China, India, Japan and Russia and its profound social and environmental consequences through to the age of globalization. Looking beyond technology and economics, the book stands out for its exploration of how the factory system transformed everyday working life, gender roles, family structures and urbanization, as well as the evolving global power imbalances between industrialized countries and those that fell behind in the process of industrialization.



Podcast: Manufacturing Happy Hour, is an interview-based podcast exploring modern industrial technologies and Industry 4.0 trends (Manufacturing Happy Hour, 2026). Placing the human side of engineering at its core, the program features conversations with industry leaders, technology entrepreneurs and manufacturing experts, combining personal experiences with practical advice. By blending topics such as the digital transformation, cybersecurity and workforce development in a relaxed “happy hour” atmosphere, the podcast distinguishes itself by making these subjects more accessible to those interested in the field.

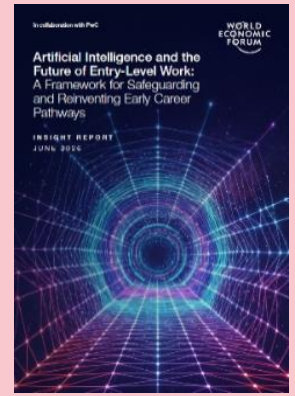


Documentary: The Factory Documentaries series, Produced by Quintus Studios, takes viewers inside vast factories around the world offering a straightforward depiction of how raw materials are transformed into complex products across a variety of manufacturing facilities through the use of advanced industrial robots, precision engineering and seamlessly coordinated supply chains (YouTube, 2026).

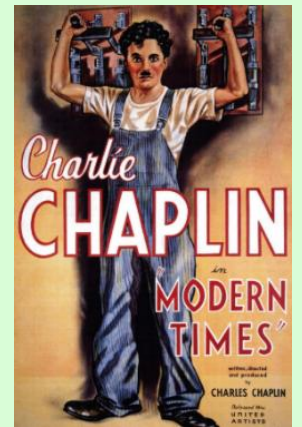




Report: Published by the World Economic Forum in June, Artificial Intelligence and the Future of Entry-Level Work examines how artificial intelligence is transforming entry-level jobs (WEF, 2026). To prevent the erosion of the future leadership talent pipeline, the report argues that young employees should first develop an understanding of fundamental business processes through updated training models and AI-supported simulations before beginning to use automation tools. In this respect, it offers a perspective aligned with our position that the technological transformation cannot be considered independently of the social transformation.



Film: Written, directed by and starring Charlie Chaplin, *Modern Times* (1936) is regarded as the last great masterpiece of the silent-film era, offering a humorous yet incisive critique of the industrial world and assembly-line automation during the Great Depression. Through unforgettable comic sequences, the film portrays the unemployment, poverty and economic insecurity which characterized this period, while also marking the first time Chaplin's voice was heard on screen. We highlight the film because it shines a light on the historical connection between technological and social transformation by focusing on the effects of technological progress, not only on production and productivity but also on working conditions, employment and human well-being.



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